

12 Years too Late?

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How Canadian and U.S. Defense Departments reveal veterans' post-conflict follow-up programs are not capable of detecting depleted uranium.

Introduction

Intentional delays, questionable science, or both?

For 12 years, Gulf War veterans, and later, veterans of the Balkans, have been asking their governments to conduct radiological assessments to determine if they have been contaminated by the battlefield uses of depleted uranium (DU). Uranium bio-assaying of urine samples can conclusively rule in or out the presence of artificial uranium in veterans suffering from a host of illnesses coinciding with deployment in conflicts where NATO and Allied Forces use DU kinetic penetrators and other, less well known radiological weapons. Veterans cannot get this type of test through their doctors or hospitals because radiological testing equipment is not used in clinical laboratories.

After nearly a decade of debate about the origins of "Gulf War Syndrome," accompanied by unexplained, premature deaths and systemic, debilitating illnesses, including inherited effects in veterans' offspring, Canada and the U.S. are facing pressure to fix their DU follow-up and screening programs. Prompting the governments is evidence published by non-governmental researchers showing deceased and ill Gulf War veterans are in fact, contaminated by DU.

Two government reports, one from Canada¹, and one from the U.S.² are an acknowledgement how these two governments' failure to conduct reliable DU studies is a calamity for veterans. Both Defense Departments admit significant limitations in their laboratories' abilities to carryout radiological and bio-assay screening programs and glaring weaknesses in clinical, DU follow-up programs. These papers and the U.S. DOD's Environmental Exposure Reports on DU in the Gulf³ and the Balkans⁴ reveal, by their own admissions, the use of inadequate testing equipment, a lack of understanding of the fundamentals of metabolised uranium and radiation dose effects, and sub-standard scientific procedures. A review of a fifth report⁵,

published by the U.S. Department of Energy on recycled uranium makes the failures of the veterans' follow-up and screening programs all the more serious. This report is a landmark admission that the complete supply chain of uranium stockpiles, from which depleted uranium, uranium alloyed, and composite uranium-high explosive ordnance are manufactured, are adulterated with highly radioactive nuclear reactor waste.

*Contradictions between government
and independent research*

It is well known in the nuclear research and nuclear medicine community that the longer the delay in assessment after exposure, internal contamination by uranium and transuranic products becomes increasingly difficult to detect. Whereas the deleterious biological and medical effects of internalised uranium multiply over time, the incorporation of uranic materials into the body's tissues and organs makes their presence and radioactivity progressively harder to detect and measure.

In 2002, Canada and the United States showed in separate reports regarding the designs and results of their DU follow-up and screening programs, how they may have waited too long to be able to detect DU or to rule it out, in the urine of hundreds (perhaps thousands) of veterans tested. The reports indicate that if DU screening programs and clinical assessments had been properly constructed and if they had conducted radiological tests earlier, a definitive determination (of the presence or absence of DU) could have been made. Even with these admissions, both governments continue to offer DU testing and report to the veterans that they are not contaminated.

Independent research and some of governments' own sources contradict the position that veterans have not been contaminated with DU or that it is too late to find it. Independent research shows that 10 years and longer is not too late for biological specimens of deceased and living vet-

erans to reveal uranium internal contamination or measure the presence of DU and other artificial isotopes of uranium housed in their bodies.

Independent laboratories and several government facilities with the capacity to conduct proper radiological bioassay studies could put to rest, once and for all, the debate about veterans' exposure to DU. Conspicuously, both the Canadian and the U.S. Defense Departments have chosen not to engage the laboratories, equipment or researchers with the capacity to measure low levels of uranium. Instead, they expend effort to discredit these options and avoid initiating properly structured and adequately resourced radiobiological and clinical assessment programs.

Due to the scientific and technical nature of these issues, an unsuspecting veteran's community, subject to the views of Defence and Veterans Affairs experts, is ill equipped to argue effectively on its own behalf. Readers will see that it is not, in fact, too late to detect and measure DU internal contamination and determine whether Gulf War and Balkan veterans have been contaminated during their deployments in DU battlefields.

The Canadian DU Screening Program

Canada's "voluntary DU screening program"

In April 2002, a joint paper by staff of the Canadian Department of National Defence's (DND) Medical Policy Unit, the Royal Military College (RMC) and their contract laboratories reported the progress of Canada's "voluntary screening program"⁶ for veterans who suspect illnesses might be linked to DU internal contamination. The paper, *An Examination of Uranium Levels in Canadian Forces Personnel Who Served in the Gulf War and Kosovo*, E.A. Ough et al., was published in the *Health Physics Society Journal*, 82, 4:527-532; April 2002. In it, the authors freely admit their laboratories and scientists are unable to determine if the veterans participating in the voluntary screening program have DU in their urine.

The paper discusses DND's procession through a series of botched radiological studies (testing sick veterans' urine samples) in which they are unable to accurately detect and measure the levels and types of uranium in veterans' urine. In reference to three years of tax-payer funded work, the authors of the DND-Ough, et al. paper state: "In situations where these isotopic ratios

[expressing DU] are required, either the analytical technique or the biological media being tested needs to be changed".

As a last resort instead of transferring the study to a laboratory with the capability to detect low levels of DU in urine (the best, non-invasive biological test material), the DND elects to examine veterans' hair. The use of body hair is questioned by the authors themselves as a legitimate biological medium to identify internally incorporated uranium (see below).

What veterans should know:

Mechanisms of uranium internal contamination⁷

It is well known that the primary mechanism of uranium internal contamination of Persian Gulf and Balkan veterans is inhalation of air-borne particulate from ballistically pulverised and thermally aerosolised DU-alloyed penetrators and armour-defeat ordnance. Uranium oxides entering the body through the lungs have a long metabolic life cycle. They are incorporated into organs and tissues over many years, perhaps permanently.

Whereas 90% or more of orally ingested uranium particulate and DU oxides are eliminated by the body's normal metabolic processes within 48 hours, inhaled uranium contaminant is incorporated into various tissues and organs. Depending on such factors as solubility, size, and chemistry of the particulate (affected by the thermo-ballistics of the weapon and environmental conditions), portions will be eliminated immediately while other portions will be housed in "target organs" (e.g., lungs, bone, spleen, liver, lymph glands, brain) to be slowly released over the life of the veteran.

The kidneys, being the organ of elimination of toxins in the blood, capture, concentrate, and excrete uranium. This is why urine is the preferred biological medium for radiological assessments (DU bioassays). The function of the kidneys and their location in the metabolic life cycle of internalised uranium expose them (kidneys) to radiological and heavy metal toxicity. The kidneys are among the first organ systems to be damaged by uranium internal contamination – the effects include reducing their efficiency at removing blood-borne toxins, including uranium. Natural detoxification processes of the body, chronic uranium internal contamination effects and incorporation into body tissues of uranium carried by blood and lymph fluid will affect the quantities of uranium

present in urine.

An acute exposure incident (i.e. deployment in DU battlefields) resulting in internal contamination by inhalation of aerosolized DU is evidenced by a measurable, short-term spike in the readings of concentrations of uranium in urine. Delaying tests intended to measure the quantities of uranium and the specific isotopes that comprise the increased quantities (i.e., depleted uranium) leads to a reduction of the measurable quantities and the presence of the specific type of the uranium responsible for the acute exposure. As a result, the quantities and specific isotopes signifying DU become progressively more difficult, but not impossible to assay. At a certain point in the life cycle of metabolised uranium, due in part to kidney dysfunction, tissue incorporation and the quantities inhaled, DU levels in the urine may become so low that only the most sensitive laboratory equipment and accurate laboratory procedures can detect its presence. When these limits are reached other biological media found in uranium's metabolic pathways can be studied (i.e., lungs, lymph, bone).

The Canadian Department of National Defense has successfully resisted acknowledging any possibility of DU's role in postdeployment deaths and illnesses of its Gulf War and Balkan veterans. By delaying radiological assessments for years, the quantities of DU continues to decline towards the threshold of detection for all but the most experienced laboratories and sensitive detection instruments.

DND explains why it can't find DU

To identify DU in any organic or inorganic sample, the three natural isotopes of uranium must be measured. Depleted Uranium's molecular signature is unmistakable and represented by a specific ratio of the proportions of the two most abundant isotopes of uranium (^{238}U and ^{235}U). Since uranium composed of the proportions of isotopes signifying DU does not exist in nature, any amount detected is evidence of man-made contamination (i.e. the internal incorporation of an artificially manufactured substance). Its presence at this late date (once the external source of contamination is eliminated) can only be explained by the fact that inhaled uranium is continuing its metabolic life through long, complex and toxic biological processes in the bodies of exposed veterans.

In its Health Physics paper, DND admits its screening program cannot detect or measure these isotopes: "The low urinary uranium concentrations [in the veterans samples] voided any attempts at isotopic ($^{238}\text{U};^{235}\text{U}$) assays". Since DND-Ough et al. published their paper overviewing the results of the Canadian veterans' screening program, the Uranium Medical Research Centre (UMRC) published a paper showing conclusively that some Canadian veterans are contaminated with DU. UMRC⁸ reported DU in veterans' urine 10 years after the Gulf War, in approximately 50% of veterans tested. In its study, *The Quantitative Analysis of Depleted Uranium Isotopes in British, Canadian, and U.S. Gulf War Veterans*; *Journal of Military Medicine*, August 2002, veterans whose total quantities of uranium in urine were at normal population ranges, are shown to have DU below background levels. This demonstrates that the proper methods and equipment can detect artificial uranium contaminant at very low levels, long after exposure.

Playing Russian roulette with veterans' lives

The fundamental question to be answered by DND's screening program is whether there is DU in the veterans' urine, or not. In the Health Physics paper, DND-Ough et al. indicate their laboratory equipment and methods do not work: "INAA, DNAA, and ICP-MS cannot provide the required sensitivity for the measurement of $^{238}\text{U};^{235}\text{U}$ isotopic ratio in urine samples". [INAA, DNAA, and ICP-MS refer to the equipment and procedures DND contract laboratories and the RMC use to detect and measure the uranium isotopes].

Following each of DND's testing situations, the failure to detect the isotopes leads DND to move to a new laboratory in attempts to isolate the isotopes. Referring to each new laboratory, the authors conclude: the "MDL" (Method Detection Limits or Instrument's Detection Limits of the procedures and equipment) could not measure the concentrations of the isotopes of uranium, and therefore could not determine the nature of the uranium found in the veterans' urine.

Given that DND-Ough et al were aware that delaying radiological assessment would challenge the accuracy and sensitivity of their equipment, they were faced with a decision. Either they use a lab and researchers capable of measuring low levels of radioisotopes or they use an alternative

biological media where the isotopes are easier to detect this long after exposure. DND's decision has been to offer the veterans the option of testing body hair: "... for those veterans still requesting isotopic assays, hair samples [were] submitted for ICP-MS analysis".

Nineteen veterans, who might have known through their own reading, the necessity of measuring isotopic ratios to rule in or out DU contamination, unwittingly elected to participate. What they don't know is that the use of body hair is irrelevant to measuring uranium internal contamination. Body hair is simply not in the metabolic pathways of uranium contamination. This is so fundamental a mistake, one wonders if DND's physicians and chemists confused uranium with arsenic. The authors, themselves, question the decision: "Hair analysis may be complicated by exogenous uranium exposure". They later state in the paper: "...but, there may be concerns about the origin (endogenous and/or exogenous) of uranium [in hair]".

DND ignores recommendations how to detect DU

Over six years ago independent researchers and experts in uranium internal contamination recommended to DND, the proper equipment and methodology to detect and measure the isotopes of uranium⁹ in veterans' urine:

1. Ensure that the biological specimens are known to be organs, tissues or fluids in the metabolic pathways of uranium internal contamination. Urine or biopsies of target organs and bone were suggested. Body hair is not in the metabolic pathways of uranium.
2. Follow a proven methodology for preparing biological samples for radiological study and protect them from exogenous and environmental contamination sources.
3. The proper laboratory equipment, the method of preparing the specimens, and the proper operation and reading of the equipment are critical to ensuring accuracy and repeatability. Thermal Ionizing Mass Spectrometry (TIMS) was recommended.
4. Screening programs need to determine the presence of DU by measuring the isotopic concentrations of ²³⁸U and ²³⁵U and calculate their ratios. Total quantities (concentrations) of uranium are not relevant this long after

exposure (see below).

5. To accurately determine the ²³⁸U:²³⁵U ratio requires equipment capable of measuring picogram concentrations of the ²³⁵U isotope which is only 0.2% to 0.72 % of the total uranium concentration in a sample. To ensure this level of sensitivity, we again recommended Thermal Ionising Mass Spectrometry (TIMS).

Contrary to DND-Ough et al., the total uranium concentration in urine is irrelevant to determining internal contamination or the presence of DU when looking for trace quantities several years after exposure. Metabolised DU remaining after several years is likely to be overshadowed by daily dietary intake and excretion of naturally-occurring (ubiquitous) uranium, ingested orally from the food-chain. Systemic biological effects on the kidneys and long-term metabolic processes of internalised uranium will also affect the measurable quantities. Normal or below normal total quantities of uranium in veterans' urine therefore, does not rule DU in, or out. Even so, DND-Ough et al. concludes: "The concentrations of total uranium in the urine of Canadian veterans were well within the range determined for nonoccupationally exposed individuals". This point is scientifically and medically irrelevant to the question of DU contamination.

In the absence of the ability to measure isotopic ratios in body tissues and fluids that incorporate and concentrate uranium, it is impossible for DND-Ough et al. to state with accuracy, that any urine samples of Canadian veterans' participating in the screening program contain natural uranium or depleted uranium.

Is DND trying to mislead veterans and their families?

DND, RMC, and their contractors reveal either they don't know the biology and chemistry of uranium internal contamination or an intentional effort to mislead veterans. Even though their methods and equipment are admittedly unable to rule DU in or out, they conclude and then inform veterans and their families that because "total concentrations" (quantities) of uranium found in their urine are normal, DU is not present. They imply that if it is present, it is lost in the background of the total concentrations of uranium and therefore not at levels significant to health.

Veterans should know the facts and under-

stand what is (and is not) revealed in the DND-Ough et al. report:

1. It is technologically possible to detect and measure DU, 10 years and longer after exposure.
2. The Canadian government's screening program does not measure or express the isotopic ratios of biological samples in the metabolic pathway of uranium and therefore fails to determine if veterans are or are not contaminated.
3. Even at trace levels, several years after exposure, small quantities of DU translate retroactively into proportionately higher and therefore biologically significant levels of DU intake at the time of exposure.
4. The laboratories and researchers in DND's screening program have themselves admitted they cannot detect DU.
5. Rather than proving independent researchers can't find DU, DND-Ough et al.'s report shows DND's DU screening program has reached its technological limitations.

Contrary to what DND-Ough et al. lead readers and the participating veterans to believe, they still don't know if the several hundred Canadian veterans tested over three years have DU contamination. The longer DND delays using the proper methods, equipment and biological media, the progressively lower the chance of conclusive analysis. The situation described in the DND-Ough et al. report reveals how DND is not considering the possibility of inhalation exposure or chronic internal contamination of veterans. Finding DU at this late date, at levels below normal concentrations of uranium is evidence of a chronic, heavy metal, toxic, radiological risk derived from an acute exposure incident in the veterans' histories. DND cannot legitimately draw valid conclusions based on the science outlined in its study. They simply don't know. Yet, they continue to offer veterans a program that doesn't work and tell them the science says there is nothing to worry about.

The U.S. DU Follow-Up Program

What's wrong with DOD's DU Follow-up Program?

Veterans attempting to wade through the endless

expanse of government documents and official-agency testimonials by NATO, CDC, NRC, IOM the UN's subsidiary agencies (WHO, UNEP, IAEA), and the U.S. Defense and Veterans Affairs Departments, have to face a myriad of biased opinions and carefully constructed "facts". The supposed, responsible objectivity of these organizations is belied over and over again by their incessant efforts to write reports to substantiate predetermined conclusions that with the exception of DU shrapnel wounded veterans, no one is at risk from DU contamination. Instead of examining the work of independent researchers or making a serious attempt to replicate studies whose methods and conclusions are contrary to the official-view, they selectively ignore this work and refuse to make it available to veterans for examination.

The U.S. Department of Defense's Environmental Exposure Reports on the Gulf and the Balkans have been served up to veterans as the penultimate compendium of collected studies and official viewpoints. The DOD and DVA are dropping these reports in the laps of veterans across America, touting the DOD/DVA Veterans' Follow-Up Program as the final word on the matter.

How can veterans argue against the apparently rational and expensively orchestrated epidemiological and clinical programs apparently dedicated to the veterans, themselves? Not only do the flaws abound, these flaws point to the issues at the heart of the scientific and medical questions about DU.

1. The DOD/DVA Veterans Follow-Up Program does not include radiological laboratory analysis¹⁰ of the isotopes of uranium in the biological specimens provided by the Registry veterans who have been selected for detailed clinical studies. Without determining exactly what isotopes of uranium are in the veterans' urine, it misrepresents fact to state that there is no evidence of DU (irrespective of total concentrations)¹¹. It is worth noting that when the DOD/DVA and other NATO countries did refer a few veterans (not retaining shrapnel) for isotopic bioassays, DU was in fact identified in their urine.
2. There is no satisfactory or objective definition of "uranium internal contamination" expressed in the Follow-Up Program protocols. By definition, the presence of any level of DU in the urine (or other biological specimens) of

veterans or civilians is evidence of contamination by an artificially produced and deployed radiological material. Any level found is, with the possible exception of the veterans retaining DU shrapnel, an indication that inhalational exposure occurred.

3. The structure of the program's protocols for follow-up clinical studies is not "symptoms-driven". The program accepts all veterans irrespective of symptom profiles and does not assess veterans based on histories of DU exposure or health. Some efforts were introduced in 1998-99 to correct this deficiency but the DOD/DVA do not acknowledge established symptom profile models of uranium internal contamination for veterans. Without the symptoms' model, the veterans cannot be properly diagnosed or referred. The proof of this deficiency lies in the fact that if DU contamination was taken seriously, veterans who present with symptoms of uranium internal contamination and deployment histories of battlefield exposure would be automatically referred for bioassays to identify the ratios of uranium isotopes (not just total concentrations).
4. DOD's and the DVA's persistent adherence to the "total concentrations of uranium" argument is a give-away that the Follow-Up Program is structured to direct veterans away from the necessary radiological studies and to dismiss any possibility of chronic internal contamination or inhalational exposure. On one hand, total concentrations of uranium in urine, higher than normal populations, can only be expected as a result of recent exposure. On the other hand, normal total concentrations (quantities) of uranium do not mean that the veterans were not contaminated in the past. The analysis of total concentrations -- the DVA/DOD procedure in use -- does not express the compositions of the isotopes of uranium. Without measuring the isotopes to detect the signature of DU, it is a misrepresentation of fact to state that "no significant exposure occurred because the concentrations are normal". The DOD/DVA program is constructed for persons who have recent exposure, largely by oral ingestion and retained shrapnel. It does not account for inhaled uranium particulate, metabolised and incorporated into the body, resulting in long-term

chronic, internal exposure.

5. The Environmental Exposure Reports are peppered with statements that dismiss risks of exposure based on the "effective biological dose" model of the International Commission on Radiation Protection (ICRP). The question of radiological dose effects of internally incorporated uranium products via inhalation is the single most contentious scientific issue with fundamental implications for DU exposed veterans. There are scientific studies and professionals challenging the ICRP model -- sufficient enough to create serious doubts about the biological dose effect assumptions used by DOD/DVA¹². The alternative views are argued best in the European scientific community and are given short shrift in North American's nuclear establishment. This issue is beyond the scope of this paper as there is little value to measuring dose effects if there is not conclusive proof of retention of DU in the body in the first place. The primary question and essential clinical building block is to determine if veterans are contaminated -- evidenced by finding or ruling out DU through conducting the proper radiological bioassay studies using procedures, equipment and researchers capable of detecting it.

The fundamental deficiencies in the Gulf and Balkan veterans' follow-up program make a sham of the Veterans' Registry, the clinical protocols and associated epidemiological studies. Surprisingly, the Institute of Medicine, in its 1997 and 1998 evaluations of the clinical protocols fails to note that the follow-up program does not direct physicians to order isotopic ratio, bioassays for veterans whose symptoms and histories suggest uranium internal contamination¹³. The Follow-Up Program and its government-funded, substantiating third-party evaluations show that it is structured so as not to find DU - simply by the fact that it omits protocols connecting exposure histories and symptoms with tests that measure the composition of the uranium in the veterans. The Gulf War Environmental Exposure Report (II) sets up a line of defence against these obvious criticisms which DOD would logically be expecting from those not required to parrot the official line. DOD and the DVA offer the following to take up their posture of defence¹⁴:

“During the past year, various ... claims of elevated uranium in urine samples from veterans ... based in unpublished, non-peer reviewed data ... based their conclusion on measurements of uranium isotopes using nuclear techniques. Discussions with scientists have indicated that measuring uranium-238 with these techniques can be subject to considerable error.”¹⁵

“Not surprisingly, the discrepancies between the government’s and outside laboratories test results concern veterans. ... In April 2000, a nongovernmental, independent laboratory started an eight-month study of these laboratories measuring techniques and findings.”

Shoring up the weak link in DOD’s clinical protocols

In October 2002, the U.S. Department of Defense (DOD) published the above mentioned, eight-month study on the internet as an Information Paper to “aid in understanding the capabilities and limitations of certain methods of measuring uranium and depleted uranium in urine...”. Titled, “Im-pact of Laboratory Performance of Urine Uranium Analysis on Exposure Evaluations for Gulf War Veterans”, DOD’s Information Paper expresses two purposes:

1. Question the quality and therefore results of independent findings of DU in Gulf War and Balkan veterans; and,
2. Evaluate the performance of DOD’s contract labs and the Department of Veterans Affairs’ (DVA) laboratories at detecting and measuring DU in the veterans’ urine.

Similar to the Canadian Department of National Defense’s DU screening program, DOD presents information to veterans that might lead them to believe that independent research is not reliable and, even if it is, it’s not relevant as there is little possibility of finding DU in urine at this late date.

DOD’s Information Paper is presented as a review of the performance of the DVA’s and their contract laboratories participating in DU screening programs. The paper compares the capacity of 6 Canadian and U.S. laboratories. The laboratories are selected as a study group to determine if they

can reliably detect and measure different artificial and natural uranium isotopes in synthetic urine. The poor performance of the government’s contract laboratories allows DOD to make a self-serving leap in logic and cast doubt on the findings of independent researchers: “Those results [of independent studies] were inconsistent with the urinary uranium values reported by the Department of Veterans Affairs and therefore raise questions about the reliability of the laboratory analysis [of the independent researchers]”.

It is noteworthy that the Atlantic Radiogenic Isotopic Research Facility (ARIRF), Memorial University, Newfoundland was not included in the study. This lab participated in UMRC’s and other researchers’ independent and published studies confirming DU in veteran’s urine. Dr. Asaf Durakovic and Leonard Dietz, working with Patricia Horan, formerly of ARIRF, found the isotopic ratios of uranium that signify DU in the urine of U.S., Canadian and British veterans. The findings and an explanation of the methodology needed to measure DU several years after exposure, is published in the Journal of Military Medicine, August 2002: The Quantitative Analysis of Depleted Uranium Isotopes in British, Canadian, and U.S. Gulf War Veterans.

It is also notable that DOD did not include in this “independent study”, its own, highly specialised nuclear research laboratories. DOD’s own labs, the U.S. Armed Forces Radiological Research Institute (AFRRI) and DOD’s long-term contract laboratories are among the best-equipped radiological assessment facilities in the world. Established during the Manhattan Project as state-of-the-art radiogenic research facilities¹⁶, these labs have conducted uranium research and nuclear weapons development for 60 years. They publicly advertise their ability to detect low-levels of isotopes of uranium and transuranics and sell these services to the private sector and DOD, to do just that.

*DOD claims DU can’t be found
two weeks after exposure*

In its Information Paper, DOD presents a discussion of the metabolic and radiological mechanisms of uranium. As DOD states, it is not possible to identify whether subjects have incorporated DU without measuring the uranium isotopes comprising DU. Yet, this fact is not included anywhere

in the post-conflict, veterans' follow-up program documentation or delineated in any of the Environmental Exposure Reports.

DOD implies that it has the capacity to detect and measure trace amounts of the isotopes of uranium and that this capacity is inherent to its own long-term, operational screening programs. DOD states that its laboratory performance reviews are responsible for ensuring this capacity is achieved and retained in its laboratories: "Laboratory accreditation programs ... ensure accurate and reproducible analytical results". Yet, DOD immediately exposes that its screening program laboratories do not perform reliably: "However, these programs [DOD's screening program laboratories] do not uniformly include measurements of total or isotopic uranium in urine".

DOD's advice to veterans and its conclusions about the technological capabilities of its laboratories are similar to the Canadian DND program, outlined in: *An Examination of Uranium Levels in Canadian Forces Personnel Who Served in the Gulf War and Kosovo*, E.A. Ough et al, April 2002. By expressing that the laboratories are unable to reliably and accurately detect and measure the isotopes of uranium - DOD admits it is not able to rule DU in, or out, in the urine of Gulf War and Balkan veterans.

DOD states an important fact about chronic uranium internal contamination. Acute exposure incidents by uranium can be detected in urine years after the point of biological up-take: "For inhaled uranium oxides ... some uranium appears in urine [years after exposure]"; and, "Ten years later [after exposure], that individual would still be excreting ... [this] uranium in urine every day". DOD then sets a very convenient technological benchmark: "Within a week or two after possible exposure, there would be little or no chance for correctly identifying the result with the actual exposure", but "...acceptable performance can only be achieved for samples collected within a week or two of exposure [author's emphasis]."

DOD uses its evaluation of the 6 laboratories to discredit in the minds of veterans, independent research contrary to the protocols of the Follow-up program and the performance of its own laboratories: "This performance [of DOD's evaluated labs] demonstrates the uncertainty in drawing conclusions about the nature of uranium present, at least for the six participating laboratories".

Rather than effectively challenging the veracity of findings of independent studies, DOD is admitting its program's have technical limitations - that its methods, equipment and scientists are not reliably able to detect and measure the isotopes of DU.

DOD sacrifices its friends to convince veterans

Just as DND, DOD has also avoided conducting DU bioassay programs to a point in time they state makes it difficult to confirm or deny uranium internal contamination: "While adequate performance for evaluating uranium exposure based on total uranium [concentrations] was achieved, improvements in sensitivity [of equipment and procedure] are needed to accurately determine concentrations approaching those of normal diet". DOD is trying to convince veterans that 1) trace amounts of specific radioisotopes cannot be accurately measured by its labs because the contaminant is masked by the normal dietary intake levels; and, 2) the concentrations (quantities) of uranium found by the laboratories are similar to the naturally occurring uranium present in all people's urine - attributing no significance to any past exposure via inhalation.

DOD is explicit about the technological limits of equipment and methods used: "[DOD evaluated] Laboratories had considerably more difficulty measuring individual uranium isotopes, particularly at lower concentration(s) The sporadic performance ... occurred because the amounts ... in the samples were close to laboratory detection limits". By expressing these limitations, the Defense Department and the DVA admit their methods and equipment, at best, can measure only the total concentrations of uranium in the urine of veterans who may have been contaminated in DU battlefields.

Without reliable identification of the specific uranium isotopes, conclusions as to whether there is or is not DU in the veterans' urine cannot be made. To discredit independent findings of DU in veterans' urine, the Information Paper's final conclusion sacrifices the reputation of the laboratories participating in DOD's review: "[The DOD's evaluated laboratories'] ... unacceptable performance ... indicates that claims [by independents] to have done so [identify DU] should be treated with caution".

Why are the Baltimore DVA & AFRRRI studies treated as an exception?

Both the Canadian and the U.S. Defense Departments' reports make a notable exception about finding DU several months to years after exposure. They recognise the Baltimore Department of Veterans Affairs¹⁷ (DVA) and AFRRRI (Armed Forces Radiobiological Research Institute) follow-on studies which found DU isotopes¹⁸ of uranium in urine years after exposure: "DVA laboratories" ... "have detected elevated concentrations of urinary uranium in veterans who retained depleted uranium fragments in their bodies..."

The DVA studies pose a particularly interesting contrast between veterans in the government's verses independent studies. The DND paper states: "Media reports have indicated that independent laboratory analysis of urine confirmed depleted uranium exposure in Gulf War veterans who did not retain fragments" [author's emphasis]. Both Defense Departments' emphasis on the distinction between the two groups of veterans (with and without retained DU shrapnel) allows them to retreat from the most prolific DU contamination pathway: inhalation and the lungs.

The DVA's and AFRRRI's studies are used to divert attention from the area of greatest concern to the greatest number of veterans: inhaled aerosols. Shrapnel wounding is a concern to only a few dozens of veterans. Its relevance and relationship to inhaled uranium is still being studied. The body's normal response to the introduction of foreign objects (e.g. shrapnel) is to isolate the object by a response called "encapsulation". Shrapnel particles are 1000's of times larger than the aerosolised oxides inhaled in DU battlefields and subject to different metabolic pathways.

Inhalable uranium particulate on the other hand is composed of various classes of microscopic particulate, ranging from soluble to insoluble uranium oxides, which when inhaled are retained by or transported from the lungs to uranium's known target organs.

A logical first conclusion about elevated uranium findings associated with retained DU shrapnel (found shortly after exposure) is that it is coincident with inhalational exposure (into the lungs). Yet, virtually all follow-on research sponsored by the Defense Departments ignores the lung-inhalational pathway, spending research dollars to favour DU shrapnel and "nose-only" inhalational

exposures¹⁹. Armed forces personnel deployed where DU shrapnel wounding occurred are exposed, by definition, to high concentrations of airborne, thermally aerosolised and ballistically pulverised DU.

Current funding of millions of dollars dedicated to follow-on studies of veterans and laboratory animals misdirects the budgets and misleads the veterans. The "nose-brain barrier"/ "nose-only inhalation" research is a particular example. While it is an anatomical fact that the first of 12 cranial nerves (olfactory filaments) extend to the retro-nasal cribriform cranial plate, there is no such morphological or physiological entity called a "nose-brain barrier". It simply doesn't exist. The "blood-brain barrier", in contrast, might be altered by toxic agents, and allow access of DU to the brain by altering brain capillary permeability. The olfactory epithelium still operates via blood-neuron interaction, whether in the nose or not in the nose. The "nose-only pathway" research will substantially fund, for example, the Lawrence Livermore National Laboratory, a lab that was not included in the DND or DOD screening programs but which is capable of conclusively measuring low-levels of DU in urine 10 years after exposure.

Conclusion

Recycled uranium – complicating the mix

The fact that DND and DOD have made selective acknowledgements of some facts and deny others remains a quandary for veterans. The constructing of follow-up and screening programs that persist at refusing to conduct isotopic analyses on veterans whose medical symptoms and deployment histories suggest a high likelihood of inhalational exposure to DU is a distinct contradiction with other government policies and a slap in the face to veterans. Most notable is the Energy Employees Occupational Illness Compensation Program Act of 2000. This U.S. legislation established a \$1.6 billion dollar entitlement program to help workers who develop cancers and lung diseases as a result of inhalational exposure to uranium and transuranic products in the Department of Energy's (DOE) nuclear complex. These DOE-complex contaminants are among the elements now known to be present in the stockpiles of raw materials and metal fabrication inventories used to make DU penetrators and non-fissionable, uranium alloyed

and uranium high-explosive, composite weapons²⁰.

In March 2001, the DOE released A Preliminary Review of the Flow and Characteristics of Recycled Uranium Throughout the DOE Complex 1952 to 1999. This landmark public report examines the uranium inventory and evaluates the impact of recycled uranium and reactor, spent-fuel products circulated throughout the DOE's and its private sector contractors' uranium processing, nuclear fuel, and weapons development, feed stockpiles. The contents of recycled uranium are exponentially more radioactive than pure, virgin uranium and pure depleted uranium. This mix of materials contains "transuranic elements, fission products, spent fuel products and nuclear activation products" of plutonium 239, 241, 242, uranium-236, and neptunium (and a host of other elements and toxins not listed in the report). The problem shown by this study is that none of the depleted uranium metal inventories used to produce DU ordnance are pure.

In a surprising admission, DOD shows that the entire stockpile of uranium is adulterated by 50 years of recycling and blending transuranics into the feedstock of the uranium enrichment process (DU constitutes 80% of the output of this cycle as a by-product of uranium enrichment). A section in the report addresses DU and attempts to downplay the radiological consequences of the adulteration of the metals and alloys used to make non-fissionable weapons and tank armour. Both independent and government radiological analyses of DU penetrators collected from DU²¹ battlefields have detected trace amounts of transuranics, including plutonium-239 in the metal. Independent studies have detected traces of uranium-236 in veterans' urine; adding a new dimension to the inhalational exposure risks to veterans from recycled uranium elements. Transuranics and spent fuel products are 10's of 1,000's of times more radioactive than pure DU or pure, non-depleted uranium (virgin uranium). Radiological studies of the isotopes of uranium in urine of veterans and DU battlefields, if properly conducted, would be able to detect, measure, and confirm or exclude the presence of transuranics in addition to the signature of DU. The degree of increase of the internal radiation dose from transuranics has not been examined beyond theoretical calculations^{22, 23}. DOD and NATO defense departments have been sponsoring studies to draw conclusions that it is

not present, and if it is, it's not relevant. DOD's failure to even consider the possibility of transuranics contamination in the Follow-Up program protocols suggests that there is more than DU to worry about.

12 years is not too late

By their own admissions, DND's and DOD's DU screening and follow-up programs have not been conducted by laboratories and researchers reliably able to measure DU in veterans. Instead, multi-millions of research dollars are diverted to gratuitous studies²⁴ of laboratory animals to examine irrelevant anatomical mechanisms and questionable biological pathways - body hair, shrapnel, "nose-only inhalation", and "nose-brain barriers". The outcomes of these studies will be meaningless for the majority of Gulf and Balkan veterans.

Inadequate and inconclusive radiological, bioassay programs mean no proofs (one way or another) of DU contamination for deceased, ill and dying veterans or the possible links to mutagenic effects of this contamination on their children. This means the largest population of battlefield DU exposed veterans will not be recognised - even if they have, in fact, been contaminated. Research into pathways of tertiary medical interest will not examine the causal relationship between DU inhalational exposure and its effects on health. Nor will it examine the primary mechanisms of exposure and environmental transport vectors coinciding with veterans' deployment histories or civilians present in the Persian Gulf and Balkan theatres. Twelve years later, the whole matter still hinges on the proper analysis and measurements of the isotopic ratios. Without these fundamental proofs, the veterans will be no further ahead than they ever were: not knowing, not being compensated, and not receiving proper clinical support.

A responsible approach by DND and DOD would be to set-up technologically competent screening programs for all veterans presenting with symptoms of uranium internal contamination, coincident with deployment histories in known DU battlefields. Where DU and possibly transuranics, are conclusively detected in veterans' urine, research can begin relevant biological and clinical studies of the target organs, metabolic pathways, radiation dose models and systemic effects of uranium internal contamination via inhalation. Contrary to DND's and DOD's programs,

independent research and even the military's own, recent admissions are proof that there is still time and the available technology to measure DU in veterans. Twelve years is not too late for this to be done right.

Footnotes

1. Ough EA, et al: An Examination of Uranium Levels in Canadian Forces Personnel Who Served in the Gulf War and Kosovo. *Health Phys* 82, 4:527-532, 2002.
 2. Information Paper: Impact of Laboratory Performance of Urine Uranium Analysis on Exposure Evaluations for Gulf War Veterans, Department of Defense, October 18, 2002.
 3. Environmental Exposure Report: Depleted Uranium in the Gulf (II), Special Assistant for Gulf War Illnesses, Department of Defense, December 13, 2000.
 4. Information Paper: Depleted Uranium Environmental and Medical Surveillance in the Balkans, Department of Defense, October 25, 2001.
 5. A Preliminary Review of the Flow and Characteristics of Recycled Uranium Throughout the DOE Complex, 1952 - 1999. Project Overview and Field Site Reports, U.S. Department of Energy, March, 2001.
 6. Medical Information for Patients - Health Services, Canadian Forces Voluntary Depleted Uranium Test Program, National Defence, <http://www.dnd.ca/health/information/>.
 7. Durakovic A: Medical Effects of Internal Contamination with Uranium. *Croat Med J* 40, 1:49-66, 1999.
 8. Durakovic A, Horan, P, Dietz L: The quantitative analysis of depleted uranium isotopes in British, Canadian, and U.S. Gulf War veterans. *Mil Med* 167, 8:620-7, 2002.
 9. Durakovic A. On depleted uranium: Gulf War and Balkan syndrome. *Croat Med J* 42:130-4, 2001.
 10. Environmental Exposure Report II, Tab P, DOD and VA Medical Evaluation Program for Gulf Veterans with Potential Exposures shows that medical follow-up and clinical study protocols are designed only to measure total uranium concentrations - not isotopic ratios.
 11. Medical Assessments of Balkan Veterans, Part V; Information Paper - Depleted Uranium Environmental and Medical Surveillance in the Balkans, Department of Defense, October 25, 2001. DOD cites a total of 22 studies and the results of uranium bio-assays of veterans from 20 countries of which all but one study concluded that there is no DU based on total concentrations of uranium. Only one, a UK MOD study analyzed the isotopic ratios in urine - it found Depleted Uranium in UK Balkan veterans.
 12. For an excellent analysis of dose effect issues, linear energy transfer, the epidemiology of inhalational exposure, and cellular and mutagenic effects of radiological internal contamination see <http://www.LLRC.org> for the works of Dr.'s Chris Busby, Richard Bramhall, and John Gofman.
 13. Adequacy of the VA Persian Gulf Registry and Uniform Case Assessment Protocol, 1998; and Adequacy of the Comprehensive Clinical Evaluation Program: A Focused Assessment, 1997; Committee on the Evaluation of the Department of Veterans Affairs Uniform Case Assessment Protocol, Institute of Medicine.
 14. Medical Testing by Other Laboratories, Section 5, Part D; Environmental Exposure Report II, DU in the Gulf, DOD, 2000.
 15. Correction: independent studies have not based their work on "elevated concentrations," but rather, findings of the specific isotopes of DU in veterans' urine.
 16. Readers are referred to the Lawrence Livermore National Laboratory, as one example among several, to examine advertisements for low-level isotopic analysis and explicit declarations of this analytical facility as a selling feature of its bio-assay services.
 17. See discussion of veterans retaining DU shrapnel fragments; Section V. Subsection E.1: Embedded Fragment Research; Environmental Exposure Report, Depleted Uranium in the Gulf II, DOD, 2000.
 18. Ejnik JW, Carmichael AJ, Hamilton MM, McDiarmid MA, Squibb K, Boyd P, et al: Determination of the isotopic composition of uranium urine by inductively coupled plasma mass spectrometry. *Health Phys* 78:143-6, 2000.
 19. Scientists Study DU - Gulf War Illness Link <http://www.lrrc.org/>
 20. DOE's Ohio Field Office Recycled Uranium Project Report, May 15, 2000, indicates DU kinetic energy penetrators and other DU alloyed weapons were made from transuranic-adulterated feed stock and metals which have been in production since 1974.
 21. UN Environmental Program press release, reported in *The Guardian*, United Kingdom, Feb 17, 2001.
 22. McLaughlin, et al: Plutonium in DU Penetrators. *Archive of Oncology* 9, 4:225-9, 2001.
 23. Dr. Helen Caldicott: Medical Consequences of Depleted Uranium. *Depleted Uranium Watch*, March 2, 2001.
 24. For a sample of currently funded DOD - DU related research that will not get veterans any closer to knowing if they are contaminated, see: Medsearch - "Medical Reference for Gulf War Related Research". Compare the budgets of these studies to the cost of conducting radioisotopic bio-assays on the urine of just one veteran: \$1,000 USD.
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