RAS 14491

SAVE THE VALLEY (HENSHEL) EX. 2

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket No. 40-8838-MLA
U.S.ARMY	)	ASLBP No. 00-776-04-MLA
(Jefferson Proving Ground Site)	)	July 20, 2007

PREFILED DIRECT TESTIMONY AND EXHIBITS OF

DIANE S. HENSHEL, PH.D.

EXHIBITS DSH AND DSH-1

IN SUPPORT OF CONTENTION B-1

OF INTERVENOR SAVE THE VALLEY, INC.

TEMPLATE = SECY-028

SECY-02

I. Qualifications

Q.001 Please state your name, your profession, and your business addresses?

A.001 My name is Diane S. Henshel. I am both a professor of Toxicology and Environmental Science and an environmental consultant. My school address is 1315 E 10th Street, Bloomington, IN 47401 and my consulting address is 4121 Cadbury Court, Bloomington, IN 47401.

Q.002 What is your educational background and professional training?

A.002 I received a B.S. in Biology and a B.A. in English from Brown University, Providence RI, in 1978. I received a PhD in Biology and Biomedical Sciences with a specialty in Neuroscience from Washington University in St. Louis, MO. I did a post-doctoral fellowship in Anatomy at Washington University, and a post-doctoral fellowship in Animal Sciences and Zoology at the University of British Columbia in Vancouver, BC, Canada.

Q.003 For whom do you currently work and in what capacity?

A.003 I am an Associate Professor at the Indiana University School of Public and Environmental Affairs. I teach environmental toxicology, ecotoxicology, risk assessment and risk communication. I do research on the effects of pollutants on health both through laboratory and field research and by analysis of publically available health and environmental data. As a consultant I work for Henshel EnviroComm. I am the principal proprietor, owner and President. Henshel EnviroComm provides technical environmental support for the government and other parties addressing environmental contamination problems. We provide toxicological laboratory support as well as risk communication and risk assessment services.

Q.004 What is your professional work history with regard to toxicology, risk assessment and environmental health?

A.004 A copy of my resume has been provided to the Board and other parties previously and is attached to this testimony as Exhibit DSH-1. I began toxicological research as a graduate student, studying the toxicological effects of monosodium glutamate (MSG) and related excitotoxins on nerve cells. I began studying environmental toxicological problems as a post-doctoral fellow, when I began to work in conjunction with the Canadian Wildlife Service on great blue herons exposed to dioxin in the Strait of Georgia in British Columbia, on double crested cormorants exposed to a mixture of organochlorines and pesticides in the Great Lakes, and on chickens exposed to dioxin as a laboratory model. Once I moved to Indiana University, I began to work with the US Fish and Wildlife Service as well, and began to work on a larger variety of wildlife affected by contaminants at sites across Indiana and on the Great Lakes. In the laboratory we have studied the effects of organochlorines, pesticides, solvents, and heavy metals. We have conducted or participated in risk assessment-related studies on native people in the Amazon, and at the Naval Surface Weapons Center - Crane Division.

Q.005 What are your professional credentials in the areas of toxicology, risk assessment and risk communication?

A.005 I am an author on over 40 peer reviewed papers and chapters and well over a dozen government-published documents. I was a contributing author for a National Research Council book and monograph, and I have made over 170 public lectures and research presentations at

international, national, regional and local symposia, workshops and scientific meetings. I have edited two books and published several editor-reviewed papers and monographs. And I have been an invited teacher in numerous short courses in toxicology and risk assessment given at professional meetings.

I am a member of many relevant professional organizations including (listed alphabetically) the Association for the Advancement of Science, American Society for Testing and Materials (ASTM) Committee E47 (among others) on Biological Effect and Environmental Fate, Association for Women in Science, International Association for Great Lakes Research, International Society for Environmental Bioindicators, Society of Toxicology, Society for Environmental Toxicology and Chemistry, Society for Neuroscience and Sigma Xi. I am on the editorial board of two professional journals (*Environmental Bioindicators, Environmental Communication)*, and am a frequent peer reviewer for over a dozen other peer reviewed journals in the general fields of environmental health, toxicology, risk assessment and environmental science. I have also served on many grant proposal review panels, including for the EPA and the Army Corps of Engineers.

Q.006 Have you received any academic honors or professional recognition in your fields of study and practice?

A.006 I am a member of Sigma Xi, the academic honors society. I was given the Outstanding Junior Professor award by Indiana University, a Teaching Award from the School of Public and Environmental Affairs, and have been named to the Leadership Circle for the Scholarship of

Teaching and Learning at Indiana University. Work from my laboratory, carried out under my guidance, has won awards from three different professional societies. I have received several service awards from professional organizations, including from the Society for Environmental Toxicology and Chemistry and from the American Society for Testing and Materials Committee E47 on Biological Effects and Environmental Fate for my work on development of standard guidance for environmental assessment and risk assessment, and for my work on the ASTM Committee E47Board in several positions, including First Vice-President. I have served on several advisory boards included the Science Advisory Board for the International Joint Commission overseeing the US-Canada Boundary Waters Treaty, and a National Research Council (NRC) Panel on Remediation of PCBs in Sediments, and have been asked to give expert testimony and act as an "invited expert" for several EPA workshops and panels related to risk assessment and toxicology, as well as for the NRC Committee on Bioavailability of Contaminants in Soils and Sediments. I was also a reviewer of the NOAA Northwest Research Science Center. I have been awarded federal, state and local grants and contracts for my work, and have also been funded by several foundations and not-for-profit Non-Governmental Organizations (NGOs).

Q.007 Have you testified as an expert previously in any jurisdiction or proceeding?

A.007 No, this is my first opportunity to testify in a formal adjudication.

Q.008 Have you previously served as a consultant with respect to the Army's Jefferson Proving Ground (JPG) or any other site involving significant depleted uranium (DU)

deposition?

A.008 Yes, I served as technical advisor to the JPG Restoration Advisory Board (RAB) from 1999 through 2003 providing technical document review and interpretation assistance to the RAB. I have also worked as a consultant to Save the Valley, Inc., since 2003 with respect to the decommissioning of the JPG DU site. In these capacities, I have attended numerous RAB meetings and reviewed the Army's decommissioning plans as they have progressed through their several iterations.

Q.009 Do you have a written summary of your education, employment, experience and background, and papers and presentations you have had over your career?

A.009 A copy of my *curriculum vita* is attached as an exhibit to this testimony, and includes a brief resume as well.

Q.010 What materials have you reviewed and actions have you taken in preparation for your testimony?

A.010 I have reviewed the initial Field Sampling Plan (FSP) submitted to the Nuclear Regulatory Commission (NRC) by the Department of the Army (Army) in May 2005 for Depleted Uranium (DU) Impact Area Site Characterization at the Jefferson Proving Ground (JPG), Madison, Indiana, as well as the various addenda to the FSP and the related sampling documents which have been submitted subsequently. I have also reviewed:

- all of the available Environmental Radiation Monitoring (ERM) data from JPG;
- all of the biology portions of documents and sources that have been disclosed by parties to

this proceeding; and

- techniques and technical resources for field sampling and laboratory analysis of radioactive isotopes.

Q.011 What are the topics of your testimony?

A.011 I will testify on two general topics. The first general topic is the deficiencies of the biological portions of the FSP, specifically the need for sampling a water-based species, the need for sufficient sampling to develop a model of how the DU moves through the food web, and the multiple serious problems relating to deer sampling, including the sample collection and data analysis protocols, especially in terms of how they have been carried out. The second general topic is the need for an air sampling component in the FSP. In both cases, the testimony will focus on the inability of the FSP, as a result of these deficiencies, to meet its charge to provide characterization of the Depleted Uranium (DU) site at Jefferson Proving Grounds adequate to support the fate and transport modeling and ultimately the risk assessment modeling required for purposes of the ultimate decommissioning of the site in accordance with NRC regulations.

III. Biological Characterization

A. General Considerations

Q.012 As you understand it, what is the basic purpose of the biological characterization activities in the FSP as modified in the addenda?

A.012 The biological characterization activities must provide site-specific input data for any risk characterization activities for JPG. All management decisions are to be based, in part, on the

results of the risk characterization activities that will be used to detect or predict the potential for adverse health effects from exposure to the introduced depleted uranium (DU) at JPG. The risk characterization needs to be based on data that accurately reflects the process(es), exposure pathway(s), rate(s), and timing(s) of DU migration from the impact areas to potential biological receptors both on- and off-site by various transport mechanisms, including but not limited to transport through the food chain. The exposure pathways assessed by the biological characterization activities are established through the conceptual site model. A decision matrix for choosing the exposure pathways to be considered for any given target organism is provided below. This decision matrix is based on virtually all risk assessment guidance currently in use.

Table 1

Generic Decision Matrix for Choosing Relevant Exposure Pathways to be Included in Conceptual Site Models for Any Risk Assessment Process*

***This decision matrix is considered separately for every target organism, as every target organism has distinct ways of interacting with the environmental exposure media. For example, deep water fish would have virtually no exposure to air, and only exposed to such dust and vapor that precipitates into it's water environment. A terrestrial animal or person would only have selective exposure to sediment or ground water, and would mostly be exposed to soil and surface water, unless drinking from well water, which pull from ground water and can contain sediment.**

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Routes of Exposure into the Organism ▸ Environmental media through which exposure occurs ▾	Ingestion (5- 20% can be absorbed, depending on age of animal, form of U)	Inhalation (Most efficient route of absorption, and fastest; rate of absorption affected most by the form of U)	Dermal Absorption (Very slow, very inefficient absorption of metals)
Air	Yes - as Dust / Small droplets	Yes - as Vapor / Gas / Dust (*fine dusts and droplets enter here, but usually end up ingested)	Yes - as Gas - if fat soluble
Soil / Sediment	Yes	Yes - as very fine dust - for any U attached to soil or sediment particles	Yes - in direct contact with U in soil or sediment
Surface Water / Ground Water	Yes - surface water directly, ground water through wells and as it transfers to surface water	Yes - as vapor - for water soluble forms of U	Yes - in direct contact with U in surface or (for invertebrates or cave dwellers) ground water
Food	Yes	Maybe - if the food has a volatile component and a volatile form of U	Yes - for animals, especially, that have significant external body contact with their food

Q.013 By what general mechanisms may DU be transported in addition to biological receptors themselves?

A.013 Generally speaking, DU may be transported by air and by water, both surface water and groundwater, as well as by the biological receptors themselves (i.e. the biota - humans, animals,

plants, and microorganisms).

Q.014 How do biological receptors transport DU?

A.014 This can occur in a variety of ways. A trespassing hunter might find an intact DU round to be an object of curiosity, pick it up, and remove it to a location remote from JPG, say his home or office. Animals may come in contact with soil and vegetation contaminated by DU and transport minute particles to locations on and offsite on their feet and fur. But, of most significance for purposes of the FSP, human, animal, and plant species may take up DU through their respiratory and ingestive processes (especially). Once inside an organism, the DU will interact with soft tissue and bone, and it will bioaccumulate in them and in other organisms further up the food chain (i.e. in the predators and higher organisms that eat the organism which initially accumulated the DU from the inorganic environment).

Q.015 You introduced the term "bioaccumulation." What does that term mean?

A.015 Bioaccumulation occurs when the rate of intake of a contaminant (here DU) exceeds the rate of elimination of the same contaminant from the body. Bioaccumulation potential is measured by Bioaccumulation Factors, which are determined experimentally as the ratio between the concentration in the biota and the concentration in the relevant environmental medium.

Q.016 Why is bioaccumulation important for purposes of the FSP?

A.016 In chronic exposure situations, such as exists currently at JPG where the DU is always present, and always slowly degrading into the soil and leaching into the water, and moving in the windblown dust (from the soil) into the air, the concentrations of DU in the media at any given

time might be relatively low. However, based on thorough analysis in the literature of other bioaccumulating metals in other ecosystems, and the limited data on bioaccumulation of low levels of uranium that has become available in the literature over the last five to ten years (see e.g. 40 CFR Parts 9, 141, and 142; Warneke 2002; UNEP, 1999 and 2003; Squibb et al, 2006) indicates that chronic low level exposure to DU can result over time in significant and toxicologically effective concentrations of the U in sensitive tissues of the body.

Q.017 What factors influence bioaccumulation of DU in biota?

A.017 First, the bioaccumulation of DU is directly proportional to the concentrations of DU in the four exposure media - air, soil/sediment, water, and food. Second, bioaccumulation rates will be proportional to the amount of food and water ingested, and the rate of respiration of DU dust and vapor- contaminated air. Third, growing organisms, e.g., young children and infants (in the case of humans), absorb DU from the gut more efficiently than do mature animals. As they are still growing, their bodies maximize absorption of metals and other nutrients. (DU, as a metal, is taken into the body through mechanisms which have evolved to absorb such health-essential metals as iron and magnesium.) Fourth, bioaccumulation increases in direct proportion to duration of exposure. For animals and plants on JPG, exposure is chronic. For people living south of the firing line and around JPG, exposure is also chronic, although the route of exposure will be different (through dust in air and through DU carried in water predominantly).

Q.018 What sources and types of biological data are required to meet the needs of a meaningful model of DU fate and transport from the impact area to potential

receptors?

A.018 Meaningful fate and transport modeling requires the following types of biological data:

- Data regarding the species of biota that use or inhabit the DU impact area
- Data regarding the migratory patterns of the biota present in the DU impact area
- Data regarding the food web relationships among the biota present in the DU impact area, as well as the other biota outside the DU impact area
- Data regarding the uptake and bioaccumulation of DU by the various biota identified to be of interest.
- Data regarding the uptake and biotransformation of the different chemical species of weathered DU found in and downstream / downwind from the DU impact area.
- Data regarding the biological effects of low level, chronic DU exposure by the various biota so exposed and identified to be of interest, both directly through respiration or ingestion of air, water, and soil/sediment and indirectly through ingestion of DU-contaminated biota lower in the food chain.

B. Major FSP Biological Elements

Q.019 What are the major elements of the biological characterization in the FSP, as modified in the addenda?

A.019 There is only one defined element of the biological chacterization in the FSP, namely deer sampling. Depending on the results of the deer sampling, the Army may also sample other biota, but that contingent element has neither been elected nor defined at this time.

Q.020 In your opinion, are these major elements of the biological characterization sufficient to model accurately the fate and transport of DU from the JPG impact area?

A.020 No, not at all. The deer sampling as outlined and as carried out, and the still as yet undefined "other biota sampling," are grossly inadequate for the purpose they are intended to serve in the FSP, that is to identify the current and predicted exposure of humans and other potential biotic receptors (i.e. animals, etc) to the DU introduced into JPG by the testing program. Moreover, as cited in the FSP (Section 2.2.3) and other sampling documents, other biota have been sampled previously at JPG but the results of these activities are essentially being discounted by the Army now.

Q.021 Why are these two elements not adequate?

A.021 The reasons are legion, but permit me to mention the most obvious and important.

First, more biota than just deer should be sampled in the initial round of sampling. In order to evaluate and model fate and transport through a food web, representative species of at least several trophic levels in the food web need to be sampled. It is impossible to properly understand whether and how the animals and the plants at JPG are being exposed to and accumulating DU if there is minimal to no data on most of the parts of the ecosystem. Based on virtually all standard risk modeling guidance in the literature (for example, standard texts by Glen Suter et al.) and produced by federal and state governments (for example, the complete set of risk related guidance available through the EPA websites), for an open environmental exposure situation such as exists at JPG, there should be at least one airborne species (e.g, a

bird or flying insect), one aquatic species (e.g., a crayfish), and one soil-based species (e.g., an earthworm or slug), in addition to a terrestrial species (eaten by humans) like deer.

Second, the initial terrestrial species sampled should not be deer, but one that is lower in the food chain and a better indicator of DU movement through the ecosystem (e.g., a small mammal such as squirrel or rabbit). Some other species were sampled during the DU Impact Area Scoping Survey reported by SEG (1995) and summarized in the FSP (Section 2.2.3, Tables on page 2-9). Looking at what little data is available, the bioaccumulation factors (BAFs) for vegetation and the aquatic filter feeders such as crayfish (both of which are eaten by higher animals and humans) are relatively high, on the order of 10^2 to 10^3 orders of magnitude. These BAFs are as high as those for persistent, bioaccumulative, and toxic chemicals (PBTs) listed as being of concern by the U.S. EPA and Environment Canada in the Persistent Organic Pollutants (POPs) Treaty. Based on this data , vegetation and aquatic filter feeders are better indicators of DU migration into the eco-food chain than are deer. Nonetheless, when samples from early and late in DU testing are not combined, it is evident that DU in the deer is increasing over time.

In sum, a more complete and representative sample of biota would enable a more accurate assessment of the extent of biological intake and impact of DU exposure from the residual DU at JPG. More comprehensive sampling results would also provide a much firmer foundation for the future determination as to whether additional biota sampling may be required.

C. Deer Sampling

Q.022 What is the purpose of the deer sampling element of the FSP?

A.022 The purpose assigned by the FSP to the Deer Tissue Sampling Study (ML062210019) is quite limited. Basically, the Army proposed to conduct a single deer hunt in the Fall of 2005 and analyze tissue samples from the harvested deer in order to determine whether DU uptake trends suggested by earlier analyses of deer tissue samples collected ten or more years ago had continued. (FSP, pp. 6-24 to 6-25). If the samples collected as a result of the initial hunt also indicated DU uptake, then additional deer sampling and/or other biota sampling would be considered.

Q.023 Is the initial Deer Tissue Sampling Study adequate to serve its intended purpose in the FSP?

A.023 No, the initial Deer Tissue Sampling Study is seriously inadequate to serve its intended purpose.

Q.024 How is the initial Deer Tissue Sampling Study inadequate?

A.024 Its inadequacies fall into two general categories: sampling methods and data collection, management, and interpretation.

1. Sampling Methods

Q.025 What are the inadequacies in the sampling methods?

A.025 There are two sampling method inadequacies in the Deer Sampling study. The first relates to the origin of the deer that were killed and the second to the representativeness of the uranium composition of the deer killed relative to deer with a natural diet.

Deer could not be harvested during the initial fall kill from the nearby hunting zones, due to displacement resulting from the hunting season that had just ended. The likeliest displacement would be from the areas of hunting toward areas without hunting, the DU impact area. Except for a few killed in the background hunting area, the only deer taken during the fall kill were at the perimeter of the DU impact area or along D road. Whether the deer from the nearby hunting areas displaced and compressed the deer native to the DU impact area or freely mixed with that limited population, the deer that were attributed to the DU impact area are more likely to be deer from the nearby hunting area than deer native to the DU impact area.

The choice of baiting as an integrated portion of the harvest for the deer tissue study introduces another uncertainty in the results and how properly to evaluate them. The Deer Sampling Study observes that the uranium content of wildlife reflects an animal's recent diet (p 1-6). By providing the deer an alternative to their natural diet, the design of the Deer Tissue Sampling Study introduces yet another unevaluated and undiscussed variable that will impact the data collected and the meaning of the results.

2. Data Collection, Management, and Interpretation

Q.026 What are the inadequacies in data collection, management and interpretation?

A.026 There are a significant number of inadequacies, as well, in the collection, management and interpretation of the data collected in the Deer Tissue Sampling Study. There are five that require discussion here.

Q.027 What is the first inadequacy requiring dicussion?

A.027 A fundamental inadequacy of the Deer Tissue Sampling Study in serving its intended purpose is its evaluation of the data produced as being non-indicative of uranium from DU penetrators in the deer tissue sampled. This evaluation is predicated upon such uranium having an isotope activity ratio that is characteristic of metallic uranium of the DU penetrators or of residual uranium in soils where penetrators weather, rather than that of the medium or media from which the deer ingest or inhale DU.

The results of the deer tissue studies confirm the likely uptake of penetrator-derived uranium when one considers the media through which exposure occurs. The deer from the background hunting area had an average isotope activity ratio of 0.94, for those samples for which a ratio could be calculated. (*See* p. 1-2, Table 1-2, Deer Tissue Sampling Study report) This ratio is what would be expected from an exposure to only natural uranium. It is not clear, as discussed above, that any deer native to the DU impact area were harvested. Taking all deer but those harvested from the background hunting area as a single population, the average isotope activity ratio is only 0.61. This is an activity ratio that is consistent with the deer consuming groundwater from the area around the impact area, base flow from streams around the impact area, and vegetation that relies upon those same waters. As discussed in Mr.Norris' testimony, the activity ratios of those media are just what would be expected assuming that they are being impacted by penetrator-derived uranium which has been subjected to fractionation during oxidation.

The results of the Deer Tissue Sampling Study indicate that penetrator-derived uranium

has probably moved into the deer population, directly counter to the conclusions of the tissue study. Since the deer do show biological uptake, the proper future implementation of the FSP should be follow-up testing of both deer and other biota. The proposed future implementation of the FSP following the deer study, however, is to forego any additional biota sampling.

Q.028 What is the second inadequacy requiring discussion?

A.028 A second basic inadequacy is the failure to meet specified accuracy in the chemical analysis of the deer samples. This deficiency is demonstrated by the discrepancy between the results of the few duplicate samples that were taken and chemically analyzed (one per JPG region). According to Table A3-1 on page A3-3 of the FSP, all duplicate samples are supposed to have less than a 50% difference in value to be considered acceptable. In fact, in the results of the first deer sampling event, as released in the August 2006 report, many of the duplicate sample sets have a measurement difference of 50% or greater, with some showing differences as great as an order of magnitude (i.e. ten-fold). By region, the duplicate sample values with the differences noted are summarized in Table 2 on the next two pages.

TABLE 2: Ratio of U Concentration Values Determined in Duplicate Samples Taken During the Winter 2005/2006 Deer Sampling Event at JPG as an Indicator of the Reliability and Acceptability of the Chemical Analysis*

*Tissue samples from these deer were used to check the quality and technical acceptability of the chemical analyses for the full data set of ten deer sampled per region. For this confirmatory data quality analysis, tissue samples were divided in two duplicate samples and each duplicate sample was analyzed separately in order to assess the accuracy and reliability of the chemical analysis. According to the Quality Assurance criteria set forth in the documents, the differences between the reported chemistry results between the two analyses of the SAME tissue sample should be no more than 50%. In this table, the ratios are set up based on the order given in the document. Thus, a ratio (the third number in each set) of 50% or less or 200% or greater, or an inability to even report the second value, indicates that the duplicate chemical analyses DID NOT MEET THE QUALITY CONTROL CRITERIA ESTABLISHED BY THE ARMY. These sample sets are in **boldface**.

Deer Sample #	Tissue	U-234	U-235	U-238
Background Hunting Zone:				
DR-BHZ-02	BONE	0.0104 / 0.0108 / 96%	**0.0015 / 0.0036 / 42%**	**0.0086 / 0.0016 / 537.5%**
DR-BHZ-02	LIVER	**0.0127 / 0.033 / 38.5%**	**0.0024 / 0.0005 / 480%**	**0.0014 / 0.0032 / 43.75%**
DR-BHZ-02	MUSCLE	**0.0036 / 0.0072 / 50%**	0.0005 / 0.0009 / 55.5%	**0.0006 / 0.0056 / 10.7%**
DR-BHZ-04*	KIDNEY	0.0043 / 0.0023 / 187%	0.0031 / 0.0026 / 119%	**0.0038 / 0.0015 / 253%**

* For some inexplicable reason, a duplicate kidney sample was alleged to have been taken from a different deer than all other duplicate samples for this region. By itself, **this is reason to question the validity of all of the sample results, as it indicates that either in the laboratory or in the field or in the analysis and documentation of the data someone made a mistake in labeling.** Since there is no way to tell where the quality assurance/quality control procedures fell drastically short, the reliability of all data collected and analyzed during this sampling event are called into question.				
Depleted Uranium Area:				
DR-DUA-04	BONE	**0.016 / 0.0041 / 39%**	**0 / 0.0046 / NO RATIO POSSIBLE**	**-0.0011[counts as 0] / 0.0014 / NO RATIO POSSIBLE**
DR-DUA-04	LIVER	0.0106 / 0.0117 / 91%	**0.0007 / 0.0038 / 18%**	**0.0028 / 0.0008 / 350%**
DR-DUA-04	MUSCLE	0.0095 / 0.0073 / 130%	**0.0045 / 0.001 / 450%**	**0.0003 / 0.0001 / 300%**
DR-DUA-04	KIDNEY	0.0022 / 0.0034 / 65%	**0 / 0.0015 / NO RATIO POSSIBLE**	0.014 / 0.0018 / 78%
The Nearby Hunting Zones:				
DR-NHZ-02	BONE	0.0112 / 0.021 / 53%	0.0052 / 0.0064 / 81%	**0.0021 / 0.0323 / 6.5%**
DR-NHZ-02	LIVER	0.0086 / 0.0116 / 74%	**0.0014 / 0.0041 / 34%**	**0.0016 / 0.0058 / 28%**
DR-NHZ-02	MUSCLE	0.0122 / 0.0135 / 90%	0.0016 / 0.0026 / 61.5%	0.0029 / 0.003 / 97%
DR-NHZ-02	KIDNEY	**0.0017 / 0.0054 / 31.5%**	0.0035 / 0.0036 / 97%	0.0053 / 0.0045 / 118%

Summarizing Table 2, the differences between initial samples and duplicates fall outside the acceptable range as specified in the FSP in 20 out of 36 duplicates, or 56% of the time; the differences effectively reach or exceed an order of magnitude in four out of 36 duplicates, or 11% of the time. In addition, there is a huge question about the accuracy of the sample labeling and tracking that calls into question the entire data set.

Q.029 What is the third inadequacy requiring discussion?

A.029 The third inadequacy of significance is the failure to properly and consistently collect information on the deer samples as they were conducted. This is indicated by observing the field notes in Appendix B: The Log Book, as not all of the data collected are in the formal part of the report. It is clear from the Log Book that some in-field measurements were only made for the Near Hunting Zone (NHZ) and Background Hunting Zone (BHZ) deer, and not at all for the DU Area deer. Specifically, ovary information was recorded periodically for female deer collected at NHZ as well as for BHZ, but not at all for the DU Area deer. Similarly, on-the-spot radiation readings were taken of all deer collected in the NHZ and for 9 out of 10 (90%) of the deer or deer tissues collected in the BHZ. None of the deer samples collected in the DU Area have on the spot radiation readings recorded. This type of data can be used to double check the comparability of the data and demonstrate some differences between the groups, if present. For example, readings in the BHZ samples, taken in the hunting zones about 5 miles from the DU Area, ranged between 6 and 8 uR/hr, with a mean of 6.7 uR/hr. For the NHZ samples, taken in the hunting zones within 2 miles of the DU Area, the readings ranged from 5 to 11 uR/hr, with a mean of 7.6 uR/hr and with 30% higher than the highest readings (8 uR/hr) in the BHZ samples. One can only surmise what the DU Area deer tissue readings might have been, but they would have undoubtedly been higher than those at either the NHZ and the BHZ.

Q.030 What is the fourth inadequacy requiring discussion?

A.030 The fourth inadequacy is the failure to fully collect, preserve, and analyze information about the

deer sampled so that a more accurate assessment of potential ecological impacts could be made. In this context, it is initially important to note that some data are collectable from the field notes (Log Book) that indicate clear differences between the three populations in size and health. However, some data, such as ovarian tissues and health, were apparently observed and collected in the BHZ and the NHZ, but seem to have been completely ignored in the DU area. Yet this kind of information and analysis would be useful in documenting differences in radiation-related effects between the populations and needs to be consistently noted and collected in all regions in all future sampling events.

However, as mentioned above, some telling data are revealed in the Log Book but not included in the Deer Sampling Report which absolutely should have been included and analyzed further. First, and most important from an effects perspective, there is a clear difference in health and fecundity between the three deer populations, assuming as do the Army and SAIC that the meager deer sample of 10 per region is in any way representative. (The assumption that a sample size of 10 is sufficient is not shared by STV and is referenced but not conceded for purposes of this observation.).

The differences are as follows:

1. The percent of each population that was female was very different between sampling regions: 80% (i.e., 8 out of 10 deer sampled) in both the BHZ and the NHZ, and only 40% (i.e., 4 out of 10 deer) in the DU Area. If the assertion made by the Army and SAIC is even partially accurate, and these deer are from relatively separate populations, this difference in the

gender ratio indicates a severe effect on wildlife in the DU area. Even if there is migration between the populations, as we suspect, this is an observation that merits additional field analysis and the initiation of a tracking study to monitor the migration and movements of the deer population at JPG.

2. There is a significant difference in fecundity between the three populations, and this fecundity is clearly related to the Army/SAIC's stated difference in expected exposure to the radiation present in the DU Area (i.e . exposure is greatest for the deer in the DU area, middle for the NHZ deer, and lowest for the BHZ deer). Fecundity as measured by the percent of pregnant female deer is significantly higher in both the NHZ (75%) and the BHZ (67%) than in th DU area (0%). Further, if the number of viable fetuses carried by the pregnant female is an indication of health, as it is considered to be, then the deer in the NHZ (50% the full load of two fetuses, 50% with the reduced load of one fetus) are clearly less healthy than the female deer in the BHZ (83% carrying two fetuses, 17% carrying one fetus).[1]

It could be surmised that size and age contributes to these two clear dose-related differences, but a quick evaluation of the data in the Log Book demonstrates that the female deer in the DU area are the largest over all (115 lb, 125 lb, 150 lb, 170 lb), while those in the BHZ and NHZ areas are similar in size (NHZ - Pregnant: 75 lb, 102 lb, 115 lb, 125 lb, 130 lb, 145 lb; NHZ - Not Pregnant: 80lb, 110 lb; BHZ - Pregnant: 105 lb, 120 lb, 130 lb, 135 lb,

[1]Another indication of the likely poor health of at least some of the sampled deer in the NHZ is the observation in the field notes / log book for dr-nhz-02 that the pregnant deer carrying only one fetus had only one ovary and that the existing ovary was abnormal, having ovarian cysts.

145 lb, 150 lb; BHZ - Not Pregnant: 60 lb, 75 lb, 125 lb). Without an analysis of the bones to determine true age of each deer, it is not fully possible to determine whether age contributes to the slight discrepancy in weight for the non-pregnant and (evaluated separately) pregnant females of which the BHZ are on average smaller. Without monitoring and tracking the deer populations, one could also not determine whether the differences in size are due to a shifting in birth times during the year, which might also indicate an effect of the DU exposure on wildlife health and function. The number of males collected in the BHZ and NHZ are small, but overall, the males in the DU area appear to be larger, although this could be due to a skewing from the sample size (BHZ: 100 lb; NHZ: 110 lg, 130 lb; DU Area: 75 lb, 75 lb, 110 lb, 130 lb, 140 lb, 160 lb).

Moreover, some of the observed differences discussed above with respect to the deer populations correspond not only to geographic variation but also to temporal variation, i.e., the impact area deer were taken during the fall kill and the other deer during the winter kill. Some differences may causally relate to the temporal variation independent of the geographic distribution, or both variations may act in consort. The failure of the deer tissue study to independently isolate major variables like time and space is another measure of the inadequacy of the implemented study to test a hypothesis of DU uptake by deer.

Q.031 What is the fifth deficieny requiring discussion?

A.031 A fifth deficiency is that a another analysis needed to be conducted on the deer sampling data but was not performed in the Deer Tissue Sampling Study, namely an assessment of

bioaccumulation. Due to the very poor reliability of the data compiled in the initial study, such an assessment using its data would be equally unreliable. In the future, however, with a larger sample size, more duplicates, and consistent collection and measurement procedures, and thus reliable sample results, the study results need to include an evaluation of bioaccumulation rates based on a correction for estimated age of the animals, as uranium does bioaccumulate and thus increases in the animals with age. Until such corrections are done, the differences in the exposures even between different populations in different parts of JPG are simply not subject to reliable interpretation.

Q.032 Deficient as the Deer Tissue Sampling is, do its results provide any useful information for purposes of the FSP?

A.032 To the extent that they may be relied upon, the results of the Deer Tissue Sampling Study indicate that projectile-derived uranium has moved into the deer population, directly counter to the conclusions of the SAIC tissue study. Since these results document biological uptake, the proper implementation of the FSP should be follow-up testing and the testing of other biota. The implementation of the FSP planned by the Army following the deer study, however, is to forego any additional biota sampling. Moreover, a detailed analysis of the data collection and analysis procedures used in the initial Deer Tissue Sampling Study raise serious questions about the reliability of the resulting data. In view of these multiple, significant deficiencies, the Deer Sampling Study must be redone and supplemented by additional biota sampling in order to have any utility for its intended purpose within the FSP.

IV. Air Sampling

Q.033 Does the FSP include an air sampling component?

A.033 No, it does not.

Q.034 Why is there no air sampling component in the FSP?

A.034 Big Oaks National Wildlife Refuge (BONWR) is managed by the US Fish & Wildlife Service (USFWS). USFWS decided that doing controlled burns in the DU Impact Area would not increase human exposure significantly. The USFWS based their decision to burn over the DU Impact Area on a study by Williams et al. (1998) carried out at Aberdeen Proving Ground (APG), a similarly DU contaminated base. ("Current available data suggests that levels of DU carried in smoke associated with burning natural vegetation is not significant. This is the only study we know of that looks at dispersion of DU in smoke in a setting similar to the conditions that are found on the refuge." (Big Oaks National Wildlife Refuge Fire Management Plan, March 2001, p25). The FSP adopted this conclusion and reasoning. (FSP, May 2005, Section 4, p 4-1).

Q.035 Do you agree with this conclusion and reasoning?

A.035 No, this conclusion and reasoning are based on outdated data. Recently (2006), scientists at the Los Alamos National Laboratory (LANL) revisited the question and found that there were significant changes (14% increases on average) in airborne Depleted Uranium at the perimeter of the entirety of the LANL property following the prescribed burns, as are being carried out at JPG/BONWR, including in the DU Impact Area. Interestingly, the increases in airborne DU

was greatest in the spring months, when the majority of the JPG/BONWR burns are started, as the vegetation has regrown enough after the winter months to help keep the soil in place in the face of the local ministorms created by the controlled burn. *See* J.J. Whicker, et al., *From Dust to Dose: Effects of Forest Disturbance on Increased Inhalation Exposure*, Science of the Total Environment (2006).

Q.036 Were these levels high enough to introduce health risks to the workers working on site, based on the calculations in Whicker et al's model?

A.036 No, the calculated levels were not high enough by themselves to introduce clearly significant adverse health effects. But, the amount of airborne DU in dust did increase measureably and significantly in one year, in fact in one season, at LANL, including at the boundary of the LANL.

Q.037 How does this LANL data support your conclusion about the need for air sampling as a part of the FSP at JPG.

A.037 At JPG, which is a very long and narrow property, civilians live very near the boundaries, and many of them live there for their whole lives. Even more concerning, civilians have moved in to the housing just below the firing line, which is even closer to the DU Impact Area. These people will slowly accumulate the residual DU from their environment in their bodies - in their kidneys, in their brains, in their hearts, and in their bones. Over a lifetime of exposure, the increased dose of airborne DU resulting from controlled burns at JPG could accumulate in these civilians to the point where it could contribute to adverse health conditions. But, without

air sampling associated with the controlled burns at JPG, the Army cannot say with any assurance what that increased dose or resulting increment to health risk will be. In my expert opinion, the dose and risk assessment models that the Army uses to make decisions about how much DU to leave in the ground and how to manage it really must include reliable data on all likely contributing routes of exposure as the total dose will include DU accumulated through all the contributing routes of exposure, including air.

I declare this 20th day of July, 2007, under the penalty of perjury, that the foregoing testimony and attached exhibit are true to the best of my knowledge, information and belief.

Diane S. Henshel

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