

RAS 14494

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of

U.S. ARMY

(Jefferson Proving Ground Site)

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Docket No. 40-8838-MLA

ASLBP No. 00-776-04-MLA

October 2, 2007

PREFILED SURREBUTTAL TESTIMONY OF

DIANE S. HENSHEL, PH.D.

IN SUPPORT OF CONTENTION B-1

OF INTERVENOR SAVE THE VALLEY, INC.

TEMPLATE = SECY-028

SECY-02

Q.1. Please state your full name.

A.1. My name is Diane S. Henshel.

Q.2. Are you the same Diane S. Henshel who previously filed initial testimony in this matter on July 20, 2007 and rebuttal testimony on September 18, 2007, on behalf of Intervenor Save the Valley, Inc.?

A.2. Yes, I am.

Q.3. What is the purpose of your surrebuttal testimony?

A.3. The purpose of my surrebuttal testimony is to respond to certain matters raised by witnesses for the Army and the Staff in surrebuttal testimony they filed on September 25, 2007.

I. Response to NRC Staff Witness Dr. Thomas McLaughlin

Q.4. Have you reviewed the testimony of NRC Staff witness Dr. Thomas McLaughlin as it relates to your rebuttal testimony?

A.4. Yes. I have reviewed his prefiled testimony which I received on September 25th, 2007.

Q.5. Do you agree with Dr. McLaughlin's testimony in A5 with respect to additional biota sampling?

A.5. No, I do not agree with his conclusions about additional biota sampling. Nor do I agree with his apparent beliefs about most citizens' awareness of regulations nor their readiness to follow laws passed that do not match with their common practices. In A5, Dr. McLaughlin follows the Army's and Staff's dogma that "no DU was detected in the deer sampled," although that claim itself is at issue as discussed in my later comments (A8 below). Dr. McLaughlin then uses this claim to argue against a need to sample any other potential bioaccumulating animal (and I

presume plant, though that is not stated), although humans could hunt other animals on JPG (squirrels and turkeys) and collect animals from streams (or illegally hunt them) off JPG.

Q.6. What is your first specific point of disagreement with Dr. McLaughlin regarding his A5 testimony?

A.6. The first point I will address is whether any animals that bioaccumulate uranium are likely to be found off JPG property. Not squirrels nor turkeys nor deer, in fact, are biologically bound to stay within JPG's boundaries, and the aquatic organisms of concern can be bioaccumulating uranium downstream from JPG, in private and public property not now owned by the Army. I am of course aware that when good habitat is available, animals (like deer and turkeys and squirrels) will tend to stay in their usual habitat most of the time, but not necessarily all of the time, especially when food is limited in the winter. Further, I am aware that squirrel home ranges are rather small and, unlike deer or turkey, squirrel are unlikely to migrate a matter of miles seasonally or due to hunting stresses. Turkeys, on the other hand, can fly reasonably well, and have little difficulty with flying over the fences surrounding the JPG property. Deer also can jump fences, and can migrate the full distance from the DU area to anywhere else within JPG, or outside of JPG, as pointed out in my previous testimony, with the appropriate research citation from the literature.

Q.7. Does this discussion also apply to aquatic organisms?

A.7. No. Aquatic organisms of the size (relatively small fish) and type (molluscs and crayfish) found in the streams in and around JPG are not great wanderers on their own. However, there are two mechanisms by which offsite molluscs and fish could be found with JPG- sourced uranium

in their bodies. First, the uranium itself corrodes off the penetrators, as pointed out in earlier testimony. Once the uranium corrodes, it can change valence state and interact variably with oxygen and other elements, producing a number of uranium-based molecules, some of which will be water soluble, some of which will be not water soluble, but remain in solid form, typically attached to soil, and most likely attached to the clay particulates in the soil. Southern Indiana, again as pointed out previously, has limestone based, holey (e.g. karst) bedrock. Karst bedrock is riddled with cracks and caves which can be in contact with the surface via sinkholes (caves that dissolve away the upper layer of bedrock and are therefore open to the surface), which are observable at JPG. Once in dissolved state or attached to small particulates, the U based molecules can migrate, through erosion, in surface water, and through groundwater, and become available to offsite aquatic organisms.

Q.8. Are there any other means by which DU can become available to offsite biota?

A.8. Yes. Above ground movement, both in water or erosion based, will be enhanced by the seasonal flooding that occurs at JPG. For example, there is currently evidence on base of a large flood that apparently occurred sometime this past spring, according to Dr. Joe Robb of the U.S. Fish and Wildlife Service. The water was six or more feet above ground level as it crossed the JPG boundary, based on the residual vegetation on the boundary fence, and came through JPG with such force that at least ten feet of fence had to be replaced as it was swept away or destroyed. A flood of this size and force moves not just sediment and water off site, but also can erode enough top soil to move DU penetrators and other ordnance from their original locations within the JPG firing range to other locations offsite.

Further evidence of this comes from a comment reportedly made by a landowner to Dr. Thomas Simon of USFWS and Mr. Charlie Morris of IDEM while they were recently sampling water and biota in and around the streams of JPG. The landowner brought Dr. Simon and Mr. Morris a "rock" and asked them to identify what kind of rock or fossil it was. Dr. Simon and Mr. Morris immediately identified it as a piece of ordnance, and noted to the disbelieving landowner (who thought it was a fossil) that one does not generally find brass fittings in fossils. The landowner's comment was that he has "lots of these" that he collected from in and around the stream-fed areas on his property. Dr. Joe Robb confirmed in discussions with me that ordnance does indeed wash off the JPG firing range into streams and other water courses and then onto properties surrounding JPG during floods. Clearly, if ordnance is migrating off JPG in this manner, then smaller bits of sediment containing DU can also migrate off JPG, both during floods and at times of lower stream flows. After all, the streams traversing the DU site, and the smaller onsite water courses supplying them, are not dammed at the boundaries of JPG.

A second mechanism by which U-containing molecules can move off base is by being transported (dissolved or as small particulates) through the karst-created subsurface conduits. Farther north in south central Indiana PCBs are the noted contaminant of greatest concern, and a thorough seasonal and storm-specific water and sediment sampling effort has been undertaken as a part of the Superfund program. The very thorough sampling effort has demonstrated that particulate-bound PCBs wash out of the subsurficial karst to the surface in a bolus at the leading edge of the storm flow, after which the slow leaching continues most of the time. Thus, contaminated sediments and pockets of contaminated water are caught in the

crevices and caves of the karst, and leach out slowly due to normal groundwater flow, and migrate in larger quantities during flooding.

Thus, I do not at all agree with Dr. McLaughlin that the uranium could not be migrating off base, because all the circumstantial evidence indicates that the uranium IS likely to be migrating off base, at least in some forms by some pathways in some amounts. Therefore, I again point out that if the DU is likely to be migrating off base, then it behooves the Army and Staff to recognize this potential and properly evaluate the dimensions of the problem in the FSP as a pre-requisite to determining whether and, if so, how the DU area can be decommissioned. That is why I have recommended that a biota sampling component be included in the FSP.

Q.9. In their testimony, Dr. McLaughlin (A5) on behalf of the Staff and Mr. Skibinski (A4) on behalf of the Army have rejected your recommendation regarding additional biota sampling as unnecessary. Is there an alternative you would consider?

A.9. It is correct that I have recommended that a significant biota sampling component be included in the FSP, and I believe that would be the best approach. However, I have only recently learned that samples of aquatic organisms from both on and off JPG have already been collected, will soon be archived, and would then be available from the USFWS for use by the Army to assess bioaccumulation of DU in those organisms. These samples were collected by Dr. Thomas Simon (USFWS) and Mr. Charlie Morris (IDEM) over the course of multiple seasons during 2006 and 2007. Samples were collected from a total of 30 sites within JPG, about 10 sites in the environs of JPG but off base, and at over several dozen other sites in the Muscatatuck watershed (the watershed that encompasses and extends well beyond JPG) at sites not directly

connected to JPG by surface water flow. This sample set provides a means to test whether DU is being taken up by aquatic organisms on JPG and downstream from JPG, and also provides a comparison set of similar aquatic organisms from the same watershed but from streams apparently unconnected to JPG.

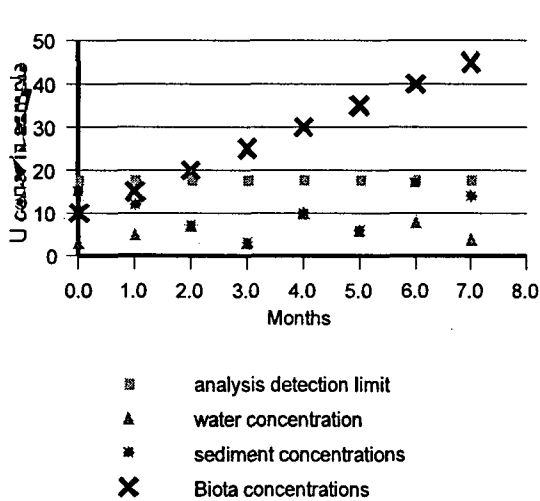
The last samples were collected during the week of September 24, 2007. The samples are currently being processed by Dr. Simon and Mr. Morris, and the extra crayfish and fish will be used for the survey verification vouchers and archived, some in alcohol, some in fixative, neither of which should affect the amount of or isotopes of uranium in the samples. (A chemist would have to determine whether the fixative or alcohol would bias the analysis or require the samples to be differently prepared for analysis.) Dr. Simon and Mr. Morris have stated that they would permit the voucher crayfish and fish to be used for additional analyses so long as each animal is left primarily intact, and the analysis is carried out on a plug removed from each animal's tail. We request that the Army take advantage of this opportunity and that they have these samples tested for total uranium and uranium isotope analysis.

Dr. Simon and Mr. Morris also collected water and macroinvertebrates. The macroinvertebrates are being analyzed by the specialists at IDEM. The last set of water samples, collected during a low flow period (when the water is primarily emerging from ground water), is currently at the ISDH (Indiana State Department of Health) laboratory that will be analyzing the samples for a suite of common pollutants and parameters. At the time of filing, ISDH still has the last round of samples since they were just delivered and haven't been processed yet. The parts of the samples that are not actually used in the ISDH analyses could

be requested from ISDH and tested for uranium content if the request is made before ISDH gets rid of the residuals after the analyses are completed.

Q.10. What is your second specific point of disagreement with Dr. McLaughlin?

A.10. A second point made by Dr. McLaughlin in A5 is that since DU has not been detected (at least above the detection limit of the tools used to measure the DU) in the water or sediment samples, then there is no reason to assess whether DU is accumulating in any other organism (or plant, one would assume) that humans (or apparently other animals) could eat. I disagree.



The accompanying graph illustrates what happens during bioaccumulation to concentration levels in the bioconcentrating organisms. (Aquatic filterfeeders and predators like molluscs [filter feeders] and crayfish and fish [predators] are excellent bioaccumulators, based on years of evidence in the literature with both heavy metals and hard to metabolize

organic compounds.) Effectively, the concentrations in water and sediment are in constant flux due to the factors that both increase and decrease the concentrations (i.e. dissolution from penetrators, migration into water phase, attachment to and detachment from sediment particles, and dilution with fresh water or uncontaminated sediment particles), and these concentrations can be below the level of detection, depending on the techniques used to both measure the U and whether the preparers use any methods to concentrate (or, alternatively, dilute) the samples

prior to analysis. However, bioaccumulation will produce significant and even toxic concentrations of bioaccumulative compounds in biota given a long enough duration of exposure. Compounds that bioaccumulate are slow to metabolize and be stored in the body. Heavy metals, including U, bioaccumulate, transform in the body to different forms, including organic [carbon containing] forms, and are stored both long term in organs like bone and kidney, and shorter term in organs like brain and the reproductive system. Over time, the concentrations can build up to the point where concentrations in sensitive organs can evoke toxic effects, like changes in behavior, kidney function changes, kidney damage, and sperm abnormalities.

STV is simply asking for the Army to evaluate the most likely bioaccumulating organisms that are known to be part of the food chains for humans and other animals. Deer are not necessarily the best bioaccumulators. Although they are of concern because hunters shoot the deer on base with an intention of eating them, deer are not necessarily the only exposure pathway of concern for the DU at JPG.

Q.11. What is your third specific point of disagreement with Dr. McLaughlin?

A.11. A third point made by Dr. McLaughlin in A5 is that my anecdote relating my students' comments about what they eat is not scientific, and that this is not evidence that people eat from streams inside JPG. Dr. McLaughlin is correct that I have never created a scientifically rigorous study of my students' eating habits. Thus, my information comes not from scientific surveys but casual in class discussions. But, I would still consider it to be reliable information since it has been repeated over many years, in situations in which the students feel

free to discuss their attitudes and behaviors honestly and openly because, they rightly feel, they are safe. (I have been addressing this issue for over a decade now.)

I would also concur with Dr. McLaughlin that this is not evidence that students, or any other area residents, cull their crayfish and other aquatic organisms from within the boundaries of JPG. Whereas that might well be a possibility, I was only asserting that there could well be exposure via the aquatic pathway, but at no time did I say, or mean to say, that the culled aquatic organisms collected by my students came from on base.

As pointed out above, however, there is no need to say that for the aquatic organism pathway to be a concern. The DU migrates off base. The fish and crayfish and molluscs could bioaccumulate on base and move off base (on their own or during flood times), or could bioaccumulate the U while off base. These are all quite possible scenarios that the Army and Staff has never even attempted to disprove with anything but hand waving and wishful assumptions. Moreover, the Army is required by law to consider a scenario in which institutional controls fail and farmers living off the land reside on the DU site. In this scenario, consumption of aquatic organisms (and rabbits and squirrels, for that matter) found onsite would be a given.

Q.12. Do you agree with Dr. McLaughlin's testimony in A6 about the cave fauna survey?

A.12. I agree with Dr. McLaughlin that the cave fauna survey does not directly prove that DU is the ONLY possible cause for the missing and deficient invertebrate faunal populations noted in ALL of the caves of the DU area that Lewis et al sampled. The mollusc survey of Big Oaks National Wildlife Refuge (JPG/BONWR) conducted by Lewis et al (2002) and submitted to

the USFWS and INDNR in 2002, also provides evidence for other potential aquatic and vertebrate accumulators as it lists and provides commentary on all the biota and evidence for biota found in their survey. The biota they found included crayfish, amphipods (includes sand and water fleas), spiders, a variety of insects, salamanders, frogs, bats, birds, mice, racoons, and evidence for a coyote. The Middle Fork Creek and Big Creek drainage (which crosses the DU area) caves in most of JPG included most of those species. Big Creek drainage had, for example, "12 species of obligate subterranean animals", while Middle Fork Creek has nine obligate subterranean species which would be (according the authors) chronically exposed to water, and thus chronically exposed to the DU leaching into and being carried by the creek. It is important to note that several of the obligatory subterranean invertebrate species listed in this survey are noted to be "globally imperiled," and thus could be considered to be a candidate for legal protection.

The mollusc survey was not set up or intended to be an ecotoxicological evaluation of the cave invertebrates on JPG/BONWR. However, Lewis et al noted that all the caves in the DU area, and only the caves in the DU area, appeared to be affected adversely, as some populations that are present elsewhere on JPG are missing in the caves in the DU Area, and in general, "caves in the depleted uranium area appear to have low population densities of stygobiont aquatic species." (p64) Lewis et al specifically did not think that the cause was the physical or chemical disturbance from the munitions impacts or explosions, or the munitions (explosives) alone as the DU area was distinctly more and differently affected than caves in other high impact regions of JPG, including the caves that were so severely affected physically

by the impacts that the actual cave structure had collapsed. Instead, as Dr. McLaughlin points out, they hypothesize that “The reason for the absence of fauna remains unknown, but groundwater contamination should be entertained as a cause.” (p64) Given that the biota in the UXO area away from the DU area were NOT affected, but only the biota in the caves in the DU area were affected to the point of some populations not being present and other populations being in low density, the only obvious difference between the caves in the two areas is the proximity to the source of DU. Both areas were the subject of test shots, had evidence of explosions, and are likely to be contaminated by RDX and other explosives.

In my opinion, these considerations certainly warrant further testing in the FSP of the cave biota to determine whether DU-related contamination is, in fact, a contributing cause to their clearly debilitated condition.

Q.13. Do you agree with Dr. McLaughlin’s testimony in A7?

A.13. No, I do not. As pointed out above, there is evidence that some JPG ordnance, at least, is no longer completely confined to the JPG grounds, as area residents outside of JPG have collections of it. If some ordnance is no longer confined to JPG, one can only surmise that some of the DU penetrators are also no longer confined to JPG.

Q.14. Do you agree with Dr. McLaughlin’s testimony in A8?

A.14. No I do not. First, no one has denied that there was a single deer reported with high levels of DU in the 1996 SEG report. If even one highly contaminated animal is found, especially when under 100 deer have been sampled all told (in a population in which 5-8 times that number are killed per year without detriment to the population), that indicates that there is a completed

exposure pathway from the DU to the deer somewhere in JPG, and one would presume that would be associated with the DU area. There is no other dense source of contamination at JPG. No one has even attempted to assert that U ore is found in high concentrations at JPG and could be identified as the source of (D)U found in the deer reported in the 1996 study. That the Army wishes to explain this finding away as, effectively, a rarity, does not change the fact that without a thorough assessment (which they have NOT done), they really don't know how rare this finding is. After all, one deer in a hundred is not all that rare.

II. Response to Staff witness Dale Condra

Q.15. Have you reviewed the testimony of Staff witness Dale Condra as it relates to your testimony?

A.15. Yes. I have reviewed his prefiled testimony I received on September 25, 2007.

Q.16. Do you agree with Mr. Condra's testimony in A4 and A9?

A.16. No, I do not. First, if the DU is not in any of the samples, all the samples would have been non-detect, and no ratio of the isotopes could have been calculated. Second, Mr. Condra then discusses my points about the statistical equality of the samples, and goes on to pull in and calculate roughly, without showing the calculations, a z test value for the duplicate samples that incorporates uncertainty. I can not judge what was calculated directly, since no values for the uncertainty parameters were provided, nor were any details provided about whence such numbers were derived, nor was the meaning of " ± 2 " given within this context. I can state that the RPD calculations that I used in my initial testimony were performed using an equation provided by Army contractors, and followed what the Army contractors said were their own

requirements for the duplicate samples.

Further, duplicate samples taken from the same tissue in the same deer should have no differences in the matrix contributing to the uncertainty, as asserted by Mr. Condra (page 2, lines 22-24; and again page 3 lines 4-5), nor should subsampling be an issue when comparing field taken duplicate samples, not laboratory generated subsamples (page 3, lines 1 - 3).

Q.17. Do you agree with Mr. Condra's testimony in A5?

A.17. No, I do not. I agree that one could not say positively that uranium is even present in *some* of these samples, but I do not at all agree that the correct conclusion is then that *none* of the samples had DU in them. Some samples were clearly positive. In addition, Mr. Condra then argues that even if some deer were positive, they are not different from background deer, so their DU levels are not different from background, either. In fact, if the deer being used as background could be spending part of their time in the DU area, the Army cannot know what the background contamination level is because it has not yet been measured.

Q.18. Do you agree with Mr. Condra's testimony in A6, A7, A8 and A10?

A.18. No, I do not. Mr. Condra dismisses the highly contaminated deer from the 1996 SEG study because the contractors did a poor job of reporting results and uncertainties, and therefore the results are, in his opinion, completely worthless. It is convenient indeed to dismiss the data, but not valid to then jump to the conclusion (once the worst data is dismissed) that therefore there is no DU moving into deer, and therefore no DU moving into any biota. Wishing the data would go away does not make the potential reality presented by the data also go away. Wishing that DU does not migrate into the food chain (or off JPG) does not make it so.

IV. Response to Staff witness Adam Schwartzman

Q.19. Have you reviewed the testimony of Staff witness Adam Schwartzman as it relates to your rebuttal testimony?

A.19. Yes. I have reviewed his prefiled surrebuttal testimony I received on September 25, 2007.

Q.20. What is your response to Mr. Schwartzman's testimony in A4 about confirmatory air sampling?

A.20. First, Mr. Schwartzman mistakenly says that we changed our request from a full-time air sampling program to a confirmatory air sampling program. What we have said from the start is that the Army cannot discount (or eliminate) the air pathway as a contributing exposure pathway without first doing appropriate air sampling. Appropriate air sampling includes sampling that takes in particulate for more than a few hours (a one or two week sampling period seems more appropriate), that takes into account and tests during burn periods, and that considers that air transport can move in multiple directions, as the wind changes over time. What we are asking for confirmation of is the repeatedly stated assertion (based on models, derived from data from elsewhere) that the air pathway is not a sufficiently significant exposure pathway for the humans, and one assumes animals then, within and around JPG. As we have said, we would like confirmation of this assertion, and to have the confirmatory sampling be appropriately designed to address the air pathway concerns in dry years with burns. To assume that there is "no undue risk to the public health and safety" without knowing from site specific data that the air pathway assumptions are valid is, in my opinion, to truly risk public health and safety, as well as ecosystem health.

Q.20. What is your response to Mr. Schwartzman's testimony in A5 about modeling the JPG ecosystem using LANL and APG data?

A.20. Southern Indiana has very dry seasons and very wet seasons, and typically both occur for a number of months in any given year. During the dry seasons the ground cracks, vegetation can dry up, and the area becomes semi-arid. During the wet season, floods and ephemeral streams and wetlands are common. It is correct that past JPG planned burns have usually occurred in the wet season. However, from my discussions with FWS personnel, I understand that they are actively considering future burns during the dry season so as to better replicate the natural fire cycle in the JPG area.

V. Response to Army witness Joseph Skibinski (et al.)

Q.21. Have you reviewed the testimony of Army witness Joseph Skibinski (et al) as it relates to your rebuttal testimony?

A.21. Yes. I have reviewed this prefiled testimony dated September 24, 2007.

Q.22. What is your response to Mr. Skibinski's testimony in A4 about interpretation of the deer sampling data?

A.22. First, it is hard to confirm or deny sampling data that is so deficient that more than half of the duplicate samples fail their own test for acceptance of the analytical results. Second, there was detectable uranium, not all the samples were non-detect. Third, it was not me who set up the false comparison to the "background" deer (sub)population, I just pointed out that it was a mistake to use this subpopulation as anything other than another group of deer on site, since there was no evidence that the same deer population was just being re-sampled, and there is

evidence from the literature that deer do migrate that distance between seasons. The Army needs to conduct a more thorough sampling event with tracking of the deer year round to ensure that they can validly interpret the deer sampling data.. Further, the high deer sample from the 1996 SEG sampling event indicates that there is migration of DU into the deer-linked food chain, and if the small deer sampling events since have not confirmed that finding, that could as well indicate that the sampling size was too small for the size of the JPG population.

Q.23. What is your response to Mr. Skibinski's testimony in A4 about other food chains in JPG?

A.23. I have previously addressed the concerns about the misinterpretation of my remarks with regard to ingestion of biota from the streams around (not necessarily in) JPG. I have also already pointed out that the concerns are: that the biota can move (on their own or during flooding) off of JPG into open streams; that the DU can move and bioaccumulate in the biota off of JPG; and that people do not always know, much less follow, regulations prohibiting eating of collectable biota, especially when they are poor (and the counties around JPG are some of the poorest in the state), and when they have a tradition of collecting and eating this food that goes back before the institution of a not well advertised law.

Finally, I did not make misleading statements about what is stated in the Deer Sampling Report. There were detectable levels of uranium in many of the tissues. That is not a misstatement nor is it, in my opinion, misleading. In my professional opinion, I don't agree that the report writers can conclude, conclusively and with sureness, that "DU was not present in any samples", especially given the uncertainty about the analyses raised by the large variability

in the analytical results of the field-gathered duplicate samples.

Q.24. What is your response to Mr. Skibinski's testimony in A6 about the conclusions that the absence of populations of cave fauna could be due to DU or could be due to other factors?

A.24. I appreciate that Mr. Skibinski acknowledges the significance of the missing and depleted populations of cave fauna in the DU area, when they are not so depleted or missing from caves in the other impact areas. However, whereas some of the alternative variables suggested by Mr. Skibinski could play a role in explaining this discrepancy between the caves in the DU area and the caves in the other impact areas (habitability and size, for example), I think that such variables would have likely been pointed out by Lewis, et al, if they considered them to be likely factors, as Lewis et al were clearly trying to understand the source of and the reason for the difference. Further, JPG is not so large as to have big differences in climate from one area on JPG to another area less than a mile away.

Q.25. What is your response to Mr. Skibinski's testimony in A8 about your flashlight and marbles analogy?

A.25.. It is important to remember that whereas the flashlight as a tool can be effectively used to detect the marbles, as the sampling can be effective in detecting uranium, one can not find the marbles that have rolled away from the drop point, or the DU that has migrated away from the DU area, if one does not move the flashlight. We are asking the Army to "move the flashlight."

Q.26. What is your response to Mr. Skibinski's testimony in A8 about the relative specific activity of DU to enriched uranium?

A.26.. I agree with the comment that to determine the total amount of uranium taken up, one needs only consider the mass of uranium. However, when determining the relative radioactivity (i.e. specific activity, or disintegrations per second), it is extremely important to recognize that DU is radioactive (it is between 1/6th and 1/20th as radioactive as enriched uranium, depending on the enriched uranium and the DU formulations), and the Army and its contractors can not dismiss DU as safe because it is relatively non-radioactive. The estimated 70,000 kg of DU remaining in the ground at JPG (http://www.jpgbrac.com/uranium/du_history.htm) is equivalent in terms of specific activity to between 3,500 and 11,000 kg of enriched uranium remaining in the ground. Whereas the mass of uranium taken up into the body is what determines the heavy metal toxicity of the uranium, it is the specific activity (disintegrations per second) that determines the relative toxicity of the accumulated uranium from a radiation toxicity perspective, as it is the radioactive particles and waves given off during a radioactive disintegration that causes the radiation-related cellular damage like DNA damage and oxidative stress.

Q.27. Do you have comments about Mr. Skibinski's testimony in A8 about Dr. Robb's observations of, exposure to, and time in the DU area?

A.27. Yes. I have recently talked with Dr. Robb about his interactions with the DU area in general, and his observations about the DU area during the burns. First, Dr. Robb pointed out that he also spends time in the DU area doing bird surveys. He estimates that he spends cumulatively about a week of work time a year in the DU area. Second, we discussed his observation that the trench (and only the trench) has not burned in his experience. Dr. Robb pointed out that he has not been able to observe the whole of the trench, but the part of the trench he has observed

has not burned. He hypothesizes this is because the bottom of the trench is a couple of feet below the surface of the surrounding ground, and is thus closer to the water table and wetter than the surrounding ground. He pointed out that if the burn takes place during a drier time of year, or during a year when the water table is not as high, then he would expect the trench to burn. Dr. Robb also pointed out that they are now trying to conduct the burns during the fall instead of the spring to have the burns coincide with a more natural cycle for when burns would occur without human help. Dr. Robb pointed out that JPG is very dry during the early fall period and that once they do begin fall burns, he expects the trench to burn as the water table is relatively low during the early fall.

Q.28. Do you have comments about Mr. Skibinski's testimony in A8 about the comparison between LANL and JPG?

A.28. Yes. LANL does not conduct burns all year, every year. The LANL burn they evaluated occurred once during May 2000 (Whicker et al, 2006). JPG burns occur even more frequently, as JPG is repeatedly and cyclically burned during a 3 to 5 year cycle. Thus, if anything, the comparison would underestimate the burn-related exposure for people who work at JPG compared to the exposure for those who work at LANL.

Q.29. Do you have comments about Mr. Skibinski's testimony in A8 about the JPG burn plume?

A.29. Yes. I appreciate the Army's point that the large surface area of the JPG burns would increase turbulence, as it is just this turbulence that we believe would be re-suspending the DU from the soil into the air.

Q.30. Do you have comments about Mr. Skibinski's testimony in A8 about dye trace studies in karst?

A.30. Yes. Dye trace studies in karst are very different than dye trace studies in non-karst areas. In karst, not all connected pathways are evident, nor do all connections through ground water surface in predictable or even proximate locations. Multiple dye trace studies have been conducted in the karst of south central Indiana to evaluate migration of PCBs in water and particulate phase. These studies evaluated dye and PCB migration through and from karst at high flow, low flow and associated with storm water flow. These dye trace studies have indicated that dye can disappear into karst and reappear in connecting surface streams that are as far as 1 to 3 miles away. And even in those studies, the investigators (EPA or PRP contractors) could not account for even close to 100% of the dye used in the study, indicating that they may not have identified all of the conduits through and out of the karst from the point of dye injection.

Q.31. Does this conclude your surrebuttal testimony?

A.31. Yes, it does.

I affirm, under the penalties of perjury, that the foregoing testimony is true to the best of my knowledge, information and belief.



Date: October 2, 2007

Diane S. Henshel, Ph.D.