

RAS 14502

# Army Anagnostopoulos Exh. # 1

U.S. NUCLEAR REGULATORY COMMISSION

In the Matter of US ARMY (JEFFERSON PROVING GROUND)

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OFFERED by: Applicant/Licensee Intervenor \_\_\_\_\_

NRC Staff \_\_\_\_\_ Other \_\_\_\_\_

IDENTIFIED on \_\_\_\_\_ Witness/Panel \_\_\_\_\_

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## Pre-filed Testimony of Army Witness Harold W. Anagnostopoulos, CHP

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**UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION**

**ATOMIC SAFETY AND LICENSING BOARD PANEL**

Before Administrative Judges:

Alan S. Rosenthal, Chair  
Dr. Paul B. Abramson  
Dr. Richard F. Cole

In the Matter of	)	Docket No. 40-8838-MLA
	)	
U.S. ARMY	)	ASLBP No. 00-776-04-MLA
	)	
(Jefferson Proving Ground Site)	)	August 15, 2007
	)	

**TESTIMONY OF HAROLD W. ANAGNOSTOPOULOS  
ON STV CONTENTION B-1,  
BASIS ITEM "m"  
AND ON CERTAIN TESTIMONY OF HENSHEL AND NORRIS**

**Subjects: Air Sampling; Sample Collection and Analysis**

**I. WITNESS BACKGROUND**

**Harold W. Anagnostopoulos ("HWA")**

**Q1. Please state your full name.**

**A1. (HWA) My name is Harold W. Anagnostopoulos.**

**Q2. By whom are you employed and what is your position?**

**A2. (HWA) As of August 13, 2007, I work as a Senior Health Physicist with the S.M. Stoller Corporation. Previously, I worked at Science Applications International Corporation (SAIC) in their St. Louis office. SAIC acts as the Army's technical consultant and expert on selected tasks related to the planned decommissioning of the U.S. Nuclear Regulatory Commission (NRC) materials license at the Jefferson Proving Ground (JPG).**

**Q3. Please summarize your professional and educational qualifications.**

**A3.** (HWA) My professional and educational experience is summarized in the résumé attached to this testimony as HWA Exhibit #1. Briefly summarized, I am certified by the American Academy of Health Physics as a Board Certified Health Physicist. I have been practicing health physics for approximately 21 years and I have been certified for 11 years. I also was registered as a Radiation Protection Technologist (RPT) in 1993. I have experience in the operation and maintenance of nuclear power reactors, the decommissioning of nuclear facilities, and emergency response. Most recently, I have served as a task manager and technical expert for the post-remediation verification of radiologically contaminated soils under a U.S. Army Corps of Engineers (USACE) Formerly Used Remedial Action Program (FUSRAP) project.

**Q4. Please summarize the nature of your professional involvement with JPG.**

**A4.** (HWA) I have been providing technical support to the Army's JPG facility since early 2004. I have visited JPG on several occasions, participated in field work, toured the Depleted Uranium (DU) Impact Area, and personally examined a DU penetrator embedded in soils in the DU Impact Area.

**Q5. What is the purpose of your testimony?**

**A5.** (HWA) The purpose of my testimony is to address, on behalf of the Army, radiological issues at JPG as raised by Save The Valley (STV) as part of its Contention B-1 in these proceedings. Specifically, my testimony will provide evidence and expert opinion refuting evidence offered by STV in support of its Basis Item "m" and evidence offered by STV concerning the adequacies of the radiological aspects of the Army's sampling program.

## **II. OVERVIEW**

### **Issues Raised By Basis Item "m" to STV Contention B-1**

**Q6. What is your understanding of the technical issues raised by Basis Item "m" of STV's Contention B-1?**

**A6.** (HWA) In Basis Item “m” to its contention B-1, STV asserts that the air pathway is a significant exposure pathway at JPG and that the license amendment for an alternate decommissioning schedule should not be approved unless the Army is required to perform air sampling and analysis specifically related to the controlled burns at JPG.

**Q7.** Do you agree with the assertion that the Army should be required to perform air sampling and analysis specifically related to the controlled burns at JPG?

**A7.** (HWA) No.

### **III. DISCUSSION**

#### **Air sampling**

**Q8.** What is the basis for your disagreement?

**A8.** (HWA) First let me say that the air pathway is nearly always a potential pathway for nearly any contaminant and situation. The question is whether the air pathway is a significant pathway at JPG and whether special monitoring is required. Section 4.2.2.1 of the Army’s Health and Safety Plan (HASP) does not set any requirements for air sampling for field workers. This section of the HASP clearly states that airborne radioactive contamination is unlikely and reminds the Radiation Protection Manager (RPM) to assess the need for personnel air sampling and/or respiratory protection as site conditions warrant. One objective of personnel air sampling is to assess potential exposures. Such sampling often is conducted solely for the purposes of collecting negative data (that is, to prove that no exposure occurred). A reminder note in a HASP does not constitute evidence that airborne distribution of uranium contamination is a significant pathway.

I strongly disagree with STV’s statement that, because of controlled burns at JPG, “...conditions are prime for enhancing migration of soil-bound DU into the

air.” STV has not identified these prime conditions at JPG nor given evidence that they exist and are significant.

The first (and later, the second) Los Alamos National Laboratory (LANL) study cited by STV (reference 12) also does not support the assertion that the air pathway is significant. To begin, the calculations provided in the study involved numerous assumptions. Some of the more significant assumptions include:

- Tree thinning at LANL with 20 percent bare soil in thinned areas.
- Average soil uranium concentration of 6 pCi/g with a high-end average concentration of 3,000 pCi/g at the firing line.
- Assumption of five times more uranium in the airborne dust than the soil.
- Exposed workers spend their entire work year outdoors and near the burned areas.
- Per an e-mail from Mr. J.J. Whicker to Mr. P. Cloud (Exhibit HWA #2), the area at LANL in which the study data were collected contained aerosolized DU, which is not present at JPG.

The study did indeed estimate that potential doses to occupational workers at LANL increased by 38 percent. It is important to note that 38 percent was calculated using the upper bound of the airborne particulate estimates and applied only to the severely burned areas. This represented an absolute worst-case scenario at LANL and includes the assumptions provided in the bulleted list above. It is also unfortunate that the use of percentage values from the LANL study in STV's contention does not place the significance or impact of the increase into their proper perspective.

**Q9. In your opinion, based on your education and experience, what is the proper perspective for evaluating the significance or impact of the increase in percentage found in the LANL study relied upon by STV.**

**A9. (HWA)** The 38 percent increase at LANL means that the calculated dose rose from 10.2 to 14.0 mrem per year. The average annual exposure to the general population from natural and man-made sources of radiation in the United

States is approximately 360 mrem (reference 19). The calculated increase in dose at LANL from the severely burned areas is approximately 1 percent of what is received from natural and man-made sources of radiation each year and is insignificant.

The upper bound, however, should not necessarily be used for decision making as it does not represent the most likely condition. The “mean plus two standard deviations” values also were cited in the LANL study for the severely burned areas. Using these more likely estimates of the true values for airborne contamination, the increase in calculated dose rose from 0.044 to 0.06 mrem per year. This most likely calculated dose from the severely burned areas at LANL is approximately 0.004 percent of what is received from natural and man-made sources of radiation and is very insignificant.

Now both of these calculated increases include the assumptions from the bulleted list already mentioned. Unfortunately, the assumptions do not hold true for JPG because:

- There has been no systematic tree thinning and virtually no bare soil at JPG.
- The average soil concentration at JPG is most likely approximately 3 times lower than that estimated at LANL (reference 6) and high-end average concentrations of DU at JPG will be seen only at or under DU penetrators. This is because only soft targets were used at JPG.
- There is no known reason to assume that there is more uranium in airborne dust than in soil at JPG.
- It is unreasonable to assume that anyone will spend an entire working year in or near the controlled burn areas at JPG. In fact, the area is quite remote and access is limited.
- Finally, the land around LANL is markedly different in geological setting and flora than JPG. Comparisons to Aberdeen Proving Ground might be more reasonable for JPG.

**Q10. In your opinion, based on your education and experience, what is the real issue with respect to STV's assertions of the need for air sampling of the controlled burns at JPG?**

**A10. (HWA)** In my opinion, it seems that the real issue at hand is not the estimated increase in dose, but rather the idea that controlled burns will spread a notable amount of radioactive contamination outside the DU Impact Area. Data from the LANL study can be used to make estimates here as well.

The estimated air concentration (again, mean plus two standard deviations) in the severely burned areas at LANL was  $4.2 \times 10^{-6}$  Bq/m<sup>3</sup> (or  $1.14 \times 10^{-16}$   $\mu$ Ci/mL). This value is approximately 0.2 percent of the NRC limit on effluent concentrations in air from a radiological facility for the worst-case Class "Y" compounds of U-238. The NRC limit assumes that the emission is occurring continuously over an entire year; clearly that would not be the case for controlled burns at JPG.

Controlled burning (where DU might be present) probably occupies no more than 2 weeks of cumulative annual burn time (rather than the 50 weeks per year assumed in the NRC limit), so one can see that the 0.2 percent value for airborne emissions estimated earlier is in actuality much lower for JPG. Since airborne emissions at the NRC limit do not cause widespread contamination of the surrounding land area, airborne emissions that are a small fraction of the NRC limit and for only 4 percent of a year also will not cause widespread land contamination.

In order to obtain another estimate of the potential impact from controlled burns, the "Hotspot" health physics code was used to estimate the potential ground deposition from controlled burns at JPG. Assuming that the entire DU Impact Area was burning at one time and assuming meteorological conditions that would maximize ground deposition (i.e., 1 meter/second wind speed, Class F stability), the amount of uranium involved in the fire was varied until a time-integrated air concentration closest to the release point was roughly equal to the concentration seen in the estimates at LANL (i.e.,  $1.14 \times 10^{-16}$   $\mu$ Ci/mL). The

resulting estimated maximum ground surface deposition was  $1.3 \times 10^{-5}$  dpm/100 cm<sup>2</sup>. This value is several orders of magnitude lower than can be detected with field instrumentation. The estimate using the "Hotspot" code is imprecise. Use of the FIREPLUME code would yield better results; however, the effort is clearly unwarranted.

**Q11. Are you familiar with the testimony offered by Ms. Diane Henshel in this hearing?**

**A11.** (HWA) Yes, I have reviewed her written testimony dated July 20, 2007.

**Q12. Do you agree or disagree with her opinions and conclusions regarding the need for air sampling as a component of the characterization activities?**

**A12.** (HWA) I disagree.

**Q13. Starting with her Answer 34, in which she states her understanding of why there is no air sampling component in the FSP, do you agree with her comments there?**

**A13.** (HWA) No. Ms. Henshel's testimony suggests that the Army's position (that the air exposure pathway is not significant) is based upon a single study (reference 3). That is an error in fact. In addition to that study, the Army's position is also based upon information from Gutierrez-Palmeiro, Inc. 1996 as cited in Section 5.16 of reference 3, and is based upon reference 4 and reference 5, which documents the results of air samples that were collected at JPG during controlled burns within the DU Impact Area. Most significantly, the determination that the air exposure pathway is not significant is documented in detail in a technical memorandum "Airborne Transport of Depleted Uranium (DU) and Site Characterization Needs," dated January 13, 2005 (reference 15). This technical memorandum pre-dates the FSP.

**Q14. In Ms. Henshel's Answer 35, she states that the data that Army used to support its position that no air sampling is needed are outdated and that a more recent study done at LANL shows the need for such air sampling. Do you agree with her conclusions and reasoning?**

A14. (HWA) No.

**Q15. Please state the basis for your disagreement.**

A15. (HWA) The data that were used by the Army (to determine that the air exposure pathway is not significant) are not outdated. The second LANL study cited by STV (reference 16) does not render the previous information invalid. In fact, the new information supports the assertion that the air exposure pathway is not significant at JPG. That is because the conditions at LANL represent a worst-case, bounding condition for airborne suspension of DU soil contamination (as compared to JPG), and the increase in dose from the airborne pathway at LANL, as described in the second study, was also insignificant. Ms. Henshel's testimony reflects an error in data use and interpretation.

Again, LANL represents a worst-case bounding condition as compared to JPG because:

1. The terrain and soil types at LANL are significantly different than at JPG. LANL is a dusty, arid environment, which optimizes the potential for airborne suspension of DU-contaminated dust.
2. The LANL fire was large. The burned area was approximately 30 million m<sup>2</sup> at LANL. The area of the entire DU Impact Area is 8.4 million m<sup>2</sup> (or 28 percent of LANL). The amount of burned area that is exposed to wind has a direct relationship with the amount soil dust that can go airborne. In addition controlled burns do not encompass the entire DU Impact Area in a single event.
3. Post-fire thinning of vegetation was performed at LANL, which exposed additional soils to the effects of wind erosion. This has not been done at JPG.
4. The nature of the DU contamination in the soil at LANL is different from JPG, since JPG did not use hard targets during ballistics testing.

The phrase "U-238 concentrations...have increased significantly...by about 10% since the Cerro Grande Fire" is a quote from the cited LANL report

(reference 16, emphasis added). That quote might not have been presented in its proper context by Ms. Henshel. The significance that is being referred-to in the quotation is the statistical significance of the magnitude of the increase in airborne DU concentration, and not an evaluation of the magnitude of the impact of that increase on human health or the environment.

To add the missing perspective, the increase in airborne DU at LANL was insignificant from an exposure standpoint because:

1. The stated 14 percent estimated dose increase to the public from the airborne DU activity at LANL equates to a dose of 0.1 millirem. Again, the average annual dose to a member of the public in the U.S. from all sources of radiation is approximately 360 millirem (reference 19). The estimated increase at LANL from airborne DU in dust is approximately 0.03 percent of the average annual dose to a member of the public from all sources and is very insignificant. In comparison, a single commercial flight from New York to Los Angeles will result in a dose of about 3.5 millirem to a passenger (FAA CARI-6 program). The dose from the commercial flight is 3,500% higher than the dose added from airborne DU activity at LANL.
2. As a point of perspective as to potentially significant pathways for uranium exposure, the typical value for uranium in rock in the natural environment is 1.8 parts per million (ppm). The ores used to produce phosphate fertilizers contain uranium in the range of 8 to 400 ppm (reference 1, page 172). It is estimated that continued use of phosphate fertilizers could eventually double the radium and uranium content of farmlands (reference 1, page 174)! The direct application pathway for uranium in fertilizers is clearly more significant than a supposed (and disproved) airborne deposition pathway for uranium from fires at JPG in the DU Impact Area. If Ms. Henshel holds onto her beliefs about a build-up of uranium in human systems, it is troubling that she has not expressed concern about the "significant and toxicologically effective concentrations of uranium in

sensitive tissues of the body” that could occur from the widespread use of fertilizers on farmlands.

**Q16. In Ms. Henshel’s Answer 36, she maintains that the increase of DU dust in the LANL study was both measurable and significant. Do you agree?**

**A16. (HWA) No.**

**Q17. What is the basis for your disagreement?**

**A17. (HWA) Ms. Henshel’s use of the phrase “not high enough by themselves to produce clearly significant adverse health effects” (emphasis added) is correct, but represents an error in data use and interpretation. It overstates the potential risk.**

The increase in dose is 1/50,000<sup>th</sup> of the dose that can be safely received by an occupational radiation worker in the U.S in 1 year. This dose is 1/1,000<sup>th</sup> of that allowed in 1 year to a member of the general public under Federal Regulations (i.e., 10 CFR 20). The dose is so low as to be difficult to impossible to even measure with reasonable certainty.

The “Dust to Dose” paper (reference 16) documented that the amount of airborne DU in dust increased in a statistically significant way at LANL, following a major fire that was followed by tree thinning activities, which exposed soils to wind erosion. As already stated, the conditions at LANL have little bearing on those at JPG, with the exception of providing a worst-case bounding condition for comparison purposes. The increase from the additional airborne DU dust had no significance to dose.

**Q18. Do you, then, agree or disagree with the opinion that Ms. Henshel expresses in her Answer 37 that the LANL study supports the need for air sampling at JPG?**

**A18. (HWA) I disagree.**

**Q19. Would you please state the basis for your disagreement?**

**A19. (HWA) Yes.** A simple inspection of maps of the JPG area show that the fenced and controlled area for the JPG range begins at least 0.75 miles away from the nearest edge of the DU Impact Area. The residents mentioned by Ms. Henshel are well in excess of 2 miles away from the DU Impact Area, which is contained within a 55,000-acre facility, for which access is strictly controlled, and is surrounded by 48 miles of fence. The lands surrounding JPG are predominantly farmlands and woodlands (reference 6).

As stated in reference 15:

*“Airborne transport of uranium involves particles. Vaporization is not a significant transport route because uranium metal has a boiling point of 3818°C. Powdered uranium metal may burn spontaneously in air, but larger pieces of metal, such as penetrators, require a heat source ranging from 700°C to 1000°C to produce ignition. A DU projectile creates very fine particles of uranium oxides (typically 75 percent U<sub>3</sub>O<sub>8</sub> and 25 percent UO<sub>2</sub>) upon impact or burning. These particles settle according to Stokes Law. The larger particles [> 5 micron] settle rapidly and travel only short distances through air because they are so dense (specific gravities of 8.3 and 10.96, respectively).”*

In addition, the airborne concentration will generally decrease with increasing distance from the source following a general inverse-square relationship. Ms. Henshel's testimony reflects an error in data use and interpretation.

Even assuming that chronic, low-level emissions of DU from the DU Impact Area via the air pathway are as postulated by Ms. Henshel, she has not established how that might cause someone to exceed 25 millirem per year, let alone how those exposures might be of a magnitude to cause adverse health effects. She has provided no evidence or estimate to show that the decommissioning criterion will be exceeded.

Contrary to Ms. Henshel's testimony, the Army can say with good assurance that the increased dose (if any) would be insignificant. This is based upon a combination of calculations, experience at other sites, and actual air

sampling that has already been conducted at the JPG site during controlled burns within the DU Impact Area (reference 4 and reference 5).

Most importantly, if Ms. Henshel is concerned with chronic low-level bioaccumulation of uranium in the local population, she might consider comparing the potential uranium exposure from the DU Impact Area (2 miles away) to the very real and somewhat significant human exposures that routinely occur due to the presence of natural uranium in well water, natural uranium in phosphate fertilizers, natural uranium from the fallout of coal fly ash, and natural uranium in foodstuffs. These routes of uranium exposure are likely to far outweigh the potential additional uranium burden from an airborne pathway from the DU Impact Area.

Considering that an average 1 square mile of earth that is 1 foot deep contains approximately 4 tons of natural uranium (reference 17), it seems logical that a natural source of uranium that is very close to the human receptor will cause more intake than an unnatural source of uranium (DU) that is physically quite remote from the receptor. Such uranium exposures from natural sources have been occurring over the entire age of man.

#### **IV. SUMMARY AND CONCLUSION**

**As to Basis Item “m”**

**Q20. Please summarize your testimony with regard to Basis Item “m”.**

**A20. (HWA)** My testimony as to STV’s Basis Item “m” can be summarized as follows:

Theoretical calculations and analysis of real data from a large-scale fire at LANL have suggested that the air pathway is not a significant exposure pathway at LANL or at JPG. More importantly, air sampling has been conducted during historical controlled burns within the DU Impact Area and little or no uranium was detected in the samples. Refer to references 3, 5, 6, 7, 8, and 11 for supporting information. These data have demonstrated that the air pathway is not significant.

## V. OVERVIEW

### Sample collection and analysis

**Q21. Are you familiar with the testimony offered by Mr. Charles Norris in this hearing?**

**A21. (HWA)** Yes, I have reviewed his written testimony dated July 13, 2007.

**Q22. Do you agree or disagree with his opinions and conclusions regarding the inadequacy of the sample collection and analysis methods found in the Army's FSP?**

**A22. (HWA)** I disagree, with two minor exceptions. Mr. Norris did identify a typographical error in the Field Sampling Plan (FSP), and he did correctly note that 1-gallon water samples are not being collected as described in the standard operating procedure (SOP) for the Environmental Radiation Monitoring Program. The significance and impact of these two issues will be described in my testimony.

**Q23. Starting with his Answer 71, in which he states his opinion as to the inadequacies in the analysis of the samples, do you agree with his comments there?**

**A23. (HWA)** No.

## VI. DISCUSSION

**Q24. Please state the basis for your disagreement.**

**A24. (HWA)** Mr. Norris testifies that some samples are to be analyzed for gross gamma activity and uses sediment sample sites as an example. Mr. Norris may not fully understand this element of the FSP. A gamma sensitive sodium-iodide detector will be used to scan the stream beds and banks to look for areas of increased counting-rates, such as may occur with a deposit of DU in the sediments. These areas, if found, may be selected for biased sediment sampling. The actual analysis of a sample will be a laboratory analysis and will not involve gross gamma activity. The selection of the gamma scanning action level, in

excess of background, is documented in Appendix C to the FSP and is based upon many years of experience in the detection of uranium contamination in soils and sediments.

Mr. Norris then testifies that the FSP is deficient in that the sample sizes are too small to provide an “unambiguous identification” of DU at low levels of contamination. He then cites a “reduced sample size” as the source of large reporting limit objectives.

First, the “unambiguous identification of DU at low levels” is not a stated objective of the FSP and is not necessary to characterize the DU Impact Area and surroundings. This “unambiguous identification” goal was asserted by STV and has not been accepted by the Army. In fact, such unambiguous identification of DU at levels that are near that which are expected in the natural background for natural uranium (and in the presence of natural uranium) presents several challenges, as will be explained later in my testimony.

Second, Mr. Norris has not stated what value of low-level contamination must be detected in order to have an acceptable characterization plan. Natural uranium can be present in rock at values of about 0.4 to 41 pCi/g (reference 1, page 140). The FSP Table A.3-1 specifies that a reporting limit of 2 pCi/g be met and, in general, lower levels are routinely met. This reporting limit is well within the range of the values expected for natural uranium in rocks and sediments and can therefore detect the condition where DU is contaminating the environment, causing a rise in the total uranium concentration.

Third, I object to Mr. Norris’s defacto assumption that DU contamination is present at JPG in areas outside of the DU Impact Area. To date, there is no indication that there is routine or widespread DU contamination outside of the DU Impact Area.

Next, Mr. Norris states that the FSP specifies a “reduced sample size” but provides no standard for comparison. Reduced in relation to what? There has been no reduction in sample sizes; sample sizes are based upon the analytical technique, laboratory needs, and project data quality objectives (DQOs), and are specific to the project and the activity.

Finally, Mr. Norris may not fully understand how field sample size can affect the reporting limit (Note: for radiological analysis, the minimum detectable concentration [MDC] is a more appropriate term and the “MDC” will be used in my testimony). For example, Table A.4-2 of the FSP specifies that 8 ounces of soil or sediment be collected as a field sample. When that sample is processed in the analytical laboratory, an aliquot of approximately 1 to 3 grams is removed and used in the laboratory method (in this case, alpha spectroscopy). It is the actual sample aliquot size that is used in the determination of the MDC for that method. Increasing the field sample size, in this case, has no impact on the MDC (reporting limit) for the alpha spectroscopy of soils or sediments. The use of larger sample aliquots in the laboratory analysis could theoretically lower the MDC, but presents problems in the processing and counting of the sample and could actually raise the MDC due to self-absorption effects in the sample matrix.

A similar situation exists for water samples, with one exception, 1L of sample usually is collected, but the water is processed through a precipitation step and all of the field sample is used. Again, a larger sample size could theoretically lower the MDC, but the amount of total dissolved solids in the sample could have a significant negative effect on the analytical results as already mentioned for the soils and sediments.

Most importantly, lowering the MDC to levels that are below that expected in the natural background, by increasing the sample size (which may not be feasible) or increasing the counting time (expensive and quickly reaches a point of little added benefit) may yield more precise information, but still not provide “unambiguous identification of DU” due to the effect of fractionation of U-234 in water, which will be discussed later in this testimony.

**Q25. Do you agree or disagree with the opinions stated by Mr. Norris in his Answer 72 as to the necessity of identifying the presence of DU and its concentrations at low levels?**

**A25.** (HWA) No, I do not agree.

**Q26. Please state the basis for your disagreement.**

**A26.** (HWA) Mr. Norris asserts that the objective of the FSP is to provide site-specific data that would allow a fate and transport model to realistically and reliably predict the future movement and concentrations of DU. He then asserts that the Army must be able to see DU at extremely low levels in order to achieve this objective. This is inaccurate on both points.

First, it is not an objective of the FSP to support a fate and transport model. The objective of the FSP is to gather additional information that is necessary, as part of a characterization, to support a decommissioning plan. The decommissioning plan will include a conceptual site model (CSM), but numerical fate and transport modeling and estimates of future offsite concentrations are not currently required.

Second, significant information can be gathered simply by looking at the total uranium values in environmental samples. DU penetrators present concentrated point sources of uranium. If a DU penetrator corrodes and the corrosion products move through the environment, high values for total uranium should be seen (and have been seen in the DU Impact Area, and in one stream at a location immediately downstream from a DU penetrator that was discovered in the stream).

A key factor in any decision to terminate the JPG radioactive materials license will be an evaluation as to whether the dose to a critical receptor from the DU in the DU Impact Area will be less than 25 millirems in a year. The RESidual RADioactivity (RESRAD) software program will be used to make that evaluation. The most sensitive input parameters to the RESRAD model at JPG are; the uranium soil concentration, the depth of the contaminated zone, the value for the Kd, and the corrosion rate of the penetrators. The characterization efforts, as described in the FSP, are primarily designed to refine these four key RESRAD parameters.

The RESRAD model accepts, as an input value, the exposure point concentration of the contaminant in soil. Since DU is not more hazardous than natural uranium and since the dose conversion factors for U-234, U-235, and U-

238 are essentially equal, the presence or absence of DU has little bearing on the results of the RESRAD modeling.

In his testimony, Mr. Norris has made several references to the "calibration" of a model. Mr. Norris does not explain what this "calibration" is, and how such a "calibration" would be performed. Mr. Norris uses ambiguous terms such as "very low detection threshold" and "high detection threshold," which do not lend themselves to a technical evaluation and rebuttal. Due to the lack of specificity in these areas, I cannot comment on their veracity.

**Q27. Do you agree or disagree with the comments Mr. Norris makes in his Answer 73 pertaining to the effects of small sampling size on the ability to identify DU and establish its concentration?**

**A27. (HWA) I disagree.**

**Q28. Please state the basis of your disagreement.**

**A28. (HWA)** Mr. Norris may not be fully familiar with the counting statistics associated with measurements of radioactivity. The counting rates are proportional to the total number of radioactive atoms that are present in a sample. The total number is a function of both the concentration of radioactive material in the sample and the mass or volume of the sample.

The SOP for the JPG Environmental Radiation Monitoring (ERM) program, OHP 40-2, does specify that 1 gallon of field sample be collected for surface water and ground water. That procedure also specifies that the water be analyzed fluorometrically for total dissolved uranium. The procedure cannot be followed as written because fluorometric analysis for total uranium is not now readily available on a commercial basis. The analytical technique was changed to alpha spectroscopy after the April 2004 ERM program sampling event. With the change in analytical technique also came a change in the total volume of

sample to be collected for the alpha spectroscopy analysis, which is 1 L, using bottles supplied by the offsite analytical laboratory.

If the 1-gallon sample were to be collected (as specified in the SOP), the entire contents would not normally be analyzed by either flourometric methods or alpha spectroscopy. Mr. Norris's numerical argument breaks down at this critical point, since his sample volume comparisons to 1 gallon are not valid; 1 gallon of sample would simply not be analyzed.

For alpha spectroscopy, this is because the total sample volume to be analyzed cannot be increased without bound. At some point, the amount of solids that are precipitated onto a filter or planchette for analysis by alpha spectroscopy become so great as to adversely impact the MDC for the analysis. 1 L or 500 mL are standard sample volumes for this method and are dependant on the total amount of solids that are present in the water sample.

Mr. Norris's argument breaks down at a second important point. Mr. Norris alleges that the 500 mL sample size for surface water in the April 2006 ERM sampling event caused "uncertainties" and allowed the Army to reject the indication of DU in two samples. Mr. Norris provides no calculation or technical evaluation to show that this is the case. (Note also that, Mr. Norris may be mixing the concepts of the "minimum detectable concentration" [MDC] with the "total propagated uncertainty". The distinction will be clarified here in my testimony).

I did an evaluation in August 2006 where I performed some back-calculations and built a mathematical model to evaluate how varying the counting time and sample size will affect the MDC of the alpha spectroscopy analysis, and the total propagated uncertainty (TPU) of the U-238:U-234 ratio calculation. This was done for sample SW-DU-002 as part of an evaluation into how we could improve the uncertainty in the estimate of the U-238:U-234 ratio.

In way of explanation, the MDC is defined as the net concentration that has a specified chance of being detected. It is an estimate of the detection capability of a measuring protocol and is calculated before measurements are taken. The detection limit is the lowest net response level, in counts, that you expect to be seen with a fixed level of certainty (customarily 95 percent). The

MDC is the detection limit expressed as an activity concentration (e.g., pCi/L). If the activity concentration in a sample is equal to the MDC, there is a 95 percent chance that radioactive material in the sample will be detected.

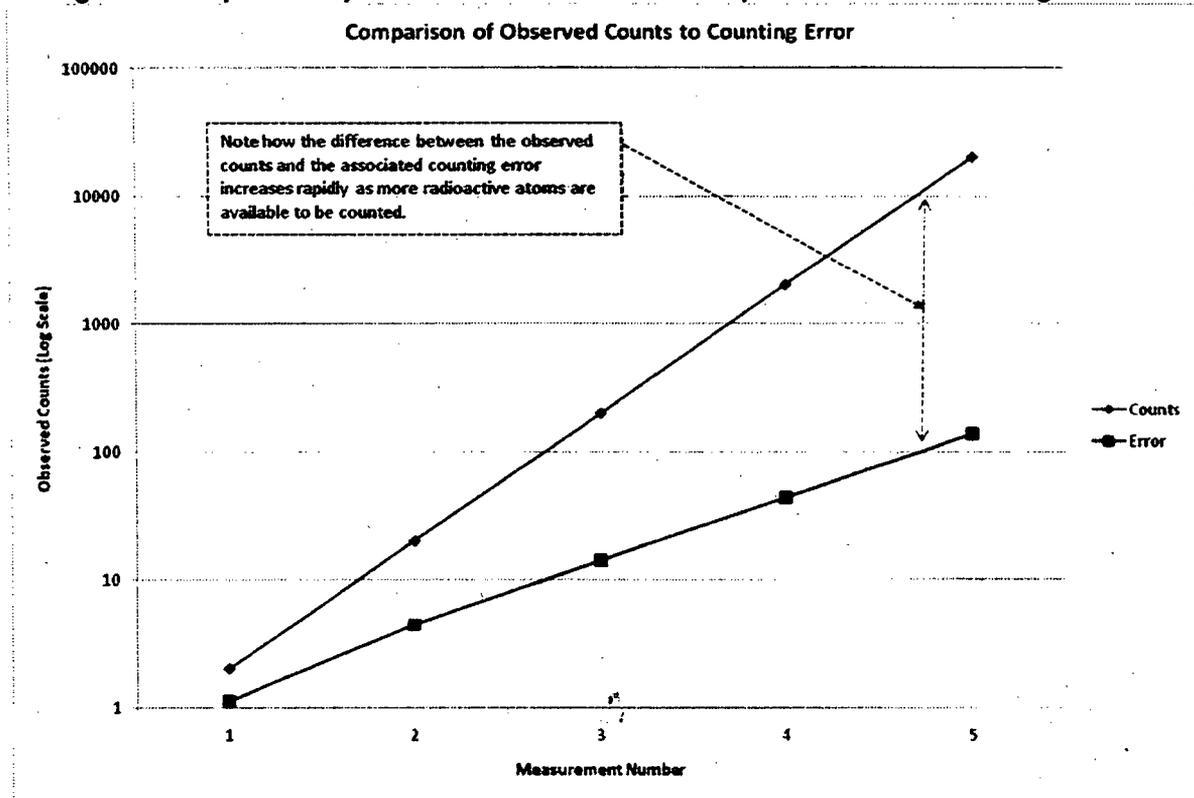
The MDC goal to be met for the ERM program water sampling is 1 pCi/L. Using a 500 mL sample for SW-DU-002 (as cited by Mr. Norris), the MDC for U-238 was reported by the laboratory as 0.066 pCi/L and for U-234 it was 0.07 pCi/L. We can see that, even using what Mr. Norris alleges as the “reduced” sample size, the MDC that was achieved by the analytical laboratory was well below the program goal of 1 pCi/L. I estimate that increasing the sample aliquot size to the full 1 L would result in an MDC for U-238 of approximately 0.033 pCi/L and for U-234 it would be approximately 0.035 pCi/L. This is a marginal improvement in the MDC.

The real technical issue here, [REDACTED] is the uncertainty in the U-238 measurement, in the U-234 measurement, and the propagation of those uncertainties into the calculation of the U-238:U-234 ratio.

Because radioactive decay is a random process, for radioactive counting statistics, the uncertainty in any estimate of the observed activity of a sample is equal to the square root of the total observed counts during the observation period. If the total observed counts is low, the square root of the total observed counts is fairly high in relation to the observed value. If the total observed counts is high, the square root of that number is higher, but much less so in relation to the observed counts. Refer to Table 1 and Figure 1 for an example.

**Table 1. Comparison of Observed Counts to the Related Counting Error**

<b>Observed Counts</b>	<b>Counting Error</b>
2	1.14
20	4.47
200	14.14
2,000	44.72
20,000	141.42

**Figure 1. Graphical Representation of the Relationship of Counts to Counting Error**

One can easily see that as the total observed counts increases, the value of the distance between the total observed counts and the counting error increases rapidly. That means that the uncertainty, in relation to the observed value, decreases rapidly. In other words, as more radioactive material is present to be detected, we achieve more confidence in the estimate of the activity that is present.

For sample SW-DU-002 in the April 2006 ERM program report, the value of the U-238:U-234 ratio was  $3.75 \pm 3.7$ . That means that the true value of the ratio could vary from 0.05 to 7.45. Clearly, the TPU for this sample is very high and the results cannot be used for decision making. The primary reason for the high uncertainty is the very low level of total uranium detected in the sample. This is supported by the fact that the U-234 value for SW-DU-002 was flagged with a "J" code during data validation. A "J" code indicates that the measured value is an estimate and may not be reliable. Other factors also come into play.

Now Mr. Norris testifies that the reason for this high “uncertainty” (e.g.,  $\pm 3.7$ ) is a “reduced sample size.” Returning to the mathematical model that I developed in September of 2006, I increased the sample size to a full 1 L. This does not change the concentration of uranium in the sample, but it does provide more uranium atoms to be counted. Assuming that doubling the sample size doubles the number of uranium atoms to be counted, the new estimate of the U-238:U-234 ratio would be  $3.75 \pm 2.6$ . That means that the true value could vary from 1.15 to 6.35. Again, the uncertainty is high and the results cannot be used for decision making.

The “reduced” sample size had no significant impact on the “uncertainty” in this sample, and the Army’s handling of the two results cited by Mr. Norris was appropriate.

[REDACTED]

[REDACTED] STV is asking for a capability that may not be technically feasible in regard to alpha spectroscopy. The issue of U-234 fractionation, [REDACTED] [REDACTED] discussed later in my testimony, further supports this case. Now, when DU is clearly present in a sample such that the total uranium concentration is elevated in regard to that expected in the natural environment, alpha spectroscopy is capable of reliably identifying the presence of DU. This was seen in the characterization of the DU Impact Area by another Army contractor several years ago.

Another analytical method, inductively coupled plasma - mass spectroscopy (ICP-MS), is a possible alternative to alpha spectroscopy for the evaluation of characterization samples at JPG. [REDACTED]

[REDACTED] This method examines the isotopic mass of the uranium radionuclides in a sample, rather than the isotopic activity. The mass of U-235 is measured directly, and the mass percentage of U-235 is used as an indication of the presence of DU in a sample.

As with any method, there are technological limitations. A normal ICP-MS sample receives a 10-times dilution before being introduced into the analytical device. This is necessary to protect the device from contamination and it aids in

the resolution of the method. Such a dilution raises the uncertainty in the results to a point where the presence of DU (if any) cannot be reliably determined. During a test on groundwater sampling location MW-DU-006 during the April 2006 ERM program sampling, it was determined that using a diluted sample was unacceptable, but use of an undiluted sample would provide usable results. The ability to analyze an undiluted sample is dependent on the level of total dissolved solids that are present in the sample. Because of this, we cannot assure that all samples for the characterization efforts at JPG will be able to be analyzed via an undiluted ICP-MS method. I also believe that STV has not made the case, to the Army's satisfaction, that such an effort is warranted or that failing to utilize such a technique causes the current characterization plans to be inadequate.

Mr. Norris is correct in that the FSP requires groundwater and surface water samples of 100 mL in volume. That is an obvious typographical error, which will be corrected in the next revision to the FSP and clarified in the planned FSP Addendum 5. The correct value is, of course, 1,000 mL.

Returning back to alpha spectroscopy methods, the allegation of low field sample volumes is not similar for soil and sediment samples. For solid samples, only a small aliquot of the field sample is analyzed. This is generally 1 to 3 grams of sample. The aliquot sample size is limited by the amount of material that is deposited on the alpha spectroscopy planchette, which is an important factor affecting the sensitivity and resolution in alpha spectroscopy. The sample volume specified in the FSP is not important to the laboratory MDC, provided that more than 3 grams of sample are collected.

**Q29. Do you agree or disagree with Mr. Norris's listing of deficiencies specific to particular media sampling methods found in his Answer 74?**

**A29.** I disagree.

**Q30. What is the basis of your disagreement?**

**A30.** (HWA) DQOs for the FSP Addendum 5 have been drafted and they do specify that water samples will not be filtered. It is important to note that Mr. Norris is indicting the FSP water sampling methods when they have not yet been initiated.

An apparent inconsistency in the FSP does not render the site characterization efforts inadequate. In fact, there was no inconsistency. Section 6.2.9 applies to groundwater and begins with “if filtered samples are required, the following procedures will be followed...” (emphasis added). Section 6.4.5 applies to surface water and does state that water samples will not be filtered. There is no contradiction.

Also, the Army is taking a phased approach to characterization. Sediment samples are first being collected from locations that are most likely to be contaminated with DU. The Army may elect to collect additional sediment samples, as necessary, from other locations based upon the results of the initial sediment samples.

This is a prudent, cost-effective approach. If DU contamination is not found at significant levels in sediments within the DU Impact Area, it is unreasonable to assume that all of the DU is actually suspended in water and leaving the area. If DU is migrating to streams, there should be local deposition of the DU.

It is not an objective of the FSP to estimate the load of DU being transported via suspended sediments in water. It is not reasonable to expend a limited budget on such a concern without first finding indications that such a transport is occurring.

In regard to sediment sampling locations, Mr. Norris is again indicting the Army and the FSP for an activity that has not yet occurred. Is there any evidence that sediment samples have been collected on the wrong bank of a creek or stream? Section 6.6 of the FSP clearly states that samples will be collected where “deposition is most likely.” In addition, gamma radiation instruments will be used to look for locations where DU might have been deposited, and biased samples will be collected at some of these locations.

Mr. Norris's testimony is dominated with comments on karst topography and postulated karst conduits through bedrock at JPG. Such pathways are possible and are being evaluated. It is unreasonable, however, to assume that sediment transport via karst conduits is the only mechanism that is moving DU contaminated sediments and that this only occurs through a conduit that discharges at a location that is outside the JPG boundary. Again, a phased-approach to the investigation of sediments is more prudent. First, we must know if sediments are being impacted. Next, we must understand any karst networks and how they move water. After that, we may find it necessary to examine sediments being moved by such a network. Sediments are sampled as a part of the FSP. If sediment contamination with DU is found, the CSM may be modified and additional investigation may be warranted. No DU transport mechanisms have been "eliminated."

Mr. Norris's testimony in regard to the potential for fractionation of U-234 is interesting. [REDACTED]

[REDACTED] Unfortunately, Mr. Norris might not have fully comprehended what I taught him about the mechanisms of fractionation, or the paper that he references in his testimony.

[REDACTED]

In way of a short explanation of U-234 fractionation, U-234, U-235, and U-238 are all present in natural uranium and DU. U-234 exhibits a specific activity that is several orders of magnitude higher than U-235 and U-238. Because of this, U-234 is decaying at a rate that is many times higher than the surrounding U-235 and U-238 (on an atomic scale). Uranium decays via the emission of an alpha particle. Since the alpha particle is fairly massive, the uranium atom exhibits a recoil impulse. This impulse can fracture the uranium

crystalline structure, causing some uranium to become more mobile in relation to other uranium. Since U-234 has such a high specific activity, this effect is more pronounced for the U-234 atom. Since some U-234 is now free from the metallic uranium crystal, it is more mobile and also exhibits less self-absorption effects. This makes the U-234 easier to detect and alters the observed U-238:U-234 ratio. This effect is seen primarily in water systems. The ERM program data at JPG clearly show U-238:U-234 ratios of approximately 0.5 in water systems, and the expected (non-fractionated) ratio of approximately 1.0 in soils and sediments.

The U-238:U-234 ratio for DU should be on the order of 6.0 to 8.0. This ratio was clearly seen during characterization activities for soils and vegetation within the DU Impact Area by another contractor. If fractionation of U-234 in DU were to occur, then the amount of U-234 that is available to be detected would rise, as already discussed. A rise in U-234 increases the value of the denominator in the U-238:U-234 ratio and effectively lowers the ratio by some amount. One might then conclude that fractionation would then take a sample containing DU and make it look like it only contained natural uranium. That would be an incorrect oversimplification, however. DU is depleted in U-234, so there is less U-234 present in DU. That means that as the amount of DU that is present rises, the amount of U-234 that is available to fractionate is greatly reduced.

The fractionation study that is suggested by Mr. Norris is not an objective of the current FSP, is not required, and will not be helpful to the understanding of the CSM at JPG. First, available literature suggests that the magnitude of the fractionation of U-234 can be highly variable. Next, fractionation is primarily observed in water and not in soils or biota. Finally, issues relative to the total propagated uncertainty (as already discussed for alpha spectroscopy methods) will still be present.

If the Army determines that the characterization program must be able to detect the presence of DU in environmental samples where the total uranium concentration is near the levels expected in the natural environment, the alpha spectroscopy method may not be capable of meeting the associated DQOs. I have conducted a literature search, have contacted technical experts at two other

locations that work with DU, and have conducted a test of the use of ICP-MS to directly measure the U-235 mass in an environmental sample. This method is still being evaluated and it exhibits its own set of technical limitations, but it shows some promise (as already discussed).

**Q31. Do you have any comment to the corrective actions recommended by Mr. Norris, in his Answer 75, to the deficiencies he perceives in the sampling and analysis?**

**A31. (HWA)** Yes. Mr. Norris testified to the need for a DQO whereby DU can be detected if it constitutes 25 percent of the total uranium in a sample. Mr. Norris does not provide a technical basis for this objective. Due to a lack of specificity, I cannot render an opinion on this objective. It has already been established that increasing the sample size, or the count time, or both will not achieve this objective for alpha spectroscopy. In addition, the fractionation of U-234 would likely prevent the achievement of this objective for alpha spectroscopy.

## **VII. SUMMARY AND CONCLUSION**

### **As to Norris Testimony**

**Q32. Please summarize your testimony with regard to Mr. Norris Testimony.**

**A32. (HWA)** Mr. Norris has indicted the FSP in numerous areas. He has testified that the FSP is inadequate because it does not provide for certain capabilities that are not stated objectives of the JPG characterization effort. He has not demonstrated, to my satisfaction, how those capabilities would be used, how they could be justified in terms of cost and risk to site workers, and how a lack of these capabilities renders the current characterization plans inadequate. Mr. Norris seems to be focused on a single potential DU transport mechanism (one for which he is a specialist) while ignoring the significant information to be gleaned by the existing FSP in regards to the other (and more likely) DU transport mechanisms. Mr. Norris has made claims in regards to sample sizes

and detection limits which do not hold up to scientific scrutiny. Mr. Norris attempts to indict the FSP for activities that have not even been initiated yet, and he establishes a new Data Quality Objective for the JPG decommissioning efforts with no scientific basis.

In my opinion, the current FSP is designed to gather the additional information that is necessary to better understand the four most sensitive RESRAD input parameters, and that should be the focus of the characterization efforts. The FSP will also gather additional information that will support the Conceptual Site Model, which is an important element of the decommissioning plan. Mr. Norris has not provided a sound technical argument to establish that the characterization of the JPG DU impact area and surroundings will be inadequate.

#### VIII. REFERENCES

**Q33. In your testimony you referred to several documents. Would you specifically identify those documents?**

**A33. (HWA) Yes.**

1. *Environmental Radioactivity From Natural, Industrial, and Military Sources*, Fourth Edition, Esenbud and Gesell, Academic Press, 1997, ISBN 0-12-235154-1. *Attached as Exhibit HWA # 3.*
2. *Radiological Assessment*, NUREG/CR-3332, Till & Meyer, U.S. NRC, 1983.
3. *Long-Term Fate of Depleted Uranium at Aberdeen and Yuma Proving Grounds, Phase II: Human Health and Ecological Risk Assessments*, LA-13156-MS, LANL National Laboratory, 1996. (Section 3.6.3, page 35) *Attached as Exhibit HWA # 4.*
4. *Review of the Environmental Quality Aspects of the TECOM DU Program at Jefferson Proving Ground, Indiana*, Abbott, et. al., Monsanto Research Corp., 1988. (section 2.1.4.2, page 2-25 and section 4.4.2.2, page 4-28) *Attached as Exhibit HWA # 5.*

5. *A Review of the Radiological Environmental Monitoring Data at U.S. Army Jefferson Proving Ground, Madison, Indiana, Abbott, EG&G Mound Applied Technologies, Inc., 1988. Not attached due to length (75 Pages).*
6. *Decommissioning Plan for License SUB-1435, Jefferson Proving Ground, Madison, Indiana, Final, U.S. Department of the Army Soldier and Biological Chemical Command, June 2002. (section 4.3.7.1) ADAMS ML021930415.*
7. *Environmental Report, Jefferson Proving Ground, Madison, Indiana, Final, U.S. Department of the Army Soldier and Biological Chemical Command, June, 2002. (Section 3.1.4). ADAMS ML021960089.*
8. *Potential Health Impacts from Range Fires at Aberdeen Proving Ground, Maryland, ANL/EAD/TM-79, Prepared for the U.S. Army, Directorate of Safety, Health, and Environment, for APG by Argonne National Laboratory, Williams et al., March 1998. Not attached because of length (101 pages).*
9. *Environmental Assessment for Testing Uranium Penetrator Munitions at U.S. Army Combat Systems Test Activity, Aberdeen Proving Ground, Maryland. Davis, 1990. Not attached because of length (43 pages).*
10. *Environmental Radiation Monitoring Program Plan for License SUB-1435, Jefferson Proving Ground, Final, U.S. Army Soldier and Biological Chemical Command, September, 2003. (Section 3.3.5) ADAMS 032731017.*
11. *Health and Environmental Consequences of Depleted Uranium Use in the U.S. Army: Technical Report, U.S. Army Environmental Policy Institute, June 1995. (Section 7.1.1) Attached as Exhibit HWA # 6.*
12. *Updated Calculation of the Inhalation Dose from the Cerro Grande Fire Based on Final Air Data, LA-UR-01-1132, Kraig, et al., Los Alamos National Laboratory, February 2001. Attached as Exhibit HWA # 7.*
13. *Health Risk Assessment Consultation No. 26-MF-7555-00D, Depleted Uranium - Human Exposure Assessment and Health Risk Characterization in Support of the Environmental Exposure Report*

- “Depleted Uranium in the Gulf” of the Office of the Special Assistant to the Secretary of Defense for Gulf War Illnesses, Medical Readiness and Military Deployments (OSWAGI), U.S. Army Center for Health Promotion and Preventative Medicine, September 15, 2000. (Section 5.2, Camp Doha) Attached as Exhibit HWA # 8.*
14. *Depleted Uranium in Kosovo, Post-Conflict Environmental Assessment, United Nations Environment Programme, Nairobi, Kenya, 2001. (section 2.2, page 15) Attached as Exhibit HWA # 9.*
  15. *Airborne Transport of Depleted Uranium (DU) and Site Characterization Needs”, memorandum from Ms. Corrine Shia to Mr. Paul Cloud, January 13, 2005, Science Applications International Corporation. ADAMS ML 070090201*
  16. *“From dust to dose: Effects of forest disturbance on increased inhalation exposure”, Jeffery J. Whicker, et. al., Science of the Total Environment, March 2006. Attached as Exhibit HWA # 10.*
  17. *“Public Health Statement for Uranium”, Agency for Toxic Substances and Disease Registry, CAS# 7440-61-1, September 1999. Attached as Exhibit HWA # 11.*
  18. *Examination and Analysis of Three Fired Depleted Uranium Penetrators, QINETIQ/FST/SMC/CR021209, QinetiQ Ltd., March, 2002. (item 4.5, 4,6, and Appendix A) Attached as Exhibit HWA # 12.*
  19. *Health Effects of Exposure to Low Levels of Ionizing Radiation, BEIR V Report, National Research Council, National Academy Press, Washington, D.C., ISBN 0-309-03997-5, page 18,,1990. Attached as Exhibit HWA # 13.*

**Q34. Does that conclude your testimony?**

**A34. (HWA) Yes, it does.**

EXHIBIT HWA #1

Résumé for

**Harold W. Anagnostopoulos, CHP**

**Work Summary:**

- Certified Health Physicist, ABHP
- Certified Radiation Protection Technologist, NRRPT
- Manager-level Supervisory Experience
- ALARA Planning and Radiological Engineering
- Quality Verification Auditor (NQA-1, 1989)
- Root Cause Expert Qualified & Certified Human Error Reduction Instructor

**Professional Experience:**

**Stoller-Navarro Joint Venture, 08/07 – Present, Senior Health Physicist.**

**SAIC, 10/05 – 08/07, Radiation Safety Officer, Technical Group Leader, & FUSRAP Task Manager, St. Louis, MO.** Technical group leader for Health Physics and Data Management personnel. Task manager for information technology services with a budget of approximately \$500K. Managed a team of 7 professional staff. Radiation Safety Officer for the St. Louis office operations.

**SAIC, 08/04 – 10/05, On-Site Radiation Safety Officer, LVI Services & Westinghouse Electric Corp, Hematite, MO.** On-site RSO and Health Physics Supervisor for equipment removal and facility decontamination at a former nuclear fuel production facility. Nuclear criticality safety controls were required for all work. Supervised 1 Radiological Engineer, 1 Lead HP Technician, 6 Sr. HPTs and 4 Jr. HPTs. Responsible for license and permit required surveillances and environmental monitoring. Developed and presented basic nuclear criticality safety training to site personnel. Developed site technical basis documents in support of the decommissioning efforts.

**SAIC, 06/04 – 08/04, Senior Health Physicist & Subject Matter Expert, Guardian Program, U.S. Department of Defense, St. Louis MO & Abingdon MD.** Subject matter expert for radiological detection for the Guardian program which will augment the CBRN capabilities of 200+ military installations. Responsible for developing specifications for the procurement of radiation detection portal monitors and hand-held emergency response detectors. Responsible for the evaluation and selection of said detectors. Lead for the resolution of radioactive materials licensing issues related to Guardian equipment.

**SAIC, 07/02 – 08/04, Senior Health Physicist & Radiation Protection Manager, FUSRAP, U.S. Army Corps of Engineers, St. Louis MO.** Lead the Final Status Survey and Verification effort. Developed and implemented highly automated computer spreadsheets for the calculation of MARSSIM statistics. Developed and implemented a database to quickly manipulate and inspect laboratory results. This reduced the backfill authorization report lead-time from several hours to one hour or less, and eliminated several sources of potential error. Authored survey plans for piles of material, consolidated materials, and structures. Authored post remedial action reports for several FUSRAP survey efforts. Task Manger for FUSRAP documents and associated technical reviews.

**SAIC, 11/03 – 01/04, Senior Health Physicist, Gulf States Steel Decommissioning Project, Highland Technical Services, Gadsden AL** Consultant responsible for the disposal of 14 radioactive gauge sources and the termination of a state radioactive materials license at a bankrupt steel mill facility. Reviewed license documents and inspected the facility to ensure regulatory compliance. Interfaced with regulators. Researched the history of the 14 radioactive gauge sources and evaluated disposal options. Authored a “Phase-1” summary report in clear language for use by the bankruptcy lawyer.

**SAIC, 07/02 – 10/02, Senior Health Physicist, Nucor Yamato Steel Corp, Blytheville AR.** Team member on an site assist project to assess license compliance, observe operations, assess vulnerabilities, and develop a Radioactive Source Melt Prevention Plan and a Radioactive Source Melt Response Plan for a large steel recycling mill. Served as the author and architect for those plans.

**Duratek Inc., 01/02 – 07/02, Senior Radiological Engineer, Oak Ridge TN.** Project Manager for emergency response, source recovery, and system restoration following a ruptured radiography source at the nation’s sixth largest oil refinery. Responsible for 24 hour operations and the coordination of three separate radiological control companies in the recovery effort. Duties included the development of Technical Basis Documents, MARSSIM survey plan(s), management of waste, and removal of source material. Project is estimated at \$1.5M.

**Duratek Inc., 03/01 – 01/02, Senior Radiological Engineer, Oak Ridge, TN.** Project Manager and Site Health & Safety Manager for decommissioning of a nuclear laundry facility license in Vicksburg, MS. Supervised the conduct of 5 Sr. HP Technicians and a crew of 5 laborers. Duties include developing technical approaches, supervision of Final Status Surveys, audits, and management of a budget in excess of \$1.6M.

**Duratek Inc., 08/00 – 03/01, Senior Radiological Engineer, Oak Ridge, TN.** Supervisor of Radiological Operations for the decommissioning of the TR-2 reactor license at the Waltz Mill site. Supervised the conduct of 1 Supervisor, 9 Senior, and 4 Junior Radiation Protection Technicians. Work included the remediation of Hot Cells, Fuel Transfer Canals, Reactor Containment, and piping tunnels.

**Mound Laboratory (DOE), 09/99 – 08/00, Radiological Engineer, Dayton, OH.**

Responsible for development and implementation of a DAC hour tracking program. Accountable for development of a MARSSIM based survey program for D&D of Mound facilities. Involved in the development of a technical basis document for Stable Metal Tritides. Team Leader for 10 CFR 835 compliance effort in radioactive material labeling and control.

**Clinton Power Station, 09/98 – 07/99, Radiation Protection Manager - Acting,**

**Clinton, IL.** Accountable for radiological safety and administration of licensed nuclear materials at a power generation facility. Managed a radiation protection staff which included: 2 health physicists, 2 certified health physicists, 18 other management, and 36 union personnel. Improved overall staff performance culminating in an *Event-Free* plant restart following a 2-1/2 year shutdown.

**Clinton Power Station, 03/98 – 09/98, Supervisor – Radiological Operations,**

**Clinton, IL.** Responsible for the day to day radiation protection activities at a power generation facility. This included a staff of 7 supervisors, 25 radiation protection technicians, and 22 technician contractors providing around the clock coverage of plant activities. Improved staff morale, ownership of radiological activities, industrial and radiological safety focus, customer service, and regulatory margin as evidenced by INPO, quality assurance, Nuclear Review and Assessment Group, and NRC reports.

**Dresden Power Station, 06/97 – 03/98, Corrective Actions Process Supervisor,**

**Morris, IL.** Responsible for all aspects of the station's prevention, detection, and correction strategies including site lessons learned. This included root cause analysis, commitment management, problem reporting, self-assessments, trending, reporting, and human error reduction at the station. Lead 7 management and 3 clerical personnel. Site program is recognized as a top performer within the corporation and has been benchmarked by other utilities.

**Dresden Power Station, 04/96 – 06/97, Site Quality Verification Auditor, Morris, IL.**

Served as the plant support (SALP Area) auditor. Drove performance improvement in survey map quality, RAM tagging, High Radiation Area controls, and plant postings via audits and implementation of a field monitoring program.

**Dresden Power Station, 08/95 – 04/96, Radiological Assessment Manager, Morris,**

**IL.** Assessment of RP activities, performance indicator monitoring, plant tours and data review to predict and prevent radiological events. Team leader for a Reactor Water Clean Up Surge Tank contamination event root cause investigation, including N.R.C, interface and briefings. The intrusiveness and aggressive actions taken obviated any further NRC involvement or action.

**Dresden Power Station, 08/94 – 08/95, Radiation Protection Unit Supervisor,**

**Morris, IL.** Served as the RP Supervisor responsible for Unit-1 (SAFESTOR Decommissioning) and Unit-2. Supervised the conduct of radiation protection technicians and field activities. Initiated technical improvements by developing an air

sample calculation nomograph, density thickness measurements of protective clothing materials, and installing electronic access control terminals at the Drywall access point. Received an award for determining the root cause and recovering the Unit-I Central Tool Storage Facility from a chronic contamination problem.

**Dresden Power Station, 03/92 – 08/94, ALARA Engineer, Morris, IL.** Acted as the ALARA Engineer for Units-1 and 2. Project Manager for the replacement of an activated nuclear detector that had been stuck in-core, in addition to other detector repairs in the Drywall at power. Acted as tour leader and liaison for the NRC during the Sphere Service Waver Leak Augmented Inspection. Served on the Boiling Water Reactor Owners Group/RP sub-committee as a Steering Committee member, 2 yr. commitment.

**U.S. Navy, 11/82 – 12/91, Nuclear Propulsion Program.**

Radiological Controls Shift Supervisor  
Engineering Watch Supervisor  
Training Manager  
Leading Engineering  
Lab Technician  
Prototype Staff Instructor

Served in the U.S.S. VonSteuben (SSBN-632) and the U.S.S. Frank Cable (AS-40).  
Details of duties available upon request.

**Professional Licenses and Certifications:**

Certified Health Physicist, American Board of Health Physics  
NRRPT Certified (inactive)

**Miscellaneous:**

Member, Health Physics Society  
Member, American Academy of Health Physics  
Assistant Editor, *The CHP Corner* of the HPS Newsletter.

**UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION**

**ATOMIC SAFETY AND LICENSING BOARD PANEL**

Before Administrative Judges:

Alan S. Rosenthal, Chair  
Dr. Paul B. Abramson  
Dr. Richard F. Cole

In the Matter of	)	Docket No. 40-8838-MLA
U.S. ARMY	)	ASLBP No. 00-776-04-MLA
(Jefferson Proving Ground Site)	)	August 15, 2007

**AFFIDAVIT OF HAROLD W. ANAGNOSTOPOULOS  
RE STV CONTENTION B-1, BASIS ITEM "m"  
AND ON CERTAIN TESTIMONY OF HENSHEL AND NORRIS**

**Subjects: Air Sampling; Sample Collection and Analysis**

County of Clark )  
State of Nevada )

I, Harold W. Anagnostopoulos, being duly sworn according to law, depose and state the following:

1. I am a Senior Health Physicist with the S.M. Stoller Corporation in their Las Vegas office. My business address is 7710 West Cheyenne Avenue, Building 3, Las Vegas, Nevada 89129.

2. I am providing testimony, dated August 15, 2007, on behalf of the U.S. Army, Licensee, in the above captioned proceeding, entitled "TESTIMONY OF HAROLD W. ANAGNOSTOPOULOS ON STV CONTENTION B-1, BASIS ITEM 'm' AND ON CERTAIN TESTIMONY OF HENSHEL AND NORRIS, Subjects: Air Sampling; Sample Collection and Analysis"

3. The factual statements and opinions I express in the cited testimony are true and correct to the best of my personal knowledge and belief.

4. I declare under penalty of perjury that the foregoing is true and correct.

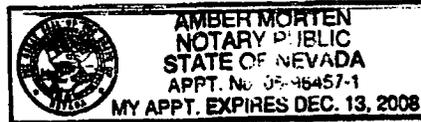
Further, the affiant sayeth not.

Harold W. Anagnostopoulos  
Harold W. Anagnostopoulos, CHP

Subscribed and sworn to before me  
this 15 day of August, 2007.

Amber Morten

Notary Public



My commission expires December 13, 2008