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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket No. 40-8838-MLA
U.S.ARMY	)	ASLBP No. 00-776-04-MLA
(Jefferson Proving Ground Site)	)	February 23, 2007

AMENDED MOTION OF SAVE THE VALLEY, INC. TO ADMIT FOR HEARING ADDITIONAL CONTENTION B-2 AND SUPPORTING BASES A THROUGH G

Pursuant to the Board's Order Scheduling Further Proceedings entered January 29, 2007, Intervener Save the Valley, Inc. ("STV") respectfully moves the Board to admit for hearing in this matter its additional Contention B-2 and supporting Bases a through g, as follows:

I. Contention B-2: The Army's implementation of the Field Sampling Plan (FSP) is inadequate to achieve its objective of appropriate characterization of the Jefferson Proving Ground (JPG) Depleted Uranium (DU) Site.

The FSP (ML051520319) is a general description of the overall goals and objectives, on-site sampling activities, laboratory tests, data analysis protocols, and other procedures which the Army's contractor SAIC proposes to use to characterize the JPG DU site as a necessary prerequisite to the development and implementation of a decommissioning plan for the site. The FSP is intended to be implemented through successive addenda detailing specific procedures and subsequent reports compiling and analyzing particular data yielded by those procedures. Thus, the JPG DU site characterization should be a dynamic, iterative process in which the various Plan components inform and influence one another, both sequentially and concurrently. As a result, the design,

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sequence, and performance of the various FSP components are critical to the Plan's adequacy in achieving its objective of appropriately characterizing the JPG DU site for decommissioning purposes. Thus far, FSP implementation has been inadequate for this purpose in crucial respects.

A. Basis a. The Fracture Trace Analysis as implemented is inadequate to serve its intended purpose.

The FSP describes the purpose and methodologies for a "fracture trace analysis" (FTA) as part of the characterization program for JPG's DU impact area (pp. 5-1 and 5-2). The stated purpose for the FTA is that it "will be used to further refine the areas or lines that will be completed as part of the geophysical investigation." The interplay between the FTA and the geophysical investigation is reiterated in the discussion of the geophysical investigation (FSP, p. 6-2) where it is stated that the "final design, location, and orientation of the geophysical investigation lines" will be contingent upon the final FTA. The methodologies described in the FSP were a) identifying semi-linear and linear features on pre-JPG air photos, b) mapping those features which represent fractures, after quality scoring, into a shape file, c) comparing or integrating the results of the air photo analysis with previous USGS fracture trace work in the area (Greenman, T., 1981, United States Geological Survey Open File Report 81-1120, *Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground*), and d) "conduct[ing] a site walkover to field verify and evaluate the completed aerial photography analysis."

The results of the FTA were presented in the report *Fracture Trace Analysis Jefferson Proving Grounds* of June 2006 (ML061670091). Based upon that report (p. 3-1), the methodologies departed from the FSP description by 1) considering only linear features on the air photos, 2) providing no comparison or integration of the results of the new air photo interpretation to previous

USGS work, 3) providing no evaluation or field verification of the aerial photography analysis based upon a site walkover, and 4) failing to incorporate other available data to aid in identifying and interpreting mapped features. Each of these departures demonstrably impairs the adequacy of the study and the validity of any resulting conclusions.

1. Mapping only linear features in an area of rolling terrain limits the analysis to the potential identification of vertical fractures. Dipping fractures intersect the earth's surface to produce the semi-linear features. (Vertical fractures are breaks in the rock that are upright, like the face of a wall. Dipping fractures are breaks in the rock that are tilted away from upright, like the surface of a roof.) The FSP (page 5-1) anticipated mapping the traces of both linear traces (*i.e.*, vertical fractures) and semi-linear traces (dipping fractures). The departure from the FSP plan weakens the FTA in several ways. First, as implemented, the FTA identified lineaments representative of only of some, not all, of the fractures. Second, intersections of fractures are often a focus of karst development, with better conduit development occurring at the line of intersection of two fractures than along either fracture individually. By mapping only vertical fractures, the FTA can identify only intersections representing vertical lines representing the potential for karst enhancement of a vertical pipe. When dipping fractures can intersect other dipping fractures or vertical fractures, the lines of intersection are sloping or horizontal. Karst enhancement of sloping or horizontal intersections produce conduits that transport water horizontally, not just vertically, potentially allowing rapid transport of water away from its place of infiltration. Ultimately, karst enhancement of horizontal or dipping conduits can produce cave systems such as are mapped at JPG and the DU impact area.

2. The FTA report mapped lineaments and interpreted fractures (Figure 1, p. 3-2) that differ

from those of the USGS study, all without comment in the FTA report. This USGS study is the fracture trace study referenced and shown on page 4 in Army's Final Responses to NRC's RAIs, November, 2004 (ML043360318). Fracture trace analysis is a highly subjective activity at all stages, from the selection of the photographic medium, spectrum, and scale to the choice of visible features that are mapped as fracture traces. The FTA report (p. 3-1) cites one definition of fracture traces that dates back to 1958. Based upon the results presented in Figure 2 (p. 3-3), the analyst for the FTA, at least in part, chose to use alternative criteria than those laid out in even that definition. For example, the FTA analyst clearly chose not to interpret some straight-line stream segments of less than one mile as fracture traces, in departure of the provided definition. Because of the inherent subjectivity of the analysis process, it is important to consider differences between or among other trace analyses that used alternative methods, criteria, or data types.

The USGS study is such an alternative analysis. The USGS analysis mapped common areas with the FTA report. The USGS analyst identified fractures that were oriented differently, that were located in different places, that had different lengths, and that occurred with different frequencies. The two analyses produced two alternative interpretations of fracturing for the same area. It is important to understand the meaning of the differences. As is discussed below in subsequent bases, the FTA integrates poorly with the geophysical survey and other available site data for conduits. Investigating the nature and causes of the differences between these two trace analyses would provide insights into the geology of the site result a better identification of those visible surface features that are predictive of subsurface conduit features.

3. The failure to discuss and document the site walkover and field verification, or perhaps failure to have done it at all, is grossly inadequate. Fracture trace analysis presumes that bedrock

fractures may manifest themselves through "soil and regolith" (p.3-1) in sufficient detail to be visible on aerial photographs. In the case of JPG, however, bedrock fractures can be visible and mapped only if they also are able to propagate themselves through the young glacial tills that blanket much of JPG. As noted in the FTA (p. 3-1), "compared to other karst areas mapped by the analyst, fracture traces were generally less distinct." Field verification was essential to establish the degree to which mantling by glacial sediments limited the utility of air photo analysis using visible light and potentially critical to an understanding of why the SAIC and USGS FTAs differ so much.

The FTA report makes no mention of site walkover and includes no appendix with field notes of such field work. No notes from such field work or any indication of scheduling of such field work were found in documents that were produced as part of mandatory disclosures. The sole indication that some type of field verification may have been done is found on Table 6-1, page 6-6, of the final *Well Location Selection Report*, January 2007 (ML070220461), in the third column, for 11 traces (of total of 110 traces that were mapped). No indication was found in this document or other disclosure documents of when such field verification was done, the methodology of such field verification, or the criterion or criteria of any ranking or classification of traces. If a site walkover was not performed, it needs to be. If a site walkover was performed, then its performance and results need to be properly documented.

4. The FTA was completed without incorporating other available data from the DU impact area that is pertinent to both the identification of conduits in the area and to the concept that the FTA approach is even meaningful for this site. The karst system that underlies the JPG and the DU impact area includes cave networks that are large enough to be entered and mapped by humans and that interconnect with sink holes on the surface. If a FTA is a tool capable of finding significant

conduit pathways that are the result of the karst system beneath the surface geology at JPG, a direct test of that capability is that the FTA finds known cave systems; *i.e.*, that known cave systems manifest themselves at the surface in such a manner that they are seen as linear traces on air photos. Caves within the DU impact area along Big Creek were mapped in detail in the mid-1990s. *See* Ray Sheldon, *Jefferson Proving Ground Karst Study*, 1993 through 1997, available at: http://www.jpgbrac.com/documents/admin_record/site%20identification%20characterization/jpg%20karst%20study.pdf [hereinafter, JPGKS]. That study surveyed six caves in the Big Creek drainage within the DU impact area (*i.e.*, between West- and East Recovery Roads); caves designated JPG-BC-07 through JPG-BC-12 and JPG-BC-19. The surveyed lengths of these cave range from 27 feet to 617 feet. Each of these caves manifested spring flow at an entrance. Three of these caves were mapped into the hillsides sufficiently far to find additional entrances at sinkholes in the DU impact area. But, only one of these caves coincides with a linear feature that was mapped on air photos as a fracture trace in the FTA. Five of six known major conduit systems that have measurable impact on the surface and ground water flow systems within the DU impact area are undetectable by the FTA. Further, the FTA maps lineaments that do not represent observed karst features of comparable magnitude.

These four inadequacies are significant, both individually and collectively, to proper FSP implementation and site characterization because the information derived from the FTA (along with information from other procedures, notably the Electrical Imaging survey (EI)) was used to determine the number and placement of FSP conduit well pairs. *See* discussion in **Basis b** below, which is incorporated here by reference.

B. Basis b. The Electrical Imaging Survey as implemented is inadequate to serve its intended purpose.

The FSP (ML051520319) describes the purpose and methodologies for a geophysical investigation consisting of an electrical imaging (EI) survey as part of the characterization program for JPG's DU impact area (pp. 6-1 and 6-2). The starting premise for the EI is that the FTA has, in addition to mapping visible-spectrum linear anomalies that represent bedrock fractures, identified "... possible areas of preferential flow pathways (ground water conduits) ..." It is noted that although this is a premise expressed in the EI discussions, such identification is not among the stated objectives of the FTA as described in Section 5.2 of the FSP. The stated purpose for the EI on page 6-2 of the FSP is "... to refine the locations of the potential preferred ground water flow pathways and to further characterize the subsurface features." The FSP also describes on page 4-2, in Table 4-1, an additional purpose of the EI survey, which is that the "[s]urvey will be conducted to identify entry and exit pathways."

The methodologies described in the FSP were a) that the "final design, location, and orientation of the geophysical investigation lines" is dependent upon the completion of the FTA, b) electrodes are placed along each survey line, c) an electrical current is placed into the ground between two electrodes, d) the resulting voltage is measured at two other electrodes, and d) a two-dimensional model of the resistivity field is calculated and contoured for interpretation. [Note: Section 6.1.1, p. 6-2 of the FSP erroneously states that the EI measures resistivity, rather than a voltage drop from which apparent resistivity is obtained. Appendix B of the FSP, *Geophysical Procedure GP011 Surface Electrical Imaging Survey*, dated June 1998, correctly states (Section B.5.4, page B-5) that the measurements are not resistivity, but apparent resistivity and are similar to electromagnetic (EM) methods. The final EI result is calculated by a computer model that computes an inversion of the data to represent an inferred resistivity field. These results are then contoured using another program, prior to display for interpretation.] Section 6.1, on page 6-2, of the FSP specifies that well locations will be selected only where (SAIC) FTA lineaments coincide with EI resistivity anomalies.

There is the underlying presumption with the EI survey methodology that the technique identifies ground water conduits in the bedrock. There are multiple unstated assumptions between a display of computed resistivity values from an EI survey and the interpretation that those values reflect the existence of a ground water conduit that are not discussed and do not appear to have been fully considered by SAIC. An EI survey's computation of low resistivity is indicative only of geologic and hydrogeologic features with low resistivity. Based upon known geologic and hydrogeologic conditions at the JPG, not all low resistivity features will be conduits and not all conduits will be expected to have low resistivity. An example of the former is a clay-filled fracture or bedding plane within clean carbonate bedrock below the water table that contains sulfide minerals and/or low resistivity (mineralized) interstitial water. Such features are common in karst terrains, would show a low resistivity, but would conduct little or no water. An example of the latter would be open karst channels through clean carbonate rock that contain largely clay-free sand or gravel sediments, if any, and contain resistive (non-mineralized) channel water or air at the time of an EI survey. Such zones are common in karst terrains, would show a high resistivity, but would conduct water freely. Active conduits above the water table, *e.g.*, drained cave networks, would be characterized by virtually infinite resistivity (since air-filled) except when flowing in response to precipitation events.

The contoured interpretations of the EI data were recently released as part of the final *Well Location Selection Report*, January 2007 (ML070220461) (hereinafter, the WLS report). These are found in Figures 5-1 through 5-5, on pages 5-7, 5-8, and 5-11 through 5-13, respectively. From these interpretations and other information described below, inadequacies in the EI and departures from the FSP are apparent.

The orientation of the EI survey lines were to have been determined based upon the final FTA results. The FTA results showed lineament traces overwhelmingly with a NE-SW or NW-SE orientation (Figure 1, page 3-2 of the FTA report.). Geophysical methods, including electrical methods, are most precise and most reliable when survey lines are perpendicular to geologic features of interest or cultural features that may provide interference (see page B-3 of Appendix B). The planned lines for the EI survey are shown on Figure 2, page 3-3, of the FTA report and the final lines that were run for the EI survey are shown on Figure 4-2, page 4-5, of the WLS report. With a single exception, the orientations of the EI survey lines are oblique rather than perpendicular to the mapped FTA lineaments. Further, EI results are best when laid out as straight lines (FSP, Appendix B, page B-3). EI Line 4 follows the sinuous path of Road D.

One processed and interpreted EI survey line, EI Line 1, was included as Figure 19 of 30 in *Selection of Monitoring Well Locations to Characterize the Groundwater For the Jefferson Proving Ground Depleted Uranium License Decommissioning* (ML062900028), presented to the NRC in a public meeting held on October 12, 2006. That line alone demonstrates the inadequacy locating wells using only the coincident criteria of a mapped FTA lineament and an EI resistivity anomaly, as well as fundamental flaws in the conceptual basis for using those coincident criteria. The remaining four processed and interpreted lines in the WLS report confirm what is seen in EI Line 1. The EI lines show no resistivity anomalies closely associated with most FTA lineaments and no FTA lineaments closely associated with most resistivity anomalies. The interpreted fractures on EI Line 1 are often resistivity anomalies that are dipping rather than vertical. The FTA identified only linear features. Linear surface traces on rolling terrain may be a result of vertical fractures traces, but not dipping fractures.

The distribution of anomalies on the EI Lines is not consistent with the simplistic picture depicted in the schematic block diagrams of Figures 6 and 7 the of the October 12, 2006 *Selection* presentation. This is in large part because those diagrams are predicated on a conceptual model of karst development that propagates from the present land's surface downward into the bedrock. The EI Lines show shallow anomalies that do not have an underlying deep anomalies, deep anomalies that do not have an overlying shallow anomaly, coincident deep and shallow anomalies that do not appear to connect to one another, and coincident shallow and deep anomalies that do appear to be connected. This observed complexity is consistent with a model for karst development that is both more commonly applicable to sites generally and demonstrably applicable to the JPG site particularly than the one proposed in the October 12, 2006 *Selection* presentation.

Major karst development occurs primarily at depth as a result of mixing of ground waters. (The complexities of karst development in terms of geology and geochemistry are well described in hydrogeology textbooks such as Freeze and Cherry's Groundwater, 1979, in Section 11.4 *Groundwater and Geomorphology*, pp. 513-515, and Langmuir's Aqueous Environmental Geochemistry, 1997, in Section 6.4 *Influences on the Solubility and Saturation State of Carbonate Minerals*, pp. 202-208.) Karst development may or may not propagate to the surface, where surface water and surface processes may modify it. Karst development occurs at particular geographic locations during historical periods when the hydrogeologic conditions of the strata are conducive to development, not just in response to conditions that exist at the present time. The carbonate strata beneath JPG may have been subject to karst development at any time, or at multiple times, in the last 400 million years, when surface and drainage conditions were far different than those that exist today. The expected result is an anastomosing network of all previous and contemporary karst systems, with each successive karst system modifying earlier ones. That modification may include further dissolution and erosion, but may also include partial or intermittent plugging with sediments and collapse of previous features. Individual or persistent flooding events may particularly modify the networks with oxygenated and/or unsaturated surface water and physical rerouting of active flow systems. Such a composite network would look, on a single cross section, much like what is seen on the lines of the EI survey.

The Army's overly simplistic interpretation of the EI lines parallels its similar interpretation of the FTA with respect to its failure to integrate the conceptual model of electrical expression of possible conduits with known site conditions. For example, EI Line 4 runs along D Road, across the center of the DU impact area. Based upon the survey of cave JPG-BC-12 (JPGKS, pp. 194 and 204), EI Line 4 should cross over that conduit (WLS report, Figure 4-2, p. 4-5) at a location where it is developed enough to allow human passage. Yet, there is no resistivity expression of this known, major conduit shown at that location on EI Line 4. EI Line 3 (WLS report, Figure 5-3, p. 5-11, at inline distance 5780 +/-) and EI Line 4 (WLS report, Figure 5-4, p. 5-12, at inline distance 1990 +/-) are annotated with the locations of sink holes, unquestionable manifestations of karst development that is directly linked to the ground surface. However, at neither location is there either a mapped surface trace from the FTA or a resistivity anomaly in the EI survey that is interpreted as a fracture.

As with the FTA, the EI survey is grossly inadequate in that it does not "see" conduits that are known to exist from other available information.

At JPG, young glacial sediments cover and mask even those elements of the complex karst network that do propagate to the surface of the bedrock. The "generally less distinct" lineaments that were mapped in the FTA are features that are apparently visible at the top of the till. They are not, however, well associated with the resistivity interpretations of the EI Lines. It is grossly inadequate to persist in selecting well locations on the criterion of the coincident occurrence of two phenomena that empirically are only infrequently and weakly related. That gross inadequacy is compounded when neither of the phenomena that are used for locating the wells can identify existing conduit features with locations that are known and have previously been mapped in the same area. See discussion in **Basis a** above, which is incorporated here by reference.

C. Basis c. The Soil Verification Survey as implemented is inadequate to serve its intended purpose.

The Soil Verification Survey (SVS) is described in concept in the FSP in Section 5.4 on pages 5-2 and 5-3. The SVS as implemented is described in final *Well Location Selection Report*, January 2007 (ML070220461) (hereinafter, the WLS report). The WLS report text description of the SVS is provided in *2. Soil Verification* on pages 2-1 through 2-9, including maps of transects used for verification. This description is supplemented by Plate 2-1, the published map of soils, Plate 2-2, the SAIC map of reinterpreted soils, Appendix A (published soil descriptions), Appendix B (SAIC soil profile descriptions), and Appendix C (soil verification logbook records).

Characterization of the soils on site is important for three major reasons (WLS report, p. 2-1). The nature of the soil will in part control the corrosion rate of penetrators in the DU impact area.

The defined soils will be used to determine partition coefficients (K_ds) for uranium. The corrosion properties, K_ds, and distribution patterns will be incorporated into the fate and transport modeling.

As described in the FSP on page 5-2 and 5-3, the anticipated soil verification survey would use hand-auger borings to 3 feet to characterize a) color, b) (relative) texture, c) horizon thickness, d) depth to glacial sediments, and e) effervescence related to carbonate minerals. The soil verification borings were to be taken along "... appropriate transects across the site typically perpendicular to contours or topographic changes." The SVS departed from the anticipated program in a number of significant ways.

The transects for the borings were not taken across the site or along paths perpendicular to topographic changes. The two transects were taken adjacent to perimeter roads around the DU impact area. Transect 1 was east-west along the side of E Road, between West Recovery (Morgan Road) and Center Recovery Road, along the north perimeter of the DU impact area. [Note: Figure 2-1, p. 2-5, WLS report, erroneously labels the road as D Road.] Transect 2 was north-south along the side of East Recovery Road, from just south of Big Creek to just south of Middle Creek, along the east perimeter of the DU impact area. Because the transects were chosen adjacent to perimeter roads, they are oriented oblique, rather than perpendicular, to the boundaries on the published soil maps.

Table 2-4 on p. 2-7 of WLS report provides a comparison of the published soil types at each sampling location and soil type interpreted by SAIC. The most common difference between the published and SAIC interpretations are with respect to the Avonburg soil series. SAIC frequently interpreted samples from areas mapped as Avonburg series as being Cobbsfork series. At two locations along Transect 1 (T-1-4 and T-1-5) SAIC interpreted Cobbsfork series instead of the mapped Avonburg series. At two locations along Transect 2 (T-2-5, and T-2-6) SAIC interpreted Cobbsfork series instead of the mapped Avonburg series. At location T-2-4, SAIC interpreted Cobbsfork series where Cincinnati series is mapped. [Note: For location T-2-3, Table 2-4 erroneously reports that SAIC interpreted Cobbsfork series at a location mapped as Rossmoyne series. According to the boring logs in Appendix B, SAIC considers T-2-3 to Rossmoyne series, as mapped.] At location T-2-10, SAIC interpreted Avonburg series where Rossmoyne series was mapped. In each case, the SAIC reclassification of soils moved the soil into a series classified as more poorly drained than the series represented on the published maps.

The consistent reclassification of soils to series that are less well drained than those mapped was influenced by the occurrence of shallow ground water in some of the borings (WLS report, p. 2-7). The discussion of the shallow water in the borings is limited to a consideration of the water as evidence of poor drainage. Unmentioned in the discussion are the heavy rains that fell the day before the SVS began. The SVS field work occurred on August 29 and 30, 2006. JPG precipitation data have not been provided as part of disclosure and site stream gauging was not yet in place. However, the US Fish and Wildlife Service does maintain a weather station as part of operations at Big Oaks National Wildlife Refuge, and precipitation records are available online. According to the website, JPG received 2.00 inches of rain on August 28, 2006, with more than one inch falling between 6:00pm and 7:00pm. *See* http://raws.wrh.noaa.gov/cgi-bin/roman/meso_base_past.cgi?stn=BIGI3&unit=0&time=LOCAL&day1=28&month1=01&year1=2006&hour1=0. Further, the USGS does have gauging stations on streams in the area that are available on the Internet. One such gauge is on the drainage immediately east of the DU impact area, on Indian-Kentuck Creek. Retrieving that data (http://waterdata.usgs.gov/nwis, USGS ID number 03291780) shows that stream flow rose from 0.4 cubic feet per second (cfs) on August 26, 2006 to over 300 cfs on August 28, the day before the SVS began. This stream discharge rate is the highest discharge seen for the area in the previous five months. Properly, the shallow water observed on the site must be considered in terms of anomalously heavy precedent rains rather than simply presuming lower-than-expected soil drainage characteristics.

The borings with soils reclassified by SAIC also typically were bored to shallower depths than those that were interpreted as consistent with published mapping. The four borings reinterpreted by SAIC from Avonburg to Cobbsfork recovered only from 12 to 22 inches. In contrast, for borings with unchanged interpretations, 14 of 16 borings recovered between 33 and 38 inches of soil. As described in Appendix A of the WLS report, the Cobbsfork soil is 85 inches thick or greater. Hence, SAIC's reinterpretations are relying on examination that constitute only the shallowest 14-26% of the full soil profile.

As a result of the soil verification study, including the reclassification of soils into the Cobbsford series, SAIC determined that it is appropriate to lump the published areas that are mapped as the Avonburg series and the Cobbsford series into a single soil domain across the DU impact area. That combined domain includes greater than 55% of the DU impact area. SAIC also determined it was appropriate to lump other soil series into composite soil domains. The 24 mapped soil types depicted on Plate 2-1 of the report are composited into only four zones across the DU impact area. (See discussion on page 2-8 of the WLS report and mapped domain on Plate 2-2 of the report.) It is further noted that on Plate 2-2 of the report the legend for those four soil types is in error. The areas that composite the Cincinnati and the Rossmoyne series are characterized on the map legend as being "somewhat poorly to poorly drained" and the areas that composite the

Avonburg and Cobbsfork are characterized on the map legend as being "moderately well to well drained." These descriptions are inconsistent with both the verbal descriptions in the SVS report and the published descriptions of these soil types.

Both the FSP (p. 5-2) and the WLS report (p. 2-2) emphasize that the published soil maps mask detail due to the scale of their observations; *i.e.*, the soils are more variable than mapped. The corrosion of penetrators is dependent upon the specific soil conditions at the locations they rest, not the average conditions of the published maps (WLS report, p. 2-2), as are the geochemical conditions that control uranium migration. Yet, rather than seeking to improve the resolution of the published maps and refine the understanding of the relationship between penetrator location and specific soils at those locations, the Army chose to coarsen the mapping, lumping soils series together across the site. A yet broader brush is proposed for painting the corrosion/transport picture than that previously published, not finer, as the starting input into fate and transport modeling. The decision to combine existing soil mapping into fewer and larger domains is a fundamentally inadequate approach that will negatively impact characterization efforts and the validity of the eventual fate and transport modeling.

The inadequacy caused by lumping is compounded by the emphasis placed specifically on characteristics that may be indicative of reducing conditions (WLS Report, p. 2-8). No redox measurements were taken. No redox measurements are reported in the published soil descriptions. Visual evidence of cyclical reducing conditions are discussed without discussion that the same evidence supports cyclically oxidizing conditions. The discussion also emphasizes soil structures in the top three feet that are perceived as encouraging cyclic reducing conditions, such as fragipans. The parts of the DU impact area that are of most concern with respect to penetrator weathering and uranium migration are not areas that still retain the native soil structures, as do the transect areas of the SVS. They are areas that have been plowed and mixed by thousands of rounds of DU, creating soil profiles unlike anything seen in the undisturbed areas. The SVS is seriously inadequate in that it has done nothing to verify the degrees of alteration from native conditions that exist in the areas of predominant impact.

D. Basis d. The well location selection methodology for ground water conduit and overburden characterization as implemented under FSP Addendum 4 is inadequate to serve its intended purposes.

The system of monitoring wells to be installed as part of the characterization program is described in the FSP in Section *6.2 Groundwater*, from pages 6-2 through 6-24. The FSP hypothesizes that conduits will be likeliest in areas where a) there is an identifiable lineament trace on aerial photography, b) there is discharging ground water to surface water associated with a mapped lineament trace, c) there is greater depth to bedrock and weathering based on the electrical imaging survey, and d) the electrical imaging survey identifies potential karst features. The depths of the paired wells were assumed to be 50 and 120 feet for purposes of FSP estimations (p. 6-4).

The locations and rationale for the location selections of 10 pairs of characterization wells were recently described in the final *Well Location Selection Report*, January 2007 (ML070220461) (hereinafter, the WLS report), in Section 6. *Selection of Characterization Well Locations*, pages 6-1 through 6-7. These locations were chosen based on the coincident proximity of mapped lineaments from the FTA and low-resistivity anomalies from the EI Survey. The inadequacies and limitations of the interpretations from these activities are respectively discussed in **Basis a** and **Basis b** above, and are incorporated here by reference.

A new addendum to the FSP details the proposed installation of the characterization pairs identified in the WLS report; the Field Sampling Plan Addendum 4, Depleted Uranium Impact Area Site Characterization: Monitoring Well Installation (ML070220165), hereinafter called Addendum 4. The proposed installation of the characterization monitoring wells largely follows that proposed in the FSP. To the extent that Addendum 4 parallels the original FSP, the inadequacies that are described in **Contention B-1, Bases a through h**, apply equally to the procedures, methods and protocols detailed in Addendum 4 and the bases and discussions are included by reference.

The full complement of the four elements that are identified in the FSP as indicative of where ground water conduits would be likeliest, and listed as *a)*- through *d)* above, were not the criteria that resulted in the selection of well locations based upon the discussion in the WLS report. The selection of the locations for the well pairs was based upon the coincident proximity of a low resistivity anomaly on an EI survey line and a mapped lineament from the FTA. As described in **Bases a and b** above, neither of these methodologies is adequate for its proposed application individually. Collectively, linking the two compounds the inadequacy.

A particular inadequacy for the selection of characterization pairs is the failure to incorporate indicator *b)* above, measurable transfers between streams and ground water, in the location process. Indicator *b)*, *i.e.*, as presented in the FSP, is itself inadequate in that it considers only areas where ground water is discharging to a stream instead of also including stream reaches where streams are losing flow to recharge ground water. The most significant conduits will be those where the magnitude of flow from ground water to the stream or from the stream to ground water is significant enough to be observed or measured. Those can be located only by qualitatively noting the location of gains or losses to stream flow along the reach of a stream, or quantitatively measuring stream flows at enough positions to identify gaining and losing stream reaches. Stream flow (seven locations) and cave discharge of ground water (two locations) are being measured continuously, beginning in September 2006 (WLS report, page 3-1). However, the multiple months of data from these locations are not included in the selection criteria for selecting the characterization well pair locations and have yet to be disclosed publicly as part of these proceedings. The result is that the locations of the characterization monitoring wells were chosen blindly with respect to available empirical data that will reflect actual flows to or from conduits and instead were selected using criteria demonstrably unable to see known conduits.

The failure to incorporate indicator *d)* from the FSP list, *i.e.*, the incorporation of karst features identified during the EI survey, marks another inadequacy in the location selection methodology for the sampling well pairs. The interpretation of the EI data identified five *features of interest* and the locations of two sink holes (karst features). Two *features of interest* are identified on EI Line 1 (WLS report, Figure 5-1, page 5-7) and well pair # 2 is proposed to drill between them, rather than into either of them (WLS report, Table 6-1, page 6-6). One *feature of interest* is identified on EI Line 3 (WLS report, Figure 5-3, page 5-11) and well pair # 10 is proposed to drill into it. However, this feature is interpreted as anomalously thick unconsolidated sediments, not a karst feature in the bedrock (WLS report, Table 6-1, page 6-6). EI line 3 also located a sink hole, but no well is proposed at its location. Two *features of interest* are identified on EI Line 4 (WLS report, Figure 5-4, page 5-12), but no well pair is proposed to drill into either of them. EI line 4 also located a sink hole, but no well is proposed at its location, either.

Addendum 4 inadequately proposes the same 50- and 120-foot generic depths for the well pairs (page 2-5) that were used in the FSP simply for estimating purposes. Because it is well understood as a matter of the proposed field practice that final well depths for each well will be determined by conditions encountered in drilling, now that specific locations have been selected along the various EI lines, those lines can and should be used to refine planned well depths and provide meaningful rationale for the targeted depths for each specific well pair. As discussed for **Basis b** above, the EI lines show a complex mix of horizontal and vertical relationships among resistivity anomalies. The well drilling plans described in Addendum 4 do not properly address this complexity at individual well pair locations. As one example, at the location for well pair # 7 (EI Line 4 at inline distance 7160 feet, Figure 5-4, page 5-12 of the WLS report) there are both upper and lower low-resistivity zones. However, a shallow well of 50 feet would be completed at a depth below the upper zone and a deep well of 120 feet would not reach the lower zone at that location. The repetition in Addendum 4 of the generic depths that were used for estimating purposes in the FSP suggests that either no conscious consideration has been given to the geologic meaning of the location-specific data which have subsequently become available with respect to what the targeted depths for specific well pairs should be, or that there is conscious disregard of the clear implications for targeted well depths of the location-specific data. Either way, use of the generic rather than location-specific well depths will defeat the site characterization purposes for which the sampling well pairs are being sited and drilled.

One change between the FSP well plan and that of Addendum 4 is the introduction of one well pair designed to investigate an area of anomalously thick unconsolidated overburden with the shallow well of the pair. One of STV's earlier criticisms of the paired-conduit characterization well program as described in the original FSP was that it did not consider the possibility that conduits would or may exist in the unconsolidated overburden, decreasing the travel time for any mobile contaminants to reach the bedrock conduit system. At present, Addendum 4 does not expressly require well installation in such overburden conduits if or when they are found (Addendum 4, page 2-5). The installation of a single shallow well in an area of anomalous overburden thickness is inadequate to characterize the overburden in the remaining areas of normal thickness.

Finally, Addendum 4 and the WLS report are inadequate with respect to their failure to understand the inherent limitation of the interpretations of data that will be collected from the well-pair network that is proposed. Each document maintains that the simple staging of water in these wells will establish flow directions in the conduits that are evaluated. Such a determination is simply not possible. Even assuming that each proposed well pair, notwithstanding the inadequacies explained above, will be located proximate to a ground water conduits, and that each well pair will be successful in penetrating the conduit at each location, the nine well pairs will collect staging data from at least eight different conduits. (WLS report, Table 6-1, page 6-6) Only well pairs # 6 and # 8 may lie in a common conduit (TFA lineament 37-11-1009-1). The stage value at a single point in a conduit cannot convey an understanding of the direction of flow in that conduit. It is analogous to attempting to determine the upstream and downstream directions in a river from gauging water elevations at a single point.

Were it possible to measure horizontal flow across a well, analogous to observing the flow direction in a stream, some inferences regarding flow direction in a conduit in the immediate vicinity of a well might be drawn. However, recent attempts using multiple technologies to determine horizontal flow directions in well bores, including in wells at JPG, have been unsuccessful. *See* Wilson, John T., *et al.*, *An Evaluation of Borehole Flowmeters Used to Measure Horizontal Ground-Water Flow in Limestones of Indiana, Kentucky, and Tennessee, 1999*, United

States Geological Survey: Water-Resources Investigations Report 01-4139 (2001), available at: http://in.water.usgs.gov/newreports/borehole_flowmeter.pdf. This report concludes(p. 1):

> Comparison of the horizontal-flow measurements indicated that the three point-measurement techniques rarely measured the same velocities and flow directions at the same measurement stations. Repeat measurements at selected depth stations also failed to consistently reproduce either flow direction, flow magnitude, or both.

E. Basis e. The implementation to date of the stream and cave gauging program as described in the WLS Report is inadequate to serve the program's intended purpose.

The FSP describes the surface water monitoring network in section *6.4 Surface Water*, beginning on page 6-29. The initial plan for gauging surface water stream flow is described in subsection *6.4.2 Surface Water Gauging Locations*, on page 6-30. The original surface water gauging station was to consist of the following five locations: Big Creek at Morgan Road (West Recovery Road), Middle Creek at Morgan Road (West Recovery Road), two unspecified caves in the Big Creek drainage within the DU impact area, and one cave in the Middle Creek drainage at an unspecified location. The FSP provides no stated rationale for the purpose or design of the stream and cave gauging program.

The surface water gauging (SWG) program as implemented is described in the final *Well Location Selection Report*, January 2007 (ML070220461) (hereinafter, the WLS report). The WLS report text description of the SWG is provided in *3. Surface Water Gauge Installation* on pages 3-1 through 3-6, including a map (Figure 3-1, page 3-3) of the locations of the gauge installations. Also in the WLS report, Appendix C has photographs of the gauge installations and Appendix G has the field log book records for the installations. The SWG was expanded relative to that laid out in the FSP. Three continuous gauging stations were constructed in Big Creek; one each at the east and west perimeters of the DU impact area and one where D Road crosses Big Creek. Continuous gauging stations were constructed at two caves discharging into Big Creek from the north side. One visual gauge was constructed in an unnamed tributary of Big Creek near the intersection of Morgan Road and E Road. Four gauging stations were constructed in the Middle Fork drainage; in Middle Fork at East Recovery Road, in Middle Fork at West Recovery Road, in a minor tributary to Middle Fork where it crosses East Recovery Road, and in a major tributary south of Middle Fork near the projected center line of the DU impact area.

The WLS report also includes a description of the purpose for the SWG program. As described in the WLS report the use of the gauging data is to compute stream flow rates from the gauge data and then use those flow rates ". . . to estimate recharge quantities and characteristics of the aquifer."

Although data have been collected since September 2006 from the gauging system of the SWG program, none of those data have been released in the WLS report or otherwise publicly disclosed. The objective for which those data will be used according to the WLS report, however, is inadequate and inappropriate, regardless of the data themselves.

The final purpose for the data is described as the estimation of precipitation recharge for the area. There are a number of methods by which such estimates are made. Two such methods are described and their use demonstrated in Dennis W. Risser, *et al.*,, *Estimates of Ground-Water Recharge Based on Streamflow-Hydrograph Methods: Pennsylvania*, United States Geological Survey: Open-File Report 2005-1333 (2005), 30 pp, available at: http://pubs.usgs.gov/of/2005/1333/ofr2005-1333.pdf. These techniques are valid only when underlying assumptions are valid, including that the stream being gauged is a gaining stream. Specifically, "[b]ase flow can be a useful approximation of recharge if losses and interbasin transfers of ground water are minimal."

(page 1).

For at least Big Creek, there is significant evidence that it is not a simple gaining stream and, therefore, it cannot simply be assumed there are no losses or interbasin transfers affecting its flows. ERM monitoring data show wells within the DU impact area have recorded heads that are consistently below the elevation of Big Creek. In its response to NRC's Action Item 1from the September 8, 2005 Meeting Report (page 2), Army acknowledges the potential of a manual gauging program recommended by NRC to identify both gaining and losing reaches of site streams to fractures. The WLS report, on Table 6-1, page 6-6 acknowledges the potential for interbasin transfers when it discusses the potential for deep conduit flow not to the local Big Creek but to the Indiana [*sic*]-Kentuck drainage to the east or to the Ohio River to the south.

Until it can be demonstrated that Big Creek, and by extension perhaps Middle Fork, is not a losing stream and that its basin does not lose water to adjacent drainage basins, it is inappropriate to use the gauging data to estimate recharge rates. To do so could underestimate the amount of recharge that is occurring in the DU impact area and underestimate the volumes and rates of migration away from the DU impact area. Further, by not recognizing stream losses and interbasin transfers, even the direction of transport away from the DU impact area can be misunderstood. The demonstration that the streams draining the DU impact area are not losing streams at any point in their courses and at any time during the year and that they do not lose water to interbasin transfers can only be done with detailed gain-loss studies over their reaches of interest. Those studies have never been done. Those gain-loss studies would also locate the discharge/recharge sites of the principle conduits affecting ground- and surface water hydrology, thereby providing additional information critical to the selection of locations for the conduit characterization wells.

Instead of initial gain-loss studies to understand the dynamics of the ground water and surface water interactions, the SWG assumes discharge/recharge conditions not in evidence, ignores evidence that refutes the assumed conditions, and sets the stage for subsequent recharge calculations based upon the unsubstantiated and mistaken assumptions that will then be cited to circularly support those assumptions. At no point does the characterization program step back and test the initial hypothesis that losses and interbasin transfers from the JPG and DU impact area stream systems are minimal. This is a fundamental flaw in the Army's surface water gauging program as described in the WLS report.

F. Basis f. The field collection and analytical methods planned and used to document and evaluate data yielded by FSP implementation are inadequate to serve their intended purposes.

The results of the various data collection programs of the FSP are only beginning to be released. The Army has expressly proposed *not* to define formally at this time its procedures or methodologies for data analysis and evaluation for yet-to-be collected or released data sets (*see* attachment to letter of January 17, 2007 from Alan G. Wilson to Dr. Thomas McLaughlin, entitled *Action Item 3. Meeting Report, October 12, 2006*) (ML070220162) However, every indication which STV has received to date evidences that the evaluation of the FSP data is being and will be performed in a manner consistent with the evaluation of recently released ERM data. Consequently, the procedures and methods being used to evaluate ERM data will be cited to illustrate the inadequacies of the formally undisclosed but clearly contemplated evaluation techniques for the FSP data. The comments in this basis reflect relevant evaluations of FSP data yeilded by the hydrogeology sampling programs discussed in Bases a through e above, and also from the initial

Deer Sampling program as discussed in more detail in Basis g below, a discussion which is incorporated here by reference.

STV presents this Basis at this time rather than deferring it to a later time for two important reasons. First, STV considers it critical that data analysis and evaluation procedures and methods be determined *before not after* samples are collected because analysis and evaluation requirements can and should constrain and define collection procedures and methods. Second, STV considers the use of methods and procedures developed for ERM purposes, *i.e.* to detect DU in concentrations that represent a threat to public health and safety, to not necessarily be appropriate for FSP purposes, *i.e.* to detect DU in concentrations that indicate its mobility and migration in various media associated with its fate and transport in the environment. Thus, STV believes it is crucial to correct the inadequacies in FSP data analysis and evaluation now rather than later.

The inadequacies of the planned FSP data evaluations fall into four areas. The first inadequacy is a failure to acknowledge the validity and significance of environmental samples with high U-238/U-234 activity ratios as indicative of the transport of DU from the impact area to areas outside the impact area. The second inadequacy is the failure to acknowledge that uranium derived from the DU penetrators in the impact area will not retain the U-238/U-234 activity ratios of the penetrators over time or in all media. The third inadequacy is the failure to integrate the complexities resulting from mixing of natural uranium and penetrator-derived uranium in the environment. The fourth inadequacy is the failure to incorporate sampling protocols and analytical methods that will resolve ambiguities related to the source of uranium in environmental and characterization samples.

1. DU Recognition in Environmental and Characterization Samples

This inadequacy can be illustrated with data from the recent ERM sampling results for April, 2006 (ML062900028). Among those samples, two had reported U-238/U-234 activity ratios greater than three. The FSP (page 2-14) states that activity ratios that exceed two are indicative of depleted uranium. These were samples SWS02, with a ratio of 3.75, and SWS08, with a ratio of 3.08 (ERM report, page 3-1). It is of note that these samples are from the locations where Big Creek leaves the JPG site and the impact area, respectively. Consequently, any uranium derived from penetrators that is in these surface water samples is not only migrating beyond the DU impact area, it is also migrating beyond the site boundary.

Of the eight surface water samples, only three had the precision necessary to allow detections of both U-238 and U-234, allowing the activity ratio to be calculated; the two samples with ratios exceeding three and one sample with a ratio of 1.1. In each of the three cases, both isotopes were detected and measured. In each of the three cases the 2-sigma uncertainty associated with the U-234 was more than 50% of the activity, resulting in a "J" flag.

Because the activity ratios of two of these samples exceeded three (rather than the FSP-prescribed value of two), the ERM report describes what it terms "further investigation" of these samples. The "further investigation" did not involve re-analysis to obtain better precision, analysis of a duplicate split, or analysis with an alternative methodology such as ICP-MS. It consisted only of re-examination of the initially reported analyses. The result of that re-examination was the conclusion that DU was "not indicated" in either sample. The re-examination for each sample consisted of three elements. First, it was noted that the concentrations of the uranium isotopes in each sample was low. Second, it was noted that the uncertainties associated with the results of each sample, particularly with the isotope U-234, were high. Third, a "propagation of error" calculation was made for the respective activity ratios. The inadequacy of each element of this re-examination is discussed below.

a. Concentration

Concentration is irrelevant as an indicator of the source of the uranium found in the samples. A low concentration of uranium in a sample has nothing to do with the source of that uranium. Once the minimum detection concentration is exceeded, a low concentration of DU is still DU. The concentration of DU in a sample above the minimum detection concentration will have significance with respect to meeting or exceeding standards for compliance or corrective action in the ERM program, but it has no significance with respect to determining whether or not DU is present at particular locations and in particular media relevant to its fate and transport for JPG site characterization purposes.

The low total concentration in each sample is significant, however, in that it is the likely result of a departure from the field collection program from that specified in the Standard Operating Procedure (SOP), provided as Appendix A to the April 2006 ERM data report. The SOP specifies on page A-5 that the one-gallon surface-water sample will not be filtered or preserved in the field. This procedure allows DU entrained in the surface water flow as suspended particles, colloidal particles or in uranium-bearing organic particles to be analyzed as part of transport from the DU impact area and/or JPG. This is the appropriate sampling protocol since any DU transported from the site has potential risk, not just DU dissolved in surface water. The sampling procedure that was used in the field, however, did not comply with the SOP. The field notes that are provided in Appendix B to the ERM sampling report show that the surface water samples were both filtered and preserved, *see, e.g.*, field logbook entry for April 11, 2006 at 13:10 and 13:20. A low concentration that results from this departure from the SOP may simply reflect the field decision not to collect that part of the mass transported by the stream in suspended form, including any uranium in that suspended mass.

b. Analytical Uncertainty

Analytical uncertainty is also irrelevant as an indicator of the source of uranium. The uncertainty of an activity measurement of an isotope is a direct function of the mass of the isotope that is being counted and the length of the count time, among other causes. It is not a function of the source of the uranium. Increasing either mass or count time will decrease the relative uncertainty associated with the measurement. Thus, the relative uncertainty is something that can be controlled as part of the sampling and analysis specifications for a project. When confronted with high relative uncertainties, the analysis can frequently be improved by reanalyzing with a longer count window, even when an additional sample is unavailable for analysis.

The uncertainties for these samples are almost certainly partially the result of two departures from the ERM SOP for the surface water samples. As indicated above, the SOP called for a sample size of one gallon. The sample size according to field logbooks was 500 ml, or less than a pint. The probable reduction of U-234 mass by filtering and the absolute loss of U-234 mass resulting from a collection of a sample 1/9 that specified in the SOP unquestionably contributed to the relatively high uncertainty reported by the laboratory. But, that uncertainty is independent of whether the source of the measured uranium is natural U, DU or a mix of the two.

Further, the relative uncertainty of isotope activity measurements that haunt the ERM samples will be exacerbated under the FSP protocols. The volume specified in the FSP for each ground water and surface water sample is further reduced by a factor of five to 100 ml from the ERM practice of 500 ml (FSP, Appendix A, page A.4-2, Table A.4-3). By cutting the mass yet further, the FSP ensures even higher levels of uncertainty in any analyses that may detect an isotope, with the concomitant opportunity for the rejection of results indicating the presence of DU.

c. Propagation of "Error"

The final argument for a finding that DU is not indicated by activity ratios in excess of three lies with a calculation of the "propagation of error" for the activity ratio. For sample SWS02, the result of this calculation is represented as 3.75 +/- 3.7, implying the U-238/U-234 ratio is anywhere between 0.05 and 7.45. The conclusion in the ERM re-examination is that this large range precludes an indication of DU in the sample. This conclusion is simply a non sequitur for the issue being considered. The lower number is well below that of natural uranium and the higher number is at least twice that of DU derived from uranium ore, so the reported result precludes neither natural uranium nor DU.

The term *error*, as used in the ERM report, is actually the uncertainty of a reported analysis. The error reported for each analysis in the ERM data table is undefined with respect to its method of calculation and its individual components, something considered "bad practice" in NUREG-1576, MARLAP, Volume III, page 19-10 (ML042320083). Based upon the Paragon Laboratory's Quality Assurance Plan, *Section 3.10*, pages 24 and 25 (*in* Field Sampling Plan Addendum for deer sampling, November, 2005 (ML053350356)), the error values represent the total propagated uncertainty (TPU) for each analysis expressed at a two-sigma level. Hence, it represents the range about the reported value within which a second analysis of that sample would fall about 96% of the time. Each isotope, U-234 and U-238, has its own reported uncertainty and each of those uncertainties affects the uncertainty of the ratio in the terms of the discussion in the ERM report. The breadth of the propagated uncertainty is simply another manifestation of inadequate field and analytical protocols that produce the two factors previously discussed.

For any method of propagating the uncertainty of the individual analyses to the activity ratio, the most likely value for the activity ratio is the activity ratio of the reported values. For any value below the likeliest ratio, there is a corresponding value above that ratio. The further from the expected value, the less likely it is. For the uncertainty around the activity ratio for SWS02, the appropriate conclusion is that DU is likely present in the sample at the JPG boundary. Further appropriate conclusions are that the concentration of DU being measured may be inappropriately low because the sample was filtered, that uncertainty in the results can be reduced by following the SOP with respect to sample size, and by specifying the laboratory use a longer count time (NUREG-1576, MARLAP, Volume II, page 16-4 (ML060930657). If these efforts are insufficient to resolve source ambiguities inherent with activity concentrations and ratios, more precise methodologies, such as ICP-MS should be specified.

2. Variability of U-238/U-234 Activity Ratios

The interpretation of ERM and characterization data is inadequate when it fails to consider isotope activity ratios other than that of the DU in penetrators as indicative of penetrator-derived uranium. Were metallic uranium particles from penetrators the only uranium form of concern, it would be adequate. However, the penetrators oxidize, and in doing so, the uranium from the penetrators fractionates. That fractionation is observed on the site in root wash from plants growing on weathering penetrators, which has been analyzed at JPG. The isotope activity ratios for the root wash are not those of penetrator uranium; they are two, three or four times higher. The same effect is observed in the U-238/U-234 activity ratios of soil at weathered penetrators in Bosnia-Herzegovina (*see* Tables D.5 and D.6 of Appendix D, in United Nations Environment Programme, Depleted Uranium in Bosnia and Herzegovina, Post-Conflict Environmental Assessment, March 2003, 282 pp.) Oxidation, and removal, of U-234 occurs sooner and faster than that of U-238, leaving in the residual a higher concentration of U-238, a lower concentration of U-234, and a higher activity ratio. Thus, soil from a plot with weathered penetrators will not be characterized by activity ratios of 3 or 4, consistent with metallic DU, but perhaps 6, 8, or 12.

Mass balance mandates that, if fractionation relatively concentrates U-238 in the soils surrounding a penetrator upon oxidation, the uranium that migrates away from the oxidizing penetrator is correspondingly depleted in U-238 and enriched in U-234, and its activity ratio will be proportionately lower. This result is also empirically observed in the ERM monitoring data from the JPG DU site. Ground water samples from the ERM data in April 2006 show activity ratios below natural uranium that are consistent with a proportionate isotope activity ratio reduction below metallic DU that is comparable to the activity ratio increase above metallic DU exhibited by residual soil samples. The empirical observations from JPG and the Balkans that oxidation/reduction reactions fractionate uranium is confirmed from laboratory tests as well. In their paper *Experimentally Determined Uranium Isotope Fractionation During Reduction of Hexavalent U by Bacteria and Zero Valent Iron*, Environ. Sci. Technol. 2006, pp. 6943-6948, Rademacher, *et al.*, documented preferential reaction of lighter uranium isotopes during redox reactions.

The U-234-enriched activity ratio in ground water is not solely the result of DU fractionation at the weathering site. There is a recoil effect which is associated with the alpha decay of U-238 in soil particles. This recoil effect enhances leaching of U-234 from the site of the damaged crystal lattice resulting from the U-238 decay. (*See, e.g.*, the discussion on page 168, United Nations Environment Programme, Depleted Uranium in Bosnia and Herzegovina: Post-Conflict Environmental Assessment, March 2003, 282 pp.) This enhanced leaching combines with the effects of fractionation to increase the concentration of U-234 and decrease the U-238/U-234 activity ratio for the mobile DU fraction in ground water. This combined effect may render samples of ground water contaminated by penetrator-sourced uranium indistinguishable based on their U-238/U-234 ratios from ground water samples containing only natural uranium. The low activity ratios in ground water due to fractionation will be an early effect of penetrator corrosion that disappears once the penetrators have been oxidized, since the fractionation is specific to redox reactions. Later dissolution and transport of the residual uranium in the soil without further redox reactions will thus produce ground water that has an activity ratio which approximates that of the residual uranium source in the soil. Thus, the interpretation of U-238/U-234 activity ratios in ground water is much more complex than in soil and may be unable to distinguish between depleted and natural uranium sources.

3. Samples with Mixed Sources of Uranium

A further inadequacy in the evaluations that are performed for the ERM if applied to FSP data is the refusal to consider the effects of mixing when evaluating the data. Ultimately the objective of the FSP is to produce a site characterization that will support a valid fate and transport model that can be used as a basis for a risk assessment. Such models rely extensively on judgement values for most parameters and there often is no way to calibrate them. Documented first arrivals of a contaminant, even at very low concentrations, offer at least a partial calibration of critical parameters. It is, therefore, very critical to be able to identify uranium from penetrators even at low concentrations. For uranium, a contaminant that also exists in nature, the earliest detection will necessarily be a mix of penetrator uranium and natural uranium, with activity ratios that are intermediate between that of natural uranium and media-specific penetrator uranium. The focus on properly evaluating low concentrations has little to do with license compliance and everything to do with building a valid model for risk assessment.

The significance and importance of considering mixing in evaluating DU contamination is widely acknowledged. The evaluations by the UNEP of DU use in the Balkans in the mid-1990s tracked the mix of DU with natural uranium, and did not simply disregard less-than-pure DU, whether the mix was being evaluated on a mass or activity basis. (*See, e.g.*, Tables D.2, -3, -5, and -6 of Appendix D, in United Nations Environment Programme, Depleted Uranium in Bosnia and Herzegovina: Post-Conflict Environmental Assessment, March 2003, 282 pp.) Current research similarly emphasizes the interpretive significance of assessing uranium activity ratios as mixtures of separate sources. (*See, e.g.*, pages 3 and 4, Thorston Warneke, High-Precision Isotope Ratio Measurements of Uranium and Plutonium in the Environment, University of Southampton: Ph.D. Thesis, January 2002, 186 pp.)

Existing ERM data and previous studies at JPG show the existence of isotopic data trends in environmental monitoring data that represent mixtures and the importance of recognizing the mixture in an interpretation. ERM surface water samples typically show either low activity ratios similar to ground water, as would be expected from base flow to a stream, or show high activity ratios, representing transport of residual DU or metallic DU associated with run-off. ERM stream sediments show natural uranium activity ratios, as would be expected from native soils, or, episodically, ratios consistent with admixtures of some residual or metallic DU. The study by

Michael H. Ebinger and Wayne R. Hansen, Jefferson Proving Ground Data Summary and Risk Assessment, Environmental Science Group, Los Alamos National Laboratory, February 1996, available at http://www.jpgbrac.com/documents/admin_record/ site%20identification%20 characterization/jpg%20data%20summary%20and%20risk%20assessment.pdf, concluded (p. 15): "The linear trend in these data demonstrates that the isotopic ratio is not a unique identifier of the source of U for these particular samples, and Figure 10 shows that the isotopic ratios from surface water data cannot be used to demonstrate reliably the source of the U." It is noted that 10 years before the Army's categorical dismissal of DU as a possibility in environmental surface water samples at JPG in April, 2006, Ebinger and Hansen saw patterns in the data of surface water samples that were consistent with mixtures of natural and depleted uranium.

Decisions as part of the FSP characterization programs should not be reached simply upon the yes/no identification of activity ratios that are characteristic of metallic DU penetrators. Each medium must be considered with respect to the expected activity ratio for natural uranium, the expected activity ratio for contaminant uranium, and the degree of mixing. Penetrator-derived uranium in ground water would be expected to have activity ratios below unity. Plants or animals exposed to uranium from ground or spring water with penetrator-derived uranium would also be expected to have low activity ratios. Alternatively, animals consuming residuum from oxidized penetrators might demonstrate activity ratios above the nominal activity ratio of penetrators. The Deer Tissue Sample Study is an example and is specifically discussed in **Basis g**, below.

4. Alternative Analytical Methodologies and Protocols

As outlined above, the identification of uranium that is derived from penetrators is a complicated process that varies with the medium and will vary with time. Substantial ambiguity has resulted from the ERM field sampling protocols, particularly with the departures from the SOPs, which produce low concentrations and high analytical uncertainty. This is a problem that has increased with time in the ERM data. The complexity and ambiguity of identifying penetrator-derived uranium is also substantially an artifact of the decision to use alpha activity ratios as the sole analytical methodology. Because the activity ratio of U-238/U-234 varies among media in nature, it becomes problematic to interpret ratios from mixed media or, in some cases, even an individual medium.

Collecting and analyzing larger samples than specified in the FSP, and running longer count windows would improve the utility of the current methodology. However, for the type of assessment that this characterization program needs, particularly identifying first arrivals and low-level changes of DU concentrations early in its transport cycle, alternative methodologies would be much more reliable. In particular, mass ratios of U-235 and U-238, obtained for example from ICP-MS, would be far more readily interpreted than alpha activity ratios. The mass ratio of U-235 to U-238 is more consistent across all media than is the activity ratio U-238/U-234, making the interpretations of low-concentration mixes significantly more reliable, regardless of the medium. (*See, e.g.*, Summary and introductory discussion on page 1, S.R.N. Chenery, *et al.*, 2002, *Uranium anomalies identified using G-BASE data - Natural or anthropogenic? A uranium isotope pilot study*, British Geological Survey: Internal Report IR/02/001 (2002), available at: http://www.wise-uranium.org/pdf/ir02_001.pdf. The Army's failure to include this alternative methodology, even for purposes of further investigation of samples whose alpha activity ratios it considers ambiguous, is a major flaw in the FSP as it is currently being implemented. At an absolute minimum, whenever activity ratios exceed twice the background activity ratio of a particular medium, the sample should also be analyzed using ICP-MS to allow assessment of mass ratios independent of activity ratios.

G. Basis g. The initial Deer Tissue Sampling Study as implemented is inadequate to serve its intended purpose.

The purpose assigned by the FSP to the Deer Tissue Sampling Study (ML062210019) is quite limited. Basically, the Army proposed to conduct a single deer hunt in the Fall of 2005 and analyze tissue samples from the harvested deer in order to determine whether DU uptake trends suggested by earlier analyses of deer tissue samples collected ten or more years ago had continued. (FSP, pp. 6-24 to 6-25). If the samples collected as a result of the initial hunt also indicated DU uptake, then additional deer sampling and/or other biota sampling would be considered. In **Contention B-1, Bases n and o,** STV has previously challenged the adequacy of a single sampling event from only one species of biota, especially where that one species is deer. However, the initial Deer Tissue Sampling Study is seriously inadequate to serve even its woefully inadequate intended purpose. Its inadequacies fall into two general categories: sampling methods and data collection, management, and interpretation.

1. Sampling Methods

There are two sampling method inadequacies of the Deer Sampling study that became apparent after its completion. The first relates to the origin of the deer that were killed and the second to the representativeness of the uranium composition of the deer killed relative to deer with a natural diet.

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

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

2. Data Collection, Management, and Interpretation

There are number of inadequacies, as well, in the collection, management and interpretation of the data collected in the Deer Tissue Sampling Study. These are described below.

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

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

The results of the Deer Tissue Sampling Study indicate that penetrator-derived uranium has probably moved into the deer population, directly counter to the conclusions of the tissue study. Since the deer document biological uptake, the proper implementation of the FSP should be follow-up testing and the testing of other biota. The implementation of the FSP following the deer study, however, is to forego any additional biota sampling.

A second basic inadequacy is the failure to meet specified accuracy in the chemical analysis of the deer samples. This deficiency is demonstrated by the discrepancy between the results of the few duplicate samples that were taken and chemically analyzed (one per JPG region). According to Table A3-1 on page A3-3 of the FSP, all duplicate samples are supposed to have less than a 50% difference in value to be considered acceptable. In fact, in the results of the first deer sampling event, as released in the August 2006 report, many of the duplicate sample sets have a measurement difference of 50% or greater, with some showing differences as great as an order of magnitude (i.e. ten-fold). By region, the duplicate sample values with the differences noted are as follows (with the individual samples separated by semi-colons, the isotope measurements (U-234, U-235, U-238) separated by commas within the sample groupings, and sample pairs that fall outside the designated acceptable range[1] marked in **BOLD**):

<u>For the Background Hunting Zone</u>

Deer sample #DR-BHZ-02 -

BONE 0.0104/0.0108/96% , **0.0015/0.0036/42% , 0.0086/0.0016/537.5%** ;

LIVER **0.0127/0.033/38.5%** , **0.0024/0.0005/480%** , **0.0014/0.0032/43.75%** ;

MUSCLE **0.0036/0.0072/50%** , 0.0005/0.0009/55.55% , **0.0006/0.0056/10.7%** ;

Deer sample #DR-BHZ-04* -

KIDNEY 0.0043/0.0023/187% , 0.0031/0.0026/119% , **0.0038/0.0015/253%** ;

* For some inexplicable reason, a duplicate kidney sample was alleged to have been taken from a different deer than all other duplicate samples for this region. By itself, this is reason to question the validity of all of the sample results, as it indicates that either in the laboratory or in the field or in the analysis and documentation of the data someone made a mistake in labeling. Since there is no way to tell where the quality assurance/quality control procedures fell drastically short, the reliability of all data collected and analyzed during this sampling event are called into question.

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[1] For the sake of methodological consistency, all difference ratios were calculated by dividing the first sample's value by the comparable duplicate's value. Since the first sample's value is sometimes larger and sometimes smaller than the duplicate's value, the acceptable range is defined as: 50% < acceptable range < 200%. All percentages at or below 50%, and all percentages at or above 200% fall outside the acceptable range as stated in the FSP.

For the Depleted Uranium Area:

Deer Sample #DR-DUA-04 -

BONE **0.016/0.0041/39% , 0/0.0046/NO RATIO POSSIBLE , -0.0011[counts as 0]/0.0014/ NO RATIO POSSIBLE**;

KIDNEY 0.0022/0.0034/65% , **0/0.0015/NO RATIO POSSIBLE** , 0.014/0.0018/78% ;

LIVER 0.0106/0.0117/91% , **0.0007/0.0038/18% , 0.0028/0.0008/350%** ;

MUSCLE 0.0095/0.0073/130% , **0.0045/0.001/450% , 0.0003/0.0001/ 300%**

For the Nearby Hunting Zones:

Deer Sample #DR-NHZ-02 -

BONE 0.0112/0.021/53% , 0.0052/0.0064/81% , **0.0021/0.0323/6.5%** ;

KIDNEY **0.0017/0.0054/31.5%** , 0.0035/0.0036/97% , 0.0053/0.0045/118% ;

LIVER 0.0086/0.0116/74% , **0.0014/0.0041/34% , 0.0016/0.0058/28%** ;

MUSCLE 0.0122/0.0135/90% , 0.0016/0.0026/61.5% , 0.0029/0.003/97%

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

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

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

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

1. The percent of each population that was female was very different between sampling regions: 80% (i.e., 8 out of 10 deer sampled) in both the BHZ and the NHZ, and only 40% (i.e., 4 out of 10 deer) in the DU Area. If the assertion made by the Army and SAIC is even partially accurate, and these deer are from relatively separate populations, this difference in the gender ratio indicates a severe effect on wildlife in the DU area. Even if there is migration between the populations, as we suspect, this is an observation that merits additional field analysis and the initiation of a tracking study to monitor the migration and movements of the deer population at JPG.

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

carrying two fetuses, 17% carrying one fetus).[2]

One could speculate that size and age contributes to these two clear dose-related differences, but a quick evaluation of the data in the Log Book demonstrates that the female deer in the DU area are the largest over all (115 lb, 125 lb, 150 lb, 170 lb), while those in the BHZ and NHZ areas are similar in size (NHZ - Pregnant: 75 lb, 102 lb, 115 lb, 125 lb, 130 lb, 145 lb; NHZ - Not Pregnant: 80lb, 110 lb; BHZ - Pregnant: 105 lb, 120 lb, 130 lb, 135 lb, 145 lb, 150 lb; BHZ - Not Pregnant: 60 lb, 75 lb, 125 lb). Without an analysis of the bones to determine true age of each deer, it is not fully possible to determine whether age contributes to the slight discrepancy in weight for the non-pregnant and (evaluated separately) pregnant females of which the BHZ are on average smaller. Without monitoring and tracking the deer populations, one could also not determine whether the differences in size are due to a shifting in birth times during the year, which might also indicate an effect of the DU exposure on wildlife health and function. The number of males collected in the BHZ and NHZ are small, but overall, the males in the DU area appear to be larger, although this could be due to a skewing from the sample size (BHZ: 100 lb; NHZ: 110 lg, 130 lb; DU Area: 75 lb, 75 lb, 110 lb, 130 lb, 140 lb, 160 lb).

Moreover, some of the observed differences discussed above with respect to the deer populations correspond not only to geographic variation but also to temporal variation, i.e., the impact area deer were taken during the fall kill and the other deer during the winter kill. Some differences may causally relate to the temporal variation independent of the geographic distribution, or both variations may act in consort. The failure of the deer tissue study to independently isolate

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

major variables like time and space is another measure of the inadequacy of the implemented study to test a hypothesis of DU uptake by deer.

There are also two structural inadequacies of the Deer Sampling study that became apparent after its completion. The first relates to the origin of the deer that were killed and the second to the representativeness of the uranium composition of the deer killed relative to deer with a natural diet.

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

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

A fifth deficiency is that a another analysis needed to be conducted on the deer sampling data but was not performed in the Deer Tissue Sampling Study, namely an assessment of bioaccumulation. Due to the very poor reliability of the data compiled in the initial study, such an assessment using its data would be equally unrelaible. In the future, however, with a larger sample size, more duplicates, and consistent collection and measurement procedures, and thus reliable sample results, the study results need to include an evaluation of bioaccumulation rates based on a correction for estimated age of the animals, as uranium does bioaccumulate and thus increases in the animals with age. Until such corrections are done, the differences in the exposures even between different populations in different parts of JPG are simply not subject to reliable interpretation.

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

II.. Support for Contention B-2:

Contention B-2 is technical in character. In addition to the technical sources cited in each supporting basis, STV will support this contention at the hearing with the expert testimony of Charles Norris, Vice-President, Geo-Hydro, Inc., and Diane Henshel, Ph.D., Associate Professor, School of Public and Environmental Affairs, Indiana University. Mr. Norris will support Bases a through f and both Mr. Norris and Dr. Henshel will support Basis g. The professional resumes of Mr. Norris and Dr. Henshel have been previously submitted in support of STV's original contentions. In preparing their expert analyses in support of Contention B-2, Mr. Norris and Dr. Henshel have been and will be guided by their professional training and experience within their particular areas of expertise, as well as by applicable NRC guidance such as the criteria in NUREG-1757, Vol.2, Section 4.2, and NUREG-1575, Section 5.3.

III. Legal Standards for Admission of Additional Contention and Supporting Bases

All contentions, no matter when submitted, must meet the requirements outlined at 10 C.F.R. § 2.309(f)(1). For each contention, the intervenor must provide: (1) a specific statement of the issue of law or fact to be raised; (2) a brief explanation of the basis for the contention; (3) a demonstration that the issue raised in the contention is within the scope of the proceeding; (4) a demonstration that the issue raised in the contention is material to the findings the NRC must make to support the action that is involved in the proceeding; (5) a concise statement of the alleged facts or expert opinions which support the requestor's position; and (6) sufficient information to show that a genuine dispute exists on a material issue of law or fact, including references to specific portions of the application that the petitioner disputes and the supporting reasons for each dispute or the identification of each failure to include necessary information in the application and the supporting reasons for the petitioner's belief. 10 C.F.R. § 2.309(f)(1).

After the filing of an intervener's initial contentions, contentions may be amended or supplemented upon a showing that: (1) the information upon which the amended or new contention is based was not previously available; (2) the information upon which the amended or new contention is based is materially different than information previously available; and (3) the amended or new contention has been submitted in a timely fashion based on the availability of the subsequent information. 10 C.F.R. § 2.309(f)(2).

In the event that the amended or new contention is not submitted in a timely fashion, the petition must meet the requirements of 10 C.F.R. § 2.309(c)(1). In order to determine whether or not a late-filed contention should be entertained, the Board will balance the following factors to the extent that they apply to the particular nontimely filing: (1) good cause, if any, for the failure to file on time; (2) the nature of the requestor's/petitioner's right under the Atomic Energy Act to be made a party to the proceeding; (3) the nature and extent of the requestor's/petitioner's property, financial, or other interest in the proceeding; (4) the possible effect of any order that may be entered in the proceeding on the requestor's/petitioner's interest; (5) the availability of other means whereby the requestor's/petitioner's interest will be protected; (6) the extent to which the requester's/petitioner's interests will be represented by existing parties; (7) the extent to which the requestor's/petitioner's participation will broaden the issues or delay the proceeding; and (8) the extent to which the requestor's/petitioner's participation may reasonably be expected to assist in developing a sound record.

IV. Legal Standards for Admission Applied to Additional Contention Proposed by STV

STV submits that its additional Contention B-2 meets all applicable standards for admission for hearing in this proceeding, as follows.

A. 10 C.F.R. § 2.309(f)(1) Requirements

STV submits that the requirements of 10 C.F.R. § 2.309(f)(1) are met because:

(1) the contention clearly states a specific issue of fact to be raised, namely the adequacy of the Army's implementation of the FSP to achieve its stated objectives,

(2) brief explanations of four separate bases for the contention are provided;

(3) the issue raised in the contention is within the scope of the proceeding because it relates only to implementation of the FSP, which the Board ruled in its December 20, 2006 Memorandum and Order on STV's original contentions defines the scope of this proceeding,

(4) each of the four bases cited in support of the contention includes a specific explanation as to why the deficiencies claimed with respect to each challenged component of FSP implementation is material to the adequacy of the characterization of the Jefferson Proving Ground (JPG) Depleted Uraniium (DU) site that is involved in this proceeding;

(5) each of the four bases cited in support of the contention includes a concise statement of the alleged facts and expert opinions which support STV's position, and

(6) each of the four bases cited in support of the contention contains sufficient information to show that a genuine dispute exists on a material issue of FSP implementation between STV and the Army, with the supporting information (a) including references to the specific sections or provisions of the FSP, its Addenda, or other related documents that STV disputes as well as the supporting reasons for each dispute or, alternatively, (b) providing the identification of each failure by the Army to include necessary information or procedures in FSP implementation as well as the supporting reasons for STV's belief regarding each alleged failure.

B. 10 C.F.R. § 2.309(f)(2) Requirements

STV submits that the requirements 10 C.F.R. § 2.309(f)(2) are met because:

(1) The critical information regarding implementation of the FSP upon which the new contention is based was not available when STV filed its original contentions in final form on May 31, 2006, because each of the documents or other sources of information which is central to each

basis only became available to STV after May 31, 2006, as follows:

(a) The Fracture Trace Analysis (FTA) report (ML061670091) was added to ADAMS on June 16, 2006;

(b) FSP Addendum 2 (part of ML061930256) was added to ADAMS on July 12, 2006;

(c) FSP Addendum 3 (part of ML061930287) was added to ADAMS on July 12, 2006;

(d) Deer Tissue Sampling results (ML062210019) were added to ADAMS on August 9, 2006;

(e) The Summary Report of Results for May 23-26, 2005 Radiation Monitoring Sampling Event at Jefferson Proving Ground.(ML062140532) was added to ADAMS on August 11, 2006;

(f) The Electronic Imaging Survey results have not to date been added to ADAMS in completed form, although the Army's detailed plans for the EIS were discussed orally with STV during settlement negotiations which occurred during August and September, 2006 and partial results from the Survey were made available to STV at the time of the public meeting of October 12, 2006 (ML062920232 and ML062930035);

(g) The Army's detailed Sampling Well Placement Plan has not been finalized until very recently, although the Army's preliminary plan for well placement was discussed orally with STV during settlement negotiations which occurred during August and September, 2006, and discussed orally with the Staff while STV listened during the public meeting of October 12, 2006 ((ML062920232 and ML062930035).

(h) The Summary Report of Results for April 10-13, 2006 Radiation Monitoring Sampling Event at Jefferson Proving Ground (ML062900028) was added to ADAMS on October 17, 2006;

(i) Subsequent to the October 12 public meeting, the Army deferred implementation of its

FSP Sampling Well Placement Plan pending further review with the Staff, notice of which was posted to ADAMS on November 13, 2006 (ML063170367). Subsequently also, the summary results of the October 12 public meeting were conveyed to the Board, notice of which was posted to ADAMS on November 21, 2006 (ML063000190); and

(j) The Well Sampling Location Report, FSP Addendum 4, and other documents representing the Army's responses to the action items from the October 12 public meeting (*see* ML070220162, ML070220165, ML070220461, ML070220466, ML070220475, ML070220488) were posted to ADAMS on January 22 or 23, 2007, thereby becoming available to STV only beginning January 23 or 24, 2007.

(2) The information upon which the amended additional contention is based is materially different from information previously available, in that (a) the FSP itself described the Army's plans for the Fracture Trace Analysis, Electronic Imaging Survey, Soil Verification, Sampling Well Placement, and Deer Sampling in only general terms and reported no results whatsoever from those activities, expressly leaving the detailed plans for and results of specific site characterization activities to subsequent addenda and reports, (b) in certain material respects expressly identified in the discussion of the amended additional contention, the specific methods and procedures described in the addenda and other documents implementing the FSP differ from those described in the FSP itself; and (c) the reports, addenda and other documents which have become available to STV after it filed Contention B-1 on May 31, 2006, include data discussed in the amended additonal contention B-2 relevant to JPG site characterization which were not previously available.

(3) The amended additional contention has been submitted in a timely fashion based on the availability of the subsequent information because (a) the information only became available after

STV submitted its original contentions in final form on May 31, 2006; (b) there was no realistic basis or opportunity for STV to submit the additional contention prior to the prehearing conference conducted on July 19, 2006, because most of the underlying information was unavailable prior to that time and the limited information which was available at that time was insufficient by itself to frame the additional contention, (c) from July 19, 2006, through November 9, 2006, the parties were engaged in active settlement discussions, during the pendency of which STV's obligation to file any amended or new contention(s) had been suspended by the Board's Memorandum and Order of July 26, 2006, (d) from November 9, 2006, through December 20, 2006, the parties were awaiting a determination from the Board as to whether they would continue their settlement negotiations with additional direction from the Board (as requested by STV) or proceed to hearing on one, some or all of STV's original contentions and supporting bases; (e) during the period between July 19 and December 20, 2006, STV seasonably notified the Board and the parties of all the critical documents which contain the subsequent information on which it now relies for its new contention, (f) based on the new information then available, STV filed its additional contention and supporting bases on January 19, 2007, which is within thirty (30) days of the Board's Memorandum and Order of December 20, 2006, notwithstanding the intervening holiday period, and (g) based on the additional new information made available since January 19, 2007, STV is filings its amended additional contention and supporting bases on February 23, 2007, the date specified in the Board's Order Scheduling Further Proceedings of January 29, 2007.

C. 10 C.F.R. § 2.309(c)(1) Requirements

As explained above, STV contends that its additional contention is timely filed under 10 C.F.R. § 2.309(f)(2). However, in the event that the Board should conclude that STV's new contention has not been submitted in a timely fashion under that rule, STV submits that it should nonetheless be admitted as a late-filed contention under 10 C.F.R. § 2.309(c)(1). In support of this alternative basis for admitting its new contention, STV would request the Board to determine that balancing the relevant factors under the applicable rule leads inescapably to the conclusion that the contention should be admitted for hearing:

This conclusion rests on the following considerations:

(1) Good cause exists for any failure by STV to file on time. By any reading of the Board's Memorandum and Order of July 26, 2007, STV's obligation to file any new contention based on the additional information cited in this motion was suspended at least through November 9, 2006, when the parties filed their Joint Status Report with the Board reporting the existence of an impasse in their settlement negotiations. However, the parties differed in the means they preferred the Board to adopt to address the impasse, with STV expressly requesting the Board to continue the settlement discussions but to provide additional direction to the parties regarding the scope of the issues to be addressed in those dicussions. It was therefore reasonable for STV to await the Board's Memorandum and Order of December 20, 2006, prior to devoting its limited resources to framing and filing its additional contention on January 19, 2007. Moreover, STV is filing its amended additional contention at the time specified in the Board's January 29, 2007 Order Scheduling Additional Proceedings.

(2) STV has already been determined to have the necessary standing to be a party to this proceeding as an appropriate representative of its numerous members who live and work in the immediate vicinity of JPG and its several members who reside in very close proximity to the site.

(3) The nature and extent of STV's interest in the proceeding on behalf of its members is

associated with the public health and the environment and is very strong, as evidenced by its non-profit status, its support within the local community, and its extensive involvement not only in this proceeding, but in several prior proceedings preceding this one as well as the JPG RAB, in which it has aggressively and effectively asserted the need for adequatge characterization of the JPG DU site..

(4) An order refusing to admit the contention on the basis of it being technically untimely would severely impair STV's ability to contest the adequacy of the FSP as implemented, thereby negatively affecting its long-time, actively and effectively expressed interest in adequate characterization of the JPG DU site.

(5) The only means available to vindicate its interest in the adequacy of the FSP as implemented is this proceeding.

(6) STV's interest regarding the adequacy of the FSP as implemented is clearly adverse to that of the Army. There is no other intervener in the proceeding to vindicate STV's interest, and the Staff's position on the adequacy of the FSP and its implementation is clearly not the same as STV's notwithstanding certain potential points of agreement.

(7) The extent to which admission of the additional STV contention and supporting bases will broaden the issues or delay the proceeding would be warranted by the Board's required separate finding that they are admissible on all grounds other than timeliness. Moreover, the additional contention and supporting bases do not broaden the issues beyond the core hydrogeology and biology sampling, data evaluation, and conceptual site modeling concerns which STV has advanced from the outset of its participation in this and prior JPG proceedings.

(8) The Board determined in its July 26, 2006 Memorandum and Order that the technical

expertise and community interests which STV brought to this proceeding suggested that it could make a contribution to JPG site characterization which warranted serious consideration by the Army and the Staff through negotiations. With the case now set for hearing, the Board should give the same serious consideration to the contribution which STV's expertise and perspective with respect to FSP implementation would add to the record on which the Board will base its decision.

V. Conclusion

For the foregoing reasons, STV respectfully requests that the Board admit for hearing its amended additional Contention B-2 and its supporting Bases a through g, as well as grant it all other relief just and proper under the circumstances.

Respectfully submitted,

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket No. 40-8838-MLA
U.S.ARMY	)	ASLBP No. 00-776-04-MLA
(Jefferson Proving Ground Site)	)	February 23, 2007

ADDITIONAL DISCLOSURES OF SAVE THE VALLEY, INC.

Pursuant to 10 C.F.R. § 2.336(b) and the Board's Order of January 16, 2007, granting the parties' joint unopposed motion regarding mandatory disclosures ("January 16 Order"), Intervener Save the Valley, Inc. ("STV"), by counsel, respectfully supplements its mandatory disclosures made on January 24, 2007, as follows:

1. Additional documents and data compilations in the possession, custody, or control of STV which are relevant to the contentions and bases admitted or proposed for hearing but for which no claim of privilege or protected status is made, electronic copies of which are publicly available at the listed URLs:

a. Ray Sheldon, *Jefferson Proving Ground Karst Study*, 1993 through 1997, available at: http://www.jpgbrac.com/documents/admin_record/site%20identification%20characterization/jpg%20karst%20study.pdf.

b. Big Oaks National Wildlife Refuge Weather Station, Precicipitation Data for January 28, 2006, available at: http://raws.wrh.noaa.gov/cgi-bin/roman/meso_base_past.cgi?stn=BIGI3&unit=0&time=LOCAL&day1=28&month1=01&year1=2006&hour1=0.

c. John T.Wilson, *et al.*, *An Evaluation of Borehole Flowmeters Used to Measure Horizontal Ground-Water Flow in Limestones of Indiana, Kentucky, and Tennessee, 1999*, United States Geological Survey: Water-Resources Investigations Report 01-4139 (2001), available at: http://in.water.usgs.gov/newreports/borehole_flowmeter.pdf.

d. Dennis W. Risser, *et al.*, *Estimates of Ground-Water Recharge Based on Streamflow-Hydrograph Methods: Pennsylvania*, United States Geological Survey: Open-File Report 2005-1333 (2005), 30 pp, available at: http://pubs.usgs.gov/of/2005/1333/ofr2005-1333.pdf.

e. NUREG-1576, MARLAP, Volume III, available on ADAMS as ML042320083.

f. NUREG-1576, MARLAP, Volume II, available on ADAMS as ML060930657.

g. United Nations Environment Programme, Depleted Uranium in Bosnia and Herzegovina, Post-Conflict Environmental Assessment, March 2003, available at http://www.world-nuclear.org/ reference/pdf/unep_du.pdf.

h. Thorsten Warneke, High-Precision Isotope Ratio Measurements of Uranium and Plutonium in the Environment, University of Southampton: Ph.D. Thesis, January 2002, 186 pp, available at: http://eprints.soton.ac.uk/42026/01/PhD_warneke.pdf.

i. Laura K. Rademacher, *et* al., *Experimentally Determined Uranium Isotope Fractionation During Reduction of Hexavalent U by Bacteria and Zero Valent Iron*, Environ. Sci. Technol. (2006), available at: http://pubs.acs.org/cgi-bin/article.cgi/esthag/2006/40/i22/pdf/ es0604360.pdf.

j. Michael H. Ebinger & Wayne R. Hansen, Jefferson Proving Ground Data Summary and Risk Assessment, Environmental Science Group, Los Alamos National Laboratory, February

1996, available at http://www.jpgbrac.com/documents/admin_record/ site%20identification%20 characterization/jpg%20data%20summary%20and%20risk%20assessment.pdf

k. S.R.N. Chenery, *et al.*, *Uranium Anomalies Identified Using G-BASE Data - Natural or Anthropogenic? A Uranium Isotope Pilot Study*, British Geological Survey: Internal Report IR/02/001 (2002), available at: http://www.wise-uranium.org/pdf/ir02_001.pdf.

STV notes that pursuant to the Board's January 16 Order, there is no obligation on its part to disclose or produce: (a) documents on ADAMS which have been served in the current proceeding or the prior JPG decommissioning proceedings initiated on petition by STV; (b) media clippings, recordings, or videos; (c) duplicate copies of documents which are identical in content and annotation but are in the hands of multiple recipients; or (d) incomplete documents and data sets that were never distributed to or reviewed by anyone other than their author(s) and never included in or with a memorandum to a case or project file.

2. Additional books and treatises copies of which are in the possession, custody or control of STV which are relevant to the contentions and bases admitted or proposed for hearing but for which no claim of privilege or protected status is made:

a. Donald Langmuir, Aqueous Environmental Geochemistry, Prentice-Hall, Englewood Cliffs, NJ (1997). This is a copyrighted textbook in common usage which is publicly and readily available. *See, e.g.,*

http://www.amazon.com/Aqueous-Environmental-Geochemistry-Donald-Langmuir/ dp/0023674121/sr=1-6/qid=1172179776/ref=sr_1_6/103-9208863-0937432?ie=UTF8&s=books.

Respectfully submitted,

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CERTIFICATION

The undersigned hereby certifies, under the penalties of perjury, that to the best of his knowledge, information, and belief the foregoing additional disclosures are accurate and complete as of this date.

Michael A. Mullett

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket No. 40-8838-MLA
U.S.ARMY	)	ASLBP No. 00-776-04-MLA
(Jefferson Proving Ground Site)	)	February 23, 2007

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing "Amended Motion of Save the Valley, Inc. to Admit for Hearing Additional Contention B-2 and Supportng Bases A through G" and "Additional Disclosures of Save the Valley, Inc." have been served this 23rd day of February, 2007, upon the following persons by electronic mail and by U.S. Mail, first class postage prepaid.

Administrative Judge Alan S. Rosenthal
Chair, Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Mail Stop: T-3-F-23
Washington, D.C. 20555-0001

Administrative Judge Paul B. Abramson
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Mail Stop: T-3-F-23
Washington, D.C. 20555

Administrative Judge Richard F. Cole
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
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Adjudicatory File
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U.S. Nuclear Regulatory Commission
Mail Stop: T-3-F-23
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U.S. Nuclear Regulatory Commission
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February 23, 2007

Secretary
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
ATTN: Rulemakings and Adjudications Staff

Re: Motion of Save the Valley, Inc. to Admit for Hearing Amended Additional Contention B-2 and Supporting Bases A through G and Additional Disclosures of Save the Valley, Inc.

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

Dear Secretary:

Enclosed please find for filing in the above-referenced docket the original and two conformed copies of Motion of Save the Valley, Inc. to Admit for Hearing Amended Additional Contention B-2 and Supporting Bases A through G and Additional Disclosures of Save the Valley, Inc., with the related Certificate of Service.

Thank you for your assistance in this matter.

Respectfully submitted,

Michael A. Mullett
Attorney for Save the Valley, Inc.

cc: Service List – Docket No. 40-8838, ASLBP 00-776-04