March 10, 2011

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SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION STAFF REVIEW OF U.S. ARMY RESPONSES TO STAFF CONCERNS ON SITE-SPECIFIC PARTITION COEFFICIENTS FOR THE JEFFERSON PROVING GROUND (NRC LICENSE SUB-1435)

Dear Dr. Goldblum:

In a letter dated January 14, 2011, Science Applications International Corporation (SAIC), on behalf of the U.S. Army, provided responses to concerns raised by U.S. Nuclear Regulatory Commission (NRC) staff regarding the site-specific partition coefficient study being conducted in support of the decommissioning of the Jefferson Proving Ground (JPG). The letter (Agency-wide Documents Management and Access System Accession # ML110190306) summarized the three concerns raised by NRC staff during teleconferences held on January 21 and 25, 2010. The concerns cited in SAIC's letter and our responses to SAIC's information is summarized below.

Concern No. 1

Representativeness of rainwater to be used in the partition coefficient (K_d) study for subsurface soil samples (below 1 or 2 feet) as differences are expected in pH and alkalinity levels in rainwater at or near ground surface verses rainwater that has mixed with subsurface minerals with depth over time.

NRC Comments on SAIC Response

To evaluate whether rainwater mixed with site soil samples provides a good representation of site groundwater, the alkalinity and pH of mixtures of rainwater and site soil samples were measured. The measured alkalinity values, ranging from 1.15 to 50 milligrams per liter (mg/L) as $CaCO_3$, with one 150.25 mg/L at $CaCO_3$ (JPG January 14, 2011 letter Table 2), were not in agreement with the measured alkalinity of groundwater samples, which had average alkalinity values of 341.5, 297.1, and 330.5 mg/L as $CaCO_3$ in the overburden, shallow bedrock, and deep bedrock, respectively (JPG January 14, 2011 letter, Table 3). This difference in alkalinity is expected to have a significant effect on uranium mobility in the environment because of the sensitivity of uranium mobility to the concentration of carbonate species. The significantly greater alkalinity of the groundwater would be expected to enhance the amount of dissolved uranium in the environment as compared to the distribution ratio (R_d) sample measurements. That is, the R_d tests using rainwater would be expected to underestimate uranium mobility in the subsurface (i.e., below 1 to 2 feet).

The licensee addressed this difference in alkalinity values in a January 14, 2011, letter by hypothesizing that the alkalinity in the soil mixtures, which was measured for 48 hours, would continue to rise due to contact with the soil during the planned 45 day R_d test.

NRC staff has concerns with this explanation for three reasons. The first is that alkalinity appeared to increase in only approximately half of the soil and water mixtures (JPG January 14, 2011 letter, Figure 1). The second reason is that there is no basis for assuming that the alkalinity would continue to increase for weeks in mixtures in which it was observed to increase for 48 hours. The third reason is that, even if the alkalinity in all of the samples did increase for the duration of the R_d test, there is no basis for assuming that samples with alkalinity that slowly approached the values of site groundwater would be represent the behavior of uranium in groundwater that had a greater alkalinity value for the entire 45 day R_d test.

Furthermore, the pH of rainwater samples does not appear to be representative of the pH of groundwater at the site. Table 4 and Figure 2 of the January 14, 2011, letter indicate the pH of rainwater mixed with soil samples from the site reach steady state rapidly and do not change significantly within 48 hours of mixing. However, the letter does not compare the pH results to the pH of groundwater samples from the site. The pH values of rainwater appear to be significantly less (mean of 6.2) than the pH values of site groundwater samples collected during the April 2008 sampling event (mean of 7.6) (JPG, 2008). Whether this pH difference significantly affects the chemical speciation and mobility of uranium in site soils depends on several factors, including sample alkalinity and total dissolved uranium (see, e.g., NUREG/CR-6708). In general, higher pH samples are more likely to be dominated by anionic uranium carbonate complexes that would be expected to be more mobile in soil than neutral or cationic species that would have greater concentrations at lower pH.

Based on the concerns described above, we suggest that JPG collect representative groundwater samples with which to conduct the R_d tests for subsurface samples. If collecting representative groundwater samples is not possible, JPG may attempt to create synthetic groundwater samples by pre-equilibrating rainwater with soil samples until the alkalinity reaches values representative of site groundwater; however, it is not clear whether the mixtures will eventually reach representative alkalinity values. If pre-equilibration is used, sample pH should be adjusted to be more representative of site groundwater. Alternatively, JPG could perform experiments or chemical modeling to demonstrate that the difference in pH between rainwater and site groundwater samples will not significantly affect uranium speciation and mobility.

Concern No. 2

Potential degradation that occurred since the time when the first 24 soil samples for the K_d study were collected in October 2008 with potential variation occurring in pH, organic carbon, or total organic carbon.

NRC Comments on SAIC Response

To address the NRC concern that soil characteristics may have changed during approximately 2 years of storage at ambient temperatures, JPG measured certain characteristics of 6 of the 32 soil samples and compared these measurements to comparable measurements performed in 2008. The mean total organic carbon (TOC) in samples appears to have increased by approximately 70% from 10,100 milligrams per kilogram (mg/Kg) to 17,268 mg/kg. This

increase could be indicative of bacterial growth. Irrespective of the cause, the significant increase in TOC could affect radionuclide sorption to the soil samples by increasing the concentration of sorption sites in the soil samples.

In addition, the soil pH appears to have decreased, on average, by approximately 0.9 pH units during storage. Whether this pH difference significantly affects the chemical speciation and mobility of uranium in site soils depends on several factors, including sample alkalinity and total dissolved uranium (see, e.g., NUREG/CR-6708).

Based on the concerns described above, we suggest that JPG collect samples from a subset of the locations sampled in 2008 (e.g., approximately 10%) and perform adsorption and desorption tests to demonstrate whether the samples collected in 2011 yield similar results to the samples collected in 2008.

Concern No. 3

Potential losses of uranium adhering to filter container walls during the K_d study

NRC Comments on SAIC Response

The JPG response appears to be reasonable.

In addition, the NRC staff has the following observations regarding the SAIC information:

1) In a July 23, 2009 letter, JPG indicated that information from desorption testing will primarily be used in evaluating the amount of DU near the source location that is available to dissolve or desorb into groundwater. JPG also indicated that values associated with adsorption testing will be used to model uranium transport through clean soil. The licensee has indicated that it plans to use TestAmerica's standard operating procedure for Kd studies, which is based on the withdrawn American Society for Testing and Materials (ASTM) test D4319-93. ASTM D4319-93 indicates that it applies only to situations in which only sorptive processes (adsorption and ion exchange) are operable for the species of interest. Thus, the use of the term "K_d" may be misleading when applied to the results of the desorption tests, which are expected to involve dissolution. The NRC staff agrees that useful information may be obtained by observing the release of uranium from contaminated soil samples, and that transport through clean soil should be based on the results of adsorption, rather than desorption, tests. However, the NRC staff does not expect that the desorption tests will be interpreted to represent uranium mobility in site soils. The NRC staff recommends that the licensee report solid and liquid concentrations measured during "desorption" tests without representing the ratio as a "K_d" value.

2) Page 2 refers to the "previously documented testing limits" or 160 picocuries per gram (pCi/g). This value is discussed in the licensee's November 6, 2008, letter. As indicated in that letter, the basis of this value is from experiments performed with samples from the Hanford site in Richland, Washington. Any applicability of this value to samples from JPG would need to be demonstrated by the licensee. The NRC staff recommends that geochemical modeling, which the licensee indicates it plans to use, may be used in

conjunction with site observations as support for solubility limits applicable to various site conditions at the JPG site.

3) On page 2, it is unclear what is meant by "solubility limits that may be ascertained as a boundary between adsorption/desorption." Specifically, it is unclear what is meant by solubility forming a "boundary" between adsorption and desorption.

4) Page 3 indicates alkalinity was measured in mixtures of soil and water using Environmental Protection Agency drinking water method E310.1. The EPA method indicates that the sample should be refrigerated at 4 °C before use in a closed container with a minimum amount of air trapped in the container. These precautions minimize the equilibration of the alkalinity in the sample with atmospheric carbon dioxide. Indicate whether these aspects of the test procedure were followed.

Based on the discussion above, we suggest that you modify your approach to developing the Kd values for the JPG site to address these concerns.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

If you have any questions, please contact me at Dominick.Orlando@nrc.gov or 301-415-6749.

Sincerely,

/RA/

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License No. SUB-1435
Docket No. 040-08838

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If you have any questions, please contact me at Dominick.Orlando@nrc.gov or 301-415-6749.

Sincerely,

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