May 20, 2004

Colonel Mike G. Mullins
Office of the Commander
Department of the Army
1 Rock Island Arsenal
Rock Island, IL 61299-5000

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION TO SUPPORT NRC'S EVALUATION OF THE PROPOSED CHANGES TO THE ENVIRONMENTAL RADIATION MONITORING PROGRAM PLAN FOR JEFFERSON PROVING GROUND (LICENSE SUB-1435)

Dear Colonel Mullins:

The NRC staff has completed an evaluation of the Army's proposed Environmental Radiation Monitoring (ERM) Program Plan for Jefferson Proving Ground. As part of this evaluation, the staff reviewed the available information in the NRC files, technical publications relevant to the monitoring of depleted uranium (DU), and the references submitted along with the ERM Program Plan. To support the evaluation of the ERM Program Plan, the staff hereby requests additional information on a variety of issues (enclosed). We would appreciate your response within 90 days of the receipt of this letter. After you have had a chance to review the requests for additional information, we are available to meet with you to discuss the requests in detail. In addition, the staff has discussed the groundwater action level proposed in Section 3.3.1.2 of the ERM with the Army and the Army has indicated that the action level for DU in groundwater in the impact area should be changed. Please include this modification to the action level with your response to the requests for additional information.

If you have any questions, I can be reached at (301) 415-5869.

Sincerely

/RA/

Tom McLaughlin, Project Manager
Materials Decommissioning Branch
Division of Waste Management and
Environmental Protection
Office of Nuclear Material Safety
and Safeguards

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

Enclosure: As stated

cc: JPG Distribution List

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REQUEST FOR ADDITIONAL INFORMATION TO SUPPORT NRC'S EVALUATION OF THE PROPOSED CHANGES TO THE ENVIRONMENTAL RADIATION MONITORING PROGRAM PLAN FOR JEFFERSON PROVING GROUND

QUESTION 1:

The Army should provide additional information on the conceptualized site model that was originally used to locate the sampling points for groundwater, surface water and stream sediments. The conceptual model of the hydrogeologic system for the DU Impact Area should include all potential water-bearing units, surface water systems, caves, springs, and the unsaturated zone that may be impacted by the degradation and movement of the DU penetrators. The Army should provide information on the interrelationship between DU concentrations in the groundwater, surface water, caves, springs and stream sediments.

BASIS:

The Army submitted references and other reports on Jefferson Proving Ground (JPG) as part of its submission of proposed changes to the Environmental Radiation Monitoring Program Plan (ERM). The Training Range Site Characterization and Risk Screening Regional Range Study, Jefferson Proving Ground, Madison, Indiana, August 2003, prepared by the United States Army Center for Health Promotion and Preventative Medicine (USACHPPM), states: "The question posed is whether the conceptualized site model that was used to locate the monitoring wells in the first place is correct." The JPG Karst Study (R. Sheldon, 1997) describes the investigation of numerous caves and other Karst features at JPG. An understanding of the interrelationships between unsaturated flow, groundwater, surface water, caves and springs that impact the fate and transport of the DU from degrading penetrators is critical in the design of the monitoring system.

REFERENCES:

United States Army Center for Health Promotion and Preventative Medicine (USACHPPM). 2003. *The Training Range Site Characterization and Risk Screening Regional Range Study, Jefferson Proving Ground, Madison, Indiana*. August 2003.

U.S. Department of Army Soldier and Biological Chemical Command. 2003. *Environmental Radiation Monitoring Program Plan for License SUB-1435, Jefferson Proving Ground*. Aberdeen Proving Ground, Maryland. September 2003.

R. Sheldon. 1997. *JPG Karst Study*.

QUESTION 2:

There appears to be conflicting information on the direction of groundwater flow. The Army should provide additional information on the adequacy of the placement (and screened interval), number, and spacing of the current 11 monitoring wells to detect depleted uranium (DU) in groundwater.

BASIS:

The Army submitted references and other reports on Jefferson Proving Ground (JPG) as part of its submission of proposed changes to the Environmental Radiation Monitoring Program Plan (ERM). The Training Range Site Characterization and Risk Screening Regional Range Study, Jefferson Proving Ground, Madison, Indiana, August 2003, prepared by the United States Army Center for Health Promotion and Preventative Medicine (USACHPPM), states: "The direction of ground-water flow in the glacial till is roughly the same as the surface water drainage, which is to the west-southwest over most of JPG." "Due to the size of JPG, the number of streams, the fact that some streams are incised, and because ground water in glacial till and shallow bedrock tend to discharge to surface drainages, there are probably multiple ground-water basins." "As shown on Figure 6-4, the estimated direction of ground-water flow is to the south." "As shown on Figure 6-6, the estimated direction of ground-water flow is to the southeast and the northwest." and "Monitoring wells near and within the Delta Impact Area south of Big Creek are too widely spaced to construct a meaningful ground-water elevation contour map."

In the ERM, the Army states: "To assess the groundwater conditions in and surrounding the DU Impact Area, a number of groundwater monitoring wells were installed and sampled over a substantial period at locations experts believed adequate for acquiring such information." "No one can ensure that groundwater monitoring systems in karst environments will not involve a contaminant 'end-running' a network." "It is well known that a complete deterministic description of the preferential pathways is not possible in karst/fractured environments." "The site is located in karst topography; therefore, the complex physics of flow and transport in fractured media apply. In these systems, the flow patterns may or may not match the directions typically inferred from the slopes indicated on groundwater table maps. Therefore, locating monitoring wells directly downgradient of a source area is complicated. In addition, migration of uranium in the subsurface is a complex biogeochemical reactive process."

REFERENCES:

United States Army Center for Health Promotion and Preventative Medicine (USACHPPM). 2003. *The Training Range Site Characterization and Risk Screening Regional Range Study, Jefferson Proving Ground, Madison, Indiana*. August 2003.

U.S. Department of Army Soldier and Biological Chemical Command. 2003. *Environmental Radiation Monitoring Program Plan for License SUB-1435, Jefferson Proving Ground*. Aberdeen Proving Ground, Maryland. September 2003.

QUESTION 3 :

The Army should provide additional information on the construction, development and maintenance of the current 11 monitoring wells.

BASIS:

Recent submittals by the Army have cast doubt on the viability of the existing monitoring wells to adequately measure DU in groundwater. The Range Study report (USACHPPM, 2003) states: “The seven existing wells incorporated into this range study were installed during the 1980's. Wells MW-1, MW-2, MW-5, and MW-6 were installed in 1983. These wells were constructed from PVC riser pipes and screens and were fitted with steel protective covers. Well caps and locks were missing from each well. The protective casing lids were also partially or completely open at each well allowing the introduction of vegetation and precipitation into the well pipes. Wells MW-9, MW-10, and MW-11 were installed in 1988. These wells were all flush mounted and only MW-10 was fitted with a well cap and lock. Wells MW-9 and MW-10 were not capped, making the introduction of vegetation, debris, precipitation, and surface runoff into the wells possible.”

The SEC Donahue Characterization Study (SEC, 1992) states: “An evaluation of the available well logs for the DU Area wells was performed. The logs were lacking in many aspects, thus a comprehensive evaluation of the data obtained from the wells was not possible. For instance, most of the well logs did not specify the depth of the first saturated zone, and those that did were not screened at the first water-producing interval. Two of the wells, DU-1 (sic) and DU-4 (sic), were screened at two separate intervals in the bedrock so that determination of which interval was actually sampled is not possible. It is generally deemed of upmost importance for site investigations to obtain groundwater samples from the water producing zone most likely to be contaminated, which is almost always the top one. The well construction diagrams and written descriptions of well construction were often contradictory, making it difficult to tell if the wells were constructed properly or if the appropriate water producing zone was sampled. The wells are too widely spaced across the area to interpret the potentiometric surface or identify the preferred flow paths.” In addition, there are numerous citations of the poor recharge rates for MW-6, MW-9, and MW-11, leading to no samples being taken for some studies. Because of the age and potential lack of maintenance on these wells, each monitoring well should be re-developed or replaced before any new monitoring is performed.

REFERENCES:

United States Army Center for Health Promotion and Preventative Medicine (USACHPPM). 2003. *The Training Range Site Characterization and Risk Screening Regional Range Study, Jefferson Proving Ground, Madison, Indiana*. August 2003.

U.S. Department of Army Soldier and Biological Chemical Command. 2003. *Environmental Radiation Monitoring Program Plan for License SUB-1435, Jefferson Proving Ground*. Aberdeen Proving Ground, Maryland. September 2003.

SEC Donahue. 1992. *Characterization Study*.

QUESTION 4:

The Army should provide additional information on the relationship between stream flow in Big and Middle Fork Creeks, and DU concentrations in surface water and stream sediments. The Army should describe how the DU concentration in the surface water and stream sediments vary during high, average and low stream flow conditions. The Army should also provide information on the relationship between groundwater elevations, stream flow, flows in caves and flows from springs. The Army should also state if its corrective measures first proposed in 1984, to be taken if the surface water action level is exceeded, are still current.

BASIS:

The DU concentrations in the surface water and sediments may vary depending on the flow rate in Big and Middle Fork Creeks. Without flow rate data for the streams, the current surface water and sediment data is of limited use. Relating the DU concentrations in surface water and sediments to stream flow will help in the construction of the site conceptual model (see QUESTION 1). Corrective measures if the action level is exceeded in groundwater were first proposed in 1984 (Abbott et al., 1984): "If DU migration is detected within the primary environmental impact area, specific control measures will be taken for isolation and removal with decontamination of the primary environmental impact area with monitoring and additional protective measures taken for the secondary environmental impact area." For surface water, the control measures listed are silt traps and settling basins.

REFERENCES:

Abbott, D., T. Gates, and A. Hale. 1984. *Review of the Environmental Quality Aspects of the TECOM DU Program at Jefferson Proving Ground, Indiana*. Miamisburg, OH, Monsanto Research Corporation.

QUESTION 5:

The Army should provide additional information on the rate of dissolution of the penetrators. The Army should also provide data on the solubility of DU.

BASIS:

The Decommissioning Plan submitted by the Army in 2002 stated that the rate of dissolution of the penetrators was unknown. However, in a report by the Royal Society in 2002, the authors state: “Much of our knowledge of the environmental behaviour of DU introduced into the environment comes from studies at sites where DU munitions were tested. For example, a series of experiments and geochemical modeling were used to determine corrosion rates, solubility and sorption (a generic term describing the chemical and physical binding of DU to soil components) of DU in soil at the Aberdeen Proving Ground in Maryland and the Yuma Proving Ground in Arizona. Results from these studies, and from studies performed in the UK at Kirkcudbright, indicate that corrosion rates are highly variable and that under conditions that favour corrosion a 1 cm diameter by 15 cm long penetrator (e.g. about the same size as that in a 30 mm round) would release approximately 90g of DU per year. For a larger projectile, such as a 120 mm round (3 cm by 32 cm penetrator), this equates to a release of approximately 500 g of DU per year. Based on these corrosion rates, the penetrators will only remain as metallic DU for between five and ten years.”

The concern is that since it has been roughly ten years since the last penetrator was fired into the DU Area a “slug” of DU has or will enter the environment and be transported into surface waters or groundwaters. The Royal Society report goes on to state: “Projections of exposure over the next 1000 years at these sites (*Jefferson Proving Ground*) (Ebinger et al, 1996; Ebinger and Oxenburg 1997) indicated a gradual decline of the importance of contaminated dust, and a gradual increase in groundwater contamination over the next 100 years, before reaching a steady concentration between 100 and 1000 years. Obviously such rates are extremely dependent on the exact mineralogy, local soil type and water conditions. The calculated level of risk was extremely sensitive to the solubility of the uranium and it was recommended by the authors that this parameter must not be overlooked when assessing potential risks associated with exposures to uranium or DU from the environment.”

REFERENCES:

The Royal Society. 2002. *The Health Hazards of Depleted Uranium Munitions Part II.*

QUESTION 6:

The Army should state if its corrective measures first proposed in 1984, to be taken if the groundwater action level is exceeded, are still current.

BASIS:

Corrective measures if the action level is exceeded in groundwater were first proposed in 1984 (Abbott et al, 1984): “If DU migration is detected within the primary environmental impact area, specific control measures will be taken for isolation and removal with decontamination of the primary environmental impact area with monitoring and additional protective measures taken for the secondary environmental impact area.” For groundwater, the control measures listed are a drawdown collection program, and a in-situ containment/treatment program.

REFERENCES:

Abbott, D., T. Gates, and A. Hale. 1984. *Review of the Environmental Quality Aspects of the TECOM DU Program at Jefferson Proving Ground, Indiana*. Miamisburg, OH, Monsanto Research Corporation.

QUESTION 7:

The Army should provide additional information on the apparent trend of increasing uranium concentration in deer kidneys and bone, and how this relates to the potential for DU in deer meat that is consumed by humans.

BASIS:

A detailed characterization survey was conducted for the Army in 1996 (Scientific Ecology Group, Inc., 1996). Deer showed a modest increase from background uranium concentrations in kidneys (from 0.05 to 0.151 pCi/g) and a larger increase from background in bone (from 0.0003 to 0.416 pCi/g). From the perspective of human health protection, the levels of uranium in deer remain low. However, it is not clear if the concentration of uranium in deer kidneys and bone will continue to increase and potentially be of concern to human health from the consumption of contaminated deer meat.

REFERENCES:

Scientific Ecology Group, Inc. 1996. *Jefferson Proving Ground Depleted Uranium Impact Area: Characterization Survey Report.* Volume 1, Revision 0. Oak Ridge, TN.

Abbott, D., T. Gates, and A. Hale. 1984. *Review of the Environmental Quality Aspects of the TECOM DU Program at Jefferson Proving Ground, Indiana*. Miamisburg, OH, Monsanto Research Corporation.