Michael Reimer
GeoMike5@att.net
July 24, 2017
RE: SUC 1593

Ms Amy Snyder, Senior Project Manager
Materials Decommissioning Branch (MDB)
Division of Decommissioning, Uranium Recovery, and Waste Programs (DUWP)
Office of Nuclear Material Safety and Safeguards (NMSS)
U.S. Nuclear Regulatory Commission (NRC)
Washington, D.C. 20555

Dear Ms Snyder,

Thank you for the e-mail of July 23, 2017 providing an update on the 2.206 petition review. I include here a brief addition to the petition that includes some newly found information on the use of DU and the sampling arguments.

Perhaps one of the strongest arguments against the suitability of using sediment samples for monitoring at Pohakuloa Training Area (PTA), Hawaii comes from the U.S. Army. The commentary, included in the Final Environmental Radiation Monitoring Plan (ERMP) of 3 February 2012, at ML 12064A506, clearly identifies the reason why sediment sampling should not be used.

"As discussed in Section 3.3.2.2, no surface streams, lakes or other bodies of water are within the boundaries of PTA; and no perennial streams are within 15 miles. Thus, no sedimentary material is available for sampling."

This is reiterated in section 5.1.4 and the statement cannot be more emphatic:

"Sediment samples will not be collected because there is no sediment present at PTA."

This was a time when air sampling was still considered. Originally, air sampling was the preferred method (ML100640108) but the face of logical criticism of proposed methods by NRC, the Army worked diligently to show that it was not needed. This effort to drop air monitoring came soon after the NRC comprehensively evaluated the proposed Army plan for sampling and found it highly deficient in justification (ML13259A081). Previous license managers at NRC, Mr. Orlando and Ms.Tadesse (see footnote 1) sent letters to the Army expressing staff review points about concerns for air sampling methods. (This is an online site: https://www.nrc.gov/docs/ML1402/ML14028A212.pdf).

Footnote 1) Ms Tadesse's comments on air sampling do not seem to be available at Adams (pdf display problem) but a brief review is available at http://www.dmzhawaii.org/dmz-legacy-site-two/?tag=nuclear-regulatory-commission It is the fourth article listed at this site, dated April 30, 2010. Quoting, "We have concluded that the Plan will provide inconclusive results for the U.S. Army as to the potential impact of the dispersal of depleted uranium (DU) while the Pohakuloa Training Area is being utilized for aerial bombardment or other training exercises."

The reason for the discussion of air monitoring issues at this point is that sediment can be transported and deposited by air transport. Think of sand dunes as an example.

The NRC expressed concerns over the air monitoring proposed plans in ERMP (ML12046A506), where the Army identifies methods how DU can become aerosolized and transported in section 3.3.5.1 but refers to the Department of Defense Directive (DoD) 4715.11 that prohibits the use of HE (high explosives) and general access to the Radiation Controlled Areas (RCA).

(https://biotech.law.lsu.edu/blaw/dodd/corres/pdf/d471511_051004/d471511p.pdf)

The claim is that this Directive would prevent the DU from aerosolizing because HE or personnel access to the RCAs is restricted and therefore does not present a health risk so air monitoring is not needed.

While oft cited as prohibiting the use of HE, the Directive really does not as it contains frequent loopholes for allowing the use of DU. The supposed prohibitions are introduced with phrases, such as 'when possible' and 'when practical', that allow exception to what is suggested to be an absolute prohibition (section 5.4.9.2 and 5.4.9.3). The Directive does not define DU as a hazardous material (section 5.4.10) but interestingly does include radium dials. Of course, exceptions are always allowable when "national security objectives" are invoked (section 5.4.9).

In ML 15161A459, Programmatic Approach for Preparation of Site-Specific Environmental Radiation Monitoring Programs, the Army gives 4 arguments why air monitoring is not necessary. Argument 2 against the use of air monitoring includes the statement:

"The Army notes that until 2011, when the NRC placed the restrictions on HE fire into M101 impact areas, the Army had no such restrictions on its HE fire."

That does not seem completely accurate. Of particular concern is Attachment 8.

"Attachment 8. Arguments against Air Sampling During HE Fire into RCAs
The Army requests the NRC not to require air sampling during Army use of high explosives (HE) in RCAs. We provide four mostly independent arguments supporting this request. (In preparing other documents, such as attachments 1, 4, and 7, the Army assumed that the NRC accepts this request and puts no restraints on Army use of HE in RCAs.)

There is a conundrum here. The oft cited DoD regulation 4715.11 is dated 2004. The Army seemingly clearly admits that HE fire continued at PTA RCAs. Now, the NRC has given permission to use HE fire into RCA areas by removal of the conditions in section 17 and 22 in ML16039A230. Therefore, it appears that HE fire has continued into the RCAs at Pohakuloa without stoppage ever since DU was initially used there.

If the Directive were paramount in limiting the use of the RCAs, only small arms fire could be used there and access would be aggressively curtailed. A penultimate question to be asked is why has the U.S. Army included the use of HE fire from NRC, now without having to notify NRC beforehand, in its Radiation Safety Plan? The ultimate question is why has NRC given this *carte blanche* permission?

All four arguments against air sampling given by the Army in ML15161A459, Programmatic Approach for Preparation of Site-Specific Environmental Radiation Monitoring Programs are arguable. Calculations often use a dilution factor of time or space to illustrate that U concentrations are below International Agency guidelines. The analytical technique of alpha spectrometry has pitfalls (Fleischer, R.L., 2008, *Difficulties in using $^{234}U/^{238}U$ values to detect enriched or depleted uranium*, Health Physics, v. 94, p.292-293). The use of the activity ratio of 3 for $^{238}U/^{234}U$ must be considered only a rough guideline for the detection of DU particularly when considering the dilution factors. It is often problematic to use ^{234}U as a surrogate for ^{235}U. Any activity ratio greater than 1 with reasonable limits on uncertainty should be indicative of DU but I have no hope of changing the NRC perspective. A different and more specific analytical technique should be considered, such as ICP-MS that can also detect ^{235}U, ^{236}U and perhaps some transuranics, if present, that would be absolute confirmation of DU. Please note that the average uranium concentration of soils in the US may not apply to Hawaii as the uranium concentration of the oceanic basalts that make up most of the island have a low U concentration, perhaps 10 times less than the US average (Budahn, James R., 1979, *Geochemical study of Hawaiian basalts*, MS thesis, Oregon State University).

Of even greater concern is that the amount of DU present at PTA is likely greatly understated. The amount typically is estimated based on a probable number of spotting rounds used for practice. It is highly probable that not only were spotting rounds used but also dummy warheads constructed of DU. (See footnote 2).

Argument one in ML15161A459 contains the common false mantra of uranium being so dense that it cannot be carried far (19.1 gm/cm^3), over 60 percent denser than lead (11.3 gm/cm^3). Of course, the species of interest, those that are insoluble and

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Footnote 2) The production of the Davy Crockett weapon system included two types of warheads, the M-388 and M-390 the latter being a practice round weighing greater than 50 pounds. The rounds were fired using a piston assembly, the pistons of which were found in the vicinity of the RCAs at PTA. Website, http://hpschapters.org/northcarolina/spring2016/President-elect%20presentation%20Cherry.pdf a power point presentation, has pictures of the warheads and pistons. Apparently the spotting rounds did not use pistons for launching the rounds. No information could be found on what happened to the dummy warheads that were fired at PTA and specifically if they had a non-nuclear explosive charge. If they did, then it is possible thousands of pounds of DU fragments could be distributed at PTA. What appear to be parts of the dummy M-390 warheads are seen in photographs in ML092950352. The photo numbers and text do not always correspond. This use is lacking in discussion but is critical to determining the total DU at PTA, including having impacts on sediment and air sampling, and calculations derived therefrom. If the number of DU M-390 rounds approximated the claimed number of M-101 spotting rounds used, then there could be upwards of thousands of pounds or more DU at PTA.

in respirable form that can lodge in the lung and remain for decades, are uranium dioxide (10.97 gm/cm^3) and triuranium octaoxide (8.3 g/cm^3). Both are lighter than lead, the common element used in comparison.

The issue of whether or not DU moves by air transport off the RCAs has become a contentious issue. The Army position on the density issue cannot be supported when considering aerosol formation and transport. A second position, is that "IF" DU can move by an air transport vector, the bombing and HE fire at PTA over the years would have aerosolized all of the DU and so none is left. That latter position by the Army is nothing short of arrogance. DU spotting round fragments have been found at PTA. There is no question that uranium aerosols can move great distances. Occurrences have been observed. Colonie, New York and Fernald, Ohio are two areas of recorded observation where it has been detected up to 40 kilometers away from the source. If those sites are not sufficient, then consider Rocky Flats, Colorado, where plutonium, with a density greater than uranium (19.84 g/cm^3 vs 19.1 gm/cm^3), was released into the surrounding Denver suburbs, measurably carried over 40 km from the source. In short, the density argument has no merit.

An issue of importance is whether or not air or "sediment" sampling should occur at the RCAs during or immediately after live fire exercises. The Army does state that it will conduct air monitoring when an area of 25 m^2 is subject to erosion of 3.75 m^3 of material. From generic definitions, erosion is the detachment and movement of soil and rock fragments by external forces. Sediment means soil, rock, or organic material that is in suspension, is being transported, or has been removed from its site of origin by external forces such as air, water, gravity, ice, or even explosions and then deposited. HE causes movement (erosion) that can be of the magnitude of that described by the Army. The issue of live fire use with HE on the RCAs is pretty much confirmed through various documents discussed above.

The size of a crater formed by explosives is dependent on many factors such as intensity of explosive, air burst or ground penetration depth of the projectile, hardness of the impact site material and so forth. A description of crater size formation from different caliber artillery shells is provided at: www.winterwar.com/Weapons/artyinfo.htm

From the generic definition of erosion, the explosion causes redistribution of material, hence a form of erosion.

In calculation of a spherical cap shape for a crater, where the depth is only ½ the radius of the width, a 152 mm shell will displace over 7 m^3 of material. This is well in excess of the Army action level of 3.75m^3. Much more material can be displaced by the shock wave from the exploding shell. Therefore, air monitoring should take place when the RCAs at PTA are used in this manner. Even in the presence of unexploded ordinance, this sampling is possible. As an example, some of the training exercises at PTA include the use of drones. Drones could fly through the plumes and even collect sediment samples from the crater ejecta.

Another issue occasionally presented to justify that the dangerous oxide form of DU is not present in quantity at PTA is that no oxides of DU were found. On searching for spotting rounds, it is claimed that there were no yellow stains found on the ground cover and the fragments found did not have yellow oxidization product. The suggestion extends to the claim that uranium has not oxidized and so the most toxic form is not present. I don't know the original source of this myth. Uranium oxidizes almost immediately at STP with contact with oxygen in the air. The DU oxide flakes off from the metal or alloy because of their different crystalline structure and oxidization continues. DU oxide (UO_2) is nearly black. The yellow form is a different oxidation state often hydrated. The Army knows this. In fact, the Army radiation safety staff officer has a Power Point presentation on DU with an illustration showing different forms of uranium oxides and the color differences are prominent.

http://hpschapters.org/northcarolina/spring2016/President-elect%20presentation%20Cherry.pdf

The Army contractor in a technical report presents photographs that clearly show yellow coating on DU fragments at PTA. Another good figure showing colors of different oxides is at http://www.y12.doe.gov/sites/default/files/Uranium-color-circles.jpg

Of concern is the comment in ML15161A459, Attachment 8.

"Attachment 8. Arguments against Air Sampling During HE Fire into RCAs
The Army requests the NRC not to require air sampling during Army use of high explosives (HE) in RCAs. We provide four mostly independent arguments supporting this request. (In preparing other documents, such as attachments 1, 4, and 7, the Army assumed that the NRC accepts this request and puts no restraints on Army use of HE in RCAs.)"

Now with this permission granted and Directive 4715.11 ignored, HE use in the RCAs can continue. The Army assumption that NRC would grant the exemption, while being presumptuous, was correct.

I hope you find this information germane to the petition issues and will share this with the petition review panel.

Sincerely,

/s/

Michael Reimer, Ph.D.
Retired Geologist