**From:** Michael Reimer
**To:** Snyder, Amy
**Subject:** [External_Sender] note of Dr. Cherry"s comment and previous letter to Mr. McCree
**Date:** Tuesday, November 07, 2017 9:52:50 PM

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Michael Reimer
GeoMike5@att.net
October 16, 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:

This is a reply to ML 17290A309 regarding your communication and his reply on use of a publication to confirm air migration of DU and a copy of a letter to Mr. McCree that I did not see listed at Adams.

Uranium is a fascinating element that has received a tremendous amount of study largely brought about by its use as a weapon of war. That also contributes to public concern about its occurrence. It is radioactive and a heavy metal toxin. Yet, it is also ubiquitous in our surroundings and in our bodies. It is very practical in some applications, from artistic use to surpassing qualities of other metals in electronic components, the latter being a field of current study.

The primary use of the element continues to be an instrument of combat and that naturally continues the concern about its safety. That is human nature. Following that concern, there are the pros and cons, typically from the users come the no-problem statements and from the safety advocates come the expressions of increased health risks.

At this point, it will no doubt take a generation or two to discern the level of risk, at low concentrations, from exposure to uranium and in this current argument, what that exposure pathway may be. But if today's mission is to err on the side of abundant caution, then my petition claims must be considered in that light.

Often, to support a position, people quote published literature. How grandiose it is to be able to make that comment about peer-reviewed literature being the penultimate authority of correctness. Any scientist reviewing the pros and cons of an emerging issue with peer-reviewed literature can attest to the fact that it is highly likely both sides can be supported by inchoative publications.

I note such is the case here concerning the migration vector of depleted uranium (DU) in the natural environment that is subject to oxidation, corrosion, saltation, abrasion, grinding, and even blasting by proximal high explosions. I refer to the October 12, 2017 comment to Ms. Amy Snyder of the Nuclear Regulatory Commission (NRC) by Dr. Robert Cherry on behalf of the U.S. Army related to the migration vectors of DU at Pohakuloa Training Area (PTA) in Hawaii, and associated with the 2.206 petition submitted by Dr. Michael Reimer concerning the license SUC 1593 for DU possession.

Dr. Cherry (ML 17290A309) seemingly takes exception to the use of the publication by Lloyd et al. supporting the migration of DU by airborne mechanisms at Colonie, N.Y. as support for airborne migration at PTA.

"Some folks often bring up the Lloyd et al. paper on National Lead releases of DU in Colonie NY. However, they never mention other references. See the attached email thread and the attached ATSDR report on Colonie NY."

I know that you are aware in previous submissions to the NRC I have given other references confirming the air migration vector of DU so Dr. Cherry's concern does not apply here. However, his comment does merit a brief discussion.

Interestingly, there are quotes from the ATSDR report of 2004 to which he refers that clearly state:

"ATSDR reviewed the available scientific information about the health effects associated with both uranium and lead. Using this information and the data available for the Colonie Site, ATSDR concluded that the levels of DU from the NL plant could have increased the risk of certain health effects in the community surrounding the plant."

and,

"Although how much the risk was increased is unknown, ATSDR concludes that in the past, the uncharacterized emissions from the NL plant were a public health hazard to the community surrounding the Colonie Site. "

In fairness, the report later re-emphasizes that:

"... the extent to which these risks were increased is unknown."

However, risk was not an element of the 2.206 petition. The NRC may ask it to be recalculated from the suspected higher concentrations of DU at PTA than allowed by the license. There certainly seems to be no argument that there was airborne migration of DU for over 20 miles from the National Lead Plant at Colonie, NY.

As an example of a paper being relevant to both pro and con on the distance of airborne transport, I like to use the publication:

Mitsakou, Christina, Eleftheriadis, Konstantinos, Housiadas, C. and Lazaridis, M. (2003). Modeling of the Dispersion of depleted uranium aerosol. Health physics. 84. 538-44.

The conclusion of the paper states that airborne migration does not cover great distances. But when the graphs are viewed, detectable DU is found many miles downwind, albeit at a concentration perhaps 10 times lower than at the source. When the full paper is read, it is clear that airborne transport does occur for many miles downwind but naturally not at the concentrations per volume as nearer the source. When dispersed, the particulate and aerosolized DU oxides carried in this airborne manner are disseminated over a larger area and have a lower per area unit concentration. It is still transported. Again, the issue is migration, not concentration.

Perhaps some of the best references concerning airborne migration would be those that were pre-1990 before the DU issue became "political." I had previously referenced the study for DOE by Mishima et al., 1985, *Potential Behavior of Depleted Uranium Penetrators Under Shipping and Bulk Storage Accident Condition*, dealing with airborne transport associated with major accidents when transporting DU to waste depositories (http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/16/074/16074533.pdf). In short, airborne transport is a significant vector.

Of course, there is a way to categorize the relevance of airborne DU transport at PTA, and that is to monitor for it. This is not to characterize some or any concentration level but simply to discern if it migrates, which is the stated purpose of the Environmental Radiation Monitoring Plan for PTA (September, 2016). In Section 1.1, Purpose:

"In order to comply with the conditions of the license, this Site-Specific ERMP has been developed to identify potential routes for DU transport and describe the monitoring approach to detect any off-installation migration of DU remaining from the use of the Davy Crockett weapons system at Pohakuloa TA."

I provide here my earlier submission where I have mentioned additional references on airborne transport mechanisms. This was part of the letter I sent to Mr. McCree but may not have been included at Adams or in the group that the Petition Review Board listed in the preliminary decision. Perhaps the Petition Review Board should have a copy of this letter.

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April 14, 2017

The Honorable Victor M. McCree
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
e-mailed to attention of Renee Taylor, Administrative Assistant
Renee.Taylor@nrc.gov

Sir:

Thank you for your response through Ms. Snyder to my March 16, 2017 letter asking that the NRC reopen on its own initiative the final license agreement for the US Army possession of depleted uranium (SUC 1593).

My letter of March 16, 2017 was a bit more than a comment. It is a statement from a concerned citizen who believes that the conditions in the license as it relates to Hawaii, specifically the Pohakuloa Training Area (PTA) are woefully inadequate and based upon insufficient and incomplete information.

My intent was to provide the NRC a basis for reopening consideration of the license conditions. I trust that they will do so and on their own initiative. Rightly or wrongly,I sense some frustration on the part of the NRC with this license. It has been close to a decade from when the application was initiated. There have been several staff changes at NRC to handle this license and a cursory review will demonstrate that what was once a very strong radiation monitoring program and associated conditions, if correctly implemented, has been diluted and weakened to a point of worthlessness. I believe the NRC is aware of this but is so exasperated and weary that they now made a rush to closure. I do not want to believe the NRC review staff was so naïve as to not recognize the shortcomings.

For the most part, my career involved various components of nuclear sciences and I taught geologic material sampling procedures and protocols. It would be improper to sit idly by without comment and allow approval of a sampling plan that is so corrupted in procedure as to be totally meaningless. I would rather see the NRC take the initiative to make proper adjustments. The reason being, I am aware of the public distrust of government agencies and do not feel berating federal employees is a productive posture.

Hawaii is a special place with a delicate, fragile environment uniquely different than the other bases included in the license. There is a significant foundation of concern for the residents. The fear of many Island residents is genuine and should not be summarily dismissed with arrogant statements that they are ill-informed about radiation and its health effects. They share a special cultural bond to the land and have a great reverence for the history of the Hawaiian Kingdom. I have no political agenda but I do seek the truth and proper reasons for decision making. If I had been asked to independently review that section concerning Hawaii, I would have pointed out the same faults and deficiencies.

I am making no claim about the intention of the information you were provided and upon which you have relied to make your decision to include Hawaii in this license with a highly questionable ERMP. For the license, to define a single sampling site as a monitoring program is ludicrous. Blindly accepting comment that a sample site is suitable because it is downstream from the RCAs without analyzing flow patterns is wrong. Discarding airborne transport as a possible migration vector for DU is irrational.

Based upon Ms. Snyder's suggestions, please then consider the previous letter and this letter of clarification to be confirmation of a formal request to institute a proceeding pursuant to 10 CFR 2.202 for a 10 CFR 2.206 action to modify license SUC 1593, or for any other action as may be proper.

The decision to permit sub-minimal monitoring for DU in Hawaii was based on: inaccurate factual information; lack of detail in the ERMP, failure to apply or require use of proper and readily available models for surface water flow; failure to fully evaluate terrain conditions existing in the PTA areas of concern including historical lava flows; permitting improper methodology for sample collection; failure to consider usefulness of sample type for program objective; ignoring citizen concern without providing explanation for decisions; ignoring aerosol creation, generation and transport; lack of consideration of the oxide forms of DU; long-term residence of a respirable particle of DU in the lung; rejection of the claim by the U.S. EPA that states any excess exposure to radiation presents an increased health risk; not considering the special climate conditions of Hawaii.

What is mystifying is the 180 degree reversal from NRCs earlier recognition that aerosol sampling is critical. No rational explanation was given for this other than to gratuitously accept the Army claims. I shall state again, one sediment sample site collection a few times a year for a 133,000 acre site is worthless.

A remedy to these shortcomings is readily at hand. It only requires some scientific common sense and technical logic.

With this e-mail I include a discussion of the points that should be considered when determining whether to make a modification to the license.

Thanking you for your attention, I am

Sincerely yours,

/s/

Michael Reimer, Ph.D.
Retired geologist

# BEGIN COMMENTARY FOR REQUEST

Expanded commentary that forms the basis for my request.

The NRC issued a License (SUC-1953) to the U.S. Army for possession of DU at many military facilities in the U.S. Part of that license specifies that an Environmental Radiation Monitoring Plan (ERMP) for each site shall be prepared that includes monitoring for depleted uranium (DU). In that such requirement is included in the plan, it is not unreasonable to expect that there is some purpose for the inclusion, and that the plan should provide for reasonable and proper, useful and determinate monitoring of DU; and that the monitoring should not be just some token action to give the appearance of satisfying the requirement in the license.

Unfortunately, for Pohakuloa Training Area (PTA) in Hawaii, the monitoring actions proposed give just such an appearance of tokenism.

The license SUC-1593 allows monitoring at PTA to use one sampling site, for sediments, for the entire training facility. PTA includes 133,000 acres. Four areas have been designated as radiation controlled areas (RCA) where the use of Davy Crockett DU spotting rounds appear to have been most probable. The single sampling site is located approximately 8 miles west of the closest RCA. The RCAs are part of what had been and is currently used for training activities including the use of artillery shells and presumable other explosives as well as those defined as high explosive (HE).

The ERMP provides very little information about the procedures of the sample selection and collection but what it does provide shows that the ERMP for PTA is woefully inadequate. That was not always the case in the earlier discussion of a proposed plan. As recently as a few years ago, an NRC review to the U.S. Army discussed proper air monitoring techniques (1). There is no explanation as to why air monitoring, because it is the most probable DU transport vector to impact human health and safety, has been dropped to favor a single sediment analysis. One might try to use the fact that the Army had through a contractor conducted air analysis for uranium but it must be kept in mind that that previous air monitoring was not looking for DU. It did find some uranium but it is unknown if that is DU or natural uranium. In other words, a claim that all the uranium found was DU could not be disproven.

The use of a single site for sediment samples to show DU migration around PTA is highly dubious. First, there is no proof that the sediment collecting site has any connection with the RCAs, either observationally or theoretically. There are many computer modeling techniques available that analyze surface flow and they should have been used either by the Army to justify the collection site or by the NRC in its review (2). Second, even a cursory review of the geologic maps will show that there are historically recorded lava flows between the bulk of the RCAs and the sample site. These could easily act as berms and redirect the water flow. The fact that the sample site is at a lower altitude does not mean that water from the RCAs singularly will be intercepted at the selected sample site. The flow pattern must be elucidated, especially to determine how much dilution from other areas is possible. This dilution effect is important as a uranium isotope ratio is being used to define the presence of DU. Third, it has been noted that PTA receives modest precipitation and that the very porous nature of the surface cover causes it to infiltrate the surface almost immediately. It is enough to maintain high humidity in the soil and rock particle interstices but there are no permanent flowing streams at PTA. Therefore, sediment transport of surface materials is a rare occurrence. Thus, it is not known if the sample site is an active or occasional sediment accumulation area.

The little information given on the sampling procedure is highly questionable but greatly in contrast with normal sampling procedures. The Department of Energy (DOE) in the late 1970s and early 1980s ran the National Uranium Resource Evaluation program. It was designed to provide reconnaissance measurements for finding uranium resources and involved collection of hundreds of thousands of sediment samples from numerous environments (Hawaii was not included in this sampling program). Sampling techniques were developed and methodology is available from various archives at National Laboratories (4). Routine sampling programs are underway today by the U.S. EPA and the U.S. Geological Survey. Even those may be inadequate but provide an excellent starting point for sampling methodology especially for the newer analytical techniques available. From the ERMP comments, there is no justification for not collecting when the sample is wet, no reason for throwing away any liquid fraction, no reason for scraping away a surface fraction when it may be the "freshest" sediment deposition. Contamination, homogenization, cleaning of tools, pre-treatment of sampling vessels, duplicates, standards, and blanks are not detailed. There is a reference given alluding to the sampling methods but the reference given has nothing of substance (details) for sediment sampling.

Clearly, sediment sampling as proposed is inadequate. More detail must be provided so that its adequacy can be evaluated. At the very least, if only one sample site is considered adequate, then it should be at the very margin of an RCA, a site that has been observed to have water flow from inside the RCA from precipitation events and deposition of sediment from within the RCA.

An argument can be posited that the Plan adopted for PTA is not a monitoring plan at all but rather a terribly designed reconnaissance plan with one sampling site (somewhat of an oxymoron). There is no expressed confirmation that the site receives new sediments from the RCAs within a reasonable time frame. How often and how much sediment is brought to the site from the RCAs is unknown and no attempt to estimate it has been presented.

Direct measurement of DU within the RCAs is dangerous. Some fragments of the spotting rounds have been found but the coexistence with unexploded ordnance (UXO) makes ground surveying hazardous. Helicopter over flights with a low energy gamma ray detector did not discover any large fragments of DU (5). The Army did speculate that large fragments within the RCAs may not be present because of the nearly 60 years of training with artillery and other explosive delivery systems. That contention is not out of the realm of possibility and reinforces the need for a more relevant monitoring plan, that of air monitoring. Even if NRC decides to continue sediment "monitoring" from a single site, it is being improperly conducted and the site should at least be moved to be adjacent to an RCA on the down-flow side. In addition, proper sampling techniques should be used and ICP-MS and ICP-AES should be used for analysis because of their greater uranium isotope sensitivity along with the ability to analyze other elements and isotopes as presented.

Uranium metal oxidizes almost immediately when exposed to air. Unlike iron and iron oxidization, a protective coating does not form. Rather, the oxide coating continues to break and fracture and oxidation continues (6).

Uranium is also pyrophoric, meaning it can burn spontaneously. This is especially true for small particles. Large particles can heat up with oxidization but the mass of the metal itself can conduct away the heat preventing ignition.

There are three reasons to consider small DU particles as the favored monitoring species at PTA. The first is that this is likely to be the form of DU at PTA; second, this is likely the most probable transport form of DU; and third, this is the form, especially the oxidized less-soluble form, that if inhaled would be the likely source of health risks.

Often heard is a comment that because uranium is so heavy, it cannot move very far and likely would not be found beyond the boundaries of the RCAs, let alone the entire PTA. Politely, that comment is not entirely accurate, when considering the small particles now believed to exist at PTA, especially the aerosol form. An aerosol tutorial should not be needed here. Suffice it to say that the U.S. EPA categorizes particles in a PM 10 and PM 2.5 classes (numbers represent micrometers in size) and they are respirable sizes. DU particle production from the use of DU munitions include this range and smaller (ref. 7: See page 63).

The blast from an exploding artillery shell produces concussion and heat that is sufficient to not only create and ignite aerosols from larger fragments but to lift them into the atmosphere in a temperature-driven plume so that they can be transported by atmospheric winds. Aerosol particles can adhere to other grains. The energy of attachment is in the range of electron volts. An explosion of about a kilogram of TNT generates 2.6 X 10E19 electron volts (4.2 X 10E6 joules) (8). This is more than adequate energy to resuspend the attached aerosols. In fact, energy generated by walking over the surface or even the energy generated by saltation of grains (wind-blown movement of soil or sand grains) is sufficient to resuspend attached aerosols.

Particulate matter is known to travel great distances. Sand from the Gobi desert is transported to the continental US and particles from the Sahara are transported to the Caribbean (9). DU was found over 25 miles from a DU manufacturing plant in Colonie, New York (10).

Given the probable creation and release mechanisms present at PTA and the artillery created plumes and the winds of the PTA area, it is highly probable that DU aerosols are distributed widely over the County of Hawaii. Proper monitoring and reconnaissance sampling will need to be conducted to determine the extent.

In order to address the most probable transport mechanism of DU from the RCAs, a monitoring system should be established that includes air sampling. Soil and plant material should also be included in the Plan. Collection should be continual but at a minimum must include times of high winds, training activities, and wildfires. The fact that a wild fire is not on an RCA should not negate the sampling requirement. DU aerosols may have been transported to any area during wind or training times and could be present in the burn area. Any time an individual enters an RCA, they should be wearing a personnel air monitoring device. Any helicopter (or drone) making an over flight of the RCA with rotor wash generating dust should be equipped with an air monitoring device. Protocols given by the NRC in (reference 1) should be followed and enhanced. Analysis should include molybdenum (that was alloyed with DU), and U-236 should be sought. Both those species could serve as surrogate indicators for DU.

Headquarters and barracks for PTA as well as civilian facilities of a Girl Scout Camp and the Mauna Kea County Park are within a few miles of the RCAs. These frequented sites should be monitored. Soldiers and civilians are routinely in harm's way. A frequent comment is that only the toxicity of DU is of concern, not the radiation. This is not the case for the DU at PTA where it is the inhalation and radiation-induced mutations that are likely to produce the greatest risk from DU exposure. The particle size is right for airborne transport, it includes the respirable size range, and it is the oxide form that has the greatest retention time (class Y) in the lung. Therefore, any calculation to a mythical individual for whole body exposure is tenuous. While such does show increased exposure to radiation for which some elevated risk can be derived, it is the lung exposed to alpha-particle and low-energy beta ionizing radiation that is the organ at risk. In fact, it is just the few cells around a DU particle that are susceptible to initiation and promotion of cancer.

An excellent study to read is: Potential Behavior of Depleted Uranium Penetrators Under Shipping and Bulk Storage Accident Conditions by Mishima and others, 1985, (http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/16/074/16074533.pdf)

It was prepared in 1985 by a DOE contractor Battelle at Pacific Northwest Laboratory for the U.S. Army and that is before DU has become a political issue. It covers many issues presented here concerning the fate and transport of DU, including discussion of the plume effect for transporting DU aerosols.

One of the important elements of that report is the dose determination of the lung caused by inhalation of DU particulates of long residence time (class Y). The above mentioned report calculates that inhalation of particulate matter can provide a dose commitment over a year of 489 mrem (reasonably rounded to 0.5 rem) and over a 50-year span of 1001 mrem, considering the lifetime of cells. Although calculated for the whole lung, it is just the cells surrounding the DU particulate and within range of the alpha and beta ionizing energy that receive the dose.

This ERMP would have been greatly improved if it had been run for review and comment through the stakeholders, in addition to the NRC. They are many including the concerned citizens, the State and County of Hawaii, the U.S. Army and its contractors, the U.S. EPA, the Girl Scouts, the employees and soldiers at PTA, the users of the Mauna Kea County Park, the hunters at PTA, and so forth.

## The Larger Picture

It is important to understand all the features of an issue when making judgments or determinations. While I recognize that such a claim may not be important to the NRC when dealing with the provisions of a materials possession license, I also recognize that Hawaii is a special place with a delicate, fragile environment uniquely different than the other bases included in the license and an enduring culture that must not be ignored. There is a significant foundation of concerned residents as I am sure you are aware from the multitude of correspondence you have received from some of them.
Personally, I have no political agenda but I do seek the truth and proper reasons for decision making. If you had asked me to independently review that section concerning Hawaii, I would have pointed out the same faults and deficiencies.

As stated in the cover letter, the decision to permit sub-minimal monitoring for DU in Hawaii was based on: inaccurate factual information; lack of detail in the ERMP, failure to apply or require use of proper and readily available models for surface water flow; failure to fully evaluate terrain conditions existing in the PTA areas of concern including historical lava flows; permitting improper methodology for sample collection; failure to consider usefulness of sample type for program objective; ignoring citizen concern without providing explanation for decisions; ignoring aerosol creation, generation and transport; lack of consideration of the oxide forms of DU; long-term residence of a respirable particle of DU in the lung; rejection of the claim by the U.S. EPA that states any excess exposure to radiation presents an increased health risk; ignoring the special climate conditions of Hawaii.

I have presented the NRC a basis for reopening consideration of the license conditions. I trust that they will consider this opportunity and do so and on their own initiative. Rightly or wrongly, I sense some frustration on the part of the NRC with this license. It has been close to a decade from when the application was initiated. There have been several staff changes at NRC to handle this license and a cursory review will demonstrate that what was once a very strong radiation monitoring program and associated conditions, if correctly implemented, has been diluted and weakened to a point of worthlessness. I believe the NRC is aware of this but is so exasperated and weary that they now made a rush to closure. I do not want to believe the NRC review staff was so naïve as to not recognize the shortcomings.

A remedy to these shortcomings is readily at hand. It only requires some scientific common sense, caring, and technical logic. No new wheel needs to be created and no one is placed in harm's way. Modification of the license to make monitoring useful and revealing can be an all-round winning approach.

## References


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