REQUEST FOR HEARING AND PETITION FOR LEAVE TO INTERVENE
re. license amendment and issuance for
Source Materials License No. SUC-1593, Amendment 2, Davy Crockett Depleted Uranium
at Various United States Army Installations
as described in the Federal Register, February 9, 2017, p. 10031

(1) PETITIONER

Cory (Martha) Harden, 874 Kulaloa Road, Hilo, Hawai'i 96720 808-959-7747

(2) RIGHT TO PETITION

I have lived about 30 miles from Pohakuloa Training Area (PTA) for about 45 years.

I also attended Kilohana Girl Scout camp around the time Davy Crocketts may have been used at PTA.

The camp is about one mile from the Pohakuloa boundary and about three miles from one of the suspected Davy Crockett ranges.

I attended the camp for two or three sessions of about 10 days, in summertime between about 1957-1962. Campers hiked about half a mile towards PTA (Pohakuloa Training Area) at least once.

"the time period of the fielded Davy Crockett Weapon System [was] 1961 through 1968…"
[Archive Search Report on the Use of Cartridge, 20 mm Spotting M101 for Davy Crockett Light Weapon M28, Schofield Barracks and Associated Training Areas, Islands of Oahu and Hawai'i,May 2007, Executive Summary, p. 4]

I have spent 1-2 hours on the PTA grounds or about 100 feet from the boundary several times in the past 10 years. I also drive past PTA on Saddle Road several times a year.

(3) PETITIONER'S INTEREST

I have health issues and am concerned about health effects of depleted uranium (DU) on myself and other island residents.

(4) EFFECT OF DECISION ON PETITIONER'S INTEREST

If the Nuclear Regulatory Commission (NRC) takes the actions listed below, that will address my interest.

SUMMARY OF CONTENTIONS

(A) NRC should take the actions listed below. Related documents with specifics, including resumes for experts quoted, are attached.

- Have the Army do air monitoring following recommendations from Dr. Pang and Dr. Reimer, with citizen involvement similar to the Rocky Flats Citizens Advisory Board. Air monitoring should continue during high winds, live-fire training, wildfires, and controlled burns. The target should be airborne oxides from DU pulverized by decades of explosives, then suspended and re-suspended in the air.

- Prohibit high explosives in Radiation Control Areas (RCAs) unless one year of air monitoring does not detect DU.

- Have the Army remove all DU, not leave it out on the ground

- Evaluate whether the DU hazard would be better addressed using regulations and/or an agency that are appropriate, since NRC regulations do not cover DU left out on the ground.

- Require (or recommend that a more appropriate agency require) the Army to correct shortcomings in studies the license is based on. Then reconsider the license application, or have a more appropriate agency address the DU. Studies should:

  (1) Account for the 2,000 spotting rounds that may have been used at PTA. Interview people, including former PTA personnel, military and civilian, who may have knowledge about the current location of the 2,000 spotting rounds sent to PTA, and about where and how the spotting rounds were used.

  (2) Evaluate the risks of inhalation of DU oxides.

  (3) Consider that DU can burn from impacts or fires, generating aerosols that can travel over 26 miles.

  (4) Consider that DU increases in radioactivity over time and may contain other isotopes.

  (5) Clarify which form of DU is being considered: metal or oxide; and soluble in fat or in water.

  (6) Consider that DU may settle in “hot spots” and may not be evenly distributed.

  (7) Clarify contradictory statements about the DU fragment size.

  (8) Evaluate whether animals may be carrying DU out of Radiation Control Areas (RCAs).

  (9) Evaluate risks for people who are not healthy white males.

  (10) Review the Waiki’i Ranch study. DU was found at the detection limit of the technique, so the actual amount could range from zero to twice the measured value.

  (11) Include up-to-date information about groundwater depth.

  (12) Require (or recommend that a more appropriate agency require) the Army to evaluate risks from DU used for other purposes besides spotting rounds, then later subjected to impacts and explosions from activities such as target practice.

  (13) Evaluate (or recommend that a more appropriate agency evaluate) whether the Army is resisting effective air monitoring because it might reveal use of DU penetrators at PTA.

(B) NRC should take the above actions because studies done in support of the license have many shortcomings. Examples are listed below. Detailed comments for these studies and others, plus related documents, are attached.

(1) Environmental Radiation Monitoring Plan (ERMP) September 2016
Dr. Reimer’s comments:
- The study does not address aerosols and their repeated resuspension.
- There is only one sample location for monitoring, with no background or reference site.
- Annexes in the study refers yield little relevant information.

- The sample for analysis will be diluted because it will be a composite from ten sample locations.
- Procedures for preparing the sample for analysis lack specificity and/or are inappropriate.
- Water-borne sediment from RCAs is unlikely to reach the sampling site because of distance and a lava flow in the way.

My comments:
"There are factual errors about groundwater depth, ownership of Pohakuloa land, and which troops train at Pohakuloa. Far more depleted uranium may be present than the ERMP assumes. The ERMP appears to say sampling will be cancelled, not just postponed, in unfavorable weather. It assumes there is depleted uranium only in the Radiation Control Areas, and does not consider the inhalation pathway of exposure."

(2) Safety Evaluation Report, January 2017
My comments: the report "includes no requirement to monitor for airborne depleted uranium oxides. It chooses inappropriate regulations for guidance, and gives no specific reasons for that choice. It fails to consider the option of air monitoring to safely monitor hazardous areas. It does not take "hot spots" into account, and assumes high explosives would drive spotting rounds only 5-6 inches into the ground. It does not account for fire tornadoes, dust storms, and other high-wind events that may carry dust long distances."

(3) Other studies
- Only about 1,000 of the 51,000 acres of the PTA impact area were surveyed.
- The contractor who did several studies appears biased—advertising finding small amounts of contaminants and avoiding large, costly cleanups.
- Helicopter rotor wash may have blown DU away during aerial searches.
- Soil sample analysis and aerial survey methodology and assay methods may have been inappropriate.
- In the burn test at Schofield, surface scrapes of ash, soil, twigs, and sticks were substituted for soil samples; one air sampler failed; some samples were collected from the wrong place; and Dr. Pang commented that study actually showed DU contamination.
- DU may migrate much further than the Army claims.

GENERAL COMMENTS
related to license amendment and issuance for
Source Materials License No. SUC-1593, Amendment 2, Davy Crockett Depleted Uranium
at Various United States Army Installations
as described in the Federal Register, February 9, 2017, p. 10031

NRC should require the Army to do air monitoring with citizen involvement, similar to the Rocky Flats Citizens Advisory Board.

The Rocky Flats Citizens Advisory Board was founded in October 1993 and completed its work in June 2006. Members on the Board were all volunteer community members interested in the cleanup and closure of the Rocky Flats site. Community interests represented on the Board included academia, Rocky Flats neighbors, business, Rocky Flats workers, local governments, environmental and peace groups, and technical specialists. A total of 83 persons served on the Board for varying amounts of time during its 13 years of operation.

The Board's mission statement was as follows:

"The Rocky Flats Citizens Advisory Board, a nonpartisan, broadly representative, independent advisory board with concerns related to Rocky Flats activities, is dedicated to providing informed recommendations and advice to the agencies (Department of Energy, Colorado Department of Public Health and Environment, and the Environmental Protection Agency), government entities, and other interested parties on policy and technical issues and decisions related to cleanup, waste management, and associated activities. The Board is dedicated to public involvement, awareness, and education on Rocky Flats issues."

The Board was organized as a non-profit corporation and was funded entirely through a grant from the U.S. Department of Energy. The Board also was part of the Environmental Management Site Specific Advisory Board (EM SSAB), a national organization of local advisory boards at other Department of Energy nuclear weapons manufacturing facilities across the country. The EM SSAB and each of the local advisory boards were official Federal Advisory Committees to the Department of Energy.

http://rockyflatssc.org/rfcab_advisory_board.html

Studies should take into account that DU increases in radioactivity over time, and can burn in impact or fire, generating aerosols that can travel over 26 miles.

We examine how U-238, which comprises more than 99% of DU, decays radioactively, producing two decay progeny that are always present with it and add significantly to its radioactivity. The pyrophoric nature of uranium metal causes it to burn (oxidize rapidly) when heated by impact or in fires to form invisible aerosol particles that become airborne.

We refer to scientific measurements that have been made of the atmospheric wind-borne transport of uranium aerosols over distances up to 26 miles (42 km) from their sources.

Abstract attached

Contamination of Persian Gulf War Veterans and Others by Depleted Uranium,Leonard A. Dietz, 7-19-96,

(last updated 2-21-99), http://stgvisie.home.xs4all.nl/ContaminationByDepletedUranium.html

Studies should clarify which form of DU the studies are considering: metal or oxide; and soluble in fat or in water.

Uranium in a form that dissolves easily can be toxic to the kidneys if ingested in large amounts, such as by inhaling dust or drinking contaminated water. The DU at the Army sites is not believed to be in this soluble form.

Backgrounder on License for Depleted Uranium at U.S. Army Sites, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/bg-license-app-du.html

Dr. Pang comments: "What do you mean by "soluble" do you mean water soluble such as things which dissolve in the watery mediums like blood and urine? Or do you mean fat/oil soluble? Stuff that does not dissolve well in the water solutions but quite well into the lymph and the lymphatics system…

This form [DU oxides] is a lot… less water/blood/urine soluble than the metal form and when it comes into the lungs it is "fat" soluble and dissolves into the lymphatics…it does eventually clear the body in the urine over decades rather than weeks…
3-24-17 9:23 PM e-mail to from Pang to Cory Harden

Department of Energy states:
"the main radiation hazard from uranium occurs when uranium compounds are ingested or inhaled…
For inhalation or ingestion of soluble or moderately soluble compounds such as uranyl fluoride (UO_2F_2) or uranium tetrafluoride (UF_4), the uranium enters the bloodstream and reaches the kidney and other internal organs, so that chemical toxicity is of primary importance. For inhalation of insoluble compounds such as uranium dioxide (UO_2) and triuranium octaoxide (U_3O_8), the uranium is generally deposited in the lungs and can remain there for long periods of time (months or years). The main concern from exposure to these insoluble compounds is increased cancer risk from the internal exposure to radioactivity."
Uranium Health Effects, U.S. Department of Energy Office of Environmental Management, http://web.ead.anl.gov/uranium/guide/ucompound/health/index.cfm]

Studies should evaluate risks for people who are not healthy white males.
"Current permitted levels of radiation are based on the model of a young, healthy white male and ignore vulnerable infants and children, the elderly, those in poor health, and women (who are considerably more vulnerable to radiation than men)."
Center for Health, Environment, and Justice E-Bulletin, February 2007

NRC and the Army should clarify contradictory statements about the DU fragment size.
The high density and large fragment size mean the DU cannot easily become airborne or move off-site.
Backgrounder on License for Depleted Uranium at U.S. Army Sites, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/bg-license-app-du.html, underline added

The underlying assumption in the concentration calculations is that the DU rounds are completely degraded and isotopes of uranium are homogenously mixed within the top 15 cm of soil within each RCA. Depending on such factors as the actual areal density of munitions in each of the RCAs, the rate of degradation of the munitions, and the dispersal of DU isotopes in the environment, this approach may significantly over or underestimate concentrations over time. For example, the soil concentrations are expected to be overestimated at early times prior to significant degradation of the DU rounds, but soil concentration may have been underestimated at later times in certain "hot spot" locations in relatively close proximity to degraded DU rounds. But the assumption that all of the DU mass for an installation is located in each and every RCA in that installation tends to lead to overestimation of the concentrations and helps mitigate the concern with underestimating concentrations, especially for Fort Benning, which has 9 RCAs.12 While the Army provided some information on the expected degradation rates and distribution of DU munitions in the range areas based on analog sites, significant uncertainty in the distribution of DU isotopes over time exists. Finally, while it might be representative of a less likely but plausible scenario in the event that knowledge of the site and controls over the site are lost over long periods of time, the use of a conservative exposure scenario like the resident farmer for a controlled area where unexploded ordnances are present is not a reasonably foreseeable land use scenario.
Safety Evaluation Report, ML16343A163, p. 17, underline added

NRC should evaluate risks from DU used for other purposes besides spotting rounds, then later subjected to impacts and explosions from activities such as target practice.
Note that the quote below is missing from the standard Web version of the article.
" (Depleted Uranium) is not used in military training, but in the 50 and 60s it was used anytime you needed a heavy weight," [sic] said Greg Komp, senior health physicist, Office of the Director of Army Safety, Washington D.C."

Army Reaffirms Commitment to Hawaii on Depleted Uranium, by U.S. Army, Pacific Public Affairs, 8-30-07
http://webcache.googleusercontent.com/search?q=cache:8lyFND0yiMgJ:https://www.army.mil/article/4671&num=1&hl=en&gl=us&strip=0&vwsrc=1

NRC should evaluate whether the Army is resisting effective air monitoring because that might reveal use of extremely hazardous DU penetrators at PTA

The Army denies ever using DU penetrators in Hawai'i, but, as we know, they repeatedly denied DU use before revelations about the Davy Crockett.

Army Colonel Killian said that since 1996, use of DU in Army training has been prohibited without an NRC license. (according to my notes from a meeting of the Kawaihae Local Resource Council on November 18, 2007 in Waimea) But that means DU was allowed beforehand.

The Navy also uses PTA, and they accidentally fired several rounds of DU ammunition from a ship in Peral Harbor into a forest on Oa'hu in 1994. http://www.dmzhawaii.org/wp-content/uploads/2009/02/navy-foia-response.pdf

The Air Force also uses PTA, but they had no response as of February 3, 2009 to a military query about DU use. Hawai'i Island Depleted Uranium Update, Colonel Howard Killian, 2-3-09

The Marines also use PTA. Note that "…US Marines mistakenly fired bullets containing depleted uranium on an island off Okinawa during training exercises in December 1995 and January 1996…" Depleted uranium in Japan, Yuki Matsuoka, Papers submitted to the conference 'Facts on depleted uranium', International Nuclear Information System, International Atomic Energy Agency https://inis.iaea.org/search/search.aspx?orig_q=RN:34083239

comments on Safety Evaluation Report of January 2017 ML16343A163
by Cory Harden, April 1, 2017

Summary
This report includes no requirement to monitor for airborne depleted uranium oxides. It chooses inappropriate regulations for guidance, and gives no specific reasons for that choice. It fails to consider the option of air monitoring to safely monitor hazardous areas. It does not take "hot spots" into account, and assumes high explosives would drive spotting rounds only 5-6 inches into the ground. It does not account for fire tornadoes, dust storms, and other high-wind events that may carry dust long distances.

Specific comments
" Although this guidance [NUREG-1556, Vol. 7] explicitly states that it does not apply to source material (Part 40) licensees, in the absence of guidance for licensing actions such as these Davy Crockett DU licensing actions, the NRC staff determined that this guidance is appropriate for determining whether the applicant meets Part 20 requirements that are germane to Part 30 and Part 40 licensing actions."
Safety Evaluation Report, p. 5
NRC has a voluminous collection of detailed guidance covering hundreds of situations. If this collection lacks "specific guidance for DU spent rounds present in the environment", that implies DU should not be left out in the open, but removed.

"3.11.3.1 In accordance with [plant name] TS 6.8.4.g.2) and 3), the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS (see Figure 5.1-3) shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table 11, Column 2 for radionuclides other than dissolved or entrained noble gases."
"a. With the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS exceeding the above limits, immediately restore the concentration to within the above limits."
3/4.11.1 LIQUID EFFLUENTS, NUREG-1301, Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors, Generic Letter 89-01, Supplement No. 1, p. 38
How will Army control the amount released? The regulations seem to assume releases are from facilities that can be controlled.

"The NRC staff used NUREG-1301, "Off-site Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors," to review the Army's the proposed methods of sample collection and the frequency of collection. Although this guidance is specific to Pressurized Water Reactors, the NRC staff found that it was appropriate to apply this guidance to a possession only license for DU in the absence of specific guidance for DU spent rounds present in the environment."
Safety Evaluation Report, pp. 9-10
There is no explanation of why staff "found it was appropriate".

"The programmatic approach recognized any environmental monitoring within an active range poses undue risk caused by unexploded ordinance."
Safety Evaluation Report, p.10
People do enter the impact area at Schofield and Pohakuloa at times, with precautions. Air monitoring could be set up around the perimeter of the impact area.

"The Army assumed that the total activity of each isotope is homogeneously distributed in the top 15 centimeters (cm) (6 inches (in.)) of soil on the individual RCAs."
Safety Evaluation Report, p. 14
The Army should consider the more likely scenario of uneven distribution in "hot spots", and much greater depth from explosives driving DU down into the ground.

"Distribution of the radioactivity over the RCA soil might represent a case in the future after munitions have degraded sufficiently to allow the radioactivity to be dispersed in the environment."

Safety Evaluation Report, p. 14
This seems to contradict NRC information:

> The high density and large fragment size mean the DU cannot easily become airborne or move off-site.
> *Backgrounder on License for Depleted Uranium at U.S. Army Sites, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/bg-license-app-du.html, underline added*

2.2.2 Submittal – Site-Specific Dose Assessments
There is no safe level of radioactivity. Also, the report does not consider combined risks from other radiation sources and from toxins.

"Each dose calculation also assumes that the depth of the contaminated zone equals 0.15 m." (about 5 inches)
Safety Evaluation Report, p. 17
See comments for p. 14.

Assumed average annual wind speeds at Pohakuloa are 5.3 meters per second, or about 12 miles per hour. But wind speeds were obviously far higher and able to transport dust during an August 2010 fire tornado near Pohakuloa. See video at: http://hawaiiindependent.net/story/fire-tornado-on-hawaii-island-caught-on-video

And a photo taken by a friend about November 19, 2003 shows dust blowing across a road near Pohakuloa.

"The Army also cited past documentation…that airborne particulate sampling conducted during recent live fire events in Hawaii did not find any evidence of DU airborne contamination."
Safety Evaluation Report, p. 23
There is no way to verify this statement, since it does not specify what "sampling" refers to.

Is the action likely to significantly affect any aspect of the natural environment? *[question from categorical exclusion checklist]*
NO Issuance of the license amendment will not change or affect the environment because the DU is already present and was deposited in the environment nearly 60 years ago. *[NRC response]*
Safety Evaluation Report, p.28
The question is about the natural environment, not the contaminated environment.

Hello Amy Snyder,

Thank you for sending the Environmental Radiation Monitoring Plan (ERMP) for Pohakuloa, September 2016, ML16265A231.

I urge NRC to require a complete rewrite. There are factual errors about groundwater depth, ownership of Pohakuloa land, and which troops train at Pohakuloa. Far more depleted uranium may be present than the ERMP assumes. The ERMP appears to say sampling will be cancelled, not just postponed, in unfavorable weather. It assumes there is depleted uranium only in the Radiation Control Areas, and does not consider the inhalation pathway of exposure, despite years of extensive comments to the contrary from professionals, and from residents including myself. Mike Reimer has also raised serious concerns about the ERMP.

Specific comments follow. Thank you for considering them.

aloha,
Cory Harden, Hilo, Hawai'i 333cory@gmail.com

……

1.1 PURPOSE
p. 1-1 sampling quarterly "unless prevented by weather"
Sampling should be done more often, and postponed--not cancelled--for inclement weather.

1.1 INSTALLATION BACKGROUND
p. 1-1 "Pohakuloa TA was acquired by the United States from the State of Hawaii and private landowners."
Part of the TA is leased from the State Department of Land and Natural Resources.

> "A lawsuit claiming the state breached its duties to protect public lands used for the Army's Pohakuloa Training Area will go to trial this week.
> …the suit says the Department of Land and Natural Resources failed to ensure that munitions are cleaned up after military exercises as the Army's existing 65-year lease for the lands between Mauna Kea and Mauna Loa requires….
> The Army leases 22,836 acres from the state to hold military training exercises…"
> *PTA lawsuit heads to trial, Hawai'i Tribune-Herald, 9-27-15,http://hawaiitribune-herald.com/news/local-news/pta-lawsuit-heads-trial*

p. 1-1 "The facility is used by the U.S. Army Hawaii, the U.S. Marine Corps, and the Hawaii Army National Guard (HARNG)."
It is also used by foreign troops.

> "The U.S. Army's Pohakuloa Training Area hosted the live-fire portion of this year's Rim of the Pacific exercise, with ground forces from eight countries leaving amphibious ships for about 12 days to practice…"
> *USNI [United States Naval Institute] News, 7-29-16, https://news.usni.org/2016/07/29/rimpac-2016-hawaiian-combat-training-range-offers-unique-opportunities*

> "About a battalion's worth of Singaporean soldiers will train in Hawaii's Pohakuloa Training Area for Tiger Balm in July."
> *Here's how the Army's Pacific mission is expanding now, Army Times, May 14, 2016, https://www.armytimes.com/story/military/2016/05/14/heres-how-armys-pacific-mission-expanding-now/84241910/*

p. 1-2 Radiation Control Area map
The assumption that DU is only in the Radiation Control Areas is highly questionable, as professionals and residents, including myself, have repeatedly told NRC for years.

1.3 HISTORICAL INFORMATION
p. 1-5 " it is assumed that most, if not all, of the 140 kilograms (kg) of DU from the rounds fired into RCAs at Schofield Barracks and Pohakuloa TA remains in the RCAs."

There may be about 380 kilograms of DU from the spotting rounds, since were probably over 2,000 spotting rounds fired at Pohakuloa. This is based on three lines of evidence: old training manuals, the number of pistons found, and the Archive Search Report.

> ***Manuals:***
> "U.S. Army Colonel Killian…said the types of exercises conducted at PTA (Pohakuloa Training Area) would require the firing of at least 2,050...spotting rounds." *[Depleted Uranium at Pohakuloa, West Hawai'i Today, 2-4-09]*
>
> "**Killian** …if you go through the training manuals of the era…it would require more than 714 rounds over an 8 year period of time to qualify the requisite amount of crews…
> **Councilmember Hoffmann** Is there any possible support for a figure of 2,000 spotting rounds at PTA?
> **Killian** If you, if you do the math, if you extrapolate the math with the, the contemporary training manuals I think you'd come up with number of 2, 050."
> *[from Harden's transcript of the official DVD of Hawai'i County Council Public Works & Intergovernmental Relations Committee meeting, 2-3-09]*
>
> ***Pistons:***
> "An environmental consultant [Peter Strauss, hired by Sierra Club] estimated there may be as many as 2,000 depleted uranium rounds at Pohakuloa Training Area…The consultant's analysis was based on an Army report estimating that between 120 and 400 firing pistons are scattered around impact ranges at PTA…Each piston would have fired up to five of the DU rounds, for a total of between 600 and 2,000 rounds fired, Strauss said." *[Sierra Club consultant disputes Army's DU tally, Hawai'i Tribune-Herald, 8-26-08]*
>
> ***Archive Search Report***
> "Total rounds verified shipped from Oahu from Lake City Ordnance Plant were 714 rounds… It is highly probable that additional stocks of the Cartridge, 20 mm Spotting M101 were order [sic] from one of the Ordnance Depots (Letterkenny or Pueblo) during the six active years of the Davy Crockett Weapon System in Hawaii." *[ASR p. 41]*

Thorough surveys were impossible.

> "The Army acknowledged in its license application that rough terrain and hazards presented by unexploded ordnance made it impossible to conduct a thorough survey for DU at Pohakuloa and Schofield." *[Waste not, Honolulu Weekly, 10-17-12]*
>
> "…the overflights are using equipment to detect very low energy gamma rays from the decay of the material. They have stated that to detect a spotting round, it must be at the surface and to detect fragments one-third the size of the spotting round, they can be buried no deeper than 2-4 inches." *[e-mail from Reimer to Harden, 12-18-09]*

Instead of 2,000 spotting rounds, only a few rounds and fragments were found. A contractor speculated the missing rounds had been cleaned up.

> "…the team located a Davy Crockett SRB…" *[Final Technical Memorandum, Depleted Uranium Scoping Investigation, Makua…Pohakuloa…Schofield…prepared for Army by Cabrera Services, p. 4-3]*
>
> "Ground based GWS [Gamma Walkover Survey] located and identified 2 DU metal fragments, one essentially intact spotter round body with no tail fin assembly...and one aluminum tail fine [sic] with some DU spotter round body still attached. …

The number of DU spotter round bodies, aluminum fin assemblies and DU fragments are much fewer than would be expected given the total number of pistons which were identified.
This fact, and in comparison to the number of DU fragments and portions of the Davy Crockett spotter rounds found at Schofield Barracks, suggests that some type of range clearance may have occurred at PTA." *[Memorandum pp. 5-1 to 5-2, indentations added]*

But there are other possibilities.

"…the "ENVIRONMENTAL RADIATION MONITORING PLAN FOR DEPLETED URANIUM AND BERYLLIUM AREAS, YUMA PROVING GROUND" (Ebinger and Hanson, Los Alamos Report LA-UR-94-1838, May 11, 1994) prepared for the U.S. Army Test and Evaluation command [notes]…fired rounds have the propensity of skipping across the surface, like a thrown stone skipping across water, ending up at distances much greater than the calculated range of the munitions.
…as the firing ranges searched for DU have been used for training with explosive ordinance and vehicular traffic after DU was used, the DU may have been highly distributed as aerosols from the decades of continued explosions and grinding under tires and tracks of vehicles. Now continued use of these areas will only result in the continuous airborne resuspension of the material." *[e-mail from Reimer to Dominick Orlando of NRC, 7-11-12]*

"[perhaps] …the searches were conducted in areas that were not primary target areas." *[e-mail from Reimer to Harden, 7-8-12]*

"…Fort Benning range personnel recently found a Davy Crockett piston on a range that previously was not an area of interest to the research team." *[Robert Cherry of the Army speaking at a November 16, 2010 meeting with the Nuclear Regulatory Commission (NRC), from meeting transcript, pp. 34-35]*

Aerial searchers looked for highly visible back/ rear plate assemblies as markers for old spotting round areas.

"The components of the Davy Crockett system particularly back plate assemblies and windscreens have a very distinct coloring as seen in photos 4-4 and 4-5 [actually 4-9 and 4-10] and are readily observable from the air." *[Memorandum, pp. 4-26 to 4-27]*

But the Davy Crockett could be fired from a truck. [[Archive Search Report On the Use of Cartridge, 20mm Spotting M101 for Davy Crockett Light Weapon M28, Schofield Barracks and Associated Training Areas, Islands of Oahu and Hawai'i, Army Corps of Engineers, May 2007, p. 3-11]
This might leave back/ rear plate assemblies on the truck instead of on the ground.
Hawai'i had 14 trucks for the Davy Crockett. [ASR p. C-291]

Hazardous disposal practices were used during the spotting round era.

"…until the late 1960s, ocean dumping was one of the ways chemical agents and munitions were routinely disposed of since World War I. The other means were **open-pit burning and land burial**…" *[Honolulu Star-Bulletin, 11-9-05, bold added]*

The spotting rounds might have been treated as scrap, since a 1961 study recommended

"that all spotting rounds be left in the impact area and that the impact area not be considered a radiation area. This suggestion was favorably considered by the…Atomic Energy Laboratory [of the Atomic Energy Commission] *[Uranium Alloys for Critical Ordnance Components, Watertown Arsenal Labs, 23 Oct 1961, p. 3; ASR p. 5-26 and p. C-120]*

A memo describes how scrap from range clearance (not DU, not from Pohakuloa) was dumped into a crater in 1962--

"The 6th Ordnance Detachment (ED) conducted range clearance in the Lalamilo Farm Lot, near Kamuela, Hawaii, during 19 February 1962 through 2 March 1962. Recovered were 800+ items of which 333 were destroyed by demolition and the remaining items

were classified as scrap. With permission received from the Base Camp Commander, this scrap was dumped into a crater in the artillery impact area at Pohakuloa."
[Appendix C-20, NARA College Park, Maryland (CP), Report for HQ, United States Army, Hawaii, APO 957 entitled Staff Office Report, Office of the Ordnance Officer, January-March 1962, dated spring 1962, RG 550, Records of the United States Army, Pacific, Entry 17, U.S. Army Hawaii 1959-1963, Box 10, CP-121406-003, in ASR, p. C-296]

1.4 PHYSICAL ENVIRONMENT
p. 1-5 "…it is believed that groundwater beneath Pohakuloa TA occurs primarily as deep basal water…"
See comment for 2.2.

1.5 EVALUATION OF POTENTIAL SOURCE-RECEPTOR INTERACTIONS
The pathway of dust inhalation must be evaluated, with DU dust re-suspended repeatedly by impacts and explosions from bombs and projectiles, and by fires.

2.0 ERMP SAMPLE DESIGN
According to my notes, during a teleconference on December 12, 2013, NRC said it would monitor for DU when high explosives are used in DU areas. This monitoring should be included in the ERMP and noted in the NRC meeting summary (ML13352A214).

2.2 GROUNDWATER
p. 2-1 "The depth to groundwater in the vicinity of Pohakuloa TA is approximately 1,000 feet bgs."
Incorrect--water has been found 500 feet down in the general area:

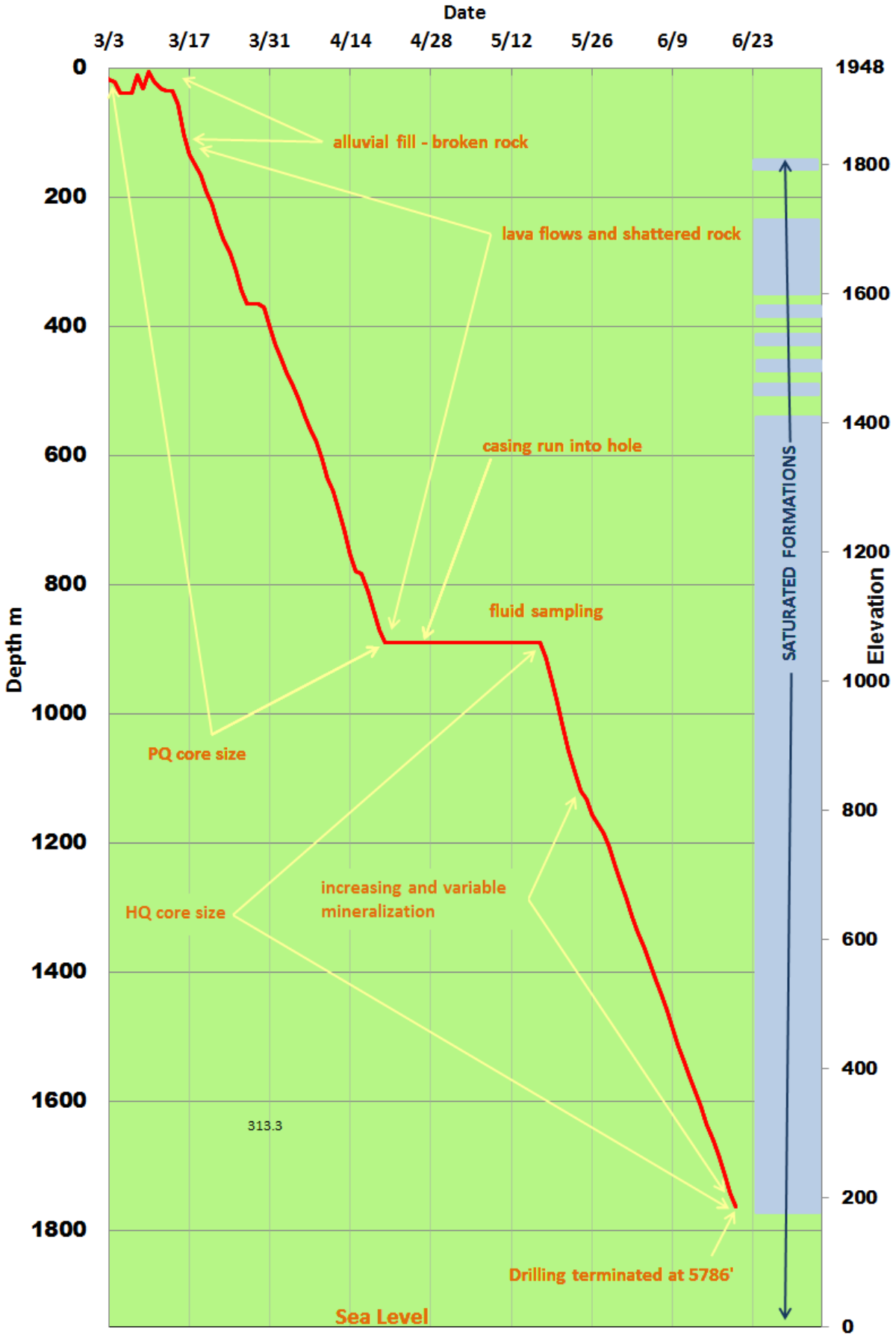
"Unexpectedly high water in the Humuula saddle region, between Mauna Kea and Mauna Loa, prompted a University of Hawaii researcher to seek a new site for additional tests.
Donald Thomas, director of the university's Center for the Study of Active Volcanoes, in 2012, received permission to drill two bore holes to collect core samples. While drilling the first sample, Thomas said, scientists got some interesting preliminary results.
"We found water that was at a higher elevation than expected," Thomas said.
They found the first thin band of water about 500 feet below the surface. A thicker band was present at about 700 feet, and a regional water table was at 1,800 feet, Thomas said….Thomas decided to seek a new site, about seven miles from the original one, to check to see how widespread that water table is…Drilling on the new site, which is on U.S. Army garrison property, could begin within a few months."
Higher Waters: Unexpected discovery in Humuula saddle region prompts new tests, Hawai'i Tribune-Herald, 2-18-14,
http://hawaiitribune-herald.com/news/local-news/higher-waters-unexpected-discovery-humuula-saddle-region-prompts-new-tests

"Researchers with the Hawaii Institute for Geophysics and Planetology have found water at much higher elevations than they had thought possible before the recent drilling of a test well around the 6,000 foot level in the Saddle region.
"The regional water table within the Humuula Saddle region appears to be much higher — about 4,600 feet above sea level — than anyone had thought, and that there are at least two so-called perched water tables that are shallower still," said Donald Thomas, director of The Center for the Study of Active Volcanoes at the University of Hawaii at Hilo. "The second test hole is intended to test that hypothesis by drilling at a considerable distance from the first one."
Researchers drilled down 5,800 feet near Mauna Kea State Park over the winter, and are preparing to measure the flow rate in the well to determine how viable the source is. A second site in the northwest corner of Pohakuloa Training Area is also set for drilling.
"It appears that there is a substantial volume of water stored at high elevation within the island. There are indications that the resource could extend over a significant area of the island — although that remains to be fully demonstrated," Thomas said. "In terms of available water in the region, it appears that there are resources that far exceed the current demand in the area."
'I think one of the broader implications of the findings in the Saddle is the general statement that we still have a lot to learn about the groundwater resources of Hawaii.' "

New database a tool in groundwater, geothermal discussions, West Hawai'i Today, 3-5-15, http://webcache.googleusercontent.com/search?q=cache:62Pqeza_1vgJ:westhawaiitoday.com/news/local-news/new-database-tool-groundwater-geothermal-discussions&num=1&hl=en&gl=us&strip=1&vwsrc=0

"Groundwater conditions were remarkably different from expected: an initial (thin) water table was encountered at 1800 m amsl [above mean sea level]; more substantial saturated zones were encountered at ~1750 m amsl, that extended over an interval of >160 m, and below that aquifer were several intervals of saturated and unsaturated formation to ~1400 m amsl where continuous saturation was found to the total depth of the hole at 183 m amsl."

Analysis of the hydrologic structures within an ocean island volcano using diamond wireline core drilling, Donald Thomas and Eric Haskins, http://www.higp.hawaii.edu/hggrc/wp-content/uploads/2014/05/ThomasHaskinsAGU2013.pdf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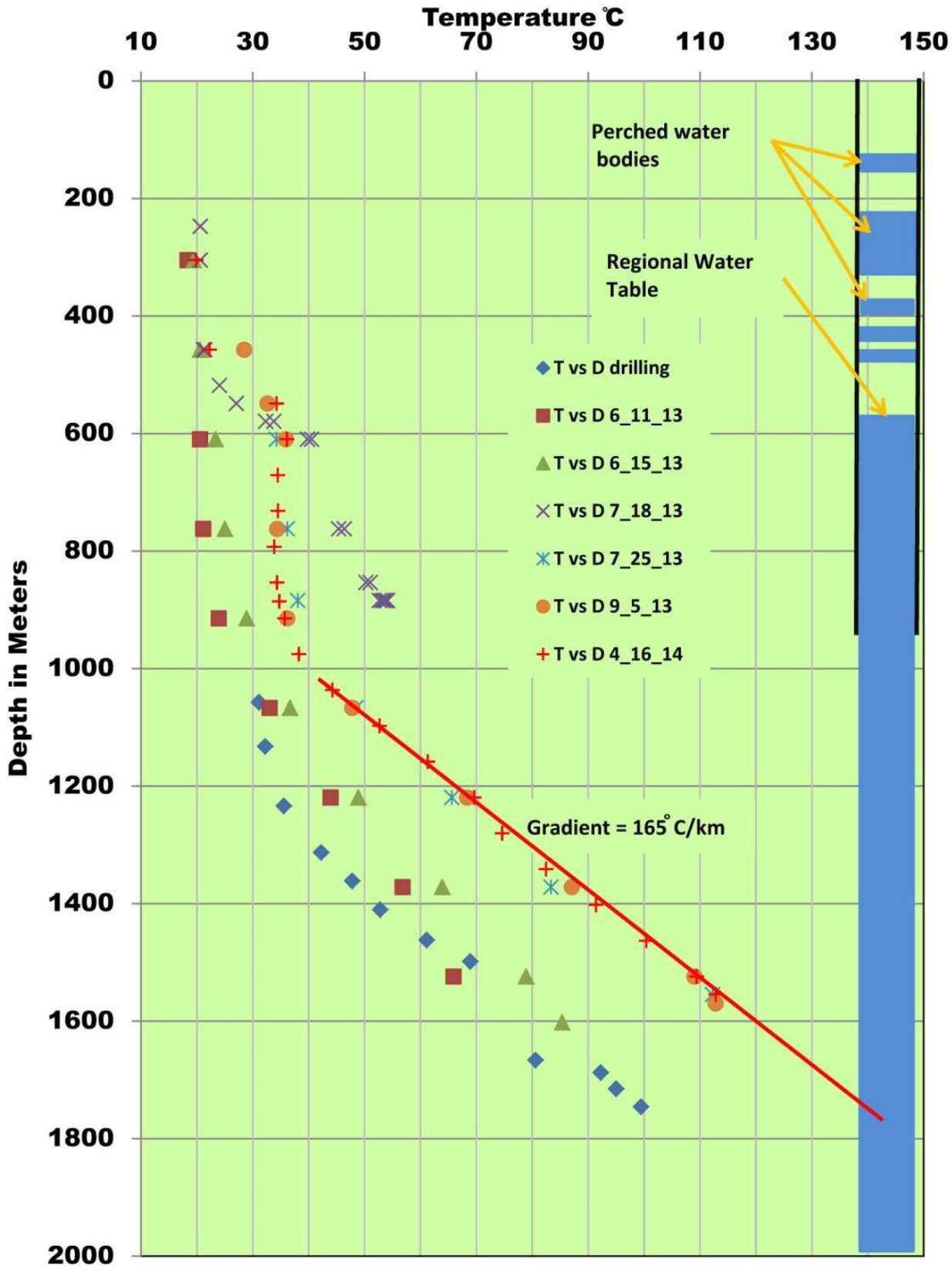
alluvial fill - broken rock
lava flows and shattered rock
casing run into hole
fluid sampling
PQ core size
HQ core size
increasing and variable mineralization
313.3
Drilling terminated at 5786'
Sea Level
SATURATED FORMATIONS

Analysis of the hydrologic structures within an ocean island volcano using diamond wireline core drilling, Donald Thomas (dthomas@soest.hawaii.edu) and Eric Haskins (haskins@hawaii.edu)
http://www.higp.hawaii.edu/hggrc/wp-content/uploads/2014/05/ThomasHaskinsAGU2013.pdf


Temperature ℃
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Depth in Meters
Perched water bodies
Regional Water Table
T vs D drilling
T vs D 6_11_13
T vs D 6_15_13
T vs D 7_18_13
T vs D 7_25_13
T vs D 9_5_13
T vs D 4_16_14
Gradient = 165° C/km

New insights into structural controls affecting groundwater flow within an ocean island volcano, Mauna Kea, Hawaii,Donald Thomas (dthomas@soest.hawaii.edu), E. Haskins (haskins@hawaii.edu); E. Wallin (ewallin@hawaii.edu); and H. Pierce (tahoepierces@gmail.com)
http://www.higp.hawaii.edu/hggrc/wp-content/uploads/2014/05/ThomasetalFall2015.pdf

4.0 RESRAD CALCUALTIONS
The ERMP fails to evaluate the cumulative effects of radiation from Pohakuloa combined with other hazards people are exposed over the course of their lifetime.

The Honorable Victor M. McCree

Executive Director for Operations

U.S. Nuclear Regulatory Commission

Washington, D.C. 20555-0001

e-mail to attention of Renee Taylor, Administrative Assistant

March 16, 2017

Sir:

I am writing as a person with interest to ask that the Nuclear Regulatory Commission reconsider the approval of License SUC1593 for the U.S. Army to possess depleted uranium at various military installations in the U.S. Part of the possession license required an Environmental Radiation Monitoring Plan (ERMP) that included monitoring for DU away from the sites identified as most probable where DU spotting rounds from the Davy Crockett weaponry was used in training in the 1960s. The sites where DU is most likely to be located are called Radiation Controlled Areas (RCA). The specific base needing attention in my request is the Pohakuloa Training Area (PTA), Hawaii County, Hawaii.

I trust that you will find cause to reevaluate this approval on your own initiative.

The sampling plan for PTA as presented calls for a single sediment sample to be collected at a single location site several times a year. The four identified locations most likely to contain DU from the training are topographically higher than the sampling site. The sampling site is off PTA proper. Scant information is provided concerning the methods used for sample collection and analysis and by nature of its paucity, it is very difficult to clarify any arguable base for protesting the terms of the license. What is presented, if given to any reasonable person familiar with geologic sampling procedures, is so egregiously defective and disparate from accepted sampling procedures, it must be deemed fatally flawed.

I had earlier written a review of the ERMP for Pohakuloa and e-mailed it to Ms. Amy Snyder. It is located at ML 17010A202.

Here, for succinctness, I will present one issue that should demonatrate why the ERMP is untenable for PTA.

The ERMP for PTA proposes to collect one sediment sample several times a year at a location several miles west northwest of the RCAs. The sampling site is at a lower elevation than the RCAs. There are several levels of drainage channels in the area, first order, second order, third order and so on. The Army acknowledges and I do not challenge the observable fact that the scarce soil and the bedrock of lava flows are highly permeable and water from precipitation percolates through the cover very quickly. There are no permanent streams in the area; they are all intermittent. This condition does not permit sediment from the RCAs to be carried far enough to reach the proposed sampling area, and, in fact, the Army has not been able to indicate that it does.

It is somewhat disturbing that the NRC Review Staff makes the statement that:

"The NRC staff reviewed the figures in each ERMP showing the topography of the base, the RCAs, direction of surface water runoff, and proposed sampling location(s). The NRC staff found the sampling locations to be downgradient from the various RCAs and therefore adequate for tracking and trending purposes to discern if there is any significant transport of DU from the RCAs through the actions of surface water runoff."

The issue that the gradient is predisposed for the flow of water from the RCAs to the sample site is completely superficial. If a proper map had been presented it would show that between the RCAs and the sample site are several recent lava flows. These flows present a formidable barrier to the general flow direction of water. A lava flow is in effect a berm to water flow. For the most part, the water flow would be directed to the northwest away from the sample site.

There is no need for arm waving on this issue. There are available today many stream flow programs that objectively will show the flow characteristics. They are not very complex and many use the Digital

Elevation Model data for input. There is no reason that such a program would not have been employed. The NRC should have employed such an approach to confirm or reject the Army contention. Given the permeability of the area and the intermittent nature of the stream flow, it is not revealed if even a 200 or 500 year flood would be sufficient to carry sediment from the most distant RCA to the sample site.

The NRC further states:

"The NRC considers it most likely that only sediment sampling (as opposed to soil sampling) will be needed because it is unlikely that significant soil transport will occur. Regardless, the NRC staff acknowledge the commitment made to sample any significant soil depositions discovered. The methods for sample analysis are commonly utilized methods and the action levels are consistent with those imposed by the NRC in license SUC-1593, LC 17."

The statement that "…it is unlikely significant soil transport will occur" indicates that there is little knowledge among the NRC review staff about geology and geographic mechanisms. The question to be answered is, where do you think the organic and inorganic particles composing a sediment come from? Granted, you can have wind-blown sedimentation and in-situ decomposition of rock, and reworking of sediment for additional transport, but these are minor compared to primary, fluid-characterized soil-transport, especially at PTA. Regarding this single collection site, the staff comment that 'it is unlikely that significant soil transport will occur' in effect confirms my contention. It reveals that sediment sampling at this selected site is a ruse. No water-carried sediment from the RCAs is likely to reach the sampling site.

Continuing that statement from NRC, "The methods for sample analysis are commonly utilized methods …" I will state emphatically that they are not! I firmly believe that such an endorsement is nothing short of embarrassment to the NRC. It again indicates that there is little if any knowledge about this type of sampling program within the review staff of NRC, and that they did not care enough about the appeals of the citizenry to even have the courtesy to look into the citizen concern.

Here I will pose a question. Has anyone on the NRC staff ever heard of the NURE Program? That stands for the National Uranium Resource Evaluation conducted by the Department of Energy and coordinated in large part by the U.S. Geological Survey and many National Laboratories, where hundreds of thousands of samples of various types were collected in the late 1970s in a national program in search of uranium resources. Protocols for sampling were developed to suit the available methods of analysis. Some corporate memory input would have been valuable for the review.

I realize that my words are harsh and likely to initiate an immediate defensive response. It would be sad if that is the case but now that I have your attention, I am presenting an opportunity for you to make necessary adjustments in the ERMP for Pohakuloa. To do less would be showing complicity in intellectual insult and a willingness to participate in the dumbing down of America.

The ERMP at Pohakuloa as presented has very little chance of finding DU. This is further confirmed by the sampling procedure. An example of stated procedure, pouring off any water that may be with the sample and attempting to homogenize it by mashing it around in the collection bag are methods far from standard procedures. Perhaps that is the goal but then in openness and transparency, it should be stated. Approval of the plan in the light most favorable to the Army is the easy way out and approving such egregious representations by the Army as I have indicated, unfortunately gives the appearance of a rubber stamp. However, if that is the case, then state it.

The citizen concern is genuine. Many, including myself, are frequent users of Mauna Kea County Park, just a few miles from an RCA. Hawaii is a precious asset for the U.S., yet it has a fragile environment. The motto of Hawaii, Ua Mau ke Ea o ka 'Āina i ka Pono, (commonly translated as: The life of the land is perpetuated in righteousness) and the mission of the NRC "…to ensure adequate protection of public health and safety, to promote the common defense and security, and to protect the environment" can work harmoniously to provide good stewardship of the land and the best protection of its citizens from unnecessary health risks, making sure the ALARA principle is followed.

If you were tasked to develop a monitoring program specifically to avoid finding DU at PTA, what the Army has presented and the NRC endorsed fits that goal precisely. Air sampling should be the primary method of monitoring for DU transport from PTA. If NRC truly supports the contention that any DU at PTA has been pulverized with over 50 years of high explosive shelling to an extent where fragments and intact spotting rounds cannot be found, then it is the aerosol component and its continued resuspension that is

of concern. I am aware, and I am sure your staff is as well, that the concerned citizens are more than willing to collaborate with stakeholders to initiate a proper monitoring program.

I realize that the chance of revaluating the license to include airborne monitoring at PTA is essentially nonexistent but here is an opportunity to at least adjust the single sediment sample collection to have at least a mere semblance of significance.

I trust that I have presented information of serious concerns and that the NRC will take advantage of my request to reevaluate on their own initiative the license SUC1593 for the Pohakuloa component. This is a very important issue, not only addressing the concern of the citizens of Hawaii County, but because it sets precedence for the future on how the NRC will rule when justification for programs they administer is deceptive or disingenuous.

I would welcome the opportunity to work with the NRC on this reevaluation.

Sincerely,

Michael Reimer, Ph.D.

Retired Geologist

GeoMike5@att.net

geomike5@att.net <geomike5@att.net> Wed, Dec 14, 2016 at 4:46 PM
Reply-To: geomike5@att.net
To: "ja@malu-aina.org" <ja@malu-aina.org>, "333cory@gmail.com" <333cory@gmail.com>, "panghi71@gmail.com" <panghi71@gmail.com>, "paka@sandwichisles.net" <paka@sandwichisles.net>

December 7, 2016

Ms Amy Snyder
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:

I reviewed the documents of September 2016,

Final
Site-Specific Environmental Radiation Monitoring Plan
Pohakuloa Training Area, Hawaii
Annex 17
For Materials License Suc-1593,

and

Final
Programmatic Uniform Federal Policy–Quality Assurance Project Plan (Ufp-Qapp)
Annex 19
Environmental Radiation Monitoring Program,

noted as being part of ML16265A221.

They were submitted by the U.S. Army and I have some comments that I hope you will seriously consider in your technical review and then implement in order for the program to have any merit at all.

There is of course the continued erosion by the Army of their obligation for responsible management of DU at the Pohakuloa Training Area (PTA), Hawaii. Years ago, there was a rigorous monitoring plan proposed. It has all but disappeared. Now, for Pohakuloa, it is proposed that there be only one sample location for monitoring. Really? There is not even a background or reference site proposed even though there is one for Schofield on Oahu (Annex 18).

It is truly unfortunate that NRC is getting pulled into this line of avoidance of responsibility. What that creates is endorsement of a junk monitoring program. There are numerous residents and officials who are genuinely concerned that DU at PTA has the ability to migrate and pose a measurable health risk. We discussed this before. People in general have a genuine fear of radioactivity. To them, there is a real risk from exposure of any magnitude. Trying to squeeze DU into the same category of exposure risk as naturally occurring uranium is bogus. Claiming that uranium is such a heavy element it cannot migrate far from its source is absolute nonsense.

The least understandable scenario is that although the Army claims there is no measurable risk, it refuses to conduct simple, comprehensive, and effective monitoring to substantiate that claim and attempts avoidance with NRC approval. With the recalcitrant attitude of the Army and because of NRC sanction of management avoidance, to the populace, the risk is real.

A genuine program is so easy to implement and after a few years, the issue could be settled. There

is no detriment to the training programs, no soldier is placed more or less in harm's way, and the citizenry, Island residents, and visitors, soldiers and employees of PTA could feel secure that all that could be done for monitoring has been done, in a direct, proper, substantial and convincing manner.

Sincerely,

/s/

Michael Reimer, Ph.D, Geologist, retired
GeoMike5@att.net

Comments on Environmental Radiation Monitoring Plan prepared by the US Army for Pohakuloa Training Area, Hawaii.

Commentary by Michael Reimer, Ph.D., Geologist, retired

December 7, 2016

Introduction:

It is known that depleted uranium (DU) is present at Pohakuloa Training Area (PTA). It will probably take years before the risk of exposure to DU is resolved through a comprehensive study. Providing proper background information collected at this time will greatly assist in the risk studies of the future. Locally, the issue seems to be whether or not DU migrates from PTA, in particular, from the Radiation Controlled Areas (RCAs) that have been identified there.

The program designed and presented by the U.S. Army will not answer that issue. The proper approach would be to do whatever is practicable to discover if DU has migrated within or off the training area. As designed, the proposed program will not provide any information on the migration issue. In fact, it is designed to specifically avoid finding DU migration. The primary transport vector for individual exposure is inhalation and that involves air transport. Yet, specifically avoided in the monitoring plan is air monitoring. I am preaching to the choir. The NRC knows that to be true.

I have no doubt that the NRC staff is cognizant of the many misstatements and over characterizations of the Army proposed plan so I will only point out a few of the most egregious.

ERMP Sampling Procedures:

The proposal to use a single sample site at PTA for collecting sediment samples from a location identified as in the direction of stream flow is absurd. Sediment is an amalgamation of all the material transported by numerous feeder conduits (streams) in a drainage area. In effect, any sample will be highly diluted with background material from many areas, not just the RCAs (radiation controlled areas). The 234/238 U ratio can vary greatly in a natural setting. The ERMP states they will define depleted uranium as an activity ratio of 238/234 uranium greater than 3. At a minimum, scores of samples in and around PTA should be collected to measure this natural variability. Many should also undergo ICP-MS analysis for comparison and 236U should be included in the analyses.

There must be a full characterization of the drainage basin proposed for that single sample, taken quarterly. How does that particular site represent drainage from the RCAs? How are the tributaries, gullies, rills and streams connected through first, second, third order branches and beyond? What percentage of the sediment being sampled from that single site is derived from the RCAs?

From the figure shown in figure 2 of Annex 17, the arrows representing general drainage flow direction indicate nothing that may even intermittently flow through the RCAs to the sampling site. In other words, without further documentation, it is possible that the sediment sample does not represent any material from the RCAs.

It seems odd that sediment will be the sample of choice after a protracted commentary is presented on why surface water will not be collected.

The proposed sampling methodology presented in section 3.2 of Annex 17 is contradictory to standardized methods that would represent reality to minimal standards of quality assurance and quality control. Reference is made to Annex 19 and HASL 300. Annex 19 is largely a collection of data control sheets in which 17, 18, 19, perhaps 20 and 30 deal with sample collection and most important fields are marked TBD (to be determined). Most also present no sampling methods and refer back to the EMSP, in other words, a dead-end loop. From the copy of HASL-300 I was able to download, it contained no methodology for sediment sampling as proposed at PTA and for uranium analysis, it included a section U-04-RC on sample preparation for fluorimetry. (An alpha spectrometry method wsa given for urine analysis in U-01-RC.) It does suggest core sampling and confirms that open-field sediment sampling is not reliable because any sample is likely diluted by material from regions of non-interest.

The ERMP for Pohakuloa, annex 17, section 3.2 contains a list of 9 elements for a sediment sampling plan. I ask that you review them.

An introduction states that a sample for analysis is going to be a composite sample from 10 areas in the stream bed. Dilution is guaranteed!

Element 2 of the sample procedures says a sufficient sample should be collected for QA/QC purposes. What is a sufficient sample size? There must be some consistency, especially among the subset of 10 samples comprising the composite sample otherwise subjective bias is further introduced.

The composite sample will be placed in a sealable plastic bag (element 3). From this bag, it is stated that rocks, pebbles, leaves, and large twigs will be among debris picked out (element 4). How is debris defined? In standard sediment-size characterization, “rocks” is not a category. Pebbles range in size from 16 to 64 millimeters as would not pass through an appropriate-sized sieve. Cobbles range from 64 to 256 mm, and boulders are greater than 256 mm. Below pebbles in decreasing size are gravel, sand, silt, clay, and colloids, the latter representing particles less than 1 micrometer in size. This mischaracterization cannot be considered an oversight, but simply part of the trivialization of a sample collection procedure.

Element 5 is rather curious. It states that if water is contained in the sediment, the sediment will be allowed to settle and then the water poured off. Critical detail is missing. For how long will the sediment be allowed to settle? Seconds, minutes, days? How about using a centrifuge? The finer particles are likely to be suspended in water for a long time, and colloids, the size most likely to contain DU and DU oxide particles, will not settle but remain in the water phase, the phase that is to be discarded by the ERMP sampling technique. Permit me to state this in common understandable terms: the baby will be thrown out with the bathwater!

At a minimum, the water should be collected separately and analyzed for DU. Proper procedure should be used so that the colloid material remains in solution and is not separated out by surface charge attraction, say to the surface of the plastic container.

Element 6 of this procedure states that the sample will be homogenized by hand mixing it together in

the plastic bag. It does not take a rock scientist to know that such a maneuver will never achieve homogenization in a sample with even moderate particle size difference. Maybe it will work for jelly beans but not for unsorted sediment. There are devices available, usually called sample splitters, that have a better chance of homogenizing a sample.

Element 7 is to fill the appropriate sample containers. As the sampling process indicates, the sample containers from any one site will not contain representative sample so that replication or duplication of any analysis will be impossible.

Element 8 states the sample location will be marked with a stake. I would recommend that the "stake" should be equivalent to a surveyor's marker that includes a unique sample identification number and is semi-permanent (until intentionally removed) and that number can be referenced so that any future collector will be able to note where a current sample should be collected. One might hope a sample collecting team would be equipped with an electronic retrieval notebook of some form that would provide such information.

Element 9 states: *Additional details of the sediment sampling and the field procedures are provided in Annex 19.* As indicated previously, they are not.

There is nothing specific to the preparation of the sample prior to analysis (see discussion above concerning HASL-300). The laboratory doing the work, or preferably multiple labs, should be identified. Will the analysis involve a fraction of the sample, will it be sorted by particle size, will it be a full digestion and the analysis beof a solution? The answers to these and numerous other procedure questions are not present in the ERMP. Further, there is no information on quality of sample analysis including accuracy and precision. It is not presented how many times a sample will be run, if there are duplicates, standards or blanks. As it stands, the ERMP as presented to you is woefully inadequate.

The trivialization of the sample collection procedure and avoidance of analytical details is representative of the frivolous nature of the entire ERMP and representative of the intent not to locate DU. If you do not seek, you shall not find. And that is the tenant applied to this program. I ask that NRC not fall victim to this corruption of scientific procedure to suit the objective of never finding any DU.

<u>Sample analysis</u>:

There is very little detail given how the sample analyses will be performed. The specific lab procedures from the chosen analytical lab should be included or at least referenced. For example, it is unknown how the sample sent to the lab will be prepared for alpha spectrometry. Will it be the sediment sample (solid) or a dissolved sample (liquid), or a chemically processed sample? How will self absorption be treated? What is the protocol for using standards, replicates, duplicates and blanks? Too much information is missing to approve this plan.

<u>Water sampling</u>:

There is an interesting contrast between Schofield and PTA in reasons why ground water is not being sampled.

There is a protracted discussion concerning the porosity of the ground at PTA about how precipitation rapidly percolates into the ground and rarely, except in extreme downpours, is surface flow created. At Schofield, in contrast, regular precipitation creates numerous intermittent streams and because the ground is less porous, the water does not percolate to the ground water table. The actual limiting

condition is probably a scarcity of wells even though there is drilling for potable water sources at PTA and perched water tables have been found. But the reasons are more excuses not to sample ground water rather than sample access. Whenever ground water is encountered and if wells are available, ground water should be collected.

For surface waters, whenever available, they should be collected. In other words, during precipitation events that produce stream flow at the sediment collection sites, ground water should be collected. The reason is because the flowing water might carry in suspension the nanoparticles of DU and DU oxides that may be present.

The ERMP for Pohakuloa does note a standing body of water 4.5 miles from PTA. Sediment samples could be cored from this ponded area. HASL 300 does cover such sampling and analysis. It could provide an interesting historical record.

Erosion events triggering sampling:

The ERMP states that if a RCA site is noticed to have eroded to the extent that 25 square meters has lost 2.75 cubic meters of material, then that will trigger a sampling event. The likelihood of such an event in the environments at Schofield and PTA is improbable. Think of that quantity. A moderate-sized house may have a living area of 25 square meters, about 13 feet by13 feet. Now fill it with 6 inches of dirt. It would take torrential rains and headward erosion of deep soil-profile gullies to product that amount of erosion. But that topographical environment does not exist at the Pohakuloa RCA sites.

The most typical form of soil erosion at PTA is caused by winds. I am sure your staff has seen photos of the dust storms produced by winds at PTA, carrying soil particles thousands of feet into the air and to distances well beyond the boundaries of PTA. That is why air sampling must be part of the monitoring protocol. Erosion always occurs when strong winds are blowing at PTA.

Because of the paucity of stream flow, it is very likely the chosen sampling site will not be refreshed by water borne sediment between sampling intervals.

The primary transport of DU is going to be by an airborne mechanism. That must be included in environmental monitoring. There is mention of a standing water body 4.5 miles from PTA. That should be sampled, including sediment cores that can provide excellent record of history of deposition environment. In addition, mosses and lichens can be sampled.

Ground fires:

In short, air monitoring downwind of grass fires at PTA should be mandated, whether or not the fire is at an RCA.

Model that had proven to work:

There is an example of monitoring that works. It was in place at Rocky Flats, Jefferson County, Colorado. It involved numerous stakeholders, federal, state, corporations managing Rocky Flats, and included the regional population.

RESRAD:

Although RESRAD is a very eloquent model involving a hypothetical resident farmer, it is not fully appropriate in the situation at PTA where there is likely a very specific exposure route.

Tell me, if you would, what is the total radiation dose to adjacent lung cells from several 40 nanometer diameter DU particles lodged and not cleared in the lung for our mythical RESRAD farmer? The EPA models of local cellular exposure involving radon progeny may be more appropriate.

Take a 40 nanometer DU particle and put it in a 100 gram sediment sample and tell me you can detect it with whole sample alpha-spectrometry especially at a 234/238 ratio of 3 within a background ratio of 1. Provide a calculation on how much DU would be required to indicate that ratio in various sample sizes. I think the answer might be enlightening.

Sampling frequency and assignment to an individual of that task:

The sampling should be a full time job in order to ensure that the procedures are done properly and that important observations about the sampling site can be recorded and adjustment to procedure, if necessary, can be properly made.

Summary:

In sum, I ask that NRC reject the ERMP for Pohakuloa. Hawaii Island is an environment different from most of the other sites. One approach for all sites does not fit the Hawaiian environment. I recognize NRC must feel some pressure to approve the plans submitted by the Army, especially after many years of back and forth discussion, but reconsider them and do not simply rubber stamp them, especially those for Hawaii. If you are going to approve a plan, then at least for the sake of NRC's reputation have the decency to approve a proper plan, not one that is full of oblique sampling procedures, missing analytical descriptions, and mischaracterized justifications.

From: Cory (Martha) Harden [mailto:mh@interpac.net]
Sent: Tuesday, May 28, 2013 9:28 AM
To: 'Gary.Gill@doh.hawaii.gov'
Subject: comments on draft depleted uranium fact sheet

Please acknowledge receipt
Attachment is identical

Hello Gary Gill,

Thank you for your work on a Hawai'i DU Fact Sheet. Enclosed is "CONCERNS ABOUT DEPLETED URANIUM (DU) IN HAWAI'I", which I hope will be helpful.

To summarize concerns, I quote Marshall Blann, PhD, consultant at Los Alamos and Lawrence Livermore National Laboratories:

> "Many…papers find, in in-vivo experiments, that Uranium isotopes can cross the blood-brain and placental barriers, concentrate in heart, muscle, brain, lung tissue, overaires, testes, bone and lymph nodes…
>
> As the biological effects of radiation have been investigated more extensively, 'safe' exposure levels have been steadily revised downwards…
>
> ..the Pohakuloa area is used for bombing practice, using two-ton dummy bombs. If a bomb were to impact a DU casing, it could cause the pyrophoric DU to ignite, sending a plume of uranium oxide hundreds of feet high in the resulting convection current…
>
> …the radioactive uranium oxide plume would…disperse, not uniformly around the county, but would rain fine oxide particles preferentially in the community winning that day's radiation lottery. …The probability may be low, but the consequences may be high.
>
> ..detectors on the ground would not detect them. [alpha particles]"
>
> *[editorial by Blann, West Hawai'i Today, 9-6-09]*

I would add these concerns: DU that was never accounted for, questionable air monitoring, unauthorized Army activities with DU, Army proposals to avoid Nuclear Regulatory Commission (NRC) oversight, apparent misstatements in Army DU documents, and possible Army DU contractor bias.

Thank you for considering this information.

aloha,

Cory Harden, PO Box 10265, Hilo, Occupied Hawai'i 96721 808-968-8965 mh@interpac.net

CONCERNS ABOUT DEPLETED URANIUM (DU) IN HAWAI'I
for Gary Gill, Deputy Director, Hawai'i State Department of Health
May 28, 2013
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(see end for profiles on people who were quoted frequently)

The Army didn't know, or didn't tell, about DU in Hawai'i, then was "outed" by citizens.

[the Army has been] "repeatedly denying depleted uranium use here, most recently in the March 2005 draft environmental impact statement for Makua and at a public hearing for the Stryker brigade EIS in 2004." *[Schofield uranium find prompts calls for probe, Honolulu Advertiser, 1-6-06]*

"Schofield Barracks, Hawaii--In August 2005, 15 tail assemblies from spotting rounds made of D-38 uranium alloy, also called depleted uranium (DU), were recovered…"
[1-5-06 media release by U.S. Army Hawai'i]

"The Army statement was issued several hours after a DMZ Hawai'i/Aloha 'Aina news conference announcing the e-mail findings [revealing the Army had discovered DU]…" *[Schofield uranium find prompts calls for probe, Honolulu Advertiser, 1-6-06]*

The Army planned and conducted unauthorized activities in DU areas.

""The Corps [Army Corps of Engineers] had planned to begin the $80 million [Schofield] construction project with a controlled burn at the range. Instead, NRC staff warned the Corps that it risked sanctions if it proceeded because it has no license to possess, decommission or transport radioactive depleted uranium at Schofield …
the Army conducted an unauthorized cleanup of soil contaminated by depleted uranium at Schofield in 2008…[NRC attorney Brett Klukan told Honolulu Weekly] that the NRC had advised the Army that areas with depleted uranium should not be disturbed." *[Stryker brigade snag, Honolulu Weekly, 11-3-10]*

"…it appears that the scope of activities actually conducted at Schofield Barracks in support of BAX construction, including soil removal and testing, prior to the January 13, 2010 oral argument may be far broader than that described by counsel for the Army at the oral argument." *[letter to Army Col. Gregory Baldwin from Keith McConnell of NRC, 11-4-11]*

"…NRC staff raised concerns regarding the Army's legal authority to perform construction activities at the Schofield Barracks installation, Army statements made during oral arguments before the Atomic Safety and Licensing Board (ASLB) regarding the U.S. Army's possession-only license application at the Pohakuloa Training Area and Schofield Barracks, and Cabrera's legal authority to perform work for the USACE at the Schofield and Pohakuloa installations… *[letter to Dr. Cherry of the Army from Keith McConnell of NRC, 11-24-10, ML103160174]*

Sweeping Army proposals for less oversight were rejected by the Nuclear Regulatory Commission (NRC). *[quotes from Staff Assessment enclosure in memorandum from Dominick Orlando of NRC to Andrew Persinko of NRC, 12-27-12, ML12354A165, bold and indentations added]*

The Army **claimed the spotting rounds did not require a license**, based on a RESRAD "computer model code designed to estimate radiation doses and risks" .

NRC disagreed, saying RESRAD "does not attempt to simulate the environmental conditions present during ground disturbing activities such as a fire or use of high impact explosives and therefore is not relevant to the requirements for air monitoring." *[pp. 1-2]*

"The Army is requesting that NRC **not require environmental radiation monitoring plans.**

> The NRC staff has determined that…some environmental monitoring is necessary." *[p. 3]*

"The Army requests that staff **not require monitoring** when personnel or equipment exits the Battle Area Complex (BAX) Radiation Control Areas (RCAs) after training exercises because the Army did not detect contamination on personnel during BAX construction and because the Garrison does not have the equipment or personnel to support monitoring.

> The Army did not provide data supporting their statement that they did not detect contamination on personnel or equipment during BAX construction…[NRC] staff does not agree with this request." *[p. 3]*

"The Army requests **relief from environmental monitoring at all DU ranges**.

> Because each site will entail different environmental conditions, the [NRC] staff cannot determine *a priori* if environmental radiation monitoring plans will be necessary…[NRC] staff does not agree…" *[p. 3]*

"The Army requests that all changes made to the requirements for installations named in the license be applicable to any newly identified installations…

> [NRC] **conclusions** regarding the type of information necessary to support an amendment to include the unidentified installation on the license **cannot be drawn *a priori***…[NRC] staff does not agree…" *[pp. 3-4]*

"**The Army states that [their directive]… does not prohibit firing high explosive rounds into areas containing DU.**

> **This statement appears to be inconsistent** with previous statements made by Army staff since 2010….[NRC decided] If the Army were to implement air monitoring adequate to detect airborne depleted uranium during ground disturbing activities, including firing high explosive ordnance into the RCAs, the license condition could be revised." *[p. 5]*

"The Army requests [revision to]…the license condition [that] applies to site decommissioning and activities that would require the ground to be disturbed with the intent to release the site or portion of the site for unrestricted use and remove it from the RCA…

> In the past **the Army has performed decommissioning activities at HI sites** and determined that the areas are suitable for release for unrestricted use. The license condition, in conjunction with conditions 22-24, are necessary to ensure the Army complies with …NRC's decommissioning regulations…the [NRC] staff does not agree with this revision." *[p. 5]*

"The Army requests that the NRC delete the requirement to inform NRC of intended decommissioning at its HI installations…

> in the past **the Army has performed decommissioning activities at HI sites** and determined that the areas are suitable for release for unrestricted use. The license condition, in conjunction with conditions 21-24, is necessary to ensure that the Army complies with the requirements of 10 CFR 40.42." *[pp. 5-6]*

"The Army requests that the requirement to perform **continuous air monitoring be deleted**…

> [but] the Army's burn data had large uncertainties…[and] RESRAD does not attempt to simulate the environmental conditions present during ground disturbing activities such as a fire or use of high impact explosives…the [NRC] staff does not agree with this requested revision." *[p. 6]*

"The study the Army provided to support the license application concludes that there was plant uptake of DU.

> NRC staff believes that was an inaccurate conclusion because the **data collection was compromised** by mixing the plant ash with soil beneath the plant that contained oxidation products…The only Army studies that have shown plant uptake have been in the plants that absorbed the DU from contaminated surface waters. Therefore, the [NRC] staff does not agree with this revision." *[p. 7]*

Concerns were raised about air monitoring methods.

"A contractor performed air sampling for a year at PTA from February 2009 to March 2010. From the limited description of the procedure (page 34) it appears standard equipment was used for the air sample collection. Although the type of filter and its pore diameter are not mentioned, and the studies appear to be diligent within some imposed limitations, it is noted that the analysis of the filters was for uranium as a portion of the total suspended particulate collected, and not DU. Consequently, it is unknown how much of the total uranium was DU. Further, without knowing the pore diameter of the filter, it is not known how much respirable particulates, including DU are revealed by this monitoring. It is believed the tables used for health guidelines are only for natural uranium…" *[comments on the September 10, 2012 "Army Response to US Nuclear Regulatory Commission (NRC) Proposed License Conditions for Davy Crockett M101 Spotting Round Depleted Uranium (DU)" by Reimer, 10-22-12]*

"My review of the sampling methods used, especially airborne collections, indicate that the methodology was one that would not find DU at the probably anticipated concentration levels." *[e-mail from Reimer to Dominick Orlando of NRC, 7-13-12]*

"First Ask Dr Morrow what did he find versus background control areas in Hawaii. Ask Dr Morrow point blank if his levels exceed or not the IOM health threshold cited by the Army in their appendix. Trick question – no health levels could be set! Ask if the EPA and WHO data specifically cover aerosolized DU dust from weaponry – there are big qualitative differences here." *[9-3-10 e-mail from Pang]*

"I felt that the contractor for the Army, Jim Morrow, was extremely knowledgeable about DU and sampling methods. He is limited by the specifications of the contract…" *[e-mail from Reimer to Harden, 10-27-09, 5:05 PM]*

"…DOH tries to make a survey more sensitive by only considering fancy machinery--they do not seem to appreciate or understand that increased sampling number and sites also makes the survey more sensitive--especially when the target is not homogenous in place and time." *[e-mail from Pang to Jim Albertini, 9-22-09]*

The Army's DU contractor appears biased.

Cabrera Services, which did studies and operations on Hawai'i DU, calls findings of little radiation risk, in Hawai'i and elsewhere, "successes".

Excerpts from a Cabrera brochure—

> Continued to establish **evidence of NO DCSR** [Davy Crockett spotting rounds] **at Makua** and narrowed down the likely **impacted areas at PTA from 2500+ acres to under 500 acres**
>
> Performed Human Health Risk Assessment for SB (Schofield) BAX Construction Area **finding no appreciable risks exist at site…**

Negotiated with NRC and State of Kansas to **dispose of 97% of soil as non-radioactive**…

Negotiated approval for non-rad disposal of over 5,000 cubic yards…

CABRERA performed radiological/chemical characterization and developed a risk assessment model to quantify radiological and chemical risk, **justifying no further action** …

Achieved no further action at LCAAP range, avoiding potential impact to munitions production…

CABRERA has similar successes at other DoD penetrator sites…

[Davy Crockett Spotter Rounds, http://www.cabreraservices.com/media/DCSR%20Program%20Summary.pdf, bold in original]

Concerns have been raised about Army documents on DU.

- **Army Response to US Nuclear Regulatory Commission (NRC) Proposed License Conditions for Davy Crockett M101 Spotting Round Depleted Uranium (DU), September 10, 2012**

DU may migrate much farther than the Army claims.
"There is a generic claim that DU, with a high physical density, cannot be transported more than 100 m. This is an example of misinformation. Transportation distances depend in large part on the size of the material. Generally, larger dust particles have rapid settling velocities but aerosol sizes are influenced by factors other than gravity to determine transportation distances. Even so, dusts from deserts are blown thousands of kilometers before deposition (R.B. Husar et al., 2001, JGR-ATM. 106 (D16): 18317-18330)." *[comments by Reimer, 10-22-12]*

- **Environmental Radiation Monitoring Plan for Pohakuloa Training Area, submitted to NRC, prepared by U.S. Army Corps of Engineers for Army, February 3, 2012**

The plan may contradict previous Army statements that fires could NOT generate tiny DU particles.
"In order to produce particles with an activity median aerodynamic diameter (AMAD) less than 5 µm, M101 rounds must be physically acted upon, impacted or heated to temperatures over uranium's melting point of 700-1,000 degrees Celsius (Army Environmental Policy Institute (AEPI), 1995). **The type of activities that could potentially produce DU particles in the 5-µm AMAD range** are: 1) use of heavy equipment on former M101 ranges could, through mechanical grinding of M101 rounds; 2) kinetic impacts between munitions and M101 rounds; and 3) **incidental range fires or prescribed burns** by range personnel to control vegetation." *[Plan, p. 15, bold added]*

"Under certain circumstances and at very high temperatures, **DU can aerosolize**. Research by military and non-military agencies confirm that **this does not occur during brush fires**." *[2007 Army Information Booklet/ Depleted Uranium (DU) in Hawaii, p. 5, bold added]*

Only about 1,000 of the 51,000 acres of the Pohakuloa impact area were closely surveyed.
"Aerial gamma surveys and gamma walkover surveys (GWS) surveys [sic] were performed over a total of 936 and 50 acres, respectively." *[Plan, p. 6]*

DU may settle in "hot spots"--not be evenly distributed. (*see next section)*
"The 299 pounds of DU was assumed to be evenly distributed over an area of 10,000 square meters to a depth of 0.457 meters (18 inches)." *[Plan, p. 12]*

- **Final Pohakuloa Training Area Firing Range Baseline Human Health Risk Assessment for Residual Depleted Uranium, submitted to Army by Cabrera Services, June 2010**

DU may settle in "hot spots"--not be evenly distributed

"To estimate the dosage workers in the area might encounter, the starting point [in Army reports on Hawai'i DU] was a radioactivity density obtained by dividing the estimated total amount of DU used in the training/firing area, by the area of the range to get the radiation per unit area. Sounds mathematically obvious, but let us (at least my fellow ancient mariners) think back to the cold war days of atmospheric testing of nuclear weapons in the upper atmosphere. With the assumption that the total radiation produced was divided by the surface area of the earth, it might have been estimated that the fallout would be at 'safe' levels. Unfortunately for this mathematical construct, many folk bought Geiger counters and checked around their neighborhoods, thousands of miles from 'atmoshpere zero'. The meters would give an occasional 'beep', then the detector would pass over a tiny speck of ash and the speaker would go crazy, the needle would 'peg out' at maximum radiation level for the meter.

The radiation had not spread uniformly according to the assumption, but fell out in tiny highly toxic pieces of ash, fluctuations from a safe average. The dangers of this potentially lethal fallout were recognized (after citizen groups called it the attention of their governments), and in a cold war these feuding governments signed a treaty banning further atmospheric testing…" *[comments by Blann; final draft published in West Hawai'i Today about 10-8-10]*

There is no "safe" level of radiation.

"The present industrial standard to my own experience, is 'ALARA', an acronym for 'As Little As Reasonably Attainable'. This is because in the past, the published 'safe' doses were adjusted downward by huge factors (e.g. to 1/3 last values), and it was finally realized that there is no 'safe' level. Each bit of exposure increases risk of biological damage. And workers on the range (and possibly citizens outside) are subject not to average levels, but the fluctuations along their daily path.

Because all labs in which I worked would immediately clean up any 'spill'- i.e. uncontained spread of radioactive sources, the recommendation to 'leave in place' the contamination at the range comes as a surprise. It will not be practical to recover it all, but an action in between, coupled with procedures to mitigate spreading outside the range seems prudent." *[comments by Blann; final draft published in West Hawai'i Today about 10-8-10]*

[the BHHRA]"…ignores U.S. Environmental Protection Agency's pronouncement that any exposure to ionizing radiation linearly increases risk." *[9-4-10 Commentary by Michael Reimer in West Hawai'i Today]*

DU increases in radiation over time.

"DU, unlike other radioactive materials that have decreasing radiation over time, DU actually increases in radiation, small but detectable. .."*[9-18-10 e-mail from Michael Reimer]*

DU may contain other isotopes.

"… if uranium is processed from spent fuel rods, because nothing can be absolutely pure, it retains some of the fuel rod isotopes…Uranium -236 is a good indicator of fuel rod processing and should be looked for when doing analyses. In fact, the spotting round fragments shoudl [sic] be analyzed to answer this question." *[9-18-10 e-mail from Michael Reimer]*

"I further challenge someone to prove there are no other transuranic radio elements in the DU alloy, such as neptunium, plutonium, or for that matter even other isotopes of uranium…" *[9-4-10 Commentary by Reimer in West Hawai'i Today]*

[Jim Morrow, contractor for the Army] "felt frustrated that the Army would not analyze one of the DU fragments to see if it contained transuranics and what the DU ratios were." *[9-3-10 e-mail from Mike Reimer]*

Other concerns…

"…the recently released Baseline Human Health Risk Assessment from depleted uranium on the Big Island is, at best, an estimate using scant empirical isotopic data to substantiate its conclusions… The risk assessment is the conclusion of a single model approach and there are numerous models that could have been used in determining risk. I take issue with the…claim that DU has 40 percent less radioactivity than natural uranium…It is misleading and technically wrong…. I challenge anyone to tell me in good conscience that the DU remaining at PTA from the Davy Crockett tests in the 1960s has 40 percent the radioactivity of natural uranium. … consideration of alternate expression of risk should be discussed and included… It ignores the emerging science that DU and its alloys or oxides in lesser quantities than natural uranium may indeed elevate risk from exposure. It ignores the fact that 40-plus years of bombing may have created aerosols capable of rebound or resuspension and be transported many miles anytime there is renewed disturbance of the surface." *[9-4-10 Commentary by Michael Reimer in West Hawai'i Today]*

"They mention oxides but did not enter their factors of insolubility into the risk equation. They need to be weighted regarding their comparatively slow (50 fold) clearance from the body due to aqueous insolubility." *[9-4-10 e-mail from Lorrin Pang]*

The report is "ignoring the form of Uranium as an oxide" *[9-1-10 e-mail from Mike Reimer]*

Jim Morrow "is measuring total uranium, not DU. So of course his risks show 10,000 times less based on U exposure. He must then ASSUME U and DU are the same and that has not been proven." *[9-1-10 e-mail from Mike Reimer]*

- **Final Technical Memorandum for Pohakuloa Training Area (PTA) Aerial Surveys, prepared for Army by Cabrera Services, July 24, 2009**

Over 2,000 spotting rounds may have been fired at Pohakuloa, based on three lines of evidence: old training manuals, the number of pistons found, and the Archive Search Report.

Manuals:

"U.S. Army Colonel Killian…said the types of exercises conducted at PTA (Pohakuloa Training Area) would require the firing of at least 2,050...spotting rounds." *[Depleted Uranium at Pohakuloa, West Hawai'i Today, 2-4-09]*

"**Killian** …if you go through the training manuals of the era…it would require more than 714 rounds over an 8 year period of time to qualify the requisite amount of crews…
Councilmember Hoffmann Is there any possible support for a figure of 2,000 spotting rounds at PTA?
Killian If you, if you do the math, if you extrapolate the math with the, the contemporary training manuals I think you'd come up with number of 2, 050."
[from Harden's transcript of the official DVD of Hawai'i County Council Public Works & Intergovernmental Relations Committee meeting, 2-3-09]

Pistons:

"An environmental consultant [Peter Strauss, hired by Sierra Club] estimated there may be as many as 2,000 depleted uranium rounds at Pohakuloa Training Area…The consultant's analysis

was based on an Army report estimating that between 120 and 400 firing pistons are scattered around impact ranges at PTA…Each piston would have fired up to five of the DU rounds, for a total of between 600 and 2,000 rounds fired, Strauss said." *[Sierra Club consultant disputes Army's DU tally, Hawai'i Tribune-Herald, 8-26-08]*

Archive Search Report
"Total rounds verified shipped from Oahu from Lake City Ordnance Plant were 714 rounds… It is highly probable that additional stocks of the Cartridge, 20 mm Spotting M101 were order [sic] from one of the Ordnance Depots (Letterkenny or Pueblo) during the six active years of the Davy Crockett Weapon System in Hawaii." *[ASR p. 41]*

Thorough surveys were impossible.
"The Army acknowledged in its license application that rough terrain and hazards presented by unexploded ordnance made it impossible to conduct a thorough survey for DU at Pohakuloa and Schofield." *[Waste not, Honolulu Weekly, 10-17-12]*

"…the overflights are using equipment to detect very low energy gamma rays from the decay of the material. They have stated that to detect a spotting round, it must be at the surface and to detect fragments one-third the size of the spotting round, they can be buried no deeper than 2-4 inches." *[e-mail from Reimer to Harden, 12-18-09]*

Instead of 2,000 spotting rounds, only a few rounds and fragments were found. Cabrera speculated the missing rounds had been cleaned up.
"…the team located a Davy Crockett SRB…" *[Final Technical Memorandum, Depleted Uranium Scoping Investigation, Makua…Pohakuloa…Schofield…prepared for Army by Cabrera Services, p. 4-3]*

"Ground based GWS [Gamma Walkover Survey] located and identified 2 DU metal fragments, one essentially intact spotter round body with no tail fin assembly...and one aluminum tail fine [sic] with some DU spotter round body still attached. …
The number of DU spotter round bodies, aluminum fin assemblies and DU fragments are much fewer than would be expected given the total number of pistons which were identified.
This fact, and in comparison to the number of DU fragments and portions of the Davy Crockett spotter rounds found at Schofield Barracks, suggests that some type of range clearance may have occurred at PTA." *[Memorandum pp. 5-1 to 5-2, indentations added]*

But there are other possibilities.
"…the "ENVIRONMENTAL RADIATION MONITORING PLAN FOR DEPLETED URANIUM AND BERYLLIUM AREAS, YUMA PROVING GROUND" (Ebinger and Hanson, Los Alamos Report LA-UR-94-1838, May 11, 1994) prepared for the U.S. Army Test and Evaluation command [notes]…fired rounds have the propensity of skipping across the surface, like a thrown stone skipping across water, ending up at distances much greater than the calculated range of the munitions.
…as the firing ranges searched for DU have been used for training with explosive ordinance and vehicular traffic after DU was used, the DU may have been highly distributed as aerosols from the decades of continued explosions and grinding under tires and tracks of vehicles. Now continued use of these areas will only result in the continuous airborne resuspension of the material." *[e-mail from Reimer to Dominick Orlando of NRC, 7-11-12]*

"[perhaps] …the searches were conducted in areas that were not primary target areas." *[e-mail from Reimer to Harden, 7-8-12]*

"…Fort Benning range personnel recently found a Davy Crockett piston on a range that previously was not an area of interest to the research team." *[Robert Cherry of the Army speaking at a November 16, 2010 meeting with the Nuclear Regulatory Commission (NRC), from meeting transcript, pp. 34-35]*

Aerial searchers looked for highly visible back/ rear plate assemblies as markers for old spotting round areas.

> "The components of the Davy Crockett system particularly back plate assemblies and windscreens have a very distinct coloring as seen in photos 4-4 and 4-5 [actually 4-9 and 4-10] and are readily observable from the air." *[Memorandum, pp. 4-26 to 4-27]*

But the Davy Crockett could be fired from a truck. [[Archive Search Report On the Use of Cartridge, 20mm Spotting M101 for Davy Crockett Light Weapon M28, Schofield Barracks and Associated Training Areas, Islands of Oahu and Hawai'i, Army Corps of Engineers, May 2007, p. 3-11]
This might leave back/ rear plate assemblies on the truck instead of on the ground.
Hawai'i had 14 trucks for the Davy Crockett. [ASR p. C-291]

Hazardous disposal practices were used during the spotting round era.

> "…until the late 1960s, ocean dumping was one of the ways chemical agents and munitions were routinely disposed of since World War I. The other means were **open-pit burning and land burial**…" *[Honolulu Star-Bulletin, 11-9-05, bold added]*

The spotting rounds might have been treated as scrap, since a 1961 study recommended

> "that all spotting rounds be left in the impact area and that the impact area not be considered a radiation area. This suggestion was favorably considered by the…Atomic Energy Laboratory [of the Atomic Energy Commission] *[Uranium Alloys for Critical Ordnance Components, Watertown Arsenal Labs, 23 Oct 1961, p. 3; ASR p. 5-26 and p. C-120]*

A memo describes how scrap from range clearance (not DU, not from Pohakuloa) was dumped into a crater in 1962--

> "The 6th Ordnance Detachment (ED) conducted range clearance in the Lalamilo Farm Lot, near Kamuela, Hawaii, during 19 February 1962 through 2 March 1962. Recovered were 800+ items of which 333 were destroyed by demolition and the remaining items were classified as scrap. With permission received from the Base Camp Commander, this scrap was dumped into a crater in the artillery impact area at Pohakuloa." *[Appendix C-20, NARA College Park, Maryland (CP), Report for HQ, United States Army, Hawaii, APO 957 entitled Staff Office Report, Office of the Ordnance Officer, January-March 1962, dated spring 1962, RG 550, Records of the United States Army, Pacific, Entry 17, U.S. Army Hawaii 1959-1963, Box 10, CP-121406-003, in ASR, p. C-296]*

Contrary to the Technical Memorandum, DU seems to be present, and in the dangerous oxidized form, and mobile.

"The report makes a comment that from the soil sampling done at PTA, there is no evidence that DU is present. This is based upon isotopic analysis of uranium and that the signature is not consistent with that of DU.
Insufficient information is provided to state that conclusion and the data provided do, in fact support the alternative conclusion. The results of a 2007 soil analysis is presented in Table 2-1 and the location of the nine samples are referenced to Table 2-3. There is no table 2-3 but the locations do appear on Figure 2-2. Table 2-1 lists the activity for uranium isotopes. The soil samples were collected in areas where sediment had or may have collected from past

runoff or erosion. That seems to indicate it could be a time integrated sample with several or multiple sources along the lines of flow contributing to the sediment accumulation. The text on page 2-3 states “None of the results indicate uranium depletion, where the 234-U activity concentration is significantly lower than the238-U activity concentration.”
Although it might be useful to define “significantly lower,” the amount as presented by the IAEA in a question and answer information sheet should suffice to indicate this magnitude.
http://www.iaea.org/NewsCenter/Features/DU/du_qaa.shtml
The activity ratio of natural uranium 234/238 is 1, suggesting secular equilibrium. The activity ratio of depleted uranium 234/238 is 1:5.5, a lower value, and up to the reader to determine degree of significance.
Of the 9 samples listed in Table 4-1, three have activities of 234-U below that of 238-U. Sample 4011 is 25 percent lower. A reasonable challenge to the “no DU” statement can be made based on the analytical results and the method of sample collecting. As the sample could be integrated over time and derived from several locations, it is very likely a mixture of natural and DU contaminated soils. Thus, DU is not only present but it is mobile!
…The report states (page 2-3) “The visual and scanning surveys identified no distinct surface areas with yellow, oxidized DU metal fragments.” Yet the figure Photo 4-1 (page 4-7) clearly shows a partial metal DU fragment of a spotting round with yellow coloration on its surface. Later (page 4-8), the report states that only very minor oxidation is present, but again the subjective characterization is open to interpretation. Regardless, there is oxidation present and the oxidized form is readily converted to aerosols and thus available for migration.
[e-mail from Reimer to Harden, 10-27-09 6:08 PM]

[Army] “reports on airborne U concentration state they follow the WHO guidelines on soluble uranium…DU and DU oxides are not soluble (have a low solubility). I think WHO groups the two anyhow. Also, ASTDR (agency for toxic substances and disease registry) looks at chronic exposures and uses soluble uranium as a guide. When entrained in your body, the soluble U has a more rapid clearance time and is considered less of a health risk.” *[e-mail from Reimer to Harden, 9-25-09]*

Helicopter searches may have failed to find DU because rotor wash blew it away.
“This report primarily summarizes on an air mapping of the Pahakuloa Training Area to search for DU, and oxides of Uranium which may have resulted from DU on the range. I would like to analyze the sensitivity/adequacy of the methods used. Before getting to those calculations, I would make comments on the technique used, and on the data for alpha spectrometry presented in the report.
“Data collection:
A set of 4 NaI detectors were used under a helicopter flying at 3-4 meters altitude.It was noted on p 4-15 of the report that flight restrictions were required " due to the presence of lightweight debris (plywood, aluminum scrap, aluminum target, and munitions debris) which could become airborne due to helicopter rotor wash. Volcanic dust limited the minimum altitude in places throughout the range". It seems reasonable to assume that the Uranium oxide dust, a contaminant critical to measure, would likewise be blown away by the same rotor wash before it could be measured.” *[comments by Blann, 7-24-09]*

The soil sample analysis method may have been inappropriate.
“Alpha spectrometric results:
Table 4-1 gives results for soil sample analyses by alpha spectrometry, on p. 4-1 " by a NELAP accredited laboratory using method ATSM-D3972."
I assume that this meant to be "ASTM-D3972", which is a protocol for testing water samples for U. Water samples differ from soil samples, especially if trace alpha emitters are the focus. The protocol cited is not valid. How was a weightless sample obtained for the alpha spectroscopy?

The soil sample would have to be completely dissolved. Before running through an anion exchange column to get the U fraction, how was the bulk of silicon etc. removed? If by precipitation, then likely trace radioactivities were co-precipitated and lost to the sample. My point is, that there is a lot of chemistry to be done before being able to do meaningful alpha spectrometry on a soil sample; citing an inapplicable protocol leaves me with no confidence in the table presented. "Trust me" is not an acceptable basis for a scientific report." *[comments by Blann, 7-24-09]*

Aerial survey methodology may have been inappropriate.
"Results of aerial survey:
Is the methodology appropriate to the task? In flyover radiation counting, 4- 4 liter volume Tl activated NaI detectors were used to gather gamma spectra, looking for 766 and 1001 keV photons emitted by 234mPa decay.To evaluate sensitivity, we need to know the branching ratios for the gammas observed, the photopeak efficiencies of the crystals for those gamma energies, and the detector solid angle. Tthe 1001 keV gamma has a branching ratio (abundance per decay) of just 0.8% (0.008)[NIM in PhysicsResearch, A424(1999)425-443], and the 766.36 keV gamma has a branch of 0.294, with a transition at 781.37 (0.00778 branch) which would be non-resolvable from the 766 using the NaI crystals of this measurement. I do note a discrepancy in branching ratio for the 1001. KeV photon with a branch of 0.837 in the Nuclear Data Table result, vs. the 0.0083 of the published research paper. The latter result seems accepted in other works- but this point needs further scrutiny. If the published paper cited is correct, Cabrera was seeking a phantom." *[comments by Blann, 7-24-09]*

Blann recommended a "more sensitive assay of ground radiation".
"Solid angles: The altitudes cited were of 3-4 meters height. NaI detectors are usually right circular cylinders with PM tube mounted at the top of the cylinder with suitable reflector/light pipe. Resolution is poor for these detectors (e.g. vs. (HP)Ge), and the photoefficiency for the 2 gammas of interest is not cited- a guess might be around 0.4 (40%). Lacking the data on detector geometry, we might generously assume a cubic 4 liter crystal, so that one face would be 252cm**2. At 3 meters height, the area of a sphere would be 1.13x10**6 cm**2 (1.13 million square centimeters), so the solid angle of one NaI detector would be 2.2*10**(-4) . At 4 meters altitude the solid angle would be reduced to 1.25*10**(-4).
Count rates required for detection: The report states that the detector system travelled at 2-3 m/sec, with countsbeing taken at 1 second intervals. My own guess is that a minimum of 50 counts of either gamma would be required to resolve the appearance of a possible peak rising above the Compton scatter plus cosmic ray background. Trying to concentrate analyses of these gammas on just' regions of interest', without a proper unfolding of photo/Compton responses, beginning at the highest energies and working down, or by simultaneous least square fitting, is to my opinion asking for questionable results.
If the solid angle is 2.2*10**(-4), the BR(branching ratio) is 0.294, and the photopeak efficiency of the detector is 0.4, the number of dps necessary averaged over the 2-3 meters travelled, will be (50 counts detected)/[(0.4 photopeak efficiency)*(0.00022solid angle)*(BR=0.26 or 0.008)= 1.7*10**6 or 5.5*10**7 Pa234 dps. Since there is transient equilibrium with 238U, 234Th and 234Pa- and 234U, the actual dps implied will be triple these numbers. If the altitude during sampling were 4 m, these numbers would all be approximately doubled due to reduced solid angle. I have not divided by 4 due to use of 4 detectors, because I believe that each will require the 50 counts to be able to separate peak from background. If better detail had been given in the report, this point could be based more on fact than experience. From this exercise I deduce that the gamma ray measurements would only yield positive detector response if the average ground radiation levels were 4.5 milliCuries for the 1001 keV gamma, or nearer 0.15 milliCuries for the 766 keV gamma.

These levels are the noise levels below which I believe definite, reliable 'signals' would not be received by the apparatus used. The gear apparently had no anti-coincidence shielding, nor was discussion given of any attenuation between 'sample' and detector. I do not feel that this lower level of radiation gives confidence in the safety of the facility for personnel working there, nor does it address the question of possible migration of oxides offsite over the past 40 years. A more sensitive assay of ground radiation should be undertaken." *[comments by Blann, 7-24-09]*

- **Final Technical Memorandum, Depleted Uranium Scoping Investigation, Makua...Pohakuloa…Schofield…prepared for Army by Cabrera Services, April 2008**

  Difficult, dangerous conditions prevented a thorough search at Makua.
  "…the vegetation was very dense, and the aerial survey was limited to ravines and dry stream beds. No pistons were spotted during the aerial survey of MMR. Physical entry to range areas was precluded by safety concerns… No DU fragments were identified at MMR." *[Memorandum p. 4-1]*

  Some identical text appears in reports for different sites.
  "…the final technical report reads the same of PTA as it does for Makua." *[e-mail from Reimer to Harden, 10-1-09]*

  Identical photos—with different labels—appear in reports for different sites.
  "In the Makua technical memorandum, the text refers to figures 4-4 and 4-5 showing oxidized parts of DU spotter rounds. Both photographs are labeled photo 4-5. The same two photos appear in the PTA final technical memorandum labeled as 4-9 and 4-10 but are not referenced in the text as far as I noticed. One might reasonably ask if these parts are from Makua or PTA or are they simply staged photos for illustrative purposes?" *[e-mail from Reimer to Harden, 10-1-09]*

- **Final Characterization Report, Schofield Barracks Davy Crockett Impact Area, April 2008**

  Again, difficult, dangerous conditions prevented a thorough search.
  "Due to the steep slopes and safety considerations, a GWS (Gamma Walkover Survey) was not performed of the ravines." *[Report p. 3-5]*

- **Final Technical Memorandum, Schofield Barracks Firing Range, Monitoring of Air Quality During Burning of Vegetation, by Cabrera Services for the Army, April 2008**

  NRC criticized the study.
  "…the Army's burn data had large uncertainties…" *[Staff Assessment enclosure in memorandum from Dominick Orlando of NRC to Andrew Persinko of NRC, 12-27-12, ML12354A165]*

  Surface scrapes of ash, soil, twigs and sticks were substituted for ash samples.
  "The sampling design for collecting ash samples was to place vegetation in a foil tray during the burn and collect ash from the tray following the burn. However, activities of the Army personnel during the prescribed burns and high winds potentially affecting the ash or the foil trays made this approach impractical. Therefore, ash samples consisted of surface scrapes that included a mixture of soil and ash…" *[Memorandum p. 2-3]*

  "…surface scrapes were used to collect ash samples, although some surface soil and solid material (e.g. twigs, sticks) were included in the samples. The wind continually stirred up the ash making it difficult to collect ash samples." *[Memorandum p. 3-4]*

"I am truly unimpressed at the care in some sample monitoring at Schofield…when the wind was too strong to collect the filters for aerosol determination, some brushings from the soil were used instead for analysis." *[commentary by Reimer, West Hawai'i Today, 9-4-10]*

One air sampler failed.
"…eight air samplers were deployed around the test burn area…Following the test burn it was found that the air sampler for filter 1050 had shut down during the test burn. …Air filter 1050 was analyzed to provide qualitative information on the presence of DU." *[Memorandum p. 3-4]*

Some post-burn samples were collected away from pre-burn sample sites.
"…three of the locations where pre-burn soil and vegetation samples were collected had not been burned. … Five ash samples were collected from locations where sufficient amounts of ash were present for sampling, but not corresponding to the soil and vegetation sample locations selected prior to the burn." *[Memorandum p. 3-4]*

Pang says the study shows DU contamination and numbers were too small for analysis.
[the Memorandum] "…uses U 238: U 234 ratios and clearly shows the targeted burn site was highly contaminated with DU. …For air sampling the numbers are too small for statistical analysis…" *[e-mail from Pang to Harden about May 2008]*

- **Army Information Booklet/ Depleted Uranium (DU) in Hawaii, 2007**

There are contradictory statements about the size of DU remnants.
"…the uranium primarily exists as large metal fragments…" *[Booklet p. 5]*

"Most DU found in the Schofield impact area is in the form of flecks and grains.." *[Booklet p. 5]*

"DU fragments have been observed throughout SBIA [Schofield Barracks Impact Area] as discrete metal fragments and as fine particulate matter." *[Schofield Characterization, p. vi]*

The Army did not do monitoring as promised.
The booklet says

> "The Army will…continue to monitor these ranges to determine whether migration occurs." *[Booklet p. 6]*

Later I wrote to Col. Killian

> "Was there any monitoring for airborne DU or other radioactivity during or after impacts from several 2,000-pound bombs dropped on October 23, 2007?" *[letter from Harden to Killian probably in 2008]*

He wrote back

> "The Army did not monitor these events." *[letter from Killian to Harden, 4-15-08]*

<u>Concerns were raised about a civilian report.</u>

Waiki'i Ranch DU Report July 2008
Including: Report on Uranium Isotope Analysis, done for Waiki'i Ranch by Prof. Randall Parrish, NERC Isotope Geosciences Laboratory, British Geological Survey

DU was found at the detection limit of the technique, so the actual measurement could range from zero to twice the measured value.
"The value of this quantity we measured in your sample was 5 x10-7, in other words this measurement is just at our detection limit." *[Report on Uranium Isotope Analysis, done for Waiki'i Ranch by Parrish]*

"The analysis showed a uranium ratio suggestive of DU but at a concentration that was close to the lower detection limit of the technique, resulting in a "trace within a trace", but it was still there!" *[comments on the September 10, 2012 "Army Response to US Nuclear Regulatory Commission (NRC) Proposed License Conditions for Davy Crockett M101 Spotting Round Depleted Uranium (DU)" by Reimer, 10-22-12]*

"Initially the army argued that since the uncertainty of the measurement was plus or minus 1% and 1% was found perhaps the real value could be zero—and so they declared that none was detected. It was pointed out that it could have equally been 2%--and they stopped making this claim. …" *[e-mail from Pang to Harden, 5-23-10]*

"I also agree that a measurement with an uncertainty that is as large as the measured value itself could range from zero to twice the measure value." *[e-mail from Allen, 7-20-09]*

"If he [Parrish] is going to say that the reading is 1% DU with a measurement error of 1% then it might really be 2%...can one do a back calculation to see if even at 1% of the U being DU is that compatible with the amount of DC [Davy Crockett] weapons that they report used?" *[e-mail from Pang, 7-19-08, 8:19 AM]*

Particle size was not measured, though smaller particles are more hazardous.
"I will assume that all the DU would be the oxide form in fine dust without the self-shielding vs larger chunks of natural uranium…oxidized forms persist in the body for decades…" *[e-mail from Pang to Harden, 5-23-10]*

"Unfortunately, the method used to analyze the sample does not measure particle size…This parameter is important for reasons Dr. Pang mentioned. Yes the smaller particles will travel farther downwind and pose more of a health risk…A question to consider is does dust with 7 ppb (or 14 ppb) DU fall within the acceptable range of exposure to DU?...oxidized forms [of U] are more dangerous. The rate of oxidation will depend on particle size."
[e-mail from Allen, 7-20-09]

"..they should take electron microscope pictures of the uranium found in Hawai'i to see if it had been fired. Uranium burns at 3000 to 6000 degress Centigrade (at ambient temperature due to friction) and creates the serious biohazard metal fumes and nano-particles." *[e-mail from Bertell, 7-16-09]*

"…the health risk and relevance must take into account the size and chemical (oxide) composition—versus the background U…does not the ratio of DU/ U change versus distance from target site?" *[e-mail from Pang, 7-19-08, 11:44 AM]*

There was only one sample.
"Dr. Pang is correct that a single sample does not provide statistical data…" *[e-mail from Allen, 7-20-09]*

"Suppose the wind variation and the on ground DU distribution made aggregate dust sampling non-homogenous, just as a person's blood glucose level changed form hour to hour. Now suppose that you tried to determine if a person was diabetic from a single sample—worse yet if an entire population's diagnosis of diabetes depended on that single sample." *[e-mail from Pang, 3-11-09]*

"It is hard to do statistics with a sample of one…" *[e-mail from Pang, 7-19-08, 8:19 AM]*

DU from spotting rounds may ignite spontaneously.

"…depleted uranium was ultimately selected [for munitions] because of its…pyrophoricity (spontaneous combustion upon exposure to air)." [*NRC Fact Sheet, License Application for Depleted Uranium at U.S. Army Sites, August 2009]*

"Uranium, especially in concentrated fine grained form, is pyrophoric at ambient temperatures…" *[Comments of Depleted Uranium Information by Bertell, 12-18-07]*

"Chemically, DU is identical to "normal" uranium…At room temperature, humidity can promote the oxidation of uranium. When uranium is fragmented in chips, powder, and turnings, the metal becomes pyrophoric, spontaneously ignites in air." *[DU Technical Brief, EPA 402-R-06-011, Dec. 2006, p. 20]*

Wildfires and controlled burns may disperse DU.

[a study] "…concludes that fires in forests where depleted uranium is present can cause the DU to be carried in the air…only small amounts of depleted uranium are dispersed by fires. The study said the dispersal of DU can happen whether the fire is a wildfire or a controlled-burn conducted for forest management." *[Depleted uranium at JPG [Jefferson Proving Ground] on meeting agenda for tonight, Madison Courier, 7-18-06]*

"The Cerro Grande [nuclear research facility area] fire did contribute a higher [radiation] dose to the public than the Viveash [area with no human-made nuclear material] fire…both doses wer 1/10,000th the federal radionuclide NESHAP [acronym not defined] limit…" *[Volkerding, Comparison of the radiological dose form the Cerro Grande fire to a nautral wildfire, environment International, 29 (2003) pp. 987-993]*

Animals may carry radioactivity out of RCAs (Radiation Control Areas).

At Hanford nuclear reservation in Washington state, rabbits, mice, wasps, flies, and gnats have become contaminated. In 2009, 33 contaminated animals or animal materials (such as droppings) were reported on the site.

A new water well is not being checked for DU.

Dr. Cherry of the Army said they will do their best to check for DU in exploratory water wells planned for Pohakuloa—but project manager Don Thomas says he's not doing that. [my notes from 7-12-12 Army/ NRC meeting; my correspondence with Thomas about 2012]

……

Profiles

Stephen Allen PhD, assistant professor of chemistry, Hawai'i Pacific University

Rosalie Bertell member of International Physicians for Humanitarian Medicine, laureate of United Nations Environmental Programme Global 500 Roll of Honor

Marshall Blann PhD, consultant at Los Alamos and Lawrence Livermore National Laboratories, Physics Directorate at Livermore, professor at University of Rochester

Lorrin Pang former Army doctor, consultant to the World Health Organization, head of Maui Department of Health (but speaking on DU as a private citizen)

Michael Reimer PhD in geology, 25 years at U.S. Geological Survey working on radiation in the natural environment, National Academy of Science postdoctoral fellowship at the National Institute for Science and Technology, research professor at Colorado School of Mines

http://stgvisie.home.xs4all.nl/ContaminationByDepletedUranium.html

Contamination of Persian Gulf War Veterans and Others by Depleted Uranium

by Leonard A. Dietz

July 19, 1996 (last updated Feb. 21, 1999)

(reproduced here with permission)

Abstract

We develop background information about depleted uranium (DU) and use it to describe a physical model of how on the battlefields in Kuwait and Iraq a large number of unprotected Gulf War veterans could easily have acquired dangerous quantities of DU in their bodies.

- We examine how U-238, which comprises more than 99% of DU, decays radioactively, producing two decay progeny that are always present with it and add significantly to its radioactivity. The pyrophoric nature of uranium metal causes it to burn (oxidize rapidly) when heated by impact or in fires to form invisible aerosol particles that become airborne.
- We refer to scientific measurements that have been made of the atmospheric wind-borne transport of uranium aerosols over distances up to 26 miles (42 km) from their sources. Stokes' well-known physical law helps to explain how airborne transport of DU particles can occur over large distances.
- We describe how gamma rays and energetic beta particles become absorbed in body tissue and can traverse large numbers of body cells, potentially causing damage to genetic material in the nuclei of living cells. We describe a biokinetic model developed by the International Commission on Radiation Protection that explains how uranium microparticles can enter the body and spread to vital organs. The model predicts that an acute intake of uranium particles can result in urinary excretions of uranium for years afterward.
- We review estimates of the tonnage of DU munitions fired during the Gulf War. Even if only one or two percent of a low estimate of 300 metric tons of DU fired burned up, this would have produced 3000-6000 kg of DU aerosols.

This background information allows us to propose a plausible contamination model at a battle site. It consists of three steps: (1) a source of hundreds of kilograms of DU aerosols generated suddenly against concentrated Iraqi armor; (2) widespread rapid dispersal of DU aerosol particles by wind action; (3) inhalation and ingestion of DU particles by unprotected U.S. service personnel on the battlefield.

The U.S. military and its representatives claim that DU munitions are safe, but they have not publicly addressed health and safety issues that apply after DU munitions have been fired. Apparently the official view is that in a combat situation it is acceptable for unprotected personnel to be exposed to the combustion products of fired DU munitions and assume any health risks involved.

We mention that 22 U.S. service personnel have been reported to have suffered imbedded fragments of DU in their bodies from "friendly fire". More than 5 years after the Gulf War, few of these fragments have been removed and the long-term health situation for these veterans has not yet been determined. We note the astonishingly high incidence of serious birth defects in families of Gulf War veterans in the State of Mississippi.

Finally, we mention how commonly used DU flight control counterweights in aircraft and DU munitions can burn in intense fires and produce dangerous concentrations of airborne DU aerosol particles that can be inhaled and ingested.

CURRICULUM VITAE 2012

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Personal information redacted by Cory (Martha) Harden

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Chemistry, Cum Laude

1975-79 Tulane Medical School, MD

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MPH in Tropical Medicine

1979-80 Federal University of Brazil;
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1980-81 Letterman Army Hospital, San
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Positions Held: 1982-87 Epidemiologist, AFRIMS (Walter Reed
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1987-90 Chief, Preventive Medicine Service,
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1987-89 Clinical Associate Professor,
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1990-92 Medical Officer, Malaria Unit,
World Health Organization, Geneva,
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1992-97 Clinician/Epidemiologist,
Walter Reed Institute of Research
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1994-5 Adviser to Pan American Health
Organization (Meningitis Vaccine)

1985-Present Adviser to World Health/UNDP
Organization (Tropical Disease
Research Unit: Chagas Disease,
Leishmaniasis, Malaria, Clinical
Trials), 2000 malaria program change to
United Nations Global Fund (for work in Central America)

1997-2000 Chief, Department of Bacteriology
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Walter Reed Institute of Research
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1997-2000 Faculty of Tropical Medicine,
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2000-present District Health Officer, Maui County
State of Hawaii

2002-4 Consultant Glaxo Smith Kline Pharmaceuticals-

2013 – Visiting Professor of Medicine, Federal University of Brasilia, Brazil

2013 – present, Consultant Drugs for Neglected Disease Initiative (DNDI)

2013 – present, Reviewer (Congress Directed Medical Research Program, CDMRP)

Awards: Army Achievement Medal, 1982, 1996.
Army Research and Development Medal, 1987.
Army Meritorious Service Medal, 1990, 1997.

Certification: Medical License State of Louisiana, 1980- 2000.
Hawaii State License, 2000-present
Board Certification in Preventive Medicine, 1990.

2002 Discovery Channel feature covering dengue outbreak and eradication on Maui

2006-8 listed on Americas Best Doctors list (3% of nation's doctors)

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Curriculum Vita
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Personal information redacted by Cory (Martha) Harden

G. Michael Reimer received a B.A. in Science Education from Alfred University, Alfred, NY in 1967 and his Ph.D. in Geology from the University of Pennsylvania, Philadelphia, PA in 1972. He was selected as a National Academy of Science/National Research Council postdoctoral fellow at the U.S. National Bureau of Standards (now National Institute of Standards and Technology) from 1972 to 1974 in the Nuclear Analytical Chemistry Section. He co-developed standards for trace metal analysis in glass and established quality control/quality assurance guidelines for use of the standards.
In 1974, he joined the U.S. Geological Survey as a Research Geologist where he pioneered the development of mobile high-resolution analytical equipment and soil-gas sampling methods for energy resource exploration including uranium, oil and gas, and geothermal. He has investigated the application of these techniques to hazard prediction regarding earthquakes and volcanoes. He established a gas monitoring station at Kilauea Volcano in 1981 and determined that the release of carbon dioxide from the summit during periods of quiescence were as great as during eruptive episodes. Dr. Reimer was the Director of the Gas Geochemical Laboratory at the U.S. Geological Survey, focusing on environmental studies and risk mapping. He served as chief of the Radon Studies Project within the USGS, and developed techniques to provide a refined radon risk map for the U.S. on a county-level scale by establishing ground-truth measurements for estimating the radon potential of the soils. He was Principal Investigator on several radon projects funded through interagency agreements and served as Radon Principal Scientist with the U.S. Department of Energy and has received numerous awards and honors for his pioneering work. He wrote the EPA chapter on Hawaii for its national Radon Risk Guide. From 1991 to 2006, he established and chaired the environmental radioactivity section for the special meetings of Methods and Applications of Radioanalytical Chemistry for the American Nuclear Society. In addition to his scientific duties, he has supervised upward mobility opportunity programs and developed guidelines for retraining and outreach activities.
Dr. Reimer was appointed Research Professor and Director of the Institute for Resource and Environmental Geosciences at the Colorado School of Mines in 1998. He has sponsored and advised students participating with him through research grants. He was a founding member of the CSM Diversity Committee and he chaired the CSM Geochemistry Graduate School Program. He has participated in various international studies including using gases to delineate seismic-induced faults at volcanoes in Italy, radon risk mapping in Ireland, radiation-site contamination evaluations in Eastern Europe, and environmental applications using gas tracers to determine pathways for toxic material transport including the proposed Yucca Mountain High Level Waste Repository. He has applied the gas sampling techniques he had developed to defining the release of methane from coal as it relates to loss of resource and creating potential hazards for nearby urban development. He participated as an international expert with the International Atomic Energy Agency in reviewing and cataloging worldwide

radioelement mapping. Currently he participates in independent research attempting to establish a theoretical base for the transport of elemental and particulate matter in the natural environment. He is a member of the Geological Society of America and the American Geophysical Union.

He has served as guest editor for Geophysical Research Letters and the Journal of Radioanalytical and Nuclear Chemistry. He has authored or coauthored over 100 peer reviewed scientific publications and over 50 abstracts with presentations at national and international symposia. He has consulted for Oil and Gas companies and provided technical expertise for modifying gas analytical equipment for specific tasks. He also was a Senior Advisor to the independent ES^2P^2AR Group concerned with the ethical use of science in support of public policy and regulation.

Dr. Reimer retired from the Colorado School of Mines and moved to Hawaii. He now works part time as a private consultant and advisor to several different companies.