PRESS RELEASE

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New Report on Hanford Contamination Finds Potential for Off-Site Radiation Doses

Seattle, WA: Hanford Challenge released a new scientific report analyzing radiation contamination found in Hanford worker vehicles and on-site building filters based on information from internal reports of contamination identified by a Hanford contractor.

The report was prepared by Marco Kaltofen, Ph.D., of Boston Chemical Data Corporation, and focused on findings related to the spread of contamination from Hanford's Plutonium Finishing Plant (PFP) following releases to the air in 2017.

Dr. Kaltofen's report confirms the presence of americium, uranium, and thorium in multiple dust samples from personal vehicles driven out of the radiation protection zones at the PFP. Radioactive microparticles containing thorium and/or uranium were found in the vehicle samples, including metallic radioactive microparticles that are fairly unique to the Hanford site.

Alpha counting revealed one bulk vehicle dust & grime sample that had a 7-fold increase over the normal and expected alpha emission rate (a greater than two standard deviation difference). "This result means that there is a 95% chance or better that the vehicle user or mechanic would be exposed to radiotoxic alpha particles while working on this contaminated vehicle. For at least three of the thirty tested personal vehicles, there remains residual alpha-radiation contamination despite being cleaned and released for use by the Dept. of Energy," said Dr. Kaltofen.

Dr. Kaltofen also reported that a March 2018 Hanford contractor report found "biologically-significant plutonium particles onsite" at Hanford, including an example particle with a calculated dose equivalent to 10 chest-X-Rays. Dr. Kaltofen noted that by comparison, the maximum allowable offsite radiation dose limit for all emissions from a federal facility is 10 mRem per year, equivalent to just one chest X-Ray. "This means that a single PFP particle can exert nearly 10 times the EPA allowable standard for an offsite emission (or equal to the dose from 10 X-rays)," Dr. Kaltofen wrote.

"These findings point to an urgent need for a deeper, broader look by an independent entity at the threats that Hanford's past and present contamination might pose to surrounding communities," said Tom Carpenter, Executive Director of Hanford Challenge.

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August 27, 2018

Tom Carpenter, Executive Director
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Re: Radioactive microparticles in Hanford Plutonium Finishing Plant workers' vehicle and house dusts

Dear Mr. Carpenter:

This cover letter summarizes findings in our research report, *Radioactive microparticles in Hanford Plutonium Finishing Plant workers' vehicle and house dusts*. This report, along with a larger but similar study performed by WRPS, found radioactive microparticles in the Plutonium Finishing Plant (PFP) area at Hanford, and on personal vehicles used at the PFP by Hanford employees.

The March 2018 WRPS report found biologically-significant plutonium particles onsite at the PFP, including an example particle with a calculated dose (CEDE) of 94.8 millirem (mRem) if inhaled. By comparison, the maximum allowable offsite radiation dose limit for *all* emissions from a federal facility is 10 mRem per year (42 USC Section 61, subpart H). This means that a single PFP particle can exert nearly 10 times the EPA allowable standard for an offsite emission (or equal to the dose from 10 X-rays). This finding by the Department of Energy's contractor WRPS, utterly conflicts with representations of Hanford officials as to the *de minimis* nature of the 42 plutonium workers acknowledged to have been exposed by Hanford management following bio-assay testing.

Our report confirms the presence of americium, uranium and thorium in multiple dust samples from personal vehicles driven out of the radiation protection zones at the PFP. Radioactive microparticles containing thorium and/or uranium were found in the vehicle samples, including metallic radioactive microparticles that are fairly unique to the Hanford site. These metallic particles are not found in nature. Metallic uranium and thorium particles can be found at other locations at Hanford, and are not necessarily unique to the PFP. They are not however, naturally found in uncontaminated soil or bedrock. Primary plutonium particles, such as those found at the PFP by WRPS, were not found in the vehicle samples.

In our study, thirty samples were tested by various means including alpha/beta counting and gamma spectroscopy. Five dust samples with elevated alpha count rates were tested for transuranic isotopes by Eberline Analytical of Oak Ridge, TN, a commercial alpha spectroscopy laboratory. Two of these five were confirmed to contain americium-241, a transuranic isotope. One analysis is still pending as of this writing. Four additional samples were tested for radioactive microparticles using scanning electron microscopy and X-ray analysis (at Microvision Laboratories in Massachusetts). Microvision found radioactive thorium and uranium microparticles, including metallic uranium, as well as mercury and other toxic metals in the vehicle dust samples.

Alpha counting revealed one bulk vehicle dust & grime sample that had a 7-fold increase over the normal and expected alpha emission rate (a greater than two standard deviation difference). This result means that there is a 95% chance or better that the vehicle user or mechanic would be exposed to radiotoxic alpha particles while working on this contaminated vehicle. This result is an important reminder. For at least three of the thirty tested personal vehicles, there remains residual alpha-radiation contamination despite being cleaned and released for use by the Dept. of Energy.

The gamma spectral and scanning electron microscopy analyses were performed by three different laboratories (two independent commercial labs and Hanford's own laboratory). Together, these laboratories have documented onsite and off-site contamination in worker vehicles resulting from Hanford-related activities. These data document serious air-borne release hazards.

A broader independent study is needed that looks at residual contamination in the communities around Hanford and assesses health risks associated with that contamination. Protective steps may need to be taken as in the example of the contaminated vehicle identified in this study.

Signed:

Marco Kaltofen *8/27/18*

Marco Kaltofen, PhD., PE (civil, MA)
Boston Chemical Data Corp.

Radioactive microparticles in Hanford Plutonium Finishing Plant workers' vehicle and house dusts

Marco Kaltofen, PhD., PE (Civil, MA)

August, 15, 2018

Introduction

Hanford Nuclear Reservation is a former special nuclear material production facility located in the Tri-Cities area in Eastern Washington. The Plutonium Finishing Plant (PFP, also called the Z-Plant) manufactured plutonium metal "hockey pucks" or plutonium oxide powders from recovered plutonium/nitric acid liquids. The plant operated from 1949 until 1989 (US DOE 2018a).

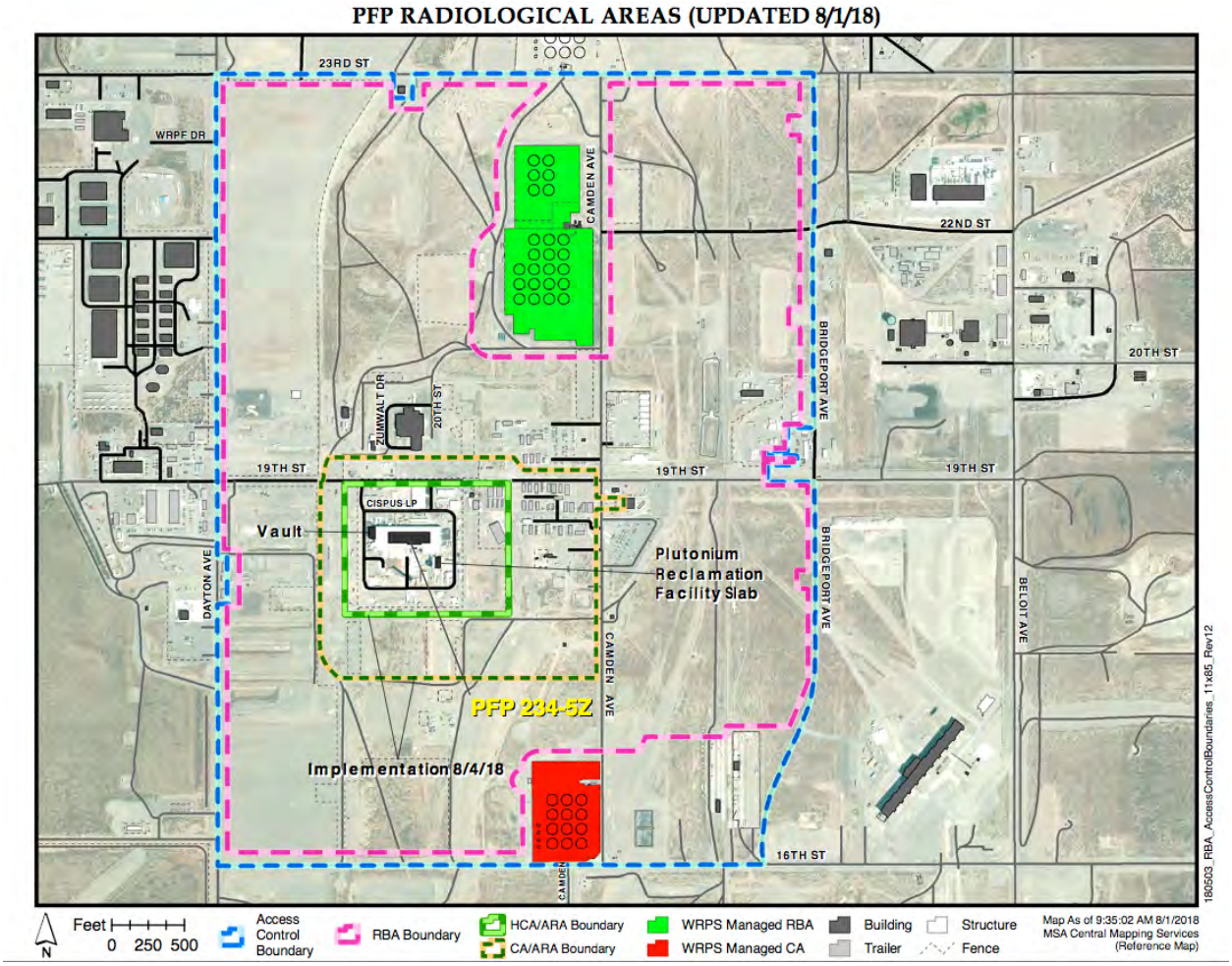
During November and December 2017 and into 2018, testing has found plutonium contaminated particles at the PFP, in vehicles parked at the PFP, and in the surrounding area outside of the PFP (US DOE 2018b). The DOE and its contractors tested vehicles and employees' homes for plutonium-contaminated particulate matter (US DOE 2018c).

Early data showing that alpha-emitting particulate matter was uncontrolled included a November 29, 2017 "cookie sheet" sampler (#47) reading 80 disintegrations per minute per 100 cm^2 of removable alpha activity.

Surveys of the homes and vehicles of seven Hanford workers began Wednesday December 20, 2017, after a spread of radioactive contamination at the nuclear reservation's Plutonium Finishing Plant in recent days. The total number of vehicles reported to be contaminated with apparent specks of radioactive material increased to 14 eight reported Dec. 19, 2017. At least two may have been driven home by workers at the plant after demolition was completed Friday on the most contaminated portion of the plant, the Plutonium Reclamation Facility.

More than 100 vehicles were surveyed to find the 14 reported to be contaminated. Seven belonged to workers and seven to contractors or the government. One, which was owned

by tank farm contractor Washington River Protection Solutions, had not been at the Plutonium Finishing Plant but was used to support work at a nearby facility. It had routinely been driven on roads near the plant. Spots of radioactive contamination were found on the other side of Camden Avenue from the plant, but not on the roadway, said Tom Bratvold, vice president for the plant closure for contractor CH2M Hill Plateau Remediation Company (Tri City Herald, 12/21/2017). The most recent map of contamination zones at the PFP is below (PFP 2018).



CA - Contamination Area
HCA - High Contamination Area
PFP - Plutonium Finishing Plant
RBA - Radiological Buffer Area
WRPS - Washington River Protection Solutions

Materials and methods

The sample set for this study included twenty-nine automobile filters cleared for release by the US Department of Energy or its contractors, plus 12 wipe samples from a vehicle (also cleared for release), and one home vacuum cleaner (Wet Vac®-style) filter collected outside of any radiation protection zone. All sample donors were anonymous workers at the Hanford Nuclear Reservation Plutonium Finishing Plant (PFP) demolition site. Two additional vehicle air filter samples were collected from nonHanford workers from outside of Washington State. The samples were initially collected by Hanford Challenge of Seattle, WA; a nonprofit 501-C(3) organization. Samples were screened prior to shipment to determine if materials registering greater than background counts would require transport directly to a commercial radiological laboratory. None of the 29 dust samples counted at a level more than two times background, using an International Medcom-Inspector® ratecounter. Particulate matter samples were separated from the filters; before filters were returned to their point of origin. The wipe samples were sent to Eberline Analytical of Oak Ridge, TN for alpha spectroscopy. All samples were received in 2018.

Dust were separated from filters by sealing the samples in polyethylene bags, then vibrating the bagged samples. Particulate matter was transferred into 50 ml whirlpak® poly bags for analyses. Microslide samples were prepared by contacting the adhesive portion of a Zefon International BT0050 Bioslide® to the inner surface of the poly bag to collect fines. Microslides typically have 40 to 60 mg of particulate matter per slide (as prepared according to Kaltofen 2018). The bagged filters were then resealed and returned to the donors.

Dust samples were analyzed by gamma spectrometry, alpha spectroscopy and Low-Energy Photon Spectroscopy (LEPS) by a licensed commercial radiological testing laboratory, Eberline Analytical of Oak Ridge, TN. Scanning electron microscopy/energy dispersive X-ray (SEM/EDS) testing was performed by Microvision Laboratories of Chelmsford, MA.

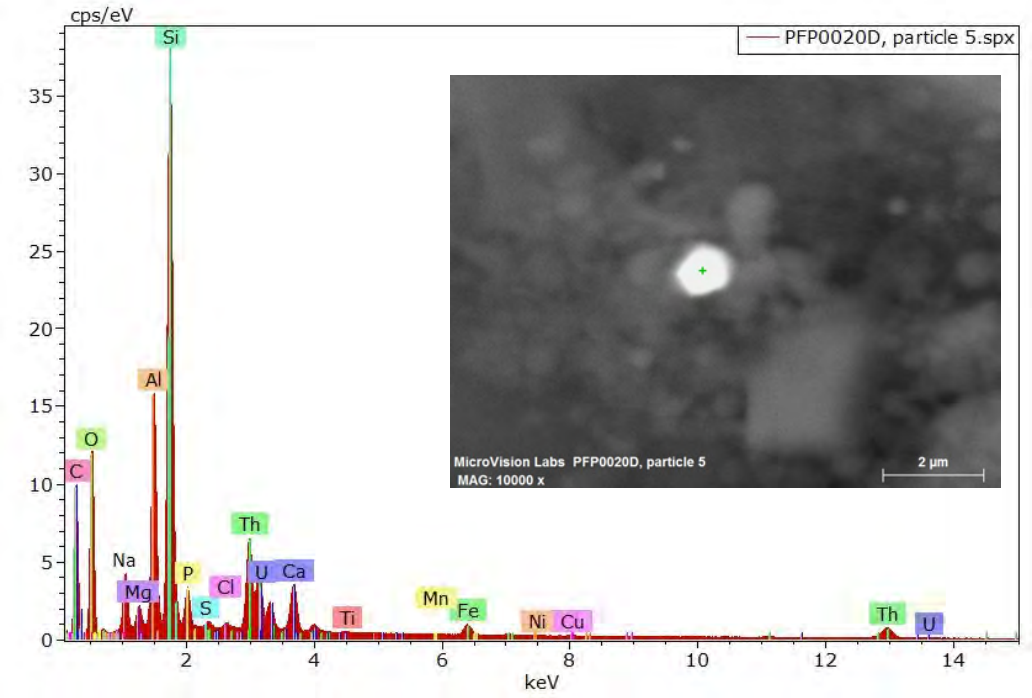
SEM/EDS analysis was performed on Zefon microslide samples coming from particulate matter samples that had total gamma photon counts more than 2X background in the 50 to 250 keV region. Radioactive microparticles in micro slide samples were isolated from

inert materials on the slides using a Robinson detector to identify particles composed of high Z materials, typical z=38 (Sr) and higher. Individual slides were also screened using a Ludlum 3030 two-channel alpha-beta detector. Any particles isolated were micro-photographed and analyzed by X-ray analysis, which was used to determine elemental compositions including the radioactive elements uranium, thorium, plutonium and americium.

Results

Based on the screening-level gamma spectroscopy (50 to 250 keV) results and alpha/beta rate counting results, four of the thirty filter-dust samples were analyzed by SEM/EDS, and three were analyzed by alpha spectroscopy. A microslide prepared from wipe samples from vehicle #19 was found to have 8.7 ± 2.9 alpha counts hr^{-2} cm^{-2} compared to the control that had 1.2 ± 0.3 counts hr^{-2} cm^{-2}. This is a >7-fold increase and is a significant >2-sigma difference from the control sample. At the time of this writing, the alpha spectroscopy data for this sample is not complete.

Filter-dust from vehicle #20 had the second most elevated alpha counts for the micro slides, at 3.1 ± 1.7 counts hr^{-2} cm^{-2} (+ 1 sigma). This sample was forwarded for SEM/ EDS analysis (See figure below).



The microscopic examination identified a radioactive industrial material composed of a metallic thorium-uranium alloy. This particle was in the respirable size range, with a diameter of 1 micron. The thorium content was 13.9% ± 0.35% and the uranium content was 0.68% ± 0.05%.

A recent study found a similar material in a radioactive microparticle isolated from indoor dust. The sample came from a commercial retail facility in Richland, WA; the community that hosts the southern end of the Hanford Reservation (Figure 5, Kaltofen 2018). This similar radioactive microparticle had a calculated activity of 0.17 mBq (1.7E-4 Bq), and consisted of 24.8% Th and 8.4% U, along with percent levels of copper, manganese, iron, titanium, cerium and calcium along with some Al-Si-O soil material. The Th-U particle in vehicle filter-dust sample #20 also contained percent levels of copper, manganese, iron, titanium, chloride and Al-Si-O soil material.

The whole filter from vehicle #1 was analyzed by alpha spectrometry, and found to have an Am^{241} activity of 0.078 ± 0.068 pCi/g. Dust from vehicle filter #5 was found to have an Am^{241} activity of 0.064 ± 0.030 pCi/g, but the minimum detectable activity for the procedure was found to be 0.065 pCi/g, making this detection uncertain. The analysis was repeated on a fresh sample #5 aliquot with a result of 0.958 ± 0.714 pCi/g. These were the only definitive transuranic results found in the PFP sample set. Cs^{137} was tested in #1 and #5 as well as well as the remainder of the PFP samples, but was not detected at < 1.0 pCi/g.

Filter-dust from vehicle #4 was tested by SEM/EDS. The procedure detected three thorium monazite particles of 2, 3 and 4 microns size; all with under 1% total thorium content. Thorium monazite is a naturally-occurring radioactive mineral that is found elsewhere in Washington, and that also has industrial uses in nuclear materials processing. Additional potentially-toxic industrial particles (of unknown radioactivity) were found in sample #4, including particles composed of mercury (45%), strontium (28%), copper (22%) and arsenic-rare earths (9%).

Filter-dust from vehicle #10 was tested by SEM/EDS. The procedure detected three thorium monazite particles of 7, 12 and 20 microns size; all with 1% to 3% total thorium content. Additional potentially-toxic industrial particles (of unknown radioactivity) were found in sample #10, including particles composed of strontium (19%) and lead (18%).

Filter-dust from vehicle #23 was tested by SEM/EDS. The procedure detected three thorium monazite particles and one somewhat less common thorium-uranium monazite particle (up to 2.8% Th and 0.39% U). Additional potentially-toxic industrial particles (of unknown radioactivity) were found in sample #23, including plentiful particles composed mostly of lead (up to 60%). Again, while monazites are found naturally, they are also a known component of Hanford's wastes at the tank farms (Kaltofen 2018), and were found in abundance in PFP samples but not in controls.

The Department of Energy's contractor WRPS tested vehicles that were not yet released from the radiation protection zone at the PFP. This testing found high levels of transuranic contamination on vehicles and surfaces within the zone. Despite the passage of eight months since the discovery of contamination on vehicles at the PFP and outside of the PFP, a work stop continues on demolition activity. Some of the plutonium particles found in this study are pictured on the following page (US DOE 2018b).

The dose from an internalized individual radioactive microparticle can be calculated. As an example, consider the 13.8 by 6 micron particle described on page 8 of WRPS's report, figure 4. The volume of the particle was estimated using EPA Method 600 (NERL 2002) to be 497 um^3 and with an assumed plutonium concentration of 50 wgt. % and a calculated density of 11.9, yielding a total of 2.96 ng plutonium. For this example this converts to 186 pCi or 6.89 Bq for Pu^{239}. The Committed Effective Dose Equivalent (CEDE) for this isotope is 5.1 E8 rem/Ci. This gives a potential maximum CEDE of 94.8 mRem for this individual radioactive microparticle actually detected within the radiation protection zone at the PFP (not in a released vehicle).

Figure 6. Image and Spectrum of a Smaller Plutonium Particle on Sample S18R000009

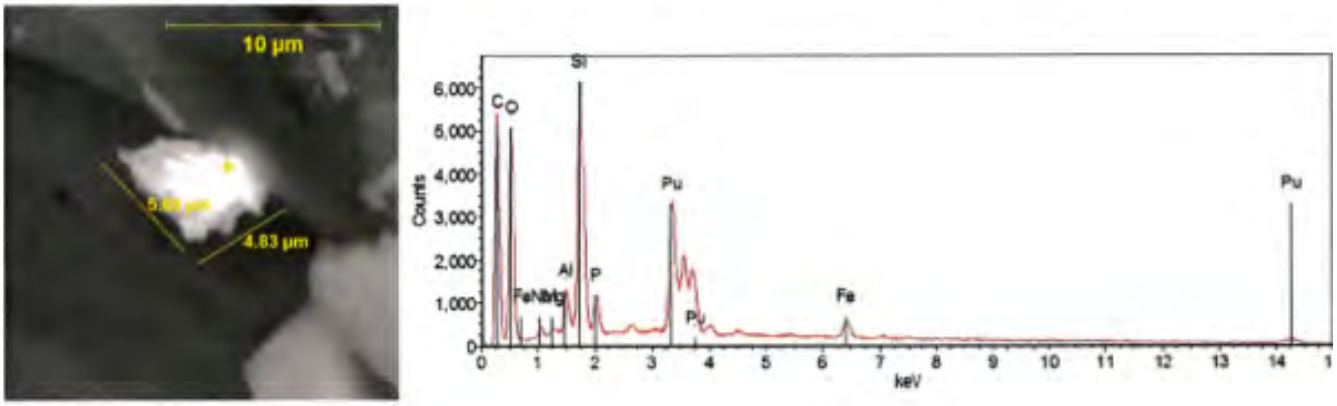


Figure 7. Image and Spectrum of a Small Plutonium Particle on Top of a Larger Soil Particle on Sample S18R000009

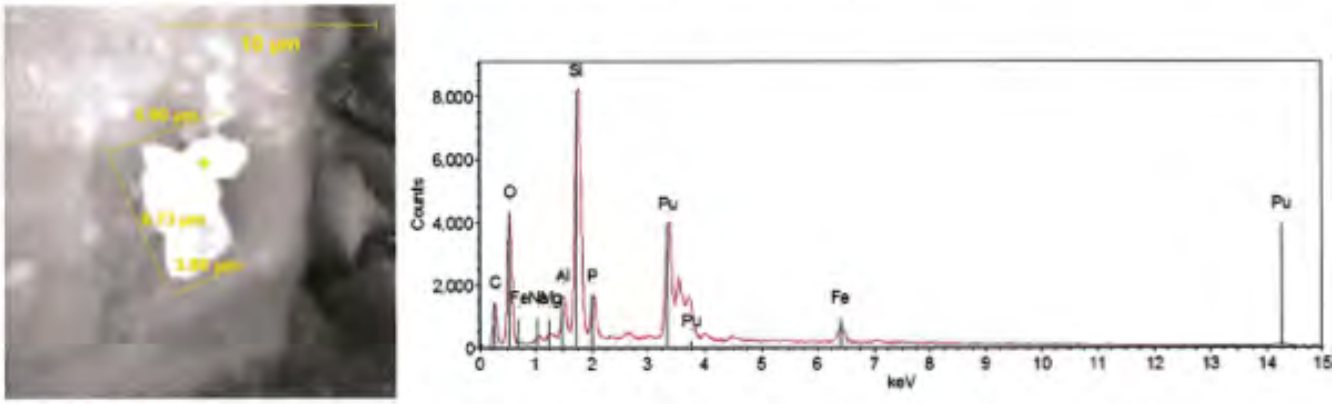
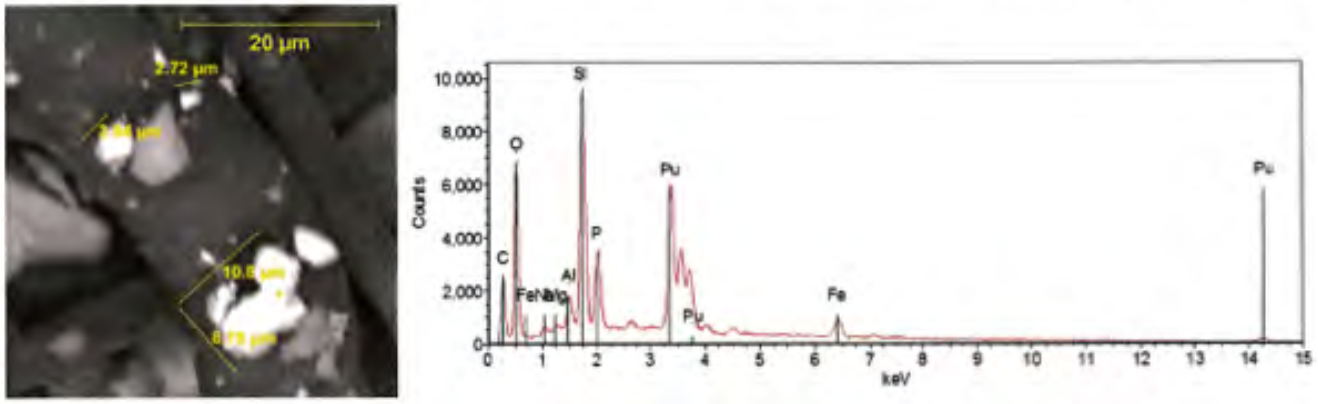


Figure 8. Image and Spectrum of a Crushed Plutonium Particle on Sample S18R000009



Conclusions:

Multiple lines of evidence indicate that modest but detectable level of alpha-emitting nuclides were collected on the air filters of vehicles belonging to Hanford workers. These vehicles had been cleared and released from radiation protection zones at the Plutonium Finishing Plant demolition site at the Hanford Nuclear Reservation.

These positive contamination results include subpicoCurie detections of Am^{241}, alpha counts at up to 7X background, the detection of an industrial particle of metallic thorium-uranium alloy, substantial numbers of weakly-radioactive thorium and thorium-uranium monazite particles, and the detection of particles (of unknown activity) composed of percent levels of mercury, lead or arsenic.

For a particle actually detected by Hanford's contractor, WRPS, inside the radiation protection zone at the Plutonium Finishing Plant, the calculated maximum Committed Effective Dose Equivalent of 94.8 mRem.

Given the small sample size in this study, it is assumed the the full potential for radioactive particulate matter in these released vehicles has not been explored.

References:

Kaltofen (2018) *Microanalysis of Particle-Based Uranium, Thorium, and Plutonium in Nuclear Workers' House Dusts*, J. Environmental Engineering Science, http://doi.org/10.1089/ees.2018.0036

NERL (2002) National Exposure Research Laboratory, Guidelines for the Application of SEM/EDX Analytical Techniques to Particulate Matter Samples, US EPA # 600/R-02/070, September.

PFP (2018) Aug. 2, 2018 PFP Recovery Update CH1807-03, url: https://www.hanford.gov/files.cfm/180503_RBA_AccessControlBoundaries_11x85_Rev12r.pdf accessed 8/15/2018

US DOE (2018a) United States Department of Energy url: https://www.hanford.gov/page.cfm/PFP#PFP, accessed 8/14/2018

US DOE (2018b) Plutonium Particle Examination by Scanning Electron Microscopy Analysis of Plutonium Finishing Plant Air Filters and Tech Smears, prepared for the United States Department of Energy by Washington River Protection Solution, LAB-RPT-18-00003 Revision 0

US DOE (2018c) United States Department of Energy url: https://www.hanford.gov/page.cfm/Updates_on_Plutonium_Finishing_Plant/PFPRecoveryUpdates, accessed 8/14/2018