TECHNICAL EVALUATION REPORT

U.S. NRC Staff Evaluation of the U.S. Army's Air Sampling Plan for Depleted Uranium from the M101 Spotting Round

License No. SUC-1593
Docket No. 040-09083
U.S. Army Installation Management Command

U.S. Nuclear Regulatory Commission

Office of Federal and State Materials and Environmental Management Programs

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1.0 Introduction

On October 23, 2013, the U.S. Nuclear Regulatory Commission (NRC) issued source material license SUC-1593 to the U.S. Army Installation Management Command (Army) to allow the possession of depleted uranium (DU) from the Davy Crockett M101 spotting round (Agency Document Access and Management System (ADAMS) Accession No. ML13259A062). License Condition 22 of SUC-1593 states: "The licensee shall provide an air sampling plan to the NRC within 90 days of [effective date of this license] for review and approval. Until the air sampling results are approved by NRC, the licensee will conduct activities on the ranges in accordance with previously approved restrictions and provisions." On December 16, 2013, the Army submitted an air sampling plan in accordance with License Condition 22 (ML14002A385) of source material license SUC-1593. This Technical Evaluation Report (TER) summarizes the NRC staff's review of the Army's air sampling plan and assesses the Army's compliance with the applicable requirements of 10 CFR Part 40 "Domestic Licensing of Source Material" and 10 CFR Part 20, "Standards for Protection Against Radiation."

2.0 Summary and Conclusions

The NRC staff finds that the Army's air sampling plan, as currently written, is adequate to evaluate the potential for releases of DU from the Schofield barracks Radiation Control Area (RCA) during high explosive fire. However, it will not meet the stated goal of the plan, which is to determine if DU in air effluent at the perimeter of the Schofield Barracks RCA during high explosive fire exceeds the project action levels, while meeting the particulate collection criteria for the air sampling data.

The sampling procedures in the current air sampling plan are capable of collecting up to 80% of airborne uranium particles that may be generated in the RCA. However, the procedures will not meet the stated criteria for the collection of particulates which is 99% of airborne uranium particles. The current plan proposes the use of cellulose filters in the air samplers. The staff has determined that the use of glass fiber or polycarbonate filters will collect respirable particles at greater efficiencies than the cellulose filters in the current plan. Therefore, in order to meet the stated purpose of the plan, the NRC staff has concluded that the Army should revise the air-sampling plan to include the use of glass fiber or polycarbonate filters to increase the collection efficiency of respirable particles less than 0.5 micrometers (μm). Conversely, if the Army elects to use Whatman 41 (or comparable) cellulose filters to collect particulates, the Army should ensure that it maintains a face velocity across the filter equal to or greater than 100 cubic centimeters per second (cm/s) (196 feet per minute (ft/min)) to achieve the maximum collection efficiency for airborne particles less than 0.5 μm.

In addition, the plan must be revised to state that, if the action levels established in the plan (i.e., 20 percent of the effluent concentration values in 10 CFR Part 20, Appendix B) are exceeded, the Army will notify NRC, pursuant to 10 CFR 20.2203.

Finally, the plan discusses moving the air sampling locations after the background values have been collected. The Army should avoid moving air sampling locations after collecting background data as doing so could increase uncertainty about the information collected during the live fire exercise, and the plan should be revised accordingly.

3.0 Background

During the 1960s, the Army manufactured spotting rounds for the Davy Crockett Weapon System at the Frankford Arsenal in Philadelphia, Pennsylvania under license SUB-307 issued by the Atomic Energy Commission (AEC), the NRC's predecessor agency, and AEC/NRC License SUB-459. These licenses allowed the Frankford Arsenal to produce the spotting rounds and distribute them to various Army installations for testing, training and deployment. The spotting round was fired from a small rifle attached to the underside of the main recoilless rifle and was used to simulate the flight path of the main munition of the Davy Crockett Weapon, which was a low-yield battlefield nuclear device. It is important to note that the spotting round was not an atomic explosive. Rather it consisted of a nosecone, a DU body (containing about 6.2 ounces of depleted uranium), and an aluminum tail assembly. The nosecone of the M101 version of the spotting round contained a small amount of explosive that produced a "puff" of smoke to allow the solider to locate the impact point of the spotting round. Other versions, such as the XM106, did not have an exploding nosecone. M101 rounds were distributed to various Army installations for training purposes. At the request of the Army, License SUB-459 was allowed to expire in April 1978 (ML111080529).

Between 1962 and 1968, the Army received and used DU (which the NRC licenses as source material) in spotting rounds, at firing ranges at various installations, including Forts Benning and Gordon (Georgia), Forts Campbell and Knox (Kentucky), Fort Carson (Colorado), Fort Hood (Texas), Fort Lewis (currently called Joint Base Lewis-McChord) and the Yakima Training Center (Washington), Fort Bragg (North Carolina), Fort Polk (Louisiana), Fort Sill (Oklahoma), Fort Jackson (South Carolina), Fort Hunter Liggett (California), Fort Greeley (Alaska), Fort Dix (New Jersey) and Fort Riley (Kansas). As a result, DU was scattered throughout a limited number of ranges used for Davy Crockett Weapon system practice/qualification. According to information provided by the U.S. Army, the Army discontinued firing these spotting rounds in Hawaii in 1968 (ML1359A062).

In August 2005, the Army identified the remnants of a DU round at the Schofield Barracks, HI installation (ML070650224). During a controlled grass burn of the range in the summer of 2006 the Army discovered several additional DU fragments. In November 2006, the Army notified the NRC that it had discovered the DU fragments at the Army's Schofield Barracks, HI installation (ML070650224). From November 2006 through February 2007, NRC and Army staff discussed the presence of the DU at the Schofield Barracks (ML070650224). In February 2007, the Army sent a letter to NRC outlining its investigation of the DU and stated that it may need a license to possess the DU (ML070650679). The Army also suggested that, before submitting a license application, it determine the total number of installations that might contain DU from the Davy Crockett weapons system. In March 2007, NRC staff sent a letter to the Army stating that the Army's approach was reasonable (ML070710239).

On November 6, 2008, the Army submitted a license application to the NRC for a possession only license for DU (ML090070095). Between November 2008 and October 2013, Army and NRC staff discussed numerous technical issues associated with the licensing of DU from the M101 spotting round. The Army provided additional information regarding the environment at the Army's Hawaiian installations and submitted revisions to the radiation safety plan for the installations (see the Safety Evaluation Report at ML13259A081). Based on the additional

information, and discussions between the NRC and Army staffs, the NRC issued a license to the Army for the possession of DU from the M101 spotting round at the Army's Hawaiian installations on October 23, 2013 (ML13259A062). To support the NRC staff's evaluation of the Army application, and the additional information submitted by the Army to support the application, the NRC staff documented its review in a Safety Evaluation Report (SER) (ML13259A081). Section 3 of the SER discusses the staff's evaluation of the Army's environmental monitoring program. Section 3.4.1 of the SER provides the NRC staff's assessment of the Army sites with respect to air monitoring and states: "The staff has assessed the sites with respect to air monitoring. The staff has concluded the Army has not presented sufficient justification for not performing air sampling at the sites during "ground disturbing" activities, such as firing high explosives (HE) or using heavy ground moving equipment."

Section 3.4.1 of the SER further states:

> The Army proposes to collect a one-time air sample during high explosive (HE) firing on the ranges, and other ground disturbing activities, at the Schofield Barracks Battle Area Complex (BAX) (ML13046A176). The Army states that if DU is not detected during this exercise, the Army expects that the NRC will not require additional air sampling at any license-allowed operation on all Army ranges. The NRC staff concludes that additional samples collected during ground disturbing activities at Schofield Barracks will provide the data needed to demonstrate that the small amount of DU on the Pohakuloa Training Area (PTA) and Schofield Barracks ranges is insufficient to become airborne and result in an exposure hazard to the public.
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> Therefore, the staff has concluded that to ensure that the Army complies with the NRC's requirements for effluent emissions the Army will need to collect an additional air sample during a ground disturbing activity on the PTA and Schofield ranges to demonstrate that residual DU from the M101 Davy Crockett spotting rounds are not hazardous to the personnel at PTA or at Schofield Barracks or to the public.

This requirement was included as License Condition 22 in source material license SUC-1593.

4.0 Staff Evaluation

4.1 Regulatory Requirements

The following regulations apply to the Army's air sampling plan:

10 CFR section 20.1101(b) and (d) establishes as low as is reasonably achievable (ALARA) requirements and limits the annual dose to the public from air emissions;

10 CFR, sections 20.1201 – 1208 provide occupational dose limits, radiation exposure requirements, and information on dose limits to an embryo/fetus;

10 CFR sections 20.1301 – 1302 establish the dose limits to the public from licensed material and requirements for compliance with those dose limits;
10 CFR sections 20.1501 and 20.1502 provide survey and monitoring requirements and details on conditions requiring individual monitoring of external and internal occupational dose;

10 CFR sections 20.1801 and 20.1802 establish requirements to maintain security and control of licensed material;

10 CFR sections 20.2201- 20.2207 provide reporting requirements related to incidents, exposure monitoring, and theft/loss of materials and transactions involving nationally tracked sources;

10 CFR Part 20, Appendix B provides allowable occupational values of Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs), effluent concentration values, and allowable concentrations for release to sewers, and;

10 CFR section 40.41 establishes the Commission's authority to incorporate conditions in source material licenses issued by the Commission.

4.2 Regulatory Acceptance Criteria

The application was reviewed for compliance with the applicable requirements of 10 CFR Part 20 and 10 CFR Part 40.

4.3 Staff Review and Analysis

Section 1 of the air sampling plan provides background information about the Army's possession of DU at the Schofield Barracks installation. It also states that the purpose of the plan is to "document the design for evaluating potential releases of DU effluent during controlled high explosive (HE) fire within the Radiation Controlled Area (RCA) at Schofield Barracks." Section 1 also references several previous air sampling events undertaken by the Army during controlled range burns at the Schofield Barracks. The results of the previous controlled burns were not provided with the air sampling plan. However, the results of the controlled burns at Schofield Barracks have been provided with previous submittals to the NRC (ML091170320) and included in the NRC staff's discussion in the SER of the license application (ML13259A081).

Section 2 of the plan provides the Data Quality Objectives (DQOs) for the air sampling plan and establishes the following technical parameters for the DQOs:

- The question to be answered is whether airborne DU is present in air effluent in excess of the plan's action levels at the Radiation Control Area boundary during high-explosive firing at the Schofield Barracks;

- Air sample results will be compared to the air concentration values in 10 CFR Part 20, Appendix B, Table 2). Action levels will be set at 20 percent of the NRC air effluent concentration values;

- Air samples will be analyzed for isotopic uranium using alpha spectrometry, results with the ratio of uranium-238 (U-238) to uranium-234 (U-234) exceeding three will indicate the presence of DU.

Section 2 identifies depleted uranium as the radionuclide of concern in the air sampling plan and states that the results of the previous controlled burn monitoring were used to develop the air sampling plan. Section 2 establishes the action levels for the air sampling plan at 20 percent of the NRC air effluent concentration values for uranium isotopes found in DU. The NRC effluent concentration for U-234 is 5×10^{-14} microcuries per milliliter (µCi/mL) of air and is the most limiting. Thus, the action level proposed in the plan is 1×10^{-14} µCi of any uranium isotope per milliliter of air.

Section 2 describes the study area as the area into which high-explosives will be fired during the sampling event (HE impact area). The study area is a smaller portion of the Schofield Barracks RCA and the air sampling locations will be around the perimeter of the impact area. It also discusses how meteorological conditions can affect the sampling event. Optimal conditions are moderate to low winds blowing directly and consistently from the same direction towards the air sampling locations.

Section 2 states that, if uranium is detected in air above the action level the Army Project Manager will be notified immediately (the actual collection of the air sampling will be done by an Army contractor). If results are less than or equal to the action level, the results will be recorded and included in a report to the Army. An activity ratio of U-238 to U-234 greater than three will indicate the presence of DU in the sample. It also establishes several instances when on-site conditions will necessitate notification of the Army Project Manager.

Section 2 establishes the Measurement Quality Objectives for the plan, including the following parameters:

- The measurement method uncertainty for alpha spectrometry measurements for concentrations equal to the action level is equal to 0.3 times the action level, or 3.0×10^{-15} picocuries per milliliter (pCi/mL);
- The required Minimum Detectable Concentration for uranium is 1.0×10^{-15} pCi/mL of air (10% of the action level);
- The value of the Minimum Quantifiable Concentration for alpha spectrometry measurements performed on air filters will not exceed the action level;
- The acceptability of the range of concentrations of uranium found on the filter media will be assessed based on the volume of air passing through the filters;

Section 2 also discusses how the sample measurement technique (alpha spectrometry under controlled laboratory conditions) will ensure that the analysis results are valid.

Section 2 addresses the Quality Assurance Objectives for the plan including:

- The precision of measurements (laboratory duplicates of less than 20 percent relative percent difference and field measurements of a standard deviation of less than 20 percent for source checks and ± three standard deviations for swipe counting);

- Sample bias (for laboratory control samples, less than a 10 percent relative percent difference from the known activity and for field measurements, less than a 20% relative percent difference from the initial average activity determined for source checks);
- Completeness of survey information (100 percent completeness);
- Comparability of samples (documenting changes and recording survey observations), and;
- Representativeness of the sampling program (correct placement of the air samplers).

Section 3 of the plan describes how the air sampling will be conducted. It includes the following attributes:

- Any changes to the survey design will be documented;
- 2-3 weeks' notice will be provided to NRC before the study will begin;
- Smoke plume behavior will be recorded;
- Meteorological conditions will be monitored before high-explosive firing to ensure air monitoring can be conducted;
- Photographs will be taken to document lateral smoke dispersion and Global Positioning Satellite (GPS) locations will be included with the photographs along with other location information;
- Whatman 41 cellulose 8 x 10 inch filters will be used to collect particulates;
- Collection times will be approximately 8 hours;
- Air collection rate (flow rate) will be approximately 45 cubic feet per minute;
- 11 air sampling locations will be established, background samples will be collected for approximately 8 hours prior to high-explosive firing from these locations;
- Six air monitors will be evenly spaced along the western and northern sides of the RCA around the planned high-explosive fire area;
- Two air monitors will be placed west of the "Area 3 Mover," east of the high-explosive fire area;
- One air monitor will be placed behind the "Live Fire Village" in Construction Area six, east of the high-explosive fire area;
- Two air monitors will be placed southeast of the high-explosive fire area at the KR-5 RCA Control Point and the KR-3 Tower;
- Final locations will be recorded using a GPS;
- Locations of individual air monitors may be adjusted to account for obstacles and accessibility issues, or to allow access to a power supply.

Air sampling locations are shown on Figure 3-1 of the plan.

Section 4 describes air sample preparation and analysis. Samples will be analyzed for uranium using alpha spectrometry. The analytical laboratory will be certified by the Department of Defense Environmental Laboratory Accreditation Program. Chain of custody will be maintained for the samples. The analytical procedures are described. Samples will be weighed, ashed to remove organics and re-weighed. The samples will be dissolved and half of the sample will be analyzed (the other half will be retained for re-analysis, if necessary). The dissolved sample will be purified and the uranium will be recovered. The purified sample will be analyzed by alpha spectrometry. Blanks will also be used for quality assurance purposes. For each batch of samples, one filter will be used as a laboratory blank, one filter will be spiked and used as a

laboratory control sample, and one filter will be spiked and used as a laboratory control sample duplicate. If sample re-analysis is necessary, an alternative method may be used.

Section 5 describes the recordkeeping and reporting for the air sampling plan and the quality control procedures that the Army will use during the air sample collection and analysis. It states that visual observations will be recorded in field log books and that photographs will be documented in a logbook or electronic photolog. Air filters will be counted for alpha and beta activity using a Ludlum Model 2929/43-10-I Smear Counter. If elevated activity above background is found, then additional count(s) may be performed one to two days later to allow for the decay of radon daughter products. Initial and follow-up-site results will be documented in a logbook or electronic log. Sample collection information will be maintained in an electronic sample log. Chain of custody will be maintained for each sample.

Visual observations will be recorded using the form provided in the plan. Field measurement instruments will be calibrated within the past year and field calibration checks will be performed at the beginning and end of each day the instrument is used. Source and background checks will be performed. Air samplers will be calibrated per the manufacturer's specifications. Calibration documentation will be maintained in electronic logs. Laboratory control samples will be analyzed. One laboratory blank, one laboratory control sample, and one laboratory control sample duplicate will be analyzed with each batch of samples. Two batches are expected to be generated during the air sampling, and will include both the air samples and background samples.

4.4 Evaluation Findings

The staff reviewed the purpose in Section 1 of the air sampling plan and determined that it would address the NRC staff conclusion that an additional sample collection during ground disturbing activities at the Schofield Barracks will provide the data needed to demonstrate that the small amount of DU on the PTA and Schofield Barracks' ranges is insufficient to become airborne and result in an exposure hazard to the public during typical exercises involving high explosive munitions.

The staff reviewed the DQOs for the air sampling plan and the technical parameters in Section 2 of the plan. The question posed by the plan is consistent with the concern raised by the NRC staff in the SER developed to support the issuance of source material license SUC-1593. Comparing the results of the air sampling to the NRC's effluent concentration values from 10 CFR Part 20, Appendix B is appropriate to determine if the Army is in compliance with 10 CFR Part 20. Establishing action levels that are a percentage of the NRC effluent concentration values, 20 percent in this instance, is an appropriate approach as it allows decisions to be made and corrective actions to be taken before an effluent concentration is exceeded. The analytical technique, alpha spectrometry, is an appropriate method for the analysis of uranium isotopes. The Army correctly characterized the radionuclide of concern as depleted uranium and the study area described in the plan, the high explosive (HE) impact area, is appropriate to determine if DU is becoming airborne during HE firing. The Army's notification process is appropriate, as it address instances when the action levels are exceeded and the Army contractor's response when this occurs. However, Section 2 states that, if uranium is detected in air at the action level the Army Project Manager will be notified immediately. The action level the Army has established is 20 percent of the 10 CFR Part 20 Appendix B values. The applicable

Appendix B values equate to a Total Effective Dose Equivalent (TEDE) of 50 millirem (mrem). Therefore, 20 percent of the Appendix B value equates to a TEDE of 10 mrem. 10 CFR 20.1101(d), the ALARA constraint, applies to the Army and as such, if this action level is reached the Army would also be required to notify NRC in accordance with 10 CFR 20.2203.

The activity ratios cited in the plan are consistent with those established in License Condition 24 of SUC-1593. The MQOs established in the plan are consistent with typical MQOs for analyses using alpha spectrometry and the quality assurance objectives are appropriate and typically found for environmental surveys.

However, the staff notes that it finds that the Army's description of previously found artifacts at Schofield Barracks in the plan's Section 2.3.1 may be somewhat inconsistent with previous reports submitted by the Army. Although the Army described fragments as being relatively intact in Section 2.3.1 of the air sampling plan, the Army previously had submitted a Technical Memorandum prepared by Cabrera Services that reported that in the scoping investigation conducted at Makua Military Reservation, PTA, and Schofield Barracks, it found oxidized DU fragments at Schofield Barracks and observed small oxidation products in soils (Cabrera Services, 2008 ML091170322). According to this Cabrera Services' report describing the scoping survey conducted in 2007, the survey team observed yellow metal fragments less than 1 square cm (cm^2) and bright yellow soil that measured elevated gamma radiation with the Ludlum Model 2221 scaler/rate meter with a FIDLER probe at the Schofield Barracks. Isotopic analysis of bright yellow colored soil indicated the presence of DU and showed that U-234 concentrations were significantly less than U-238 concentrations (Cabrera 2008). Due to the possibility of resuspension of DU oxidation products at Schofield Barracks during ground disturbing activities, such as firing HE or using heavy ground moving equipment, and the large uncertainties in the Army's air sampling and RESRAD modeling during ground disturbing events, the NRC staff required additional air sampling at Schofield Barracks (ML13259A062, ML13259A081).

However, in contrast to the DU found at Schofield Barracks, oxidized DU metal fragments or oxidized DU particles were not observed in soils at the PTA. Therefore, the staff finds that air sampling at the PTA range is not necessary for the following reasons: (i) substantially less DU has been found at the PTA than at Schofield Barracks after extensive survey activities, (ii) the few DU metal fragments identified at the PTA were not oxidized, (iii) no DU yellow oxidized particles were observed on soil or rock surface areas within the PTA, and (iv) air sampling and analysis during 2010 BAX construction at the PTA Range did not confirm even trace amounts of DU (ML12046A506, ML113140533). The staff's review of the survey design in Section 3 finds that the planned air sampling should collect particulates greater than 0.5 µm, but unlikely to efficiently (e.g., greater than 80%) collect and detect airborne uranium particles less than 0.5 µm.

The Army states that its objective in monitoring air during the HE firing is to determine if any DU passes the site boundary and therefore, used smoke plume modeling, experience, wind direction and safety in its selection of air sampling locations. Smoke plume modeling and experience from previous burn studies show that the smoke and dust will transport with prevailing winds and come to rest at least 150 meters from the point of origin. The sampling plan's Figure 3-1 illustrates the sampling locations. The Army plans 11 air samplers total: (i) six air samplers to be evenly spaced along the western and northern sides of the RCA that

surround the planned HE fire area, (ii) three air samplers east of the HE fire area, and (iii) two air samplers southeast of the HE fire area at the KR-5 RCA Control Point and the KR-3 Tower. The staff finds the choice of high volume air samplers, filter size, and sampling locations are sound because (i) flow rates and large filters will increase the sampling efficiency by increasing the sample size, and (ii) the sampling locations surround the planned detonation area and should collect data irrespective of any change in wind direction during the sampling event.

Selection of the sampling media, the filter, is based on the following factors (Lipmann, 1988):

- high collection efficiency, preferably greater than (>) 99 percent;
- low resistance to air flow
- high retention of particulates on filter surface (e.g., low burial loss of alpha emitters);
- chemical composition (i.e., easy to digest for radiochemical analysis);
- high tensile strength;
- low background (i.e., absence of naturally occurring radionuclides);
- low cost; and
- high dust loading capacity

The Army states in Section 3.2 of the plan that it plans to collect air samples with 8 inch (in) x 10 in Whatman 41 or comparable cellulose filters at 45 cubic feet per minute (cfm) for 6-8 hours. To meet or exceed the action level concentration of 1×10^{-14} µCi/mL, the Army selected 1×10^{-15} µCi/mL as the Minimum Detectable Concentration (MDC). The Army cites Lideken et al. (1963) that the filters are known for their collection efficiencies for 0.2 to 10 µm sized particles and are readily dissolved for radiochemistry analysis, as required for alpha spectroscopy. Thus, the Army concludes the filters meet the physical and analytical requirements for the monitoring conditions. However, the staff notes that the cited reference and ANSI Standard N13.1 (1969, since withdrawn) states that Whatman 41 or comparable cellulose filters have collection efficiencies less than (<) 99 percent at face velocities < 100 cm/s (195 ft/s). The face velocity is the air velocity across the surface area of the filter, and the larger the surface area, the lower the air velocity. The face velocity is determined by dividing the flow rate by the surface area (i.e., 80 in^2 (0.56 ft^2 or 516 cm^2)). Because the outer edge of the filter is covered by the filter holder, the effective filter surface area is less (i.e., ~63 in^2 (0.44 ft^2 or 407 cm^2)) and, thus the face velocity is about 102 ft/min (~52 cm/s) and the collection efficiency for particles <0.5 µm is about 90 percent (ORAU 2002).

Cellulose filters are the most widely used because they are inexpensive, have low background, relatively high collection efficiency at high face velocities, high tensile strength, and are easily digested for radiochemistry analysis. However, cellulose filters are non-uniform and hygroscopic (i.e., they have the ability to hold moisture), which results in variable flow resistance that increases with dust loading and moisture (Lippmann 1988). Particulates collect throughout the depth of the filter resulting in burial loss of alpha particles, and the collection efficiency decreases as the face velocity decreases (ORAU 2002). Glass fiber filters are more expensive, are resistant to radiochemical digestion, and have lesser mechanical properties than cellulose filters. However, glass fiber filters have reduced hygroscopicity, maintain higher collection efficiencies at low pressure drops, withstand high dust loading and demonstrate lower alpha particulate burial losses than cellulose filters, which makes them the most widely used filter media for environmental air sampling (Lippmann 1988, ORAU 2002). Polycarbonate filters contain uniform sized pores in a solid matrix, which range from 0.03 to 0.8 µm. Pore size has

little effect on collection efficiency because the filters collect particulates by impaction, diffusion, and interception (ORAU 2002). Polycarbonate filters have low flow resistance comparable to the Whatman 41, but high collection efficiencies comparable to glass fiber filters, and are more expensive than cellulose or glass fiber (Lippmann 1988).

Therefore, the staff concludes that the Army must change filter type from cellulose to glass or polycarbonate filters, filter size, or the flow rate of the air samplers in order to increase the collection efficiency to greater than 99 percent. Otherwise the Army will not be meeting its objective of determining if any DU passes the site boundary in air effluent during HE firing.

The staff finds the Army's plans for sample preparation and analysis consistent with industry best practices. The Army states that samples collected using chain of custody forms will be shipped to a laboratory accredited by the Department of Defense Environmental Laboratory Accreditation Program for isotopic U analysis using alpha spectrometry. The laboratory will check the samples received against the chain of custody for accuracy of information and any discrepancies will be resolved prior to reporting the results to the Army. The Army states that the entire filter will be dissolved and diluted to a known volume and that one half of the dissolved sample will be analyzed and the second half retained for re-analysis if required. The Army will provide blank filters to the laboratory so that the filters can be used as quality control (QC) samples, such as a laboratory blank and two spiked laboratory control samples. The laboratory will retain all sample material for re-analysis using an alternative method, such as Inductively Coupled Plasma Mass Spectrometry (ICP-MS), should any of the sample results prove to be inconclusive or to split or confirm sample results.

The records, and the manner in which the Army proposes to maintain the records, are adequate to provide documentation of the air sampling program results. Chain of custody will be maintained for all samples. Calibration and source check procedures are consistent with NUREG-1556, Volume 7, Section 8.10.2.

5.0 References

Cabrera Services, 2008. Final Technical Memorandum Depleted Uranium Scoping Investigations Makua Military Reservation, Pohakuloa Training Area, Schofield Barracks Impact Area, Islands of Oahu and Hawaii, April 2008, (ML091170322).

Lindeken, C.L., R.L. Morgin, and K.F. Petrock, 1963. Collection Efficiency of Whatman 41 Filter Paper for Submicron Aerosols, *Health Physics*, 9, 305-308.

Lippmann, M. 1988. “29. Sampling Aerosols by Filtration,” Subcommittee 9 J.N. Harman, Chairman. Methods of Air Sampling and Analysis, 3d ed., J.P. Lodge, ed., Lewis Publishers, Inc., pp. 190-214.

Malissa, H., ed. 1978. Analysis of Airborne Particles by Physical Methods, CRC Press, Inc., West Palm Beach.

ORAU 2002. NRC Air Sampling for Radioactive Materials Course (H-119), Notebook 1, Oak Ridge Associated Universities, Oak Ridge, TN.

U.S. Department of Army Installation Management Command, Environmental Radiation Monitoring Plan For Pohakuloa Training Area Hawaii, November 2011, ADAMS Accession No. ML113140553.

[USARMY 2008] Technical Memorandum, Schofield Barracks Firing Range Monitoring of Air Quality During Burning of Vegetation, Wahiawa, Hawaii, Evaluation of Uranium Depletion, April 2008 (ML091170320)