DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
2405 GUN SHED ROAD
JOINT BASE FORT SAM HOUSTON, TX 78234-1223

REPLY TO
ATTENTION OF
Safety Office

December 16, 2013

ATTN: Document Control Desk
Deputy Director, Decommissioning and Uranium Recovery Licensing Directorate
Division of Waste Management and Environmental Protection
Office of Federal and State Materials and Environmental Management Programs
Mailstop T8 F5
US Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Deputy Director:

This letter addresses license condition 22 in license number SUC-1593 (Docket 040-09083), which says, "The licensee shall provide an air sampling plan to the NRC within 90 days of [October 23, 2013] for review and approval." The required air sampling plan is enclosed.

The 25th Infantry Division will conduct a scheduled training exercise at the Battle Area Complex (BAX) at Schofield Barracks on February 4-11, 2014. This presents the best opportunity to implement this air sampling plan for high explosive (HE) fire into an impact area that overlaps the radiation controlled area (RCA). If not approved prior to this event, HE fire will be directed into an impact area outside of the RCA. Therefore, we request that your review and approval be completed in time to allow for set up and execution of the attached sampling plan during this exercise.

Background air samples will be taken on February 3 with one or more days of air sampling during HE fire between February 4 and 11. If we are unable to perform the air sampling at that time, we will inform NRC once a similar training exercise is scheduled with sufficient HE fire for adequate air sampling. The next opportunity may not be for several months.

You may reach me by telephone at (210) 466-0368 or by email at robert.cherry@us.army.mil.

Sincerely,

Robert N. Cherry, Jr.
License Radiation Safety Officer

Enclosure

FSME20

FINAL

EFFLUENT SAMPLING PLAN FOR AIR MONITORING OF DEPLETED URANIUM DURING HIGH EXPLOSIVE FIRE

SCHOFIELD BARRACKS, OAHU, HAWAII

Contract Number: W912DR-08-D-0026
Delivery Order: ZW01
CABRERA Project Number: 08-3123.00

Prepared for:

US ARMY CORPS OF ENGINEERS
US Army – Engineering and Support Center
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December 2013

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

%	percent
ADAMS	Agencywide Documents Access and Management System
Cabrera	Cabrera Services, Inc.
CFM	cubic feet per minute
CFR	Code of Federal Regulations
COC	chain of custody
DQO	Data Quality Objective
DU	depleted uranium
EPA	U.S. Environmental Protection Agency
g	gram
GPS	Global Positioning System
HE	high explosive
ID	identification
m	meter
MDC	minimum detectable concentration
MQC	minimum quantifiable concentration
MQO	measurement quality objective
mrem/yr	millirem/year
NRC	U.S. Nuclear Regulatory Commission
PARCC	precision, accuracy, representativeness, comparability, and completeness
QAO	quality assurance objective
QC	quality control
RCA	radiation controlled area
µCi/mL	microcuries per milliliter
U	Uranium
^{234}U, ^{235}U, ^{238}U	isotopes of uranium: uranium-234, uranium-235, uranium-238
UO_2	uranium dioxide
U_3O_8	triuranium octaoxide
USACE	U.S. Army Corp of Engineers

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1.0 INTRODUCTION

Schofield Barracks is the largest Army post in Hawaii, located on an 18,000 acre site in central Oahu. The Schofield Training Area totals 4,695 acres located in a large valley, with a ridgeline along the north, west, and southwest boundaries. In August 2005, 15 tail assemblies from spotting rounds made of D-38 uranium (U) alloy, also called depleted uranium (DU), were recovered by a contractor clearing a Schofield Barracks range impact area of unexploded ordnance and scrap metal. During the 1960s, DU that was in the tail assembly of training rounds for the Davy Crockett weapon system was used because of its high density and weight. The DU components are approximately four inches long and one inch in diameter. Other activities involving the use of DU have not been reported on Army installations in Hawaii. The presence of DU at Schofield Barracks has raised concerns about potential exposure to site workers and members of the public during practice fire explosive events.

The purpose of this 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. The term "HE fire" in this plan refers to artillery, mortar, or tank fire of HE projectiles. This HE fire will be conducted on the range during a training exercise.

Cabrera Services, Inc. (Cabrera) has monitored potential releases of DU effluent during several previous prescribed range burns at Schofield Barracks and is employing the lessons learned during those projects to ensure a successful effluent monitoring project during planned HE fire (Cabrera, 2008). This document has also been prepared in accordance with the approved *Radiation Safety Plan for U.S. Army Garrison Hawaii Ranges Affected by Depleted Uranium in M101 Davy Crockett Spotting Rounds* (U.S. Army, 2011). Previous test burn activities at Schofield Barracks are listed in Table 1-1.

Table 1-1. Previous Effluent Monitoring Events

Year	Scope of Investigation
July 31 to August 3, 2007	Performed test burns and reference area burns to determine the potential effluent discharge of DU and to monitor the actual burn.
August 22 and 29, 2008	Monitored to determine potential effluent discharge of DU during range burn.
June 16, 2011	
July 28 to July 30, 2012	

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2.0 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) specify the type, quality, quantity, and uses of data needed to support decisions and are the basis for designing data collection activities. To determine the project DQOs, a series of planning steps are used as specified in QA/G4, *U.S. Environmental Protection Agency (EPA) Guidance for Data Quality Process* (EPA, 2004). The DQO development process is used in order to optimize the data collection necessary to meet the applicable decision criteria. The seven steps of the DQO process are presented in the following subsections.

2.1 Step 1 – State the Problem

The "problem" is defined as the potential to expose members of the public not participating in the training exercise to airborne DU effluent during HE fire at the Schofield Barracks range. Sufficient resources will be allocated to define the problem and develop the project planning documents, which identify the survey implementation process. Members of the planning team include the U.S. Army Corps of Engineers (USACE), US Army Garrison Hawaii, Installation Management Command, and their contractors.

2.2 Step 2 – Identify the Decision

The principal study question is whether the airborne DU effluent present at the perimeter of the RCA at Schofield Barracks during the HE fire exceeds the project action levels. The results of the air samples will be compared to project action levels derived from NRC published limits for airborne concentrations for members of the public, as identified in Appendix B of Title 10 Code of Federal Regulations (CFR) Part 20, "Standards for Protection Against Radiation" (NRC, 2004). The project action levels were set to 20% of the values published in Column 1 of Table 2 of 10 CFR Part 20, Appendix B. The Appendix B concentration values are equivalent to the radionuclide concentrations, which if inhaled continuously over the course of a year would produce a total effective dose equivalent of 50 millirem per year (mrem/yr) to a member of the public. The reduction to 20% of the values in 10 CFR Part 20, Appendix B allow for consistency with the EPA's 10 mrem/yr standard for effluent releases (NRC, 2004). The proposed actions provide the following alternatives:

- Report concentrations of airborne DU that exceed the effluent concentration limits, or
- Document the results of the investigation for concentrations of airborne DU below the effluent concentration limits.

The key decision statement is the determination of whether the HE fire will cause airborne concentrations of uranium isotopes at levels above the 40 CFR 61 effluent concentration limits.

Additionally, the air sample data will be analyzed for isotopic U. Results with the ratio of uranium-238 (^{238}U) to uranium-234 (^{234}U) exceeding three will indicate the presence of DU.

2.3 Step 3 – Identify Inputs to the Decision

2.3.1 Radionuclides of Concern

The only known source of radionuclides is DU contained in the tail assembly of training rounds found during previous investigations at Schofield Barracks. DU is the byproduct of uranium enrichment processes, and is defined as U, containing less than 0.711 percent (%) uranium-235 (^{235}U). DU consists

primarily of ^{238}U with smaller amounts of ^{234}U and ^{235}U, based on both mass and activity perspective. The activity (A) ratio of ^{238}U to ^{234}U in natural uranium is $A(^{238}U)/A(^{234}U)$ = 48.83 %/48.83 % = 1. In typical DU, $A(^{238}U)/A(^{234}U)$ = 90.1 %/8.4 % = 10.7. Generally, the NRC assumes that DU is present in a mixture of natural uranium and DU if, for the mixture, $A(^{238}U)/A(^{234}U) > 3$ (NRC, 2001).

The DU was U metal when it was released to the environment. The artifacts previously found at Schofield Barracks were intact. Discovery of any DU during the investigation is expected to be intact or present as large chunks of U metal. Although U is pyrophoric when it is present as fine particles, this feature is not the expected form of DU at Schofield Barracks.

U metal has a melting point of 1132 °C and a boiling point of 3927 °C. It oxidizes slowly in the environment to form multiple oxides of U (e.g., UO_2, U_3O_8). These oxides have different chemical and physical characteristics; the oxides are relatively insoluble in water and are generally considered immobile in the environment.

There is limited potential for U to be taken up by plants. Although U is a heavy metal that is toxic to many organisms, its uptake in plants is very small or nonexistent. In its expected metallic form, U would not be available for uptake by plants.

2.3.2 Potentially Affected Media

The medium of concern for the study is DU particulates in air. However, the potential for the DU at Schofield Barracks to become airborne is expected to be very small, and is not expected to affect other media to a significant extent. The physical form of DU, a four inch long and one inch diameter cylinder, limits interaction with other media. Reference and test burns were used previously to collect site-specific information on DU in soil, plants, ash, and air particulates in order to determine if DU had affected other media. The analytical results of those burns are being used in the design of this plan (Cabrera *Technical Memorandum*, April 2008).

2.3.3 Action Levels

The limiting air concentration for effluents from 10 CFR 20 for U isotopes is 5×10^{-14} microcurie per milliliter (µCi/mL) for ^{234}U. For DU, ^{238}U concentrations would be significantly greater than ^{234}U concentrations; thus, the action level is conservative when applied to DU. The action level for the airborne concentration will be 20% of the most conservative limit for effluents from 10 CFR 20 for U isotopes of 5.0×10^{-14} µCi/mL.

Activity ratios of ^{238}U to ^{234}U exceeding three is indicative of DU and will be so reported to the NRC.

2.4 Step 4 – Define the Study Boundaries

The study area is the portion of the RCA the Army intends to use as an HE impact area. The perimeter of this study area will serve as the spatial boundary for the study. The effluent samplers will be positioned near the spatial boundary to perform perimeter monitoring during the HE fire.

Multiple specific constraints on data collection include factors associated with equipment availability and weather conditions. Data collection itself, if there are outliers or high levels detected, can impact the data

collection process. With a maximum of 11 air particulate samples collected at one time, meteorological data is collected according to Army weather reports at locations both up and downwind from the HE fire. The preferred weather conditions are moderate to low speed winds that consistently blow from the same direction and without any precipitation or cloud cover. A lack of wind will allow the smoke and other particulate, such as dust or dirt, to travel straight up where it cannot be sampled by monitors located up or downwind (the term "smoke plume" in this plan includes all particulate, such as dust or dirt, that is disturbed during HE fire). When wind direction is variable, it is difficult to determine the proper location of the air samplers and it limits an accurate account of particulate on each filter. Precipitation will potentially damage the filter media and impact the smoke plume. Overcast conditions will make it difficult to make visual observations of the HE fire and describe the plume. A complete list of meteorological conditions to be documented is provided in Section 3.1 of this plan.

2.5 Step 5 – Develop a Decision Rule

The decision rule for the air monitoring study is based on the action level and the alternative actions.

If the incremental concentration of ^{238}U in air above background at the study area perimeter is greater than 1.0×10^{-14} µCi/mL, then the results of the air monitoring study will be documented and reported to the client Project Manager (PM) as soon as possible. If the concentration of ^{238}U in air is less than or equal to 1.0×10^{-14} µCi/mL, then the results of the air monitoring study will be documented and included with the final report. Additionally, the residues on the air sample filters will be analyzed for isotopic U. Per NRC policy, $A(^{238}U)/A(^{234}U) > 3$ will indicate the presence of DU..

There are additional decision rules that apply to measurements performed during the Range HE fire surveys that serve as inputs to the decision. Table 2-1 lists these decision rules.

Table 2-1. Decision Rules

Parameter of Interest	IF	THEN	Comments
Meteorological data			
Weather Stability Class	If stability class is not within SB BAX HE fire parameters (e.g., high wind or no wind, gusting wind, variable wind direction, rain),	Notify the Army PM.	Poor weather conditions may render samples unreliable or hinder the actual use of the monitors. Any decision to delay the HE fire will be made with after agreement between USACE, the Army PM, the Installation Management Command, and Cabrera, as applicable.
Air Sample Data			
Compliance with the Release Criterion	If the maximum ^{238}U concentration in air from the detonations exceeds the average ^{238}U concentration in air from the 2007 reference area burn by more than 1.0×10^{-14} µCi/mL,	Notify the Army PM.	Concentrations of ^{238}U that exceed background by more than the NRC effluent levels indicate the potential for releases of unacceptable concentrations of DU.
Compliance with Activity Ratio	If $A(^{238}U)/A(^{234}U) > 3$,	Notify the Army PM.	Per NRC policy, $A(^{238}U)/A(^{234}U) > 3$ will indicate the presence of DU.

2.5.1 Step 6 – Specify Tolerable Limits on Decision Errors

The collection and analyses of data are designed as a graded approach using a combination of sample collection and off-site laboratory analysis of air samples in order to manage uncertainty.

Analytical uncertainty is controlled by use of appropriate instruments, methods, techniques, and Quality Control (QC). Minimum detectable concentrations (MDCs) for individual radionuclides using specific laboratory analytical methods have been established. Specifying values for the MDC controls the level of uncertainty associated with individual analytical results and limits decision errors.

2.5.2 Step 7 – Optimize the Design for Collecting Data

Review and analysis of observations will be performed in order to optimize the type, location, and number of samples collected during the HE fire.

2.6 Measurement Quality Objectives

Because DQOs apply to both sampling and measurement activities, method performance characteristics selected specifically for the selected measurement process are required from a measurement perspective. Measurement quality objectives (MQOs) are statements of performance objectives or requirements for a particular method performance characteristic. Method performance characteristics include method uncertainty, detection capability, quantification capability, range, specificity, and ruggedness. MQOs can be applied to data collection methods as well as sample analysis methods. MQOs are described in the following sections.

2.6.1 Method Uncertainty

The measurement method uncertainty refers to the predicted uncertainty of a measured value that would be calculated if the method were applied to a hypothetical sample with a specified concentration. Measurement method uncertainty is a characteristic of the measurement method and the measurement process. The air filter samples collected during the HE fire will directly address the principal study question; thus, method uncertainty is defined for these sample measurements. The required measurement method uncertainty for alpha spectrometry measurements performed in support of this air monitoring survey for concentrations equal to the action level is set equal to 0.3 times the action level, or 3.0×10^{-15} µCi/mL. This assumes Type I and Type II decision error rates of 0.05, or 5%.

2.6.2 Detection Capability

Since decisions will be made for individual measurements, it is critical that the detection capability of the measurement method be sufficient to detect radioactivity at the level of concern. Since decisions about the principal study question will be determined based on air filter collections during the HE fire, the detection requirements only apply to those air filter samples collected during the HE fire. The initial objective for detection capability is the smallest concentration of radioactivity that can be reliably distinguished from zero. This value is called the MDC. The required MDC for the HE fire is set at 1.0×10^{-15} µCi/mL, or 10% of the action level. Required air sampler collection times and flow rates are provided in Section 3.2 of this plan.

2.6.3 Quantification Capability

The action level for this project is stated in terms of concentration, not detection. It is necessary to know the quantification capability of the selected measurement method. The quantification capability is expressed as the smallest concentration of radioactivity that can be measured with a specific relative standard deviation. This concentration is called the minimum quantifiable concentration (MQC). The value of the MQC for alpha spectrometry measurements performed on air filters collected during the HE fire will not exceed the action level.

2.6.4 Range

The range of the measurement method is defined as the range of concentrations that can be measured accurately. Alpha spectrometry is applicable to a broad range of count rates. If the count rates get too high, the sample can be diluted or moved farther from the detector face. The activity levels expected from the types of samples collected as part of this air monitoring survey can be measured accurately using

alpha spectrometry. The key factor in determining whether a concentration range is acceptable will be the volume of air passing through the filters during the HE fire.

2.6.5 Specificity

Specificity is the ability of the measurement method to determine the radionuclide producing the measured radiation. Alpha spectrometry combines chemical separation and purification of U in the sample in order to remove potential interferences; consequently, alpha spectrometry measures the energy and number of alpha particles as a means of identifying the isotope of concern and its activity in the sample. Alpha spectrometry is a very specific measurement method that can be used to determine the concentrations of both ^{238}U and ^{234}U, and thus provide information on the level of U depletion.

2.6.6 Ruggedness

Ruggedness is a measure of the relative stability of the measurement method performance when small variations in method parameter values are made. Since alpha spectrometry is not a rugged measurement method, these analyses are performed under laboratory conditions where variations can be minimized. Degradation of the sample spectrum can potentially result from incomplete purification or partial absorption of alpha particles from the final sample amount. Therefore, it is important to ensure that there is a sufficient sample supply in order to allow re-analysis, if it is required.

2.7 Quality Assurance Objectives

The overall quality assurance objective (QAO) for this air monitoring survey is to have all analyses performed on analytical systems that are in statistical control and meet method specifications. QAOs are the QC specifications to be implemented throughout the project in order to ensure data meet known and suitable quality criteria, such as precision, accuracy, representativeness, comparability, and completeness (PARCC). The quality of analytical data will be controlled through the performance of QC measurements and the calibration of field and laboratory equipment following established protocols.

2.7.1 Precision

Precision is a measure of how well a measurement method can provide repeated results. Precision is measured by performing replicate measurements of the same sample and documenting the variability in the results. The analytical laboratory will perform duplicate laboratory control samples with every batch of samples as a means of providing information on the precision of laboratory measurements. The objective for precision of laboratory duplicates is less than 20% relative percent difference. Operational checks will be performed every day a field instrument is used in order to provide information on the precision of field measurements. The objective for obtaining precise field measurements is to meet a standard deviation of less than 20% for source checks and ± 3 standard deviations for swipe counting instruments.

2.7.2 Bias

Bias is a measure of how well a measurement method can estimate the activity for a sample with known activity (e.g., spike, laboratory control sample). Bias is measured by analyzing samples with known activity and comparing the measurement results to the expected results. The analytical laboratory will analyze a laboratory control sample with each batch of samples to provide information on bias for

laboratory measurements. The objective for determining the bias of laboratory control samples is to achieve less than a 10% relative percent difference from the known activity. Operational checks will be performed every day a field instrument is used in order to provide information on field measurement bias. The objective for determining the bias of field measurements is to achieve less than a 20% relative percent difference from the initial average activity determined for source checks.

2.7.3 Completeness

Completeness refers to the amount of data from the survey design that is required to be available to meet the DQOs. Since decisions will be made for each sample result individually, it is important that all samples be collected and analyzed. The objective for completeness for this effluent monitoring survey is 100%.

2.7.4 Comparability

Comparability refers to the ability to compare data from one set of data with other sets of data. Comparability for this air monitoring survey will be ensured through the use of approved sample collection methods. Modifications based on data collected during this survey will be documented in order to explain the purpose and rationale for the modification. Comparability of visual observations is based on establishing known perspectives and locations for observers relative to the HE fire and performing observations from similar perspectives for each firing.

2.7.5 Representativeness

Representativeness is a measure of how well the samples collected reflect the actual conditions at the site. Since decisions about the principal study question are based on individual sample results, individual samples need to be representative of the media being sampled. The distribution of air monitors around the perimeter of the range is designed to ensure that the air filters are representative of the air particulates potentially leaving the range.

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3.0 SURVEY DESIGN

The survey design consists of environmental condition monitoring combined with sample collection and analysis. The environmental conditions monitoring is used as a means of documenting various meteorological conditions that may impact the survey design. The sample collection and analyses provide quantitative data that are used in order to address the principal study question reflected in the decision rule. The survey design may require changes that meet field conditions found at the site or to apply lessons learned from each of the previous burns (2007 and 2008). All adjustments will be documented. Any changes potentially affecting completion of project goals will be communicated to the client prior to implementation.

A period of advanced notice (approximately two-three weeks) will be provided by the Army to NRC Region IV personnel before HE fire and air monitoring activities begin.

3.1 Environmental Conditions

Monitoring consists of recording observations and photographs documenting the conditions occurring during the HE fire. Data collected on the behavior of the smoke plume will be recorded in a log book. Examples of the type of environmental conditions that will be recorded are shown in Table 3-1.

Meteorological forecasts should be closely monitored before planned HE fire begins. Close coordination between air monitoring personnel, range personnel, and the firing units will be essential to ensure that if meteorological conditions are unsuitable for air monitoring during HE fire, then this is adequately communicated to all parties as far in advance as possible.

Photographs will be taken from locations as close to the HE fire as allowed by safety personnel as well as from more distant locations. At a minimum, photographs will be taken from locations perpendicular to the wind direction in order to document the shape of the smoke plume as it moves downwind, as well as from a location directly upwind of the HE fire in order to document the lateral dispersion of the smoke plume. Global Positioning System (GPS) measurements will be collected to accompany photographs and document the location of the photographer, time, date, the direction the photographer was facing, weather conditions, and any information pertinent to the project or behavior of the smoke. Weather information will be collected from the onsite meteorological system located at Range Control. Printouts of weather datum will be retained in onsite records.

Table 3-1. Types of Monitoring Data

Type of Data	Examples
HE Detonation Information	Detonation Name (date and range area)
	Date
	Time (start, stop)
Observer Information	Observer Name
	Location (relative to detonations)
	Elevation (relative to detonations)
Weather Information	Sky Cover (clear, mostly sunny, fair, partly cloudy, mostly cloudy, cloudy, variable clouds)
	Temperature (maximum, minimum, average)
	Wind Speed (average, maximum gust)
	Wind Direction (average, range)
Explosion Behavior	Height of Smoke Plume
Smoke Plume	Shape (sketch or photo)
	Slope (steep is straight up, shallow is close to ground)
	Color
	Visibility (can the observer see through the plume)

3.2 Sample Numbering

Samples will be identified using the following numbering methodology:

SBHF13-###-RT#-DD-XX

Whereas,

SBHF13 = Project designator for Schofield Barracks HE Fire and year
= Sample number beginning at 001
RT# = Associated range
DD = Sample Matrix [AS (filter paper)]
XX = Sample Phase [BK (Background), HF (HE Fire)]

Air particulate samples are collected in order to provide information on U concentrations in air. Particulates in grass smoke caused by the explosions are primarily in the fine particulate range, measuring 2.5 microns or less in diameter (ALA 2010). The choice of filter paper will be based on its capacity to collect these small particles over the relatively short sampling time (approximately six to eight hours per filter); the presentation of little or no naturally occurring radionuclides that could interfere with analysis and interpretation of data; the ability to physically withstand the flow rate (approximately 45 cubic feet per minute [CFM]) and weather conditions; and be easily digestible for the required alpha spectroscopy analysis. Since filter media and binders sometimes include measurable levels of natural U, it is important that the U concentrations in the filters be evaluated.

Samples will be collected using 8 inch x 10 inch Whatman 41 cellulose (i.e., or comparable manufacturer paper) filters. Whatman 41 paper filters are well known for their retention efficiencies in the 0.2 to 10

micron particle size range (HP, 1963), are a choice medium for chemical separation techniques for alpha spectroscopy, and meet the physical and analytical requirements for the monitoring conditions.

The HI-QCF 973T or equivalent high volume sampler will be operated at approximately 45 CFM to collect air samples to meet or exceed the action level 1×10^{-14} µCi/mL and the desired MDC of 1×10^{-15} µCi/mL. The air sampler will be calibrated to manufacturer specifications.

A total of 11 air particulate samples will be collected prior to the Range HE fire to measure ambient background conditions; 11 samples will be collected during each day of the Range HE fire. If the HE fire activities take two days, then the sampling will be repeated each day it continues, up to as many as eight days.

Prior to the start of the HE fire, a background sample will be collected using each of the 11 high volume air samplers. The background samples will be collected using 8 inch x 10 inch Whatman 41 cellulose (i.e., or comparable manufacturer paper) filters. Whatman 41 paper filters are well known for their retention efficiencies in the 0.2 to 10 micron particle size range (HP, 1963) and are a choice medium for chemical separation techniques for alpha spectroscopy. The background samples will be collected for approximately eight hours using the maximum flow rate of the sampler (approximately 45 CFM). The locations of the air filters will be documented using a GPS. The air filters will be removed from the air samplers and placed in re-sealable plastic bags. Each bag will be labeled with the sample identification (ID), date, sample start time, sample stop time, flow rate, and initials of the person collecting the sample. The sample will be placed in a container and custody will be maintained until the sample container is sealed and transferred to the shipping company. Typical MDCs during the 2007 burns were in the low 1E-16 picocurie per gram range.

Prior to the start of HE fire each day, new filters will be placed in each of the air samplers and the samplers started. After the completion of the HE fire each day, as allowed by site safety personnel, each of the air monitors will be turned off. Air monitors should collect samples for at least eight hours at 45 CFM to ensure the desired MDC of 1×10^{-15} µCi/mL is achieved, regardless of HE fire duration. The air filters collected during the HE fire should be in the same location as the place where backgrounds were collected. If it is necessary to move one or more of the air monitors, then the new location will be documented using a GPS. The air filters will be removed from the air samplers and placed in re-sealable plastic bags. Each bag will be labeled with the sample ID, date, sample start time, sample stop time, flow rate, and initials of the person collecting the sample. The sample will be placed in a cooler and custody will be maintained until the sample container is sealed and transferred to the shipping company.

3.3 Air Sample Locations

The placement of air samplers during sample collection is a critical factor in measuring U in air. The objective of monitoring the air during the Range HE fire is to provide information on the behavior of DU in the environment, including the potential for airborne particulates containing U.

During the Range HE fire, there will be 11 air monitors available for the project, regardless of the potential for the wind to shift during the HE fire. The sample locations are selected based on professional judgment, smoke plume modeling, wind direction, and safety concerns.

Smoke plume modeling and experience from the prescribed burn in 2007 indicate that the smoke and dust will travel with the prevailing winds and then touch down at least 150 meters from the point of origin. Therefore, the placement described above and shown in Figure 3-1 should allow for successful monitoring.

The objective of the Range HE fire air monitoring is to determine if any U passes the site boundary during the Range HE fire. Six air monitors will be evenly spaced along the western and northern sides of the RCA around the planned HE fire area. Two air monitors will be placed west of the "Area 3 Mover," east of the HE fire area. One air monitor will be placed behind the "Live Fire Village" in Construction Area six, east of the HE fire area. Finally, two air monitors will be placed southeast of the HE 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 (e.g., closer to a building).

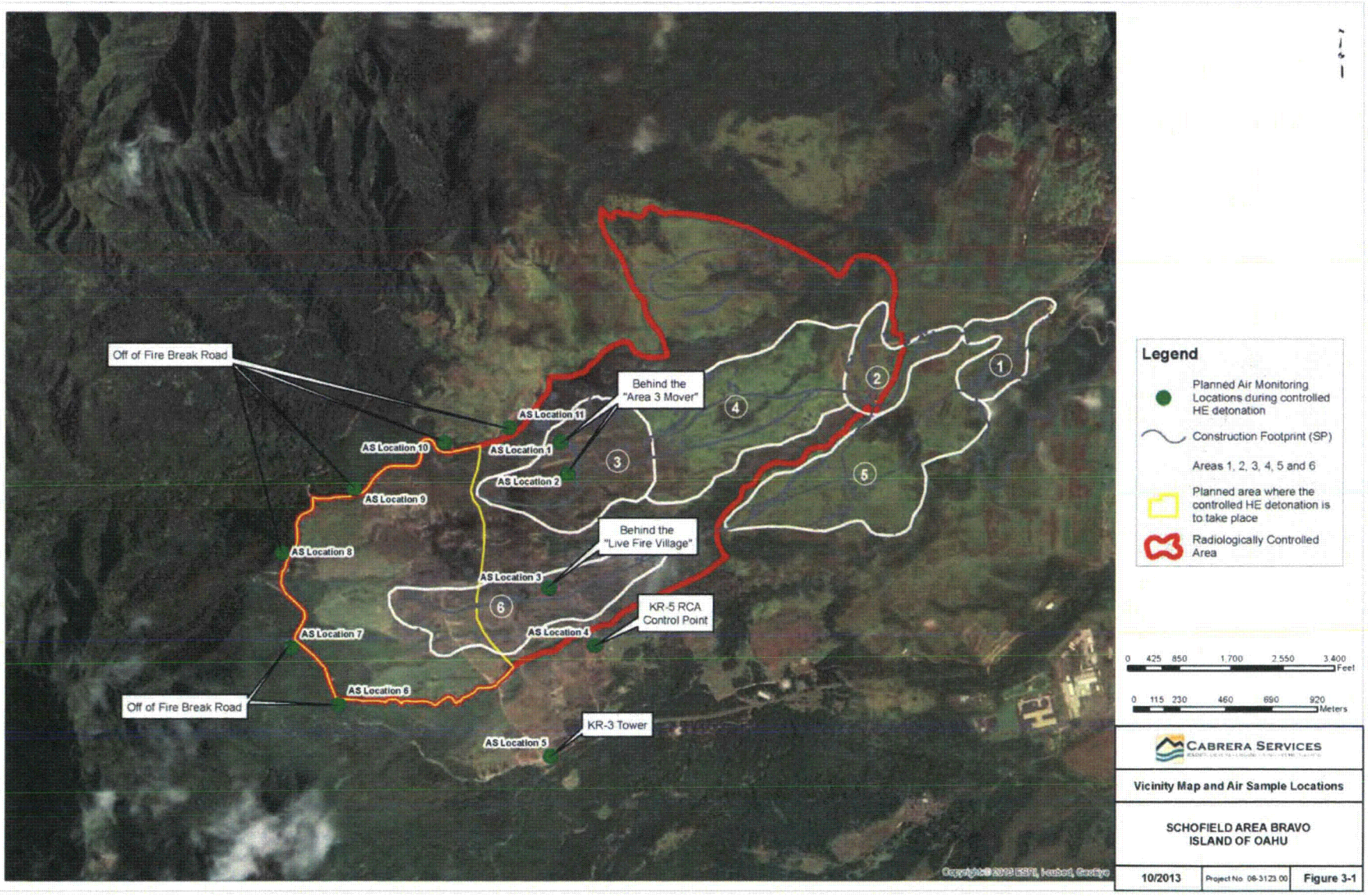

Figure 3-1 Planned Air Monitoring Locations During HE Fire

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4.0 SAMPLE PREPARATION AND ANALYSIS

All of the samples collected as part of the air monitoring program will be sent to an off-site laboratory for sample preparation and analysis. The samples will be analyzed for isotopic U using alpha spectrometry. The laboratory will be the Department of Defense Environmental Laboratory Accreditation Program, certified for performing the required analyses.

When the samples are received at the laboratory, they will be checked against the chain of custody (COC) in order to ensure that all of the data have been accurately transferred to the laboratory. Any discrepancies will be resolved prior to reporting the results.

All samples will be weighed when they arrive at the laboratory. After weighing, the samples will be placed in a furnace and ashed in order to remove organic material.

After removal from the furnace, the samples will be weighed again. Air samples will be reported per liter based on the volume of air that passed through the filter. The ash weights for the filters are used in order to provide an indication of filter loading.

The entire air filter will be dissolved and diluted to a known volume. One half of the dissolved sample will be analyzed, retaining the second half for re-analysis if required. The dissolved sample will be purified and the U separated from other elements. The purified sample will be counted by alpha spectrometry in order to provide estimates of concentrations for the individual U isotopes.

Blank air filters will be provided to the laboratory. For each batch of samples, these filters will be used as QC samples for the project. 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.

All retained sample material will be available for re-analysis using an alternative method, such as Inductively Coupled Plasma Mass Spectrometry, should any of the sample results prove to be inconclusive or a determination is made for the need of splitting or confirming sample results.

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5.0 RECORD KEEPING AND REPORTING

This section describes the documentation and QC requirements for the air monitoring survey.

5.1 Record Keeping

The results of all visual observations, field measurements, and sample collection activities will be documented as described in the following sections.

5.1.1 Visual Observations

The results of visual observations will be recorded in field log books. The visual observations will describe the overall plume behavior as well as ambient conditions at the HE fire location. Ambient conditions at the sample collection locations or receptor locations may also need to be described if they differ significantly from the conditions at the HE fire location. All log book entries will be dated and include the initials of the person entering the information. Log book entries will be entered in indelible ink.

5.1.2 Photographs

Photographs will be documented either in a logbook or in an electronic photo log. The log will document the time, date, name or initials of the photographer, location of the photographer, and direction the photographer was facing. The log may also include weather conditions and any information pertinent to the project or behavior of the smoke.

5.1.3 Field Measurements

Collected air filters will be counted for alpha and beta activity on-site using a Ludlum Model 2929/43-10-1 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 on-site results will be documented in a logbook or electronic log.

5.1.4 Sample Log

Information on sample collection activities will be documented in an electronic sample log. The sample log will include the sample ID, state plane easting and northing in meters, the area surveyed (e.g., reference, test, or range), sample media (i.e., air filter), and date and time the sample was collected. Air filters will include the start and stop time of sample collection, as well as the flow rate at the beginning and end of the collection period.

The log will also include any comments regarding the sample collection process pertinent to the project.

5.1.5 Chain of Custody

A COC will be filled out for each day samples are collected. The COC form documents the persons responsible for controlling the samples from the time they are collected until the samples arrive at the laboratory. The COC also allows the field team to provide necessary information to the laboratory concerning the number, type, and ID of the samples. The COC will include the sample ID, collection date and time, number of containers (generally one), and the requested analyses (i.e., isotopic uranium by alpha spec). Also, the COC will include contact information so that the laboratory can send the results and contact the appropriate party regarding questions about the samples. Under the comments section, the volume will be included for each air filter. The person collecting the samples will sign the COC on the day the samples are collected. The sample collector will maintain physical control of the samples (e.g., maintain visual contact, lock the samples in a vehicle, lock the samples in an office) until custody is transferred to another person. The original COC will be placed inside the shipping container with the samples prior to sealing the container. This means that the shipper does not sign the COC when accepting control of the samples; the shipping papers serve as documentation of custody. When the samples arrive at the laboratory, the laboratory accepting custody of the samples will sign the COC. Any discrepancies between the samples received and the information recorded on the COC will be resolved prior to reporting the analytical results.

5.2 Quality Control

Quality of the data will be maintained by understanding and implementing the DQOs, MQOs, and QAOs presented in Section 1.0. This section summarizes the QC requirements of the project.

5.2.1 Visual Observations

Visual observations are subjective and subject to difficulties in determining the quality of the data. In order to maintain the quality of visual observations, it is necessary for the observers to understand the objectives of the survey as well as understanding the information required from the visual observations. Observers will be briefed on the project objectives by either the contractor PM or the contractor field lead prior to performing observations. Observers will follow the standard list of information required and provided in Table 3-1. in order to ensure the type of information provided is consistent. Photographs and observations will be taken from predetermined locations to allow comparison of data from each of the three previous burns.

5.2.2 Field Measurements

All instruments used to perform field measurements will be properly calibrated within the past year and copies of the calibration documentation will be maintained at the site. Instruments used to perform field measurements will be checked at the beginning and end of each day they are used, as described in the appropriate Cabrera Standard Operating Procedure.

Air samplers will be calibrated in accordance with the manufacturer's specifications, and copies of calibration documentation will be maintained at the site. Flow rates will be checked at the start and finish of each monitoring period. The average of the flow rates recorded at the beginning and end of the monitoring period will be used as the flow rate to evaluate the sample.

Source checks will be performed to document that the instrument responds to radioactivity as expected. Background checks will be performed in order to document that the instrument is not broken or contaminated.

The results of the operational checks will be documented in an electronic file with the instrument reading, date, and time per Cabrera OP-358, *HP Instrument General Quality Control Procedure (Rev 1.0)* (Cabrera, 2013). Warning limits and control limits will be established at the beginning of the project. A time-series plot of the measurement results will be maintained in order to visually compare the operational checks with the warning limits and control limits over the life of the project. Results that are outside the control limits will be investigated by repeating the measurement. If the results continue outside the control limits, the instrument will not be used until the problem can be determined and resolved.

5.2.3 Laboratory Measurements

Samples collected as part of this air monitoring survey provide information critical to resolving the principal study question. All of the samples need to be analyzed and reported with the maximum sensitivity possible. This means that samples will not be split by the laboratory in order to obtain laboratory duplicates. The limited number of air monitors available to the project means that field duplicates will not be collected. Therefore, precision will be determined based on duplicates of laboratory control samples. Since the air filters provide information directly related to the principal study question, blank air filters will be used as laboratory blanks, laboratory control samples, and laboratory control sample duplicates.

One laboratory blank, one laboratory control sample, and one laboratory control sample duplicate will be analyzed with each batch of samples. Two batches of samples are expected during this air monitoring survey. One batch of samples will include the background air filters. Also, the background air filters and the air filters collected during the Range HE fire will represent one batch of samples.

5.3 Documentation

The results of this air monitoring survey will be documented in a brief report. The report will provide the results of the visual observations, field measurements, and sample analyses described in this plan. The report will also evaluate the sample data relative to the action level and, if useful, additionally evaluated relative to the action level with background considered. The evaluation of the sample results will include for each sample and for the aggregate of all samples calculations of $A(^{238}U)/A(^{234}U)$ and the uncertainty in these values for evaluations of the presence of DU in the air samples.

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6.0 REFERENCES

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Cabrera, 2008, *Technical Memorandum Schofield Barracks Firing Range Monitoring of Air Quality during Burning of Vegetation*, April 2008. ADAMS Docket Number ML091170320.

Cabrera, 2013, OP-358, *HP Instrument General Quality Control Procedure (Rev 1.0)*, August, 2013.

EPA, 2007, *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4*. U.S. Environmental Protection Agency, April, 2007.

EPA, 2011, Title 40, Code of Federal Regulations, Part 61. U.S. Environmental Protection Agency, July 2011.

HPS, 1963 *Collection Efficiency of Whatman 41 Filter Paper for Submicron Aerosols*, Health Physics, Pergamon Press 1963. Vol 9, pp. 305-308.

NRC, 2004, Energy, Title 10 Code of Federal Regulations; January 2004.

NRC, 2001, *Systematic Radiological Assessment of Exemptions for Source and Byproduct Materials*. NUREG-1717. June 2001.

U.S. Army, 2011, *Radiation Safety Plan for U.S. Army Garrison Hawaii Ranges Affected by Depleted Uranium in M101 Davy Crockett Spotting Rounds*, June 2011. ADAMS Docket Number ML11193A227.

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Attachment A
Field Forms

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CABRERA SERVICES
RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION

Daily Safety Toolbox Meeting	
Project Name:	Project Number:
Location:	*Date/Time:*
General Scope of Work:	
Site Weather Conditions:	

Emergency Telephone Numbers		
Police:	Fire:	Ambulance:
Other (UXO, Facility, etc.):		
Name:	Phone #:	
Name:	Phone #:	
Name:	Phone #:	
Name:	Phone #:	

Day's Work Tasks	
Task 1:	Task 2:
Task 3:	Task 4:
Task 5:	Task 6:
Training Requirements: First Aid/CPR for both CABRERA employees	

Safety and Health Information						
Job Safety Analysis Completed for this Work?			Yes		No	
RWP Permit:		Yes		No	RWP #	
Confined Space Permit:		Yes		No	#	
Radiation Hazards: None						
Chemical Hazards (including marking tape, decon agents, etc.):						
Physical Hazards:						
Work Control Methods (JHA, Work Plan, monitoring, etc.): Sampling and Analysis Plan including site specific Work Plan						
PPE: Safety glasses/goggles;						
Special Equipment (Generators, ISOCS, Backhoes, etc.): Radiation Detecting Equipment						
Types of Communication: Maintain line of site/ Buddy system						
Special Topics:						

Safety and Health Information (continued)
Lessons Learned from Previous Day:
Questions and Feedback from Attendees:

Meeting Conducted By	Printed Name	Signature	Company
CABRERA Field Lead			
Radiological Lead			
Safety and Health Rep			

Meeting Attendees		
Print Name	Signature	Company

Signature indicates that the employee understands the content of the briefing, has been given the opportunity to ask questions, provide feedback or raise concerns, and has completed the specified training requirements.

Site Photo Log

Site Location:		
Date:		
Photographer:		
Photo No.	**Location**	**Description/Comments**
1		
2		
3		
4		
5		
6		
7		
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11		
12		
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17		
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22		
23		
24		

CHAIN OF CUSTODY

PROJECT		SITE ID		DATE		PAGE / of
COMPANY						
SEND REPORT TO						
ADDRESS						
CITY / STATE / ZIP						
OFFICE PHONE		MOBILE PHONE				
FAX						
E-MAIL						

Lab ID	Field ID	Matrix	Sample Date	Sample Time	Pres.	QC					Remarks

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter DS=dry smear WS=wet smear

For metals or anions, please detail analytes below.

Comments:	QC PACKAGE (check below)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw data)

Preservative Key: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaHSO4 7-Other 8-4 degrees C 9-5035

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

AP-012-01 - Radiation Work Permit

RADIATION WORK PERMIT		
Job Supervisor:	Date:	RWP #:
Location of Work:		
Description of Work:		

SUMMARY OF RADIOLOGICAL CONDITIONS

LOCATION	CONTAMINATION LEVELS	RADIATION LEVELS	AIRBORNE CONCENTRATIONS

REQUIRED RADIOLOGICAL CONTROLS

☐ Coveralls	☐ Glove Liners	☐ Lapel Air Sampler
☐ Hood	☐ Plastic Shoe Covers	☐ Lab Coat
☐ Surgeon's Cap	☐ Rubber Shoe Covers	☐ Pre-Job Meeting
☐ Surgeon's Gloves	☐ Tape Gloves to Sleeves	☐ Continuous HP Coverage
☐ Rubber Gloves	☐ Plastic Suit	☐ TLD
☐ Trained Radiation Worker(s)	☐ Other	

Special Instructions:

YOUR SIGNATURE INDICATES THAT YOU HAVE READ AND UNDERSTAND THE RADIOLOGICAL CONDITIONS AND CONTROLS.

NAME	SIGNATURE	NAME	SIGNATURE

Approved by (print name)	Signature	Date
Re-approved by (print name)	Signature	Date
RWP Terminated by (print name)	Signature	Date

AP-012-02 - Radiation Work Permit Addition Sheet

RADIATION WORK PERMIT ADDITION SHEET			
RWP #			
NAME	SIGNATURE	NAME	SIGNATURE

Reviewed by (print name)	Signature	Date

OP-008-02
Chain of Custody and Sample Tracking Log

Sample ID#	Type	Project Name	Project Number	Project Manager	Sampler	Laboratory	Container	Analysis Req'd	Collection Date	Send Date	Req'd Report Date	Report Received
Comments:												

OP-005-01 - Sample Status Log

PROJECT NUMBER:			PROJECT LOCATION:			
SAMPLE ID #	SAMPLING LOCATION	SAMPLE DATE	SAMPLE TIME	REQUESTED ANALYSIS	TECHNICIAN INITIALS	SAMPLE STATUS

Reviewed by (print name) _____ Signature _____ Date _____

Survey Meter Source Check Form

Instrument: _____ Serial No.: _____

Source: _____ Acceptable Range: _____ to _____

Date	Cal Due	Reading	H.P. Technician	H.P. Technician Initial

Review By: _____ Date: _____

OP-021-03

Daily Calibration Check

Instrument_____ Serial No._____

Alpha Source No./Activity_____ Beta Source No./Activity_____

Background Information				Source Information				
Date/Time	Total Time	Total Counts	BKG CPM	Total Time	Total Counts	CPM	Net CPM	% Eff.

Prepared By: _____ Date: _____
Print/Sign

Reviewed By: _____ Date: _____
Print/Sign

CABRERA SERVICES

Instrument Inventory Log

Vendor	Make	Model	Probe	S/N	Cal Cert Rec'd?	Date Rec'd	Date Ret'd	Comments	Tracking# of Rtn Shipment

Project#: 08-3123.00

Schofield Barracks Area 6

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