WCH-101
Rev. 0

River Corridor
Closure Contract

Sampling and Characterization of 618-2 Anomalous Material

April 2006

Washington Closure Hanford

Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Assistant Manager for River Corridor

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1.0 INTRODUCTION

This as low as reasonably achievable (ALARA) Level II review documents radiological engineering and administrative controls necessary for the sampling and characterization of anomalous materials discovered during the remediation of the 618-2 solid waste burial ground. The goals of these engineering and administrative controls are to keep personnel exposure ALARA, control contamination levels, and minimize potential for airborne contamination.

Excavation of the 618-2 Burial Ground has produced many items of anomalous waste. Prior to temporary packaging and/or storage, these items have been characterized in the field to identify radiological and industrial safety conditions. Further sampling and characterization of these items, as well as those remaining from an excavated combination safe, is the subject of this ALARA Level II review.

An ALARA in-progress review will also be performed prior to sampling and characterization of 618-2 anomalous materials offering risks of differing natures. General categories of anomalies requiring further characterization include the following:

- Containers of unknown liquids and/or solids and powders (excluding transuranics)
- Drums containing unknown liquids and/or solids
- Metal containers with unknown contents
- Known or suspected transuranic material.

1.1 BACKGROUND

On December 14, 2004, during remediation of the 618-2 Burial Ground, the project discovered a deteriorated combination safe. The safe was damaged during excavation when it was brought to the surface. Upon investigation, the project observed that the safe contained several containers of liquids and dry powders. By document research and analysis, the project determined that plutonium-239, in separated form, was the predominant radionuclide present in each of the containers. Initial ALARA Level I planning was based on the assumption that 1 g of plutonium, associated with fission products, was evenly distributed throughout the burial ground. The items removed from the safe at the time of initial discovery were containerized in 5-gal and 8-gal drums to await further characterization and for development of a disposal path. Shortly after discovery of the combination safe, several discrete items exhibiting extremely high levels of removable alpha contamination (up to approximately 1.5 E+06 dpm/100 cm^2) were encountered in the 618-2 stockpile staging area. While performing radiological surveys of one of these items, a radiological control technician (RCT) received an uptake leading to the assignment of a committed effective dose estimate of 3.0 rem. The subcontract technical representative was notified of the events and work was immediately suspended. Following this event, U.S. Department of Energy, Richland Operations Office and contractor assessments, root cause analyses, and corrective actions ensued.

Corrective actions included the following:

- Development and implementation of work control processes for monitoring and measuring hazardous chemical and radiological field conditions. This was accomplished through development of an Operations Monitoring Plan (OMP), prepared in accordance with BHI-DE-01, *Design Engineering Procedures Manual*, Engineering Department Project

Instruction (EDPI)-4.39-01, "Operations Monitoring Plan." This OMP used the chemical and radiological inventories identified in the *Integrated Hazard Evaluation Worksheet for the 618-2 Burial Ground* (WCH 2005).

- Development of an enhanced material handling process. Key features of the enhanced process included the following:

  1. The use, addition, and blending of fixatives (other than water) to the soil-debris mass.

  2. The use of encapsulation fixatives (e.g., paint), long-handled tools, and better work practices for handling and investigating discrete items suspected of removable alpha contamination.

  3. Development of a site-specific instruction (SSI-2005-001 [WCH 2006]) and associated specific plans to ensure worker protection when handling, sampling/characterization, and packaging of anomalous material discovered during 618-2 Burial Ground remediation.

Remediation work was restarted in the 618-2 Burial Ground in December 2005. Since the restart, the following has been performed:

- Stockpiles of 618-2 excavated material created prior to the work suspension have been resorted, loaded and shipped to the Environmental Restoration Disposal Facility (ERDF) using the newly established handling process.

- Excavation of the southern and middle 618-2 trenches has been completed.

- Excavation of the northern trench is in process.

- The project erected a high-efficiency particulate air (HEPA)-ventilated containment structure composed of three individual compartments for the purpose of handling and sampling 618-2 anomalous materials. The structure has been used successfully to stabilize (grout) several items removed from the combination safe encountered in the southern trench of the 618-2 Burial Ground.

Since the restart of 618-2 remediation operations, air sampling performed during material handling, sorting, and load-out, including material grouting evolutions, has shown no elevated airborne radioactivity. Total effective dose equivalent (TEDE) for the project since restart of remediation activities is 0.0 person-rem.

2.0 DESCRIPTION OF PROJECT

The 618-2 Burial Ground was operated from 1951 to 1954, and consists of three trenches running east-west. According to the Waste Information Data System (WIDS), the unit was used for disposal of uranium-contaminated equipment and materials, plutonium, and fission products; however, there is no detailed record of the materials placed in the burial ground. The site is known to have received laboratory wastes in the form of both contaminated combustible and contaminated noncombustible materials.

Excavation to date has exposed more than 50 anomalies requiring further analysis/ characterization, with discovery of more anomalies expected during excavation of the northern trench. Following an evaluation qualifying the anomaly as "safe to handle," each individual anomaly requiring a separation for potential incompatibility concerns was placed in a metallic drum. These overpack drums are stored in a posted RMA/RMSA located northeast of the 618-2 Area of Contamination (AOC) immediately adjacent to the HEPA-ventilated sampling tent. Anomalies not drummed may be stored in the AOC or the above noted RMA/RMSA. Contents of each anomalous material container will be sampled and analyzed to determine the proper disposition. Once a path for disposal has been determined, the final packaging of the anomalous material will be performed.

3.0 PROJECT WORK PLAN

3.1 PROCESS INITIAL CONDITIONS

Upon discovery, each of the anomalies receives an initial radiological and industrial hygiene (IH) hazard screening to ensure the item can be safely packaged in its own temporary storage container, or stored without benefit of an overpack drum. Physical characteristics (e.g., size, volume, condition) are noted. A record of this pertinent information is maintained by the project's resident engineer to assist with the anomalous material sampling/characterization path. This record will also be used to process the anomalous waste material exhibiting similar characteristics in an assembly line-like manner, versus jumping between materials offering different challenges and risks. After this initial screening has been accomplished and recorded, the anomaly is typically placed inside an overpack drum previously lined with a plastic bag. This bag minimizes the potential for contaminating the drum interior, and reduces the radiological risk when re-opening the drum in the future. The bag opening is closed and sealed with tape, and the drum lid bolted in place. This screening and packaging process is performed by personnel wearing Level B personal protective equipment (PPE), using remote handling tools. The anomaly is never directly handled by project personnel during this phase. The sealed overpack drum, upon radiological release from the excavation site, is transported to a RMA/RMSA located adjacent to the sampling tent to await sampling/characterization. After clearance from radiological and IH concerns, some large metallic items (not of a configuration conducive for drumming) may be stored in the RMA/RMSA without benefit of an overpack drum.

The combination safe, and any drums known or anticipated to contain transuranic material, are stored inside a CONEX container located within the same RMA/RMSA (Figure 1).

A HEPA-ventilated, three-section sampling tent has been erected to support the sampling effort. This sampling tent is located adjacent to the overpack drum storage location, within the RMA/RMSA boundaries (Figure 1).

Within this HEPA-ventilated sampling tent, an engineered glovebag/glovebox structure will be available for use. This localized containment will be operated within the appropriate and applicable guidance of the Washington Closure Hanford glovebag program (e.g., training, setup, inspections, emergencies). The glovebag program will be discussed in detail later within this ALARA Level II review.

Figure 1. RMA/RMSA Containing Sampling Tent, CONEX Container, and Drums Containing Anomalous Material.

3.2 SAMPLING/CHARACTERIZATION PROCESSES

Anomalies discovered during remediation activities can generally be divided into four categories. A discussion of the sampling activities for each of these groups of anomalies is provided below.

General categories of material requiring further characterization include the following:

- Containers of unknown liquids and/or solids and powders (excluding transuranics)
- Drums containing unknown liquids and/or solids
- Metal containers with unknown contents
- Known or suspected transuranic material.

3.2.1 Containers of Unknown Liquids and/or Solids and Powders (Excluding Transuranics)

Table 1 indicates the known radiological conditions and characteristics identified during the initial field screening of anomalies consisting of containers of unknown liquids, solid and powders. Additional anomalies bounded by those shown are anticipated during the excavation of the northern 618-2 trench.

Table 1. Small Containers of Unknown Liquids and/or Solids and Powders (Excluding Transuranics). (3 Pages)

Anomalous Waste ID	Direct Contamination (dpm/100cm^2) B-γ / α	Removable Contamination (dpm/100cm^2) B-γ / α	ISOCS/Ortec Result	Description
1/12/06-a	5000 / <100	<1000 / 50	NORM, Cs-137	250 ml glass flask w/white powder
1/16/06-a	34000 / <100	<1000 / <20	NORM	500 ml glass jar w/liquid and suspendable solids
2/16/06-a	8000 / <100	<1000 / <20	NORM	250 ml glass container approx., ¼ full, clear liquid
2/24/06-a	40000 / <100	<1000 / <20	NORM	500 ml glass container, white powder
2/24/06-b	400000 / <100	<1000 / <20	NORM	200 ml glass container, approx. 50 ml of liquid
2/27/06-a	<5000 / <100	<1000 / <20	NORM	200 ml glass container, approx. 100 ml of an orange liquid
3/15/06-a	<5000 / <100	<1000 / <20	Not yet performed	500 ml glass container, approx. ½ full, yellowish liquid
3/15/06-b	10000 / <100	<1000 / <20	Not yet performed	100 ml glass container, approx. ½ full, yellowish liquid
3/15/06-c	700000 / <100	2200 / 56	Not yet performed	500 ml glass container, yellowish liquid
3/15/06-d	<5000 / <100	<1000 / <20	Not yet performed	200 ml glass container, yellowish solids
3/15/06-e	<5000 / <100	<1000 / <20	Not yet performed	500 ml glass container , approx. ½ full, clear liquid
3/15/06-f	<5000 / <100	<1000 / <20	Not yet performed	500 ml brown glass container, approx. ¾ full, liquid of unknown color
3/15/06-g	<5000 / <100	<1000 / <20	Not yet performed	250 ml glass container, clear liquid
3/17/06-a	<5000 / <100	<1000 / <20	Not yet performed	500 ml brown glass container, approx. ½ full, liquid
3/17/06-b	<5000 / <100	<1000 / 85	Not yet performed	500 ml brown glass container, approx. ½ full, liquid
3/17/06-c	<5000 / <100	<1000 / <20	Not yet performed	500 ml brown glass container, approx. ½ full, liquid
3/17/06-d	<5000 / <100	<1000 / <20	Not yet performed	500 ml brown glass container, approx. ½ full, liquid
3/20/06-a	20000 / <100	<1000 / <20	Not yet performed	500 ml Erlenmeyer flask, approx. ½ full, solid gray-white waxy material

Table 1. Small Containers of Unknown Liquids and/or Solids and Powders (Excluding Transuranics). (3 Pages)

Anomalous Waste ID	Direct Contamination (dpm/100cm^2) B-γ / α	Removable Contamination (dpm/100cm^2) B-γ / α	ISOCS/Ortec Result	Description
3/22/06-a	<5000 / <100	Smears not taken	Not yet performed	500 ml Erlenmeyer flask, approx. 3/4 full, whitish waxy material
3/22/06-b	<5000 / <100	8400 / 1650	Not yet performed	250 ml glass container, bottom missing, full, whitish powder
3/22/06-c	<5000 / <100	<1000 / <20	Not yet performed	500 ml clear glass container, approx. ½ full, brown/orange liquid
3/23/06-c	<5000 / <100	Smears not taken	Not yet performed	1 gal. clear glass jug, approx. ¼ full, clear liquid
3/28/06-a	<5000 / <100	<1000 / <20	Not yet performed	750 ml clear glass container, approx. ½ full, clear liquid
3/29/06-a	<5000 / <100	<1000 / <20	Not yet performed	500 ml clear glass container, approx. 1/3 full, clear liquid
3/29/06-b	<5000 / <100	<1000 / <20	Not yet performed	100 ml clear glass container, approx. ¼ full, clear liquid
3/29/06-c	88000 / <100	<1000 / <20	Not yet performed	100 ml glass container, approx. ¾ full, yellowish liquid
4/03/06-a	<5000 / <100	Smears not taken	Not yet performed	500 ml glass container, nearly full, thick black viscous (like molasses) consistency
4/03/06-b	<5000 / <100	Smears not taken	Not yet performed	500 ml clear glass container, approx. ½ full, brownish liquid
4/03/06-c	<5000 / <100	Smears not taken	Not yet performed	200 ml clear glass container, approx. 2/3 full, clear liquid
4/03/06-d	<5000 / <100	Smears not taken	Not yet performed	250 ml clear glass container, approx. 20 ml clear liquid
4/03/06-e	10000 / 800	4000 / 450	Not yet performed	250 ml clear glass container, approx. ¼ full, yellow/brown liquid
4/04/06-e	11260 / <100	<1000 / <20	Not yet performed	500 ml open glass container, approx. ½ full, whitish powder
4/04/06-f	8700 / <100	8500 / 50	Not yet performed	750-1000 ml glass container, approx. ¼ full, brown syrup-like liquid
4/04/06-g	63640 / <100	8640 / 24	Not yet performed	250 ml glass container, approx. ¼ full, greenish liquid

Table 1. Small Containers of Unknown Liquids and/or Solids and Powders (Excluding Transuranics). (3 Pages)

Anomalous Waste ID	Direct Contamination (dpm/100cm^2) B-γ / α	Removable Contamination (dpm/100cm^2) B-γ / α	ISOCS/Ortec Result	Description
4/7/06-a	<5000 / <100	Smears not taken	Not yet performed	1000 ml clear glass container, approx. 100 ml of yellowish liquid

3.2.2 Sampling and Characterization of Small Containers with Unknown Liquids and/or Solids and Powders (Excluding Transuranics)

An in-progress ALARA review that addresses working with anomalies within this specific category will be performed prior to handling activities. All overpack drums containing this type of anomalous material will, at a minimum, be surveyed via the Ortec Detective (or equivalent) PRIOR to invasive sampling activity. Drummed anomalous waste exhibiting radiological and physical condition similar to that shown in Table 1 will be characterized for disposition while working inside the HEPA-ventilated sampling tent. This tent protects the public and environment from a potential release of radioactive material. Further, invasive sampling will be performed manually inside the localized containment (glovebag/glovebox), by personnel wearing Level B PPE. This localized containment limits the spread of contamination inside the sampling tent, while the Level B PPE protects the workers.

Containers of anomalous material will be opened to allow direct access to the material. Invasive sampling/characterization will include some or all of the following:

- Radiological survey
- pH analysis.

Liquids will be mixed with an absorbent material located inside the local glovebag containment. Some or all absorbent material will be packaged for shipment to an off-site laboratory if further analysis is required. If sufficient data has been gathered during the invasive sampling to allow direct disposal to ERDF, the absorbent material and bottle/vial can be returned to the original overpack drum for grouting, or returned to the excavation site for processing as directed by Waste Operations personnel. Solids and powders will be handled within the same type enclosure (local glovebag) as liquids, except an absorbent may not be required.

3.2.3 Drums Containing Unknown Liquids and/or Solids

Table 2 indicates the known radiological conditions and characteristics identified during the initial field screening of anomalies consisting of drums of liquids and unknowns. Additional anomalies bounded by those shown are anticipated during the excavation of the northern 618-2 trench.

Table 2. Drums Containing Unknown Liquids and/or Solids.

Anomalous Waste ID	Direct Contamination (dpm/100cm^2) B-γ / α	Removable Contamination (dpm/100cm^2) B-γ / α	ISOCS/Ortec Result	Description
2/14/06-a	<5000 / <100	<1000 / <20	NORM	55-gal drum, intact, contents unknown
3/21/06-a	70000 / <100	<1000 / <20	Not yet performed	55-gal drum, leaking, approximately ½ full, oil
3/21/06-b	<5000 / <100	<1000 / <20	Not yet performed	55-gal drum, leaking, approximately ½ full, oil
3/21/06-c	40000 / <100	<1000 / <20	Not yet performed	55-gal drum, intact, contents unknown
3/23/06-a	<5000 / <100	Smears not taken	Not yet performed	55-gal drum, intact, contents unknown
3/23/06-b	20000 / <100	<1000 / <20	Not yet performed	55-gal drum, intact, contents unknown
3/23/06-d	<5000 / <100	<1000 / <20	Not yet performed	Oil only, approx. 20 gal (Old damaged drum placed back in sorting pile)
4/10/06-a	<5000 / <100	Smears not taken	Not yet performed	55-gal drum, intact, appears to be empty
4/10/06-b	<5000 / <100	Smears not taken	Not yet performed	55-gal drum, intact, appears to be empty

3.2.4 Sampling and Characterization of Drums Containing Unknown Liquids and/or Solids

An in-progress ALARA review that addresses working with anomalies within this specific category will be performed prior to handling activities. Overpack drums containing this category of anomalous material are typically of a size (85 to 110 gal) and weight prohibiting their relocation to the confines of the sampling tent. For this reason, these overpacks will be sampled within posted radiological areas adjacent to the sampling tent. All overpacks containing this type of anomalous material will be surveyed via the In-Situ Object Counting System (ISOCS) PRIOR to invasive sampling activity (Figure 2). The ISOCS will allow determination and quantification of radiological inventory contained in the drum prior to invasive sampling activities. Sampling of drums will be performed by personnel wearing Level B PPE, inside radiological boundaries posted HCA/ARA (and RA as required), based on the potential for these conditions to arise during the handling activity. Invasive sampling/characterization will include some or all of the following:

- Radiological survey
- pH analysis
- X-ray fluorescence (XRF).

Figure 2. In-Situ Object Counting System.

After sampling of the drum contents is complete, the drum will be resealed inside its respective overpack to await analysis results and determination of its disposition.

Samples from the drums containing liquids and unknowns will normally be sent to an off-site laboratory for analysis.

Available information indicates the potential for excavated drums to show a transuranic content is minimal; however, should this situation occur the drums will be sampled/characterized only after additional special planning by project management has been performed.

3.2.5 Small Metal Containers with Unknown Contents

Table 3 indicates the known radiological conditions and characteristics identified during the initial field screening of anomalies consisting of metal containers with unknown contents. Additional anomalies bounded by those shown are anticipated during the excavation of the northern 618-2 trench.

Table 3. Small Metal Containers With Unknown Contents.

Anomalous Waste ID	Direct Contamination (dpm/100cm^2) B-γ / α	Removable Contamination (dpm/100cm^2) B-γ / α	ISOCS/Ortec Result	Description
4/04/06-a	<5000 / <100	<1000 / <20	NORM, ^{137}Cs	4" dia. x 8" long SS canisters, contents unknown
4/04/06-b	<5000 / <100	<1000 / <20	Not yet performed	4" dia. x 8" long SS canisters, contents unknown
4/04/06-c	<5000 / <100	<1000 / <20	Not yet performed	4" dia. x 8" long SS canisters, contents unknown
4/04/06-d	<5000 / <100	<1000 / <20	Not yet performed	4" dia. x 8" long SS canisters, contents unknown
4/06/06-a	700000 / <100	<1000 / <20	Not yet performed	Sealed metal container, rusted, cylindrical, 12" x 18", contents unknown

3.2.6 Sampling and Characterization of Small Metal Containers with Unknown Contents

An in-progress ALARA review that addresses working with anomalies within this specific category will be performed prior to handling activities. All overpack drums and non-overpacked items of this category, at a minimum, will be surveyed via the Ortec Detective (or equivalent) PRIOR to invasive sampling/characterization activities. Anomalous waste exhibiting radiological and physical condition similar to that shown in the above table will be characterized for disposition while working inside the HEPA-ventilated sampling tent, and inside the local containment (glovebag/glovebox) as material physical dimensions allow. Anomalous material of a dimension that will not allow use of the local containment will be characterized with the ISOCS prior to invasive handling. Identification of a transuranic material content will require a unique plan, management approval, and completion of an in-progress ALARA review prior to invasive handling.

Sampling of this anomalous material will be performed by personnel wearing Level B PPE, inside radiological boundaries posted HCA/ARA (and RA as required), based on the potential for these conditions to exist during the handling activity. Containers of anomalous material will be opened to allow direct access to the material. Invasive sampling/characterization will include some or all of the following:

- Radiological survey
- pH analysis
- XRF.

Any liquids encountered will be mixed with an absorbent material. Some or all the absorbent material can be packaged for shipment to an off-site laboratory if further analysis is required. If sufficient data has been gathered during the invasive sampling to allow direct disposal to ERDF, the absorbent material and remaining debris can be returned to the original overpack drum for grouting, or returned to the excavation site for processing as directed by Waste Operations personnel. Any solids and/or powders encountered will be handled in the same containment enclosure (glovebag) as liquids, except an absorbent may not be required.

3.2.7 Known or Suspected Transuranic Material

Table 4 indicates the known radiological conditions and characteristics identified during the initial field screening of anomalies consisting of known or suspected transuranic materials. Additional anomalies bounded by those shown may be encountered during the excavation of the northern 618-2 trench.

Table 4. Known or Suspected Transuranic Material.

Anomalous Waste ID	Direct Contamination (dpm/100cm^2) B-γ / α	Removable Contamination (dpm/100cm^2) B-γ / α	ISOCS/Ortec Result	Description
3/02/06-a	182000 / 287000	5455 / 37333	Not yet performed	2" dia. x 6" long jar nearly full of pink-colored pellets
4/06/06-b	No direct survey (high background)	1.06E6 / 1.15E6	^{239}Pu, ^{241}Am, ^{137}Cs	1000 ml brown glass container, approx. ½ full, liquid color unknown
Drum # 6182-04-0008	Unknown	Unknown	≈2930 uCi ^{239}Pu* ≈0.23 uCi ^{241}Am*	250 ml Erlenmeyer flask, removed from 618-2 combination safe
Drum # 6182-06-1585	Unknown	Unknown	≈2650 uCi ^{239}Pu*	Red can with vial, removed from 618-2 combination safe
Drum # 6182-04-0010	Unknown	Unknown	≈8810 uCi ^{239}Pu*	Red can with absorbent, removed from 618-2 combination safe
Drum # 6182-04-0009	Unknown	Unknown	≈30200 uCi ^{239}Pu*	1-gal glass jug, "$LaFl_3$" written on outside of jug, removed from 618-2 combination safe
Combination Safe	Unknown	Unknown	≈1.64E+05 uCi ^{239}Pu** ≈1.46E+02 uCi ^{241}Am**	Safe contains broken glass, broken concrete chunks, and other unknown material. Potentially contains additional intact containers

*Taken from ACS Survey Report, Docs Open 0564716 (BHI 2005b).
**Taken from ACS Survey Report, Docs Open 0563628 (BHI 2005a).

Sampling and Characterization of Known or Suspected Transuranic Material

An in-progress ALARA review that addresses working with anomalies within this specific category will be performed prior to handling activities. All overpack drums containing this type of anomalous material will be surveyed via the ISOCS PRIOR to handling or invasive sampling activity. The ISOCS will allow determination and quantification of radiological inventory contained in the overpack drum. Drummed anomalous waste exhibiting radiological and physical condition similar to that shown in Table 4 will be characterized for disposition only while

working inside the HEPA-ventilated sampling tent. Further, this invasive sampling will be performed manually inside the localized containment (glovebag/glovebox), by personnel wearing Level B PPE, and inside radiological boundaries posted as HCA/ARA (and RA as required). These radiological postings are based on the potential for these conditions to exist during the handling activities.

The combination safe is currently stored inside a SWB container. Due to the inventory present and the unknown components within the safe, the project will be required to further investigate the items before a disposal path can be determined (Figure 3). To accomplish this, the safe will need to be removed from the SWB and placed in the HEPA-ventilated sampling tent. An inspection of the safe interior will be performed to inspect for additional containers of anomalous material. Verification, clean-out, and packaging of anomalous containers will be performed by personnel wearing Level B PPE, and inside radiological boundaries posted as HCA/ARA (and RA as required). These radiological postings are based on the potential for these conditions to exist during the handling activities. Additional enhancements to the sampling tent protocol, such as HEPA unit power source redundancy and use of fogging/fixatives, will be considered and addressed in the in-progress ALARA review to be completed immediately prior to safe characterization activities. The disposition of items removed from the combination safe is dependant upon issues such as radiological risk, potential use, waste classification, and waste packaging/ shipping requirements. Any new anomalous items encountered in the combination safe, and the empty safe itself, will require survey with the ISOCS to confirm or negate transuranic status. The final path for these items will be determined by project management upon completion of characterization.

Figure 3. Combination Safe and Removed Contents.

4.0 ANTICIPATED RADIOLOGICAL CONDITIONS

Tables 1 through 4 have shown the known radiological conditions on external surfaces of anomalous material already encountered. Significant levels of both alpha and beta-gamma, direct and removable contamination can be expected throughout the anomaly handling process, with the highest levels generally associated with the combination safe and removed items. The potential for elevated airborne radioactivity levels inside the sampling tent during anomalous material processing exists. Calculations based on the known loose surface contamination levels of materials to be handled inside the sampling tent (but outside the local containment glovebag/glovebox) indicate airborne radioactivity levels of up to 56 DAC could be reached.

To date, no identified anomalous material requiring further sampling and characterization has required establishment of a Radiation Area posting.

5.0 EXPOSURE ESTIMATE

A job-specific radiation work permit (RWP) will be utilized for controlling radiological work activities. The TEDE exposure estimate for this RWP, based on the known and anticipated anomaly processing, is 42 person-mrem. See Table 5 for details.

Table 5. Anomalous Material Handling Dose Estimate. (2 Pages)

Work Group	Rad Area Work Hours	External Dose Rate (mrem/h)	Estimated External Dose (mrem)	Estimated Airborne Concentration (DAC)	Estimated Intake (DAC-h)	Estimated TEDE per person (mrem)	Number of Workers	Total Estimated TEDE (person-mrem)
Job Description: Handling/sampling anomalous material inside sampling tent **with** glovebag/glovebox in use								
RCT	40	0.05	2	0.0	0	2	1	2
Sampler	40	0.05	2	0.0	0	2	1	2
Laborer	40	0.05	2	0.0	0	2	1	2
Job Description: Handling/sampling anomalous material inside sampling tent **without** glovebag/glovebox in use								
RCT	40	0.05	2	0.06	2.4	8	1	8
Sampler	40	0.05	2	0.06	2.4	8	1	8
Laborer	40	0.05	2	0.06	2.4	8	1	8
Job Description: Handling/sampling anomalous material outside sampling tent								
RCT	10	0.05	0.5	0.0	0	0.5	1	0.5
Sampler	10	0.05	0.5	0.0	0	0.5	1	0.5
Laborer	10	0.05	0.5	0.0	0	0.5	1	0.5

Table 5. Anomalous Material Handling Dose Estimate. (2 Pages)

Work Group	Rad Area Work Hours	External Dose Rate (mrem/h)	Estimated External Dose (mrem)	Estimated Airborne Concentration (DAC)	Estimated Intake (DAC-h)	Estimated TEDE per person (mrem)	Number of Workers	Total Estimated TEDE (person-mrem)
Job Description: Sampling tent decon, ISOCS support, grout/packaging support								
RCT	20	0.05	0.5	0.06	1.2	3.5	1	3.5
Laborer	20	0.05	0.5	0.06	1.2	3.5	2	7
Estimated TEDE (person-mrem) for Work:								**42**

Determination of the potential airborne radioactivity concentration while handling anomalous material inside the sampling tent follows, but outside the local containment (glovebag/glovebox):

Prepared By:		A. E. Zacharias	Date:	4/18/2006
Work Package #		RWPR FF2-06-0002 Rev. 00 HCA/ARA I/S Sampling Tent Using PAPR		
Reference:	RC-100-4.2	A. E. Zacharias		
Formula	C=SF x SA x 4.5E-7/containment factors			
SF=	Resuspension Factor (cm^{-1})			1.00E-07
SA1=	Alpha Surface contamination level (dpm/cm^2)			20000
SA2=	Beta Surface contamination level (dpm/cm^2)			50000
CF=	Containment factor			10
4.5E-7=	Conversion factor for dpm to uCi			4.50E-07

C_{Alpha}=	Average Alpha workplace concentration (uCi/cm^3)	=	9.00E-11
C_{Beta}=	Average Beta workplace concentration (uCi/cm^3)	=	2.25E-10

Resuspension factor is for mechanical cutting, maintenance, hack hammer, drilling
Containment factor is for keeping material wet

Surface contamination is for removable contamination per square cm

9.00E-11	divided by	2.00E-12	(Plutonium DAC)	=	45.00	DAC
2.25E-10	divided by	2.00E-11	(Uranium DAC)	=	11.25	DAC
56.25	divided by	1000	(Resp. PF)	=	0.06	ADAC*

*Based on a conservative PF of 1000, versus 10,000 typically assigned to the airline respirator w/Ska-Pak to be used during all anomalous material handling.

Determination of the potential airborne radioactivity concentration while handling anomalous material outside the sampling tent follows:

Prepared By:	A. E. Zacharias	Date:	4/18/2006
Work Package #	RWPR FF2-06-0002 Rev. 00 HCA/ARA O/S Sampling Tent Using PAPR		

Reference:	RC-100-4.2	
Formula	C=SF x SA x 4.5E-7/containment factors	
SF=	Resuspension Factor (cm^{-1})	1.00E-07
SA1=	Alpha Surface contamination level (dpm/cm^2)	200*
SA2=	Beta Surface contamination level (dpm/cm^2)	2000*
CF=	Containment factor	10
4.5E-7=	Conversion factor for dpm to uCi	4.50E-07

C_{Alpha}=	Average Alpha workplace concentration (uCi/cm^3)	=	9.00E-13
C_{Beta}=	Average Beta workplace concentration (uCi/cm^3)	=	9E-12

Resuspension factor is for mechanical cutting, maintenance, jack hammer, drilling
Containment factor is for keeping material wet

Surface contamination is for removable contamination per square cm

9.00E-13	divided by	2.00E-12	(Plutonium DAC)	=	0.45	DAC
9.00E-12	divided by	2.00E-11	(Uranium DAC)	=	0.45	DAC
0.90	divided by	1000	(Resp. PF)	=	0.00	ADAC**

*The allowable surface contamination levels for work outside the sampling tent have been lowered due to lack of containment and HEPA ventilation.
**Based on a conservative PF of 1000, versus 10,000 typically assigned to the airline respirator w/Ska-Pak to be used during all anomalous material handling.

6.0 WORK CONTROLS

Protection of personnel and the environment during sampling and characterization of anomalous materials will be controlled through the use of the following:

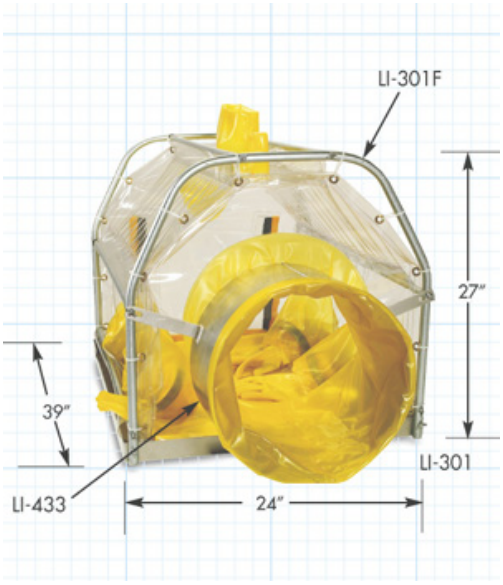
- Engineering controls (multiple physical barriers)
- PPE
- Administrative controls (ensuring an understanding of the radioactive constituents prior to accessing the anomalous material).

The combination of the following described engineering and administrative controls, in addition to the use of respiratory protection while performing the sampling and characterization work, will mitigate the radiological hazard to personnel and the environment.

6.1 ENGINEERING CONTROLS

Approximately 80% of the anomalies encountered through excavation of the south and middle 618-2 trenches are small enough to allow further handling, sampling, and characterization to occur inside a small localized containment structure (glovebag/glovebox). A containment structure similar to that shown in Figure 4 will be utilized.

Figure 4. Containment Structure (glovebag and support frame will be located inside sampling tent).



The anomalous material (already sealed in a plastic bag) will be transferred into the containment for the required invasive sampling. This containment will be utilized in a manner ensuring the sampling personnel, though wearing Level B PPE, will never have a need for direct handling of the anomalous material. This glovebag containment constitutes the first engineered physical barrier, and will be located inside the sampling tent.

A second engineered barrier exists in the form of the sampling tent structure. The sampling tent consists of three 8-ft by 8-ft by 8-ft chambers, accessed and separated by sealable doors. This tent will be maintained at a negative pressure through the use of a flow-certified HEPA ventilation unit. The HEPA (110VAC) unit can be powered by a portable generator, and has proven adequate for maintaining the sampling tent at a negative pressure during previous repackaging and grouting of highly contaminated items recovered from various 618-2 locations. The sampling tent interior is intended to be maintained free of loose surface contamination. In the event removable surface contamination is detected, it will be removed prior to the next sampling/characterization evolution.

6.2 ADMINISTRATIVE CONTROLS

A job-specific RWP will be written to apprise workers of the controls, limiting conditions, air sampling, and PPE requirements applicable for this anomalous material sampling and characterization process. In addition, prior to processing anomalies outside the bounds of those already handled, an in-progress ALARA review will be completed.

The following protocol will be observed PRIOR to opening overpack drums containing anomalous material:

- All overpack drums containing material that will be processed inside the sampling tent will be surveyed with the Ortec Detective at a minimum. If transuranic material is identified, the overpack drum will be surveyed with the ISOCS to quantify the radioactive material.

- All overpack drums containing material that will be processed outside the sampling tent (due to size, weight, or handling difficulty) will be surveyed with the ISOCS to quantify the contained radioactive material. If transuranic material is identified, project management will assess the need to process the anomalous material within the sampling tent or another enclosure.

All sampling and characterization activities will be performed within radiological boundaries posted as HCA/ARA, based on the potential for these conditions to exist during the activity.

6.3 PERSONNEL PROTECTIVE EQUIPMENT

Respiratory protection will be required during all sampling and characterization activities, both for potential radiological and IH related hazards. The RWP will prescribe the PPE requirements addressing the potential radiological aspects. The Site Safety Representative will prescribe IH-related PPE in accordance with the site-specific health and safety plan. Workers will be instructed to wear PPE and respiratory protection appropriate for both the radiological and IH hazards.

The combination of the previously described engineering controls, in addition to the use of respiratory protection while performing the sampling and characterization work, will mitigate the radiological hazard to personnel and the environment.

7.0 SPECIALIZED TRAINING

The *ERC Radiological Glovebag Program* (BHI 2000) provides the technical basis for developing site-specific direction for glovebag installation and use. This document provides guidance that is based on technically acceptable industry practice. The expectation is that the radiological engineer uses this technical basis to develop site-specific steps and sequences for execution, appropriate for the specific work. In those cases where the glovebag is intended as the only barrier between the worker and/or environment and the source material, stringent design conformance, task management, and control of work activities is vital. For the scope of activities covered by this ALARA Level II review, the glovebags intended function is to limit the spread of contamination inside the HEPA-ventilated sampling tent. As a result, a graded approach toward glovebag certification, inspection, and worker training will be applied.

7.1 GLOVEBAG USE TRAINING

The following practices suggested in *ERC Radiological Glovebag Program* (BHI 2000) will be incorporated while working with glovebags:

- Training - Personnel expecting to install or use the glovebag will attend an initial or refresher training session. Topics to cover should include the following:

  - Glovebag selection
  - Installation
  - Use (equipment bag-in, bag-out)
  - Maintenance
  - Inspection
  - Removal
  - Breached glovebag actions

- Glovebag Installation – The applicable sections of the Pre-Installation Inspection Checklist (Appendix B of BHI 2000) and the Post-Installation Installation Inspection Checklist (Appendix C of BHI 2000) will be completed during the glovebag installation process.

- Glovebag Inspection - Daily, prior to use, a RCT will perform a removable contamination survey on exterior surfaces of the glovebag. Additionally, a glovebag worker will visually inspect the glovebag to verify the following conditions:

  - No visible damage to the glovebag
  - Glovebag is properly tied off
  - Visibility is maintained
  - Sharp tools or items are not exposed so they could penetrate the glovebag or gloves
  - No excess material or equipment is present inside the glovebag
  - Activities outside the glovebag will not jeopardize the integrity of the glovebag

Completion of survey and inspection should be documented on the Daily Log Sheet, WCH-TM-R016.

- Actions Should A Glovebag Breach Occur – Glovebag workers will be trained to perform the following actions:

  - Immediately stop any operations in the glovebag
  - Warn other personnel in the area and the RCT
  - IF contamination release is suspected OR if the breach is too large to be repaired quickly and safely, THEN exit the area and wait for direction from supervision and RadCon.
  - IF the breach is small and confinable, THEN isolate the breach using tape, bags, or other appropriate means.
  - WHEN glovebag operations are to be resumed, THEN request that the RCT re-inspect the glovebag prior to use.

7.2 MOCK-UP TRAINING

Personnel directly involved in the performance of sampling and characterization activities inside and/or outside the sampling tent will complete a mock-up or walkthrough exercise prior to actually performing the activity. This mock-up will familiarize the workers with entry and egress paths, airline hose management, PPE donning/doffing protocol, and radiological survey requirements. Workers will also practice glovebag activities expected to be routinely performed such as transferring material in and out, opening containers, analyzing material with XRF, and packaging of sample media.

8.0 CONCLUSION

The work plan for the sampling and characterization of 618-2 anomalous material uses a combination of physical barriers, administrative controls, and PPE to protect the workers and environment. The incorporated controls are designed to ensure that personnel exposures, contamination spread, and airborne radioactivity are maintained ALARA. A TEDE estimate of 42 person-mrem is projected.

9.0 REFERENCES

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