BHI-01719
Rev. 1

618-7 Burial Ground Field Investigation Plan

Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Environmental Restoration

Submitted by: Bechtel Hanford, Inc.

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ACRONYMS

AOC	area of contamination
BHI	Bechtel Hanford, Inc.
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
IH	industrial hygiene
NFPA	National Fire Protection Association
PPE	personal protective equipment
RCT	radiological control technician
SSO	site safety officer
WTS	waste transportation specialist

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerel	millibecquerels	0.027	picocuries

1.0 INTRODUCTION

This field investigation plan outlines the methodology and approach for intrusive field operations and data collection activities at the 618-7 Burial Ground to support future remedial actions at the site. The activities identified in this plan are supported by the following infrastructure documents:

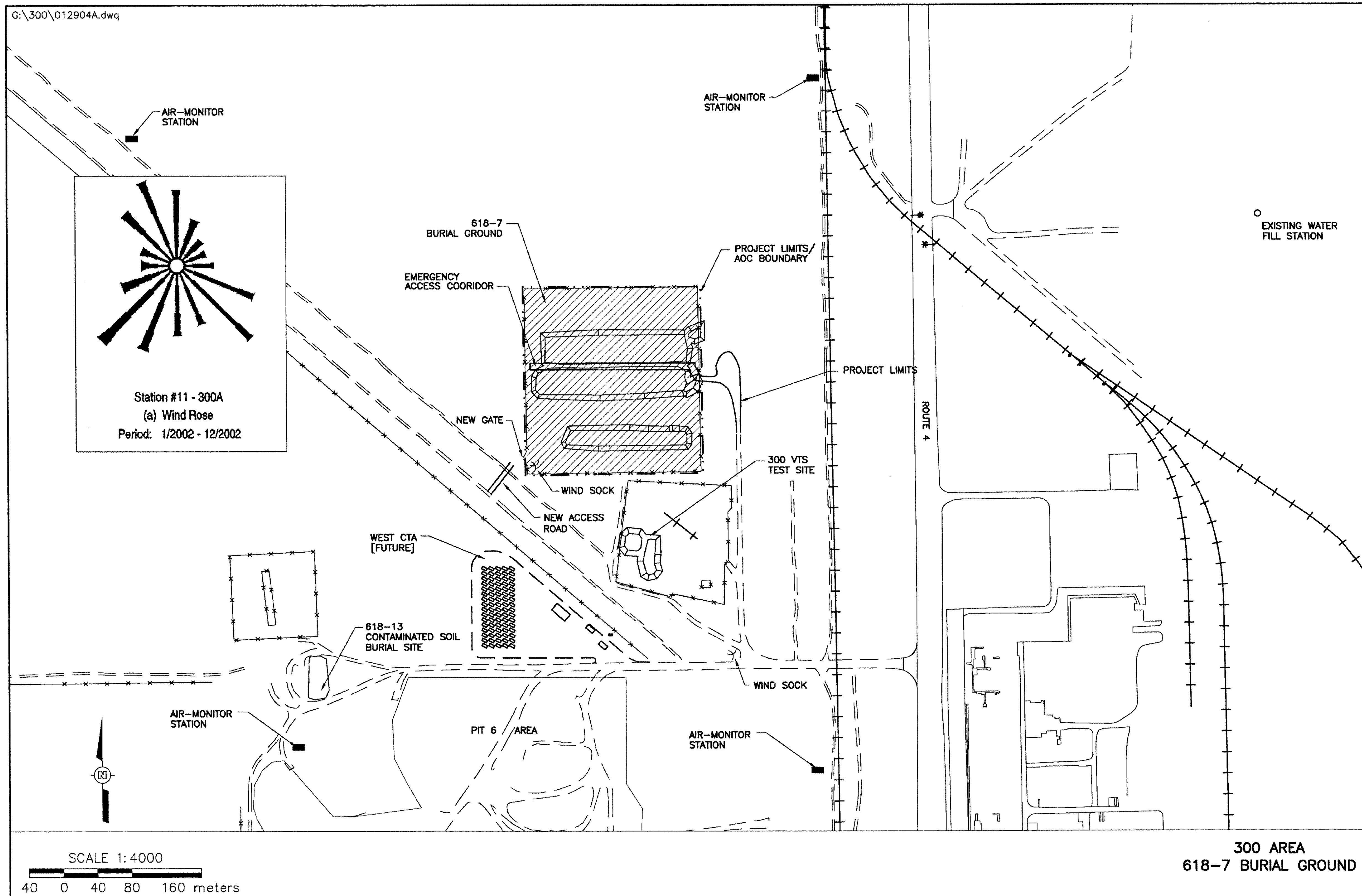
- Remedial action work plan
- Sampling and analysis plan
- Air monitoring plan
- Excavation permit
- Site-specific waste management instructions
- Radiological work permits
- Final hazard categorization/auditable safety analysis
- Emergency action plan
- Subcontractor plans and procedures (e.g., health and safety plans, material handling plans).

Health and safety precautions and contingency plans for this task are integrated with the investigation activities with the intent of providing a guidance tool for the pre-job safety briefing and a field reference for personnel performing and supporting this task.

1.1 BACKGROUND

The 618-7 Burial Ground is located northwest of the Hanford Site 300 Area complex and was a general purpose burial ground that began operation in 1960 (Figure 1-1). The original burial ground consisted of one east-west-oriented trench, 198 m (650 ft) long and 30 m (100 ft) wide and about 4 to 4.6 m (13 to 15 ft) deep. In 1965, a second trench identical to the first trench was constructed about 6 m (20 ft) north of the northern edge of the first trench and began receiving waste in 1966. At about the same time, a third trench was constructed to the south of and parallel to the original trench. This trench is 140 m (459 ft) long, 6.1 m (20 ft) wide, and contains thorium-contaminated waste from the thorium program. Burial of waste in the 618-7 Burial Ground ceased in 1973. The current configuration of the burial ground is a vegetation-covered area with patches of cobbles, surrounded by wooden poles and a 2.4-m (8-ft) wire fence. A locked gate is located on the east side of the fenced area and is posted with "underground radioactive material" signs.

Figure 1-1. 618-7 Burial Ground.



The 618-7 Burial Ground waste inventory is primarily from the 321, 313, 333, 3722, and 3732 Buildings. Miscellaneous contaminated equipment and hundreds of drums of Zircaloy-2[1] chips alloyed with beryllium and contaminated with uranium were buried in the trenches from 1962 to 1973. Because the Zircaloy-2 was considered pyrophoric, the drums were filled with water to avoid spontaneous combustion. It is possible that water has leaked out of the drums. Other low-level materials that were slightly contaminated with uranium and thorium were also buried in the trenches. The drums containing Zircaloy are most likely located in the middle and northern trenches. The southern trench was used for disposal of thorium-contaminated waste.

It is estimated that fuel fabrication produced about 2,450 kg (5,400 lb) of Zircaloy-2 and Zircaloy-2/beryllium turnings per year and that a 208-L (55-gal) drum contains about 89 kg (197 lb) of chips (Weakley 1984). Assuming a constant production rate during 14 years of N Reactor fuel fabrication (1960 to 1973), the burial ground could contain about 29,400 kg (64,800 lb) of chips in about 704 114-L (30-gal) drums or about 384 208-L (55-gal) drums. This quantity of drums would occupy a total volume of about 80 m^3 (2,820 ft^3), which is about 0.2% of the volume of the middle and northern trenches. Additional background information is presented in the *Historical Records Search Supporting the Field Investigation of the 618-7 Burial Ground* (BHI 2004b).

After the 618-7 Burial Ground was closed and the burial of water-filled drums was prohibited in 1973, the Zircaloy-2 waste was grouted and disposed in the Hanford Site 200 Area. A general process for stabilizing uranium scrap was modified for the Zircaloy-2 waste as outlined below (Weakley 1977):

- Remove water from drums.
- Pour wet cement on top of turnings in drum.
- Tamp down exposed turnings.
- Add more turnings and wet cement until drum is full.
- Wash outside of drum.
- Let material solidify for at least 7 days.
- Ship for disposal.

The practice of grouting is consistent with industry methods for management and disposal of zirconium waste. Additional details on the mix design were not identified.

[1] Zircaloy-2 is an alloy of zirconium containing 1.2% to 1.7% tin, 0.07% to 0.2% iron, 0.05% to 0.15% chromium, and 0.03% to 0.08% nickel.

1.2 PREVIOUS INVESTIGATIONS

Previous investigations at the 618-7 Burial Ground included two geophysical surveys conducted to further delineate the trench configurations and drum locations within the trenches. A 1995 investigation identified the following information related to the configuration of the trenches (BHI 1995):

- The southernmost trench, because of its "V"-shaped geometry, is most likely the "V"-shaped trench referred to in the technical baseline report (BHI 1994). The dimensions of this trench are roughly 9.1 m (30 ft) wide across the top and 137 m (450 ft) long. The thickness of fill overlying the buried waste varies from 0.6 to 2.7 m (2 to 9 ft).

- The middle trench has four square concrete monuments that were apparently used to mark its southern and northern boundaries. This trench is the only trench that has such markers. The trench is approximately 31 m (100 ft) wide and 158 m (520 ft) long. It contains high concentrations of buried waste throughout. The thickness of fill overlying the buried waste varies from 0.6 to 2.7 m (2 to 9 ft).

- The northernmost trench is similar in to the middle trench. It is roughly 27 m (90 ft) wide and 162 m (530 ft) long and also has high concentrations of buried debris throughout. The thickness of fill overlying the buried waste varies from 0.6 to 2.7 m (2 to 9 ft).

Additional geophysical surveys were performed in 2004 with the objective to identify likely locations of buried drums within the trenches. A summary of the survey results is presented in Figure 1-2.

1.3 CONTAMINANTS OF CONCERN AND PHYSICAL PROPERTIES

Contaminants of concern for this investigation include zirconium metal, beryllium metal, uranium, and thorium. Zirconium is the primary element in the Zircaloy-2 chips generated from the process of machining the end caps of Zircaloy-clad fuel elements. The end caps were vacuum brazed using a 5% beryllium/Zircaloy-2 alloy. The chips vary in size, but are generally 0.13 mm (0.005 in.) thick and 6 mm (0.25 in.) wide. The fuel elements were a source of uranium contamination. There is also a potential for the presence of organic compounds from cutting oils that may have been used during the machining process. Other potential contaminants are unknown and will be identified as part of the field investigation objectives.

General hazards associated with zirconium handling are summarized in Table 1-1, as extracted from various resources. According to the National Fire Protection Association (NFPA) *Standard for Combustible Metals, Metal Powders, and Metal Dusts* (NFPA 484), zirconium has the following properties dependent on particle size:

- A dust cloud of fine particles of zirconium with an average particle diameter of 3.3 μm (0.0001 in.) can ignite spontaneously at 20°C (68°F).

Figure 1-2. Geophysical Survey Results and Planned Excavation Locations.

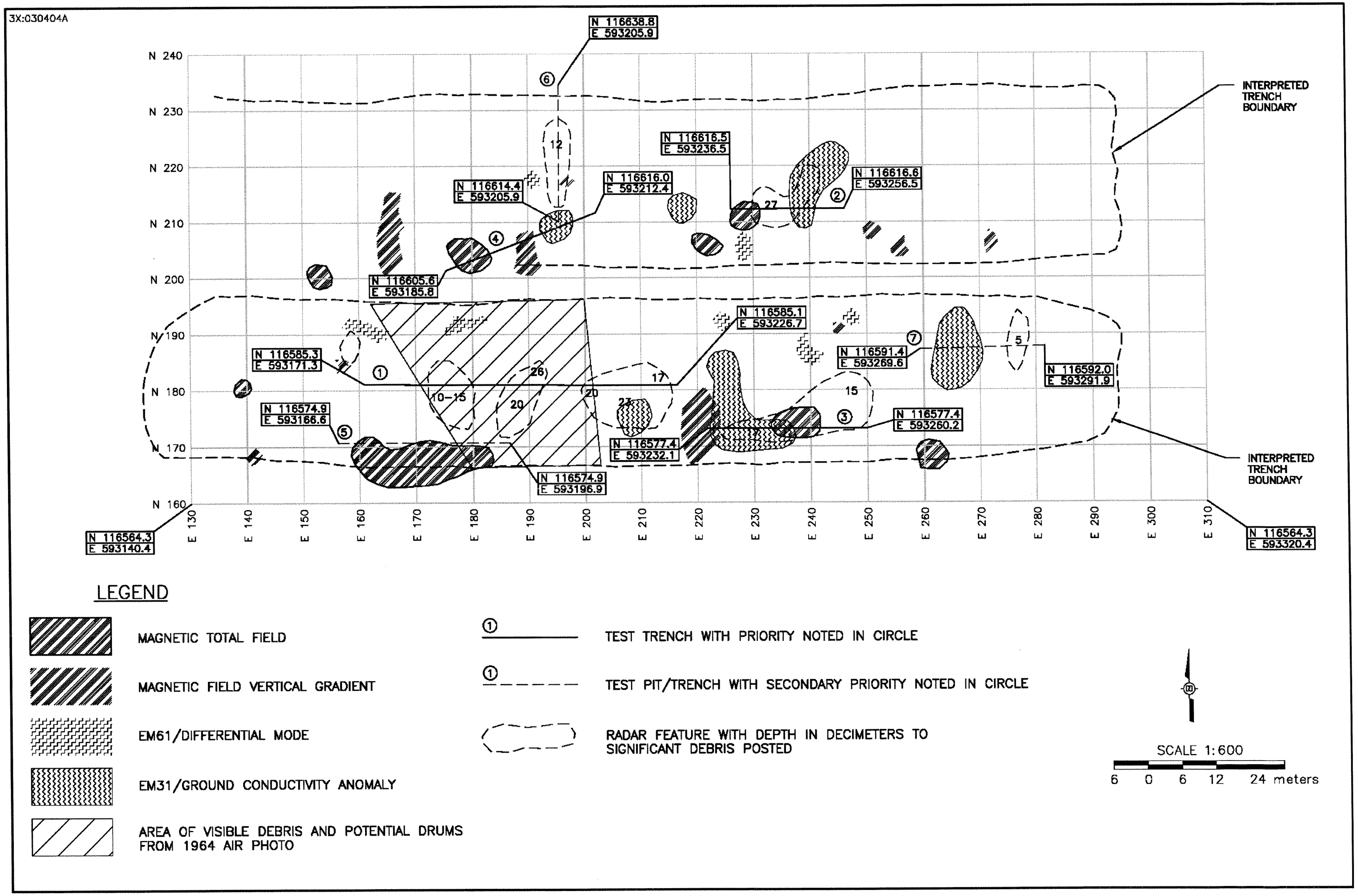


Table 1-1. Zirconium Hazards Summary.

Form	Size	Hazard	Ignition Temperature	Handling Methods	Storage Methods	DOT-Regulated
Dust	<54 µm[a]	Spontaneous ignition and explosion[a,b]	Spark, static electricity[a,b]	• Minimize sparks and static electricity.[a,b,c] • Processing equipment must be bonded and grounded.[c] • Prevent spills or handling that produce dust or clouds.[c] • Processing equipment must be classified in accordance with NFPA 70.[e] • Operators should use nonsparking shoes and noncombustible or flame-retardant clothing. • Where possible, handle in an inert atmosphere. • No smoking.	• Store in separated, clean steel cans (3.8-L [1-gal] maximum capacity) that are covered.[a,b,c,d] • Store separately from other combustibles.[c] • Separate from oxidizing agents.[a] • Keep dry or, if water is used, ensure that material is completely submerged.[a,b,f] • Indoor storage must be in a fire-resistive room with explosion venting.[d] • No smoking.	Yes
Filings, sawdust, and chips	54 µm-840 µm[a]	Ignition and burning[a]	>280°C[a]	• Minimize sparks and spark-producing equipment.[f] • No smoking.	• Store in separated, clean steel cans (3.8-L [1-gal] maximum capacity) that are covered.[a,b,c,d] • Store separately from other combustibles.[c] • Separate from oxidizing agents.[a] • Keep dry or, if water is used, ensure that material is completely submerged.[a,b,f] • No smoking.	Yes
Larger pieces	>840 µm	Minimal	>500°C	• General industrial safety practices.	• Open storage permitted.[c] • Segregate from other combustible material.[c] • Separate from oxidizing agents.[a]	No

[a] From *An Evaluation of the Zirconium Hazard* (Deholander 1956).
[b] From the *Fire Protection Handbook*, 18th Edition (NFPA 1997).
[c] From *Standard for Combustible Metals, Metal Powders, and Metal Dusts* (NFPA 484).
[d] From DOE-HDBK-1081-94, *Primer on Spontaneous Heating and Pyrophoricity* (DOE 1994).
[e] NFPA 70, *National Electrical Code*.
[f] From *Review of Zirconium-Zircaloy Pyrophoricity* (Cooper 1984).
DOT = U.S. Department of Transportation

- Zirconium powder having an average particle diameter of 17.9 μm (0.0007 in.) could not be ignited under similar circumstances until heated to 350°C (662°F).

- Zirconium chips and turnings less than 80 μm (0.003 in.) thick are ignitable and susceptible to rapid burning.

- Where all other factors are equal, partially wet material ignites more easily and burns more rapidly than dry material.

- Finely divided chips, turnings, or powder can be easily, sometimes spontaneously, ignited and can burn very rapidly. The most serious accidents have been associated with the handling of zirconium powders, finely divided scrap, and so-called "black reaction" residues.

The NFPA requires that zirconium lathe turnings and chips be collected in covered containers and removed daily to a safe storage or disposal area. Zirconium dusts should be removed daily and kept thoroughly wet. Zirconium alloys, such as Zircaloy-2, have similar pyrophoric behavior as zirconium (Cooper 1984).

1.4 PROBLEM DEFINITION

Historical records indicate that "hundreds" of drums containing chips of Zircaloy alloyed with beryllium were disposed of in the 618-7 Burial Ground as identified in Section 1.1. The chips were immersed in water to mitigate the pyrophoric property of Zircaloy and are contaminated with uranium. The condition of the buried drums and other co-contaminants that may be present in the chips, water, or in the surrounding soil are unknown. Safety, fire protection, waste management, and engineering personnel need additional information on the physical and chemical/radiochemical attributes of the drums, the drum contents, and the surrounding soil to support planning for safe and appropriate removal, handling, packaging, and disposal of the waste during remedial action operations at the site. Thorium waste that is buried in the southern trench is outside the scope of the problem to be addressed in this field investigation.

1.5 DECISIONS STATEMENTS, REQUIRED INPUTS, AND ASSOCIATED ACTIONS

Specific issues to be addressed by the 618-7 Burial Ground investigation were identified by the project team/data users and formulated into four decision statements as part of the data quality objectives (DQO) process. The decision statements are presented in Table 1-2 with a summary of the required inputs and associated actions. Results from the DQO process are presented in Appendix A.

Table 1-2. Decision Statements for the 618-7 Burial Ground Investigation.

#	Decision Statements	Required Inputs	Actions
1	Determine if the physical and chemical/radiochemical attributes of the drums and their contents require use of Level B PPE to protect site workers during remedial action operations.	Results from physical inspection of drum and contents, IH monitoring and radiological surveys, and laboratory analysis of samples from each identified phase (e.g., liquid, solid, and sludge) present in drum.	Establish plans to begin remedial action operations using Level B PPE or evaluate alternative PPE levels that will protect site workers.
2	Determine if the condition of drums and/or sizes of Zircaloy chips in the drums present a pyrophoric risk during drum removal/handling operations.	Results from physical inspection of drum and contents, and laboratory analysis of chips.	Identify appropriate actions to mitigate the pyrophoric property during removal and handling operations or use standard methods.
3	Determine if the drum contents and/or surrounding soil require treatment to meet ERDF acceptance criteria.	Process knowledge and results from laboratory analysis of samples for each identified phase (e.g., liquid, solid, and sludge) present in the drum and the soil beneath the drum.	Identify appropriate treatment methods or establish the process for direct disposal at ERDF.
4	Determine if grouting of the drum contents is an appropriate stabilization and/or treatment method to meet ERDF waste acceptance criteria.	Results from inspection of the grouted monolith for integrity. Results from laboratory analysis of grouted waste matrix for toxicity (applicable only if original waste is hazardous for metals).	Establish final design to mix drum contents with grout or determine other appropriate stabilization/treatment methods for waste disposal.

ERDF = Environmental Restoration Disposal Facility
IH = industrial hygiene
PPE = personal protective equipment

1.6 SAMPLE DESIGN SUMMARY

Because the total number of buried drums and the nature/variability of their contents are unknown, a nonstatistical design will be used for the 618-7 Burial Ground investigation. Data will be collected to support developing plans and processes for full-scale remedial action operations at the site. Based on the information collected during this field investigation, it is recognized that DQOs for additional sampling of the drum population during remedial action operations may need to be identified through a separate process.

Excavation locations will be focused in the 618-7 Burial Ground areas that are most likely to have buried drums present based on historical records and geophysical survey results. Excavation, removal, inspection, and characterization of at least five drums are desired. If possible, the drums will be excavated from different areas of the burial ground while minimizing the overall disturbed areas and number of drums excavated. General observations of the depth, orientation, layering, and condition of unearthed drums will be recorded. Excavated drums will be selected for characterization based on a preference to obtain information from drums with dissimilar exterior features (e.g., size, type, and markings). It is recognized that the degree to which these objectives can be met may be affected by project schedule and budget constraints.

During all phases of the field investigation, industrial hygiene (IH) and radiological surveys will be conducted to collect chemical and radiochemical information from the breathing zone, work areas, and drum contents. Each drum will be inspected and opened to identify the physical inventory of the contents. Within each drum, samples of each phase (e.g., liquid, solid, and sludge) identified through the physical inspections will be collected and submitted to a contract laboratory for analysis to determine the chemical and radiochemical properties of the waste. Samples of surrounding soil from beneath the drums will also be collected and submitted to a contract laboratory for analysis to determine the chemical and radiochemical properties of the soil.

Sample material from at least one of the drums will be mixed with grout to test an assumption that it is an appropriate stabilization and/or treatment method for the waste to meet Environmental Restoration Disposal Facility (ERDF) waste acceptance criteria. Depending on the information collected during the physical surveys, the grout may be mixed with a multiple-phase sample that is representative of the entire drum contents and/or samples that are representative of the individual phases present in the drums. Samples of the grouted waste matrix will be collected and submitted to a contract laboratory for analysis to determine the integrity and leaching properties (i.e., toxicity; applicable only if original waste is hazardous for metals) of the stabilized/treated material.

1.7 HAZARDS ANALYSIS

As part of the field investigation design, a hazards analysis was conducted to identify the relative risks and potential mitigative actions associated with excavation and handling of drummed waste at the 618-7 Burial Ground. The analysis was conducted by a team of individuals representing industrial safety, field operations, engineering, project management, fire protection, radiological controls, and industrial hygiene. A three-by-three matrix was used to determine unmitigated relative risk associated with fugitive dust, fire, and explosion events based on assessment of probability and consequences for various field operations anticipated for the investigation. Qualitative assessment of the event probability and consequences was based on the criteria presented in Table 1-3.

Table 1-3. Qualitative Assessment of Event Probability and Consequences.

Ranking	Event/Hazard Probability	Worker/Public Consequences[a]
Low	Not likely to occur during the activity	Minor onsite and negligible offsite impacts
Medium	Not anticipated but could occur during the activity	Moderate onsite and minor offsite impacts
High	Anticipated to occur during the activity	Considerable onsite and offsite impacts

[a] It was assumed that consequences to the environment and property from release outside of the field investigation exclusion zone would be high for all scenarios, based on $1 million threshold. Contamination spread outside of the exclusion zone to personnel and/or equipment is addressed by standard preventive/mitigative measures and procedures (e.g., step-off pads).

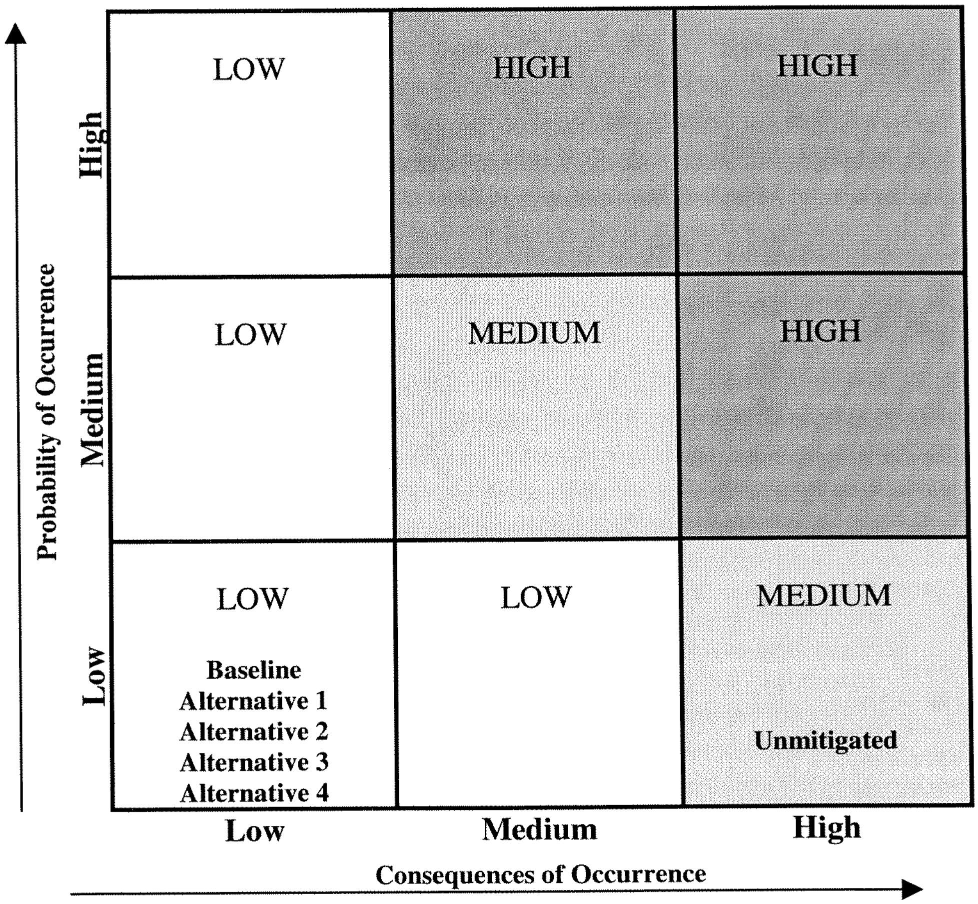
Focusing on the operations that presented the greatest relative risk, baseline design elements were identified along with four alternatives that added to or modified baseline design elements to progressively increase the level of risk reduction. Summaries of the baseline/alternative design elements and the overall cumulative risk matrix are presented in Table 1-4 and Figure 1-3, respectively. The design elements associated with Alternative 1 were selected for the 618-7 Burial Ground field investigation. Additional information is presented in the *618-7 Burial Ground Field Investigation Hazards Analysis* (BHI 2004a).

Table 1-4. 618-7 Investigation Design Elements.

Baseline Operations for Known/Suspect Drum Field • Radiological protection program • Industrial safety protection program • Hazardous waste site operations • Exclusion zone for beryllium protection • ALARA principles • No manned entry into excavation • Fire break at site perimeter • Restrict/reduce combustible material • Restrict work in windy conditions • Restrict hot work • Remote temperature monitoring of drums • Electrical storm work restriction • Manned hydraulic excavator with toothless bucket • Blast shields on heavy equipment • Level B PPE (includes splash protection and flame resistant) • Controlled excavation pace • Controlled water application for dust control • Minimize size of open excavation • Minimize number of drums exposed • Field screen drums for uranium • Restrict removal of uranium drums • Remove, overpack, and isolate drum for intrusive work • Nonsparking, backhoe-mounted spike to pierce drum • Ground/bond equipment to pierce drum • Stabilize overpacked drum for reburial • No drums staged on surface at shift end • No open excavation at shift end • Abandon and evacuate in fire event.
Alternative 1 Risk Reduction (changes/additions to baseline) • Add fire-suppression capabilities: Equipment and operator standing by to douse with sand.
Alternative 2 Risk Reduction (changes/additions to Alternative 1) • Replace backhoe-mounted spike with remote-operated punch • Add video cameras/monitor system for support zone viewing of excavation operation.
Alternative 3 Risk Reduction (changes/additions to Alternative 2) • Add permitted enclosure with HEPA filtration to control emissions • Add inert atmosphere within permitted enclosure to reduce fire/explosion.
Alternative 4 Risk Reduction (changes/additions to Alternative 3) • Add robotics system to conduct all operations within permitted enclosure (eliminate manned entry).

ALARA = as low as reasonably achievable
HEPA = high-efficiency particulate air

Figure 1-3. Overall Cumulative Relative Risk.



2.0 FIELD INSTRUCTIONS FOR DATA ACQUISITION

The task design was developed based on information gathered in technical literature and input from subject matter experts. Activities shall be recorded in a field logbook. At the direction of the field superintendent (or designee), a photographic or video record of the activities shall also be captured. Locations for intrusive activities are identified in Figure 1-2 based on historical information and geophysical survey results. Selection of drums will be made by the field superintendent (or designee) with a preference to obtain samples from drums unearthed from different areas of the burial ground and drums with dissimilar exterior features (if available). Modifications to the plan may be made in the field as directed by the field superintendent (or designee) and will be documented in the field logbook. Contingency planning is documented in Appendix B.

Health and safety precautions are integrated with requirements for each subtask defined in this investigation plan. The IH and radiological personnel will be present during all field activities. Required IH or radiological surveys are identified as specific steps within the applicable subtask. In addition to the required surveys, supplemental IH surveys and/or radiological surveys may be performed at any time during the field operations at the discretion of the site safety officer (SSO) and radiological control technician (RCT), respectively.

Most of the field activities will be performed by a subcontractor under the direction of Bechtel Hanford, Inc. (BHI). A general description of the anticipated field activities is provided in the following subsections. Actual work processes will be performed in accordance with the prescriptive means and methods outlined in the subcontract plans and procedures (e.g., excavation and materials handling plan and health and safety plan).

2.1 SITE PREPARATION

Before beginning the intrusive field activities, equipment/supplies will be mobilized and the site will be prepared to support the investigation. Necessary items will include appropriate heavy equipment to conduct excavation activities, weigh drums, lift drums into overpacks, pierce drums to access contents, and move overpacked drums between the designated work areas (e.g., inspection area and staging area). Vegetation will be cleared around the site perimeter to establish a fire break, and emergency access roads will be constructed. A water supply will be required for dust control and stabilization of the drum contents (as necessary). A supply of new 208-L (55-gal) and 322-L (85-gal), open-top drums (7 to 10 each, per waste management specifications) will be staged at the site to use (as needed) for overpacking 114-L (30-gal) or 208-L (55-gal) drums that are excavated. A stockpile of sand and a conveyed aggregate delivery system (e.g., sand slinger) will be staged at the site for suppression of fires involving Zircaloy chips/fines, as needed. Air monitors must be operating in accordance with the approved air monitoring plan prior to initiating excavation operations (operation for a 2-week period prior to the start of work is desired to establish a baseline). If needed, drum control areas will be prepared within the area of contamination (AOC) according to the specifications outlined in the applicable fire protection documents.

A general site layout will be developed and discussed with all site workers at a pre-job briefing prior to the start of field activities. Items identified on the site layout will include the AOC, designated work areas, storage areas, and emergency evacuation routes.

2.2 EXPLORATORY TRENCHING

Intrusive field operations will be performed in two phases to support the design objective to minimize the number of drums excavated, excavate drums from different areas of the burial ground, and obtain information from drums with dissimilar exterior features (e.g., size, type, and markings). Phase one of the intrusive field operations will consist of trenching to locate buried drums or loose Zircaloy chips/fines. Target areas for the trenching operations are identified in Figure 1-2.

At each location where intrusive activities are conducted, the subcontractor will excavate soil and debris in accordance with approved means and methods that reflect the design elements identified in Table 1-4 and the following general earthwork objectives (to the extent practicable):

- Minimize use of heavy equipment directly above areas suspected and/or known to contain buried waste within the disposal trench footprint
- Minimize the potential to inadvertently pierce a drum (e.g., toothless bucket)
- Minimize disturbance to surrounding drums during the excavation process.

All soil and debris removed to locate buried drums will be set aside within the waste site AOC. General observations of orientation, approximate depth, layering, and condition of drums as well as the type of surrounding material (e.g., soil, soil with debris, loose Zircaloy chips/fines, other drums) will be noted by BHI sampling personnel. Once drums are located, the drums will be covered with a minimum of 0.6 m (2 ft) of sand and the remainder of the trench will be backfilled. If drums are inadvertently damaged during the trenching operation and an unstable condition is suspected, associated material may be excavated and managed in accordance with Section 2.3, at the direction of the field superintendent (or designee). With the exception of identified buried drums with sand cover, all trenches will be backfilled by the end of the shift such that no open excavations exist off-shift. If trenching operations fail to locate any drums at a given target area, the field superintendent (or designee) may direct the subcontractor to backfill the excavation and relocate equipment and personnel to the next target area. Soil fixatives will be applied in accordance with the air monitoring plan and documented in the field logbooks.

2.3 EXCAVATION AND REMOVAL

Following the phase one activities, the project team will meet to review results from the trenching activities and plan phase two operations for excavation and removal of selected drums or loose Zircaloy chips/fines. Excavation locations and associated drums will be selected based on a preference to obtain information from at least five drums buried at different locations within the site and with dissimilar exterior features (e.g., size, type, and markings). If available, drums will be selected preferentially over loose Zircaloy chips/fines that were identified during the trenching activities. Drums identified by field survey results as containing depleted uranium waste will be excluded from removal operations.

The general design elements and earthwork objectives identified in Section 2.2 will also be implemented to excavate and remove buried drums or loose Zircaloy chips/fines. All soil and debris excavated to remove buried drums or loose Zircaloy chips/fines will be set aside within the waste site AOC.

2.3.1 Intact Drums

The process for removing and handling of drums that appear to be intact is outlined in the following subsections.

2.3.1.1 Drum Removal. Before being removed from the excavation face, the drum will be observed for crystallized material around the drum openings/joints or bulging/disfiguration (which may indicate pressurization), IH surveys will be conducted, and radiological surveys will be conducted. The temperature of the drum will also be checked using an infrared thermometer and recorded. If radiological survey results indicate that the drum contains uranium waste, the information will be noted in the field logbook and the field superintendent (or designee) will select an alternate drum for removal. If abnormal conditions are observed or survey action levels are exceeded, workers will be directed to back off in an upwind direction pending further instructions from the SSO.

Once the exposed drum has been allowed to equilibrate and cleared the survey/temperature checks, the drum will be removed from the excavation face and put into the designated inspection area within the waste site AOC. Unless otherwise directed by the field superintendent (or designee), no personnel will enter the excavation to support drum removal. The preferred method to bring the drum to the surface is within an appropriately sized excavator bucket.

2.3.1.2 Physical Inspection. The project sampler will perform and document a nonintrusive, physical inspection of each drum after it has been removed from the dig face. Information gathered/recorded during the physical inspection will include the following:

- General observations of the drum condition
- Drum size
- Weight
- Any markings present on the drum exterior
- Temperature
- IH survey readings (performed previously)
- Radiological survey readings (performed previously).

Information gathered during the physical inspection will be documented on a form similar to the example provided in Appendix C. When complete, the form will be put into the field logbook.

2.3.1.3 Access and Stabilization. As directed by the field superintendent (or designee), excavated drums will be overpacked within the AOC in accordance with the approved subcontractor means and methods. All overpacks shall be of new condition and obtained through the project waste transportation specialist (WTS), with the applicable package identification number clearly marked on the overpack exterior in a manner that will withstand the weather and remain legible. Lids will be configured to ensure the overpack cannot become pressurized while preventing intrusion of rainwater (e.g., NucFil®-type vent). During the overpacking process, the temperature of the drum will be checked and recorded. If abnormal temperature readings are observed, site workers will be directed to back off in an upwind direction pending further instructions from the SSO.

Individual overpacked drums will be isolated from other drums, and the inner drum will be remotely pierced to obtain access to the drum contents. Each drum will be visually surveyed and cleared prior to being pierced. The drum and piercing equipment will be grounded and bonded. Radiological surveys and IH surveys (headspace and breathing zone) will be conducted once the inner drum has been pierced, and the temperature of the drum will be checked and recorded. Workers will be directed to back off in an upwind direction pending further instructions from the SSO if survey action levels are exceeded or abnormal temperature readings are observed.

Using a colliwasa or other appropriate sampling equipment, the project sampler will observe and record the physical contents of the drum including the estimated volume/amount, phase (e.g. liquid, solid, and multi-phase), color, pH, and any other observations noted during the inspection. Based on general observation of the drum contents, the following actions will be taken.

- If the drum contains metal chips and/or sludge that are not immersed in water, the subcontractor will be directed to add water to the inner drum (as necessary) to ensure that the solid/sludge material is fully immersed and in a stable configuration. In addition, water will be added to the annular space between the inner drum and overpack such that the fill level is slightly above the level of solid/sludge material in the inner drum. The project sampler will document the approximate fill levels in the inner and overpack drum.

- If the drum contains material other than metal chips or sludge, site workers will be directed to back off in an upwind direction pending further instruction from the project engineer and SSO.

Any contact waste generated by the process to access and stabilize the drum contents will be discarded in a bag/container identified by the WTS for sample waste.

2.3.1.4 Sample Collection. In accordance with the applicable BHI procedures, samples will be collected to characterize the chemical and radiochemical nature of the waste. The project sampler will collect a sample of each phase (e.g., liquid, solid, and sludge) present in the drum in accordance with the container and volume requirements specified by the applicable sample authorization form documents. Water shall be added to all solid and sludge sample containers so

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the contents are fully immersed. In addition, a grab sample (from the spoil pile or excavation face) of the soil that surrounded the buried drums will be collected, with preferential selection of soil that has been in contact with material that may have leaked from buried and/or decomposed drums (based on visual observation, radiological survey results, and/or IH survey results). All samples that are collected shall be sent offsite to a contract laboratory for the suite of analyses summarized in Table 2-1. Material will also be collected for radiological activity screens of all samples to authorize shipment to the contract laboratory.

Table 2-1. Sample Analysis Matrix.

Analysis[a]	Sample Media				
	Liquid	Solid	Sludge	Soil	Grout Matrix[b]
Chemical					
ICP metals	X	X	X	X	
Volatile organics	X	X	X	X	
Semivolatile organics	X	X	X	X	
PCBs	X	X	X	X	
pH	X		X	X	
TCLP metals		X	X	X	X
TCLP volatile organics		X	X	X	
TCLP semivolatile organics		X	X	X	
Cyanide	X	X	X	X	
Sulfide	X	X	X	X	
Flashpoint	X		X		
Radiochemical					
Gross alpha/beta	X	X	X	X	
GEA	X	X	X	X	
Isotopic uranium	X	X	X	X	
Isotopic thorium	X	X	X	X	
Physical Properties					
Particle size		X	X		

[a] Actual analytical methods, sample sizes, containers, and preservatives will be specified on the applicable sample authorization form documents.
[b] Analysis of the grout matrix is not applicable if waste is known to be nonhazardous.
GEA = gamma energy analysis
ICP = inductively coupled plasma
PCB = polychlorinated biphenyl
TCLP = toxicity characteristic leaching procedure
X = required analysis

After the sampling process is completed, the temperature of the drum will be checked and recorded. Workers will be directed to back off in an upwind direction pending further instructions from the SSO if abnormal temperature readings are observed. The overpacked drum will be returned to the designated area within the AOC prior to being reburied. Any contact waste generated as part of the sampling process will be discarded in the bag/container identified by the WTS for sample waste.

2.3.2 Loose Zircaloy Chips/Fines

If intact drums are not available, loose Zircaloy chips/fines may be removed and handled in accordance with the following subsections.

2.3.2.1 Removal. Before removal from the excavation, exposed Zircaloy chips/fines will be allowed to equilibrate, IH surveys will be conducted, and radiological surveys will be conducted. The temperature of the chips/fines will also be checked using an infrared thermometer and recorded. If abnormal conditions are observed or survey action levels are exceeded, workers will be directed to back off in an upwind direction pending further instructions from the SSO. Once cleared, the loose Zircaloy chips/fines will be removed from the dig face and brought to the surface in the excavator bucket for sampling.

2.3.2.2 Sample Collection. In accordance with the applicable BHI procedures, the project sampler will collect a sample of the Zircaloy chips/fines from the excavator bucket. Water shall be added to all solid and sludge sample containers so the chips/fines are fully immersed. In addition, a grab sample (from the spoil pile or excavation face) of the soil that surrounded the Zircaloy chips/fines will be collected. All samples that are collected shall be sent offsite to a contract laboratory for the suite of analyses summarized in Table 2-1. Material will also be collected for radiological activity screens of all samples to authorize shipment to the contract laboratory. Any contact waste generated as part of the sampling process will be discarded in the bag/container identified by the WTS for sample waste.

2.4 BACKFILL

Soil and debris that was removed during the field investigation will be used to backfill the open investigation areas in accordance with the approved subcontractor means and methods. Overpacked/stabilized drums and loose Zircaloy chips/fines that were removed during the investigation activities will be reburied at the approximate location and depth from which they were encountered. To ensure a stable configuration between the field investigation and the start of remedial actions at the site, a minimum fill depth of 1 m (3.3 ft) will be used at locations where drums or loose Zircaloy chips/fines were encountered and/or remain exposed. As necessary, additional fill may be imported from approved borrow sites to achieve the minimum depth requirements. Locations where Zircaloy waste (drummed or loose) was reburied will be surveyed, field marked, and recorded in the logbook for future reference.

2.5 GROUT ZIRCALOY CHIPS/FINES

On a bench-scale level, sample material from at least one of the drums will be mixed with grout to test the assumption that it is an appropriate stabilization and/or treatment method for the waste to meet ERDF waste acceptance criteria. This bench-scale test may be performed in parallel with characterization of the drum contents based on historical past practices and on an underlying assumption that the contents are either hazardous by toxicity characteristic for heavy metals or not hazardous (it is recognized that use of grout is generally not an acceptable treatment method for waste with organic waste codes, unless a treatment waiver has been approved by the U.S. Environmental Protection Agency [EPA]).

Depending on the information collected during the physical surveys, the grout may be mixed with a multiple-phase sample that is representative of the entire drum contents and/or samples that are representative of the individual phases present in the drums as directed by the project engineer and WTS. It is anticipated that the material will be mixed in a 19-L (5-gal) container, unless otherwise directed by the project engineer. The following general process design may be used for the test to be consistent with Hanford Site and industry practices:

- Remove water from sample material
- Pour grout on top of sample material in test container
- Tamp down exposed sample material
- Add more sample material and grout until test container is full
- Let grout solidify for at least 7 days.

As an alternative, the project engineer may select a process design that includes mixing (e.g., small cement mixer or other means) to result in a more homogeneous grout/Zircaloy matrix. At the direction of the project engineer one or both designs may be implemented based on the physical characteristics of the Zircaloy chips identified for the test.

All aspects of the test shall be performed within the waste site AOC, including mixing and curing. The resulting monolith shall be fractured to observe and document the integrity of the grouted waste matrix. If designation of the original waste material is unknown or hazardous by toxicity characteristic for heavy metals, a sample of the grouted waste matrix will be collected and submitted to a contract laboratory for analysis to determine the toxicity (i.e., leaching properties) of the stabilized/treated material (Table 2-1). If the original waste material is hazardous based on constituents other than heavy metals, the WTS and project engineer will be consulted for direction on sample collection and analysis.

3.0 QUALITY ASSURANCE

The 618-7 Burial Ground investigation is being conducted as a precursor to remedial actions at the site. Consequently, the quality assurance objectives for the investigation will be implemented in accordance with the *300 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2004a), Section 2.0, "Quality Assurance Project Plan." The referenced quality assurance plan includes the following elements:

- Project organization
- Training and certification
- Field documentation
- Sample collection, custody, analytical methods, preservation, and holding times
- Quality control
- Instrument calibration, inspection, and maintenance
- Assessments and response actions.

Supplemental information and exceptions to the quality assurance requirements specified in the *300 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2004a) are identified in the following subsections.

3.1 PROJECT ROLES AND RESPONSIBILITIES

Project management, sampling support and sampling equipment, waste management support, and RCT support will be provided by BHI. Equipment operations, site readiness, excavation, manual labor, and safety and IH monitoring will be performed by a subcontractor under the direction of BHI. Additional information regarding the division of responsibilities will be provided in the applicable subcontract documents.

3.2 DATA VALIDATION

Formal data validation will not be performed for this sampling activity. Sample collection and laboratory procedures will follow quality assurance and control processes to ensure that data are usable for project planning and waste designation purposes. Analytical results will be reviewed by the project team and by waste management personnel during the planning and designation process.

3.3 FIELD QUALITY CONTROL

One field duplicate sample will be collected for soil and each phase (e.g., liquid, solid, and sludge) identified inside the excavated drums. One field duplicate sample will also be collected for the treated waste matrix. Trip blanks, equipment blanks, and split samples will not be collected as part of this field investigation.

4.0 WASTE MANAGEMENT

All waste shall be managed in accordance with the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (DOE-RL 2004b) and the *Site-Specific Waste Management Instruction for the 618-7 Burial Ground Characterization* (BHI 2004c). The following information summarizes the general waste management approach for the 618-7 Burial Ground field investigation.

- All activities will be performed within the waste site AOC.
- Soil and debris removed to obtain access to the drummed waste will be used to backfill the excavation from which it was removed.
- Loose Zircaloy chips/fines will be returned to the excavation from which they were removed, covered them with a minimum of 1 m (3 ft) of soil, and field marked for future reference.
- Unless otherwise directed by the field superintendent (or designee), excavated drums (which includes drums that have been overpacked and/or stabilized) will be returned (in an upright position) to the excavation from which they were removed, covered with a minimum of 1 m (3 ft) of soil, and field marked for future reference. Other potential pathways include storing the drums within the AOC or at other locations approved by the EPA, and/or sending the drums offsite to an approved facility for treatment/disposal.
- Sampling equipment and personal protective equipment (PPE) will be bagged/containerized and sent to the ERDF or buried within the AOC with a minimum of 1 m (3 ft) of soil cover and field marked for future reference.
- Unused samples and associated laboratory waste for the analysis will be dispositioned in accordance with the laboratory contract and agreements for return to the Hanford Site. If sample waste is to be returned from the contract laboratories, prior approval from the EPA is required.

5.0 FIRE PROTECTION

Fire protection is a concern at the 618-7 Burial Ground because of the reactive properties of finely divided zirconium. However, the process design was developed to minimize the risk of fire and result in a packaging configuration that is stable for subsequent handling and staging. Hanford Fire Department personnel have been provided with the necessary information and have made site visits to the 618-7 Burial Ground to develop an understanding of the area and the potential hazards. As part of the site preparation, fire breaks will be cut around the site perimeter. The subcontractor will stage a stockpile of sand and mobilize a conveyed aggregate delivery system (e.g., sand slinger) with a qualified operator for suppression of fires involving Zircaloy chips/fines. Fire extinguishers charged with Met-L-X® will also be staged at the site to help contain metal fires. In addition, Hanford Fire Department representatives will be onsite during the investigation operations to provide incident command and coordinate response activities in the event of a fire.

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6.0 HEALTH AND SAFETY

All field operations will be performed in accordance with BHI health and safety requirements outlined in BHI-SH-01, *ERC Safety and Health Program*; BHI-RC-01, *Radiation Protection Program Manual*; and the subcontract (Exhibit G, U.S. Department of Energy orders on beryllium, and a beryllium control plan). The field activities have been designed to minimize exposure and control contamination for all site personnel to the extent possible. During all operations, an effort shall be made to minimize the number of personnel working in the exclusion zone consistent with as low as reasonably achievable principles. The PPE requirements for workers are specified in the health and safety plan and radiological work permit documents. The level of PPE may be adjusted as authorized by the SSO and RCT based on site conditions, the task(s) being performed, radiological survey results, and IH survey results.

All personnel assigned to support execution of this field investigation shall participate in a pre-job safety briefing, and attendance shall be documented on a roster. New personnel that may be asked to support the work during the activities shall be provided the same briefing and shall also sign the roster. Additional safety briefings shall be held and documented at the beginning of each subsequent day that work is performed to support this field investigation. Any lessons-learned activities from previous work days shall be included in the safety discussions. All employees have the authority and the responsibility to stop work if an unsafe condition is encountered at any time during execution of this field investigation.

7.0 REFERENCES

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APPENDIX A

DATA QUALITY OBJECTIVES SUMMARY REPORT

APPENDIX A
DATA QUALITY OBJECTIVES SUMMARY REPORT

A.1 INTRODUCTION

A graded approach was implemented to determine the data quality objectives (DQOs) for the 618-7 Burial Ground investigation. Personnel that participated in some aspect of the DQO process are identified in Table A-1. Selected outputs from the seven-step DQO process are summarized in the following sections.

Table A-1. DQO Team Participants.

Name	Organization	Technical Expertise
N. F. Barilo	BHI S&H Program Support	Fire Safety
R. A. Carlson	BHI Task Lead	Project Management
S. R. Coleman	BHI Industrial Hygiene	Safety
K. E. Cook	CHI Design Engineering	Design Engineering
F. M. Corpuz	BHI Project Engineer	Project Engineering
J. W. Donnelly	BHI Project Environmental Lead	Environmental Regulations
M. J. Haass	BHI Civil/Structural/Value Engineering	Field Engineering
R. T. Hynes	BHI Waste Management and Transportation	Waste Management
J. A. Lerch	CHI Environmental Sciences	Environmental Sciences
J. D. Ludowise	CHI Environmental Sciences	CHI Project Lead
R. W. Ovink	CHI Environmental Sciences	DQO Facilitator
D. A. St. John	CHI Analytical Field Services	Analytical Field Services

BHI = Bechtel Hanford, Inc.
CHI = CH2M HILL Hanford, Inc.
S&H = Safety and Health

A.2 BACKGROUND

The 618-7 Burial Ground was a general purpose burial ground that began operation in 1960. The original burial ground consisted of one east-west-oriented trench, 198 m (650 ft) long and 30 m (100 ft) wide and about 4 to 4.6 m (13 to 15 ft) deep. In 1965, a second trench identical to the first trench was constructed about 6 m (20 ft) north of the northern edge of the first trench and began receiving waste in 1966. At about the same time, a third trench was constructed to the south of and parallel to the original trench. This trench is 43 m (140 ft) long, 6.1 m (20 ft) wide, and contains thorium-contaminated waste from the thorium program. Burial of waste in the 618-7 Burial Ground ceased in 1973. The current configuration of the burial ground is a vegetation-covered area with patches of cobbles, surrounded by wooden poles and a 2.4-m (8-ft) wire fence. A locked gate is located on the east side of the fenced area and is posted with "underground radioactive material" signs.

Materials buried at this burial ground were primarily from the 321, 313, 333, 3722, and 3732 Buildings. Miscellaneous contaminated equipment and hundreds of 114-L (30-gal) drums of Zircaloy-2[2] chips contaminated with moderate amounts of beryllium and uranium were buried in the trenches from 1962 to 1973. However, Weakley (1984) reports that the drums used were 208 L (55 gal) in size. Because the Zircaloy-2 was considered pyrophoric, the drums were filled with water to avoid spontaneous combustion. It is possible that water has leaked out of the drums. Other low-level materials that were slightly contaminated with uranium and thorium were also buried in the trenches.

Volumes of contaminated soil have been estimated to be 24,228 m^3 (855,600 ft^3), with approximately 14,200 m^3 (501,500 ft^3) of overburden. The drums containing Zircaloy are most likely located in the middle and northern trenches. The southern trench was used for disposal of thorium-contaminated waste. Additional geophysical surveys will be performed to further identify the anticipated location of buried drums within the middle and northern trenches.

A.3 PROBLEM DEFINITION

Historical records indicate that "hundreds" of drums containing chips of Zircaloy alloyed with beryllium were disposed in the 618-7 Burial Ground, as identified in Section A.2. The chips were immersed in water to mitigate the pyrophoric property of Zircaloy and are contaminated with uranium. The condition of the buried drums and other co-contaminants that may be present in the chips, water, or in the surrounding soil are unknown. Safety, fire protection, waste management, and engineering personnel need additional information on the physical and chemical/radiochemical attributes of the drums, drum contents, and surrounding soil to support planning for safe and appropriate removal, handling, packaging, treatment, and disposal of the waste during remedial action operations at the site.

A.4 DECISION STATEMENTS

The decision statements (DSs) associated with the 618-7 Burial Ground investigation are presented in Table A-2 as developed from the principal study questions (PSQs) and alternative actions (AAs). The table also provides a qualitative assessment of the severity of the consequences of taking an AA if it is incorrect. This assessment takes into consideration human health; the environment; and political, economic, and legal ramifications. The severity of the consequences is expressed as low, moderate, or severe.

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[2] Zircaloy-2 is an alloy of zirconium containing 1.2% to 1.7% tin, 0.07% to 0.2% iron, 0.05% to 0.15% chromium, and 0.03% to 0.08% nickel.

Table A-2. Decision Statements Summary.

PSQ-AA#	AA	Consequences of Implementing the Wrong AA (Low/Moderate/Severe)
PSQ #1 – Do the physical and chemical/radiochemical attributes of the drums and their contents require the use of Level B PPE to protect site workers during remedial action operations?		
1A	If yes, begin remedial action operations using Level B PPE for site workers.	Low to moderate depending on the time of the year. Site workers may be subject to unnecessary heat stress during remedial action operations.
1B	If no, evaluate appropriate PPE level for protection of site workers.	Severe. Site workers may be exposed to chemical and/or radiological hazards during remedial action operations.
DS #1 – Determine if the physical and chemical/radiochemical attributes of the drums and their contents require use of Level B PPE to protect site workers and begin remedial action operations using Level B PPE, or evaluate alternative PPE levels that will protect site workers.		
PSQ #2 – Does the condition of the drums and/or the sizes of Zircaloy chips found in the drums present a pyrophoric risk during drum removal and handling?		
2A	If yes, determine appropriate actions to mitigate the pyrophoric property during removal and handling.	Low. Additional waste may be generated and additional costs may be incurred for mitigative measures that are not necessary.
2B	If no, use standard methods for drum removal and handling.	Severe. A pyrophoric reaction may occur during drum removal and handling operations causing risk to workers and the environment.
DS #2 – Determine if the condition of the drums and/or sizes of Zircaloy chips found in the drums present a pyrophoric risk during drum removal/handling operations and identify appropriate actions to mitigate the pyrophoric property during removal and handling operations, or use standard methods.		
PSQ #3 – Do the chemical/radiochemical attributes of the drum contents and/or the surrounding soil require treatment to meet ERDF waste acceptance criteria for disposal?		
3A	If yes, determine appropriate treatment methods to meet ERDF waste acceptance criteria.	Low to moderate. Additional costs and waste handling operations may occur for unnecessary treatment.
3B	If no, establish process for direct disposal at ERDF.	Moderate to severe. Unauthorized disposal of waste not meeting ERDF waste acceptance criteria may occur.
DS #3 – Determine if the drum contents and/or the surrounding soil require treatment to meet ERDF acceptance criteria for disposal and determine appropriate treatment methods or establish the process for direct disposal at ERDF.		
PSQ #4 – Is the assumption valid that grouting the drum contents will be an appropriate stabilization and/or treatment method to meet ERDF waste acceptance criteria?		
4A	If yes, proceed with current assumptions to grout the drum contents prior to disposal at ERDF.	Moderate to severe. Unauthorized disposal of waste not meeting ERDF waste acceptance criteria may occur.
4B	If no, determine other appropriate treatment methods for disposal.	Low to severe. Severe if unauthorized disposal of waste not meeting ERDF waste acceptance criteria occurs.
DS #4 – Determine if grouting of the drum contents and/or surrounding soil is an appropriate stabilization and/or treatment method to meet ERDF waste acceptance criteria and proceed with current assumptions, or determine other appropriate stabilization/treatment methods for waste disposal.		

ERDF = Environmental Restoration Disposal Facility
PPE = personal protective equipment

A.5 DECISION INPUTS

The required inputs and information sources that will be used to address the DSs identified for the 618-7 Burial Ground investigation are summarized in Table A-3. References for associated action levels are presented in Table A-4.

Table A-3. Required Inputs and Information Sources. (2 Pages)

DS #	Required Input	Information Sources[a]
1	Physical attributes of drum and contents	Historical records, current industry practices, physical inspection (e.g., drum markings, drum integrity, waste phases, and fill levels).
	Breathing/work zone attributes	Industrial hygiene monitoring (e.g., organic vapors, beryllium, zirconium using field instruments and battery-powered personal air samplers); radiological surveys.
	Chemical/radiochemical attributes	Laboratory data for each identified phase (e.g., liquid, solid, and sludge). Volatile organics (8260); semivolatile organics (8270); PCBs (8082); ICP metals, including beryllium and zirconium (6010); gross alpha/beta (GPC); gamma isotopes (GEA); and uranium (AEA).
2	Drum condition	Physical inspection (e.g., drum integrity and fill levels).
	Chip temperature	Internal temperature surveys (infrared thermometer).
	Zircaloy chip particle size	Laboratory data (particle size).
3	Listed waste	Process knowledge. There is no basis for the assignment of any listed waste codes from the historical information documented in the WIDS database and review of *Listed Waste History at Hanford Facility TSD Units* (WHC-MR-0517).
	Toxicity (federal and state)	Laboratory data for each identified phase (e.g., liquid, solid, sludge) and surrounding soil. TCLP metals (EPA 1311/6010/7471), TCLP volatile organics (EPA 1311/8260), TCLP semivolatile organics (1311/8270), and ICP metals (6010). Process knowledge and historical information do not identify use or disposal of any pesticides or herbicides at the site.
	Corrosivity	Laboratory data for each identified phase (e.g., liquid, solid, and sludge) and surrounding soil; pH (EPA 9040).
	Reactivity	Laboratory data for each identified phase (e.g., liquid, solid, and sludge) and surrounding soil; cyanide (EPA 9010), sulfide (EPA 9030).
	Ignitability	Laboratory data for each identified liquid phase; flashpoint (EPA 1010).
	Persistence	Laboratory data for each identified phase (e.g., liquid, solid, and sludge) and surrounding soil. Volatile organics (EPA 8260), semivolatile organics (EPA 8270).
	PCB content	Laboratory data for each identified phase (e.g., liquid, solid, and sludge) and surrounding soil; PCBs (EPA 8082).

Table A-3. Required Inputs and Information Sources. (2 Pages)

DS #	Required Input	Information Sources[a]
4	Integrity of grouted waste matrix	Observation of fractured monolith.
	Toxicity of grouted waste matrix[b]	Laboratory data for treated matrix. TCLP metals (EPA 1311/6010/7471).

[a] All referenced laboratory methods are from *EPA Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (EPA 1997).
[b] Input does not apply if waste designates as nonhazardous in DS #3.
AEA = alpha energy analysis
EPA = U.S. Environmental Protection Agency
GEA = gamma energy analysis
GPC = gel permeation chromatography
ICP = inductively coupled plasma
PCB = polychlorinated biphenyl
TCLP = toxicity characteristic leaching procedure
WIDS = Waste Information Data System

Table A-4. Action Level Reference Summary.

DS #	Action Level Reference
1	DOE beryllium regulation (10 CFR 850); OSHA permissible exposure limits (29 CFR 1910.1000); ACGIH threshold limit values
2	NFPA *Fire Protection Handbook* (NFPA 1997); *Standard for Combustible Metals, Metal Powders, and Metal Dusts* (NFPA 484)
3	"Identification and Listing of Hazardous Waste" (40 CFR 261); "Land Disposal Restrictions" (40 CFR 268); "Dangerous Waste Regulations" (WAC 173-303)
4	"Land Disposal Restrictions" (40 CFR 268); WAC 173-303

ACGIH = American Conference of Governmental Industrial Hygienists
CFR = *Code of Federal Regulations*
DOE = U.S. Department of Energy
NFPA = National Fire Protection Association
OSHA = Occupational Safety and Health Administration
WAC = *Washington Administrative Code*

A.6 STUDY BOUNDARIES

The population of interest for the 618-7 Burial Ground investigation is the buried drum contents and surrounding soil. The total number of drums buried at the site and the variability of the contents are unknown. There are no temporal boundaries that exist for data collection. Practical constraints identified for the investigation include the following:

- Intrusive activities will require preparation or verification of infrastructure documents (e.g., excavation permit, radiation work permit, fire protection plan, and hazard classification) to authorize the work.

- Intrusive activities in areas where there is a potential to encounter unknown materials will require appropriate personal protective equipment (e.g., Level B).
- The number of drums that can be removed and sampled may be limited by authorizing infrastructure documents, the ability to locate drums, and/or project budget.
- Removal and characterization of waste that may be commingled with the drums is excluded from the 618-7 Burial Ground investigation.

A.7 DECISION RULES

The decision rules (DRs) for the 618-7 Burial Ground investigation are presented in Table A-5 as developed from the DSs, required inputs, and action level references.

Table A-5. Decision Rules Summary.

DR #	If	Then	Otherwise
1	The physical and chemical/radiochemical attributes of the drums and their contents (as determined by inspection, field surveys, and laboratory measurements) require use of Level B PPE to protect site workers based on the applicable limits (OSHA, DOE, and ACGIH)	Establish process to begin remedial action operations using Level B personal protective equipment.	Evaluate alternative personal protective equipment levels that will protect site workers.
2	The drum condition and/or sizes of Zircaloy chips present in the drums (as determined by physical inspections, temperature monitoring, and laboratory measurements) present a pyrophoric risk during drum removal and handling operations	Determine appropriate actions to mitigate the pyrophoric property during removal and handling operations (e.g., add water to stabilize drum contents).	Use standard removal and handling methods.
3	The drum contents (as determined by laboratory measurements) and/or surrounding soil require treatment to meet ERDF acceptance criteria for disposal based on the applicable regulations (40 CFR 261, 40 CFR 268, WAC 173-303, and ERDF waste acceptance criteria)	Determine appropriate treatment methods.	Establish the process for direct disposal at ERDF.
4	Grouting of the drum contents and/or surrounding soil is an appropriate stabilization and/or treatment method to meet ERDF waste acceptance criteria (as determined by laboratory measurement of the grouted matrix in comparison with the applicable regulations and ERDF waste acceptance criteria)	Establish appropriate design and proceed with current assumptions to grout the drum contents and/or surrounding soil.	Determine other appropriate stabilization and/or treatment methods for waste disposal.

A.8 DECISION ERRORS

Decision error consequences are summarized in Table A-2. Because the total number of buried drums and the nature/variability of their contents are unknown, a nonstatistical design will be used for the 618-7 Burial Ground investigation. Data will be collected to support developing plans and processes for full-scale remedial action operations at the site. Contingent on the data collected during the investigation, it is recognized that a separate process may be needed to identify the DQOs for additional sampling of the drum population during full-scale remedial action operations.

A.9 SAMPLE DESIGN SUMMARY

Excavation locations will be focused in the 618-7 Burial Ground areas that are most likely to have buried drums present based on historical records and geophysical survey results. Excavation, removal, inspection, and characterization of at least five drums are desired. If possible, the drums will be excavated from different areas of the burial ground while minimizing the overall disturbed areas and number of drums excavated. Excavated drums will be selected for characterization based on a preference to obtain information from drums with dissimilar exterior features (e.g., size, type, and markings).

During all phases of the field investigation, industrial hygiene and radiological surveys will be conducted to collect chemical and radiochemical information from the breathing zone, work areas, and drum contents. An infrared thermometer will be used to monitor the internal temperature of the drums during handling, inspection, and sampling activities. Each drum will be inspected and opened to identify the physical inventory of the contents. Within each drum, samples of each phase (e.g., liquid, solid, and sludge) identified through the physical inspections will be collected and submitted to a contract laboratory for analysis to determine the chemical and radiochemical properties of the waste. Samples of soil from beneath the drums that may have been in contact with the contents will also be collected and submitted to a contract laboratory for analysis to determine the chemical and radiochemical properties of the soil.

Sample material from at least one of the drums will be mixed with grout to test an assumption that this type of treatment is necessary and appropriate for the waste to meet Environmental Restoration Disposal Facility waste acceptance criteria. Depending on the information collected during the physical surveys, the grout may be mixed with a multiple-phase sample that is representative of the entire drum contents and/or samples that are representative of the individual phases present in the drums. Samples of the treated material will be collected and submitted to a contract laboratory for analysis to determine the integrity and toxicity (i.e., leaching properties) of the treated waste matrix, as applicable based on designation of the untreated waste.

A.10 REFERENCES

10 CFR 850, "Chronic Beryllium Disease Prevention Program," *Code of Federal Regulations*, as amended.

29 CFR 1910, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

40 CFR 261, "Identification and Listing of Hazardous Waste," *Code of Federal Regulations*, as amended.

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*, as amended.

EPA, 1997, *Test Methods for Evaluation Solid Waste, Physical/Chemical Methods,* SW-846, 3rd edition (as amended by Update I [July 1992], Update IIA [August 1993], Update IIB [January 1995], and Update III), U.S. Environmental Protection Agency, Washington, D.C.

NFPA, 1997, *Fire Protection Handbook*, 18th Edition, National Fire Protection Association, Quincy, Massachusetts.

NFPA 484, *Standard for Combustible Metals, Metal Powders, and Metal Dusts*, National Fire Protection Association, Quincy, Massachusetts.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

Weakley, E. A., 1984, *Disposal Methods of Be-Zr-2 Chips and Zr-2 Chips and Fines*, UNI-2794, United Nuclear Industries, Inc., Richland, Washington.

WHC, 1996, *Listed Waste History at Hanford Facility TSD Units*, WHC-MR-0517, Westinghouse Hanford Company, Richland, Washington.

APPENDIX B

CONTINGENCY PLANS

APPENDIX B
CONTINGENCY PLANS

B.1 OBSERVATION OF SMOKE OR BURNING MATERIAL

If smoke or burning material is observed at any time during the field investigation, the following steps shall be taken:

1. Personnel shall safely exit the exclusion zone.
2. The Hanford Fire Department shall be deployed to respond and manage/control the situation.
3. The incident shall be reported to the Environmental Restoration Contractor (ERC) single point of contact and the Bechtel Hanford, Inc. (BHI) task lead.
4. Further instruction may be provided by the site safety officer (SSO).

B.2 EXPLOSION

If an explosion occurs at any time during the field investigation, the following steps shall be taken:

1. Personnel shall safely exit the exclusion zone.
2. In the event of life-threatening personnel injury, fellow workers shall move the injured personnel to a safe location if safe to do so. If the emergency is not life-threatening, injured personnel shall be left at the location to be treated by rescue personnel.
3. The Hanford Fire Department shall be deployed to respond and manage/control the situation.
4. The incident shall be reported to the ERC single point of contact and the BHI task lead.
5. Further instruction may be provided by the SSO.

B.3 LEAKING DRUM/LOSS OF INTEGRITY

If a leaking drum is discovered or the integrity of a drum is lost during the field investigation, the damaged drum and any contents that are released shall be surveyed by a radiological control technician. If the survey indicates that the radiological work permit has been exceeded, operations shall be suspended, work shall be placed in a safe condition, contamination shall be stabilized to prevent spread, postings shall be verified to be appropriate for the conditions, and the Radiological Controls supervisor shall be contacted. Any spills shall be reported to the BHI spill/release point of contact.

B.4 INCLEMENT WEATHER CONDITIONS

If sustained winds result in an inability to control dust or if sustained periods of heavy rain are encountered at any time during the field investigation, the work areas shall be stabilized and operations shall be suspended until the weather returns to an acceptable condition as determined by the field superintendent (or designee).

B.5 LOSS/DAMAGE OF EQUIPMENT

If any equipment is lost or damaged during the field investigation, the following steps shall be taken:

1. Available backup equipment shall be used to continue operations at the direction of the field superintendent and SSO.

2. If backup equipment is not available, operations shall be suspended until the field superintendent and SSO determine that all necessary equipment is available and in working order to resume safe operation.

B.6 PERSONAL CONTACT WITH DRUM CONTENTS

If a worker is splashed or comes into contact with the drum contents during the field investigation, the following steps shall be taken:

1. Immediately dry-wipe the worker's personal protective equipment that was splashed or that came into contact with the drum contents.

2. Report to the SSO for an evaluation to determine if the worker needs to immediately exit out of the work area, replace personal protective equipment, continue working, or take other appropriate actions as determined by the SSO.

B.7 OTHER CONDITIONS

If other conditions not specifically identified in this appendix are encountered or if personnel are unsure of a situation at any given time during the field investigation, the field superintendent and SSO shall be contacted for further direction.

APPENDIX C

DRUM INSPECTION/SAMPLING FORM

APPENDIX C
DRUM INSPECTION/SAMPLING FORM

This form is provided as an example only and is similar to the form that will be used in the field.

DATE: ____________________ | **TIME:** ________hrs | **PIN:** ____________________

DRUM EXCAVATION SUMMARY

Size: ________________ gal   **Type** (e.g., bung, open top): ____________________________

Weight: _____________ lbs   **Height:** _______________ in.

Dig Face Orientation/Nesting:

General Condition:

External Markings:

Radiological Reading: **Temperature Reading:**

IH Reading:

Other Comments/Attachments:

INTRUSIVE INSPECTION SUMMARY

Radiological Reading:

IH Readings: breathing zone ________________   headspace __________________

All fill levels measured from top of drum to phase of interest.

Phase/Description: **Phase/Description:**

Fill Level: ______ in. (from top)   **Fill Level:** ______ in. (from top)

Phase/Description: **Phase/Description:**

Fill Level: ______ in. (from top)   **Fill Level:** ______ in. (from top)

STABILIZATION/FINAL CONFIGURATION SUMMARY

Original Drum Size: __________ gal   **Overpack Size:** ___________ gal

Stabilization Material: Water _______   Other ___________________

Final Fill Levels: Original Drum ______ in. (from top)   Annular Space (overpack) _____ in. (from top)

CHARACTERIZATION SUMMARY

Phase: __________ **Sample #:** ___________ **Phase:** __________ **Sample #:** ____________

Phase: __________ **Sample #:** ___________ **Phase:** __________ **Sample #:** ____________

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