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**Field Test Plan
Buried Waste Technologies
Fiscal Year 1995**

**R. E. Heard
R. A. Hyde
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J. D. Evans
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Buried Waste Technologies
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Published June 1995

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MASTER

**Field Test Plan
Buried Waste Technologies
Fiscal Year 1995**

INEL-95/0233

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ABSTRACT

The U.S. Department of Energy, Office of Technology Development, supports the applied research, development, demonstration, testing, and evaluation of a suite of advanced technologies that, when integrated with commercially available baseline technologies, form a comprehensive remediation system for the effective and efficient remediation of buried waste. The Fiscal Year 1995 effort is to deploy and test multiple technologies from four functional areas of buried waste remediation: site characterization, waste characterization, retrieval, and treatment. This document is the basic operational planning document for the deployment and testing of the technologies that support the field testing in Fiscal Year 1995. Discussed in this document are the scope of the tests; purpose and objective of the tests; organization and responsibilities; contingency plans; sequence of activities; sampling and data collection; document control; analytical methods; data reduction, validation, and verification; quality assurance; equipment and instruments; facilities and utilities; health and safety; residuals management; and regulatory management.

SUMMARY

The U.S. Department of Energy (DOE), Office of Technology Development, supports the development and demonstration, testing, and evaluation of a suite of technologies that, when integrated with commercially available baseline technologies, form a comprehensive system for the effective and efficient remediation of buried waste throughout the DOE complex.

The Fiscal Year 1995 effort will include field testing of technologies at the appropriate test site. Each technology to be field tested has been assigned one of the following test sites: Idaho National Engineering Laboratory cold test pit, North Boulevard Annex test pit, Idaho State University, and the Massachusetts Institute of Technology. Specific test locations are identified in this document under each technology description. The field test will include the following systems: imaging infrared interferometer, tensor magnetic gradiometer, dig face characterization, high-resolution imaging holography impulse array, real-time monitoring of transuranic dust, cooperative telerobotic retrieval, waste conveyance for buried waste retrieval, excavated waste assay, and the DC graphite arc.

This test plan defines what will be done, where field testing of each technology will be conducted, key objectives for the testing and how the objectives will be quantified, how the field testing will be executed, pretesting of field equipment, test sequencing, operational issues, test pit preparation, and contingency planning.

Individual technologies will develop operating procedures, detailing methods of testing to quantitatively or qualitatively measure the test objectives identified in this test plan.

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ACRONYMS

ANSI	American National Standards Institute
BNL	Brookhaven National Laboratory
CC	contractor coordinator
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chain of custody
DOE	U.S. Department of Energy
DOE-HQ	U.S. Department of Energy Headquarters
DOE-ID	U.S. Department of Energy Idaho Operations Office
DPM	deployment program manager
DQO	data quality objective
EM	electromagnetometer
EM	Environmental Management (DOE office)
EPA	U.S. Environmental Protection Agency
EWA	excavated waste assay
FY	Fiscal Year
GERT	General Employee Radiological Training
GPH	high-resolution imaging holographic impulse radar
GTCC	greater-than-Class C
INEL	Idaho National Engineering Laboratory
ISU	Idaho State University
LLW	low-level radioactive waste
MIT	Massachusetts Institute of Technology

MSDS	material safety data sheet
NQA	Nuclear Quality Assurance
OSHA	Occupational Safety and Health Administration
OTD	Office of Technology Development
PI	principal investigator
PM	project manager
QA	quality assurance
QC	quality control
QPP	Quality Program Plan
RCRA	Resource Conservation and Recovery Act
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
SGTV	self-guided transport vehicle
SPCC	Spill Prevention Countermeasures Control (plan)
TARG	Technical and Academic Review Group
TCLP	toxicity characteristic leaching procedure
TP&SR	Technology Preparedness and Status Report
TRU	transuranic
TTP	technical task plan
U.S.	United States
VOC	volatile organic compound

Field Test Plan Buried Waste Technologies Fiscal Year 1995

1. INTRODUCTION

The U.S. Department of Energy (DOE), Office of Technology Development (OTD), is supporting the development and demonstration, testing, and evaluation of a suite of technologies that, when integrated with commercially available baseline technologies, form a comprehensive system for the effective and efficient remediation of buried waste.

1.1 Description and Background

1.1.1 OTD Mission/Objectives

Funded by DOE, the goal of OTD is to provide innovative technologies in a timely manner for the DOE Environmental Management (EM) Office. These technologies are being developed and demonstrated to assist EM in operating and remediating the various waste sites throughout the DOE complex.

The amount of buried waste located throughout the DOE complex is estimated to be approximately 3.1 million cubic meters. The majority of the waste is located at the Hanford Site, Savannah River Site, Idaho National Engineering Laboratory (INEL), Los Alamos National Laboratory, Oak Ridge National Laboratory, and Rocky Flats Plant. The wastes are buried or stored in trenches, pits, buildings, storage pads, or other repositories.

Approximately half of all DOE buried waste was disposed of before 1970. At the time, disposal regulations permitted the commingling of various wastes, i.e., transuranic (TRU), low-level radioactive waste (LLW), and hazardous waste. As a result, much of the buried waste throughout the DOE complex is believed to be contaminated with both hazardous and radioactive materials. DOE buried waste typically includes TRU waste, LLW, hazardous waste, greater-than-Class C (GTCC) waste, mixed TRU waste, and mixed LLW. Interstitial soils are also believed to be contaminated as a result of these disposal practices. This significantly increases the potential volume of materials requiring remediation.

Waste pits at the INEL Subsurface Disposal Area (SDA) were originally excavated to the underlying basalt layer and generally backfilled with 2 to 5 ft of soil to provide a level floor. The SDA waste trenches were generally excavated to the basalt layer, approximately 10 ft down, averaged about 7 ft wide, and were up to 1,800 ft long. Following excavation, wastes were placed or dumped into the pits and trenches. From 1952-1963, waste containers were stacked to optimize disposal space. During 1963-1969, waste packages were randomly dumped into the pits and trenches to limit worker radiation exposure. In 1969, the waste containers were again stacked to optimize disposal volume. Once emplaced, the wastes were backfilled and covered with silty clay and sandy soil (soils native to the area).

Typical buried waste includes construction and demolition materials (e.g., lumber, concrete blocks, and steel plates), laboratory equipment (e.g., hoods, desks, tubing, and glassware), process equipment (e.g., heat exchangers, valves, ion exchange resins, high-efficiency particulate air filters), maintenance equipment (e.g., hand tools, cranes, oils, and greases), and decontamination materials (e.g., paper, rags, and plastic bags).

A variety of disposal containers were used and included steel drums (i.e., 30, 40, and 55 gal), cardboard cartons, and wooden boxes (i.e., up to 105 x 105 x 14 in.). Larger individual items were disposed of separately as loose trash. Degradation of the waste containers is believed to have resulted in contamination of the immediate surrounding soil.

1.2 Scope of Tests

For Fiscal Year 1995 (FY-95), OTD has funded technologies to be demonstrated during a selective retrieval field test, research and development with laboratory testing or limited field testing, paper studies or computer simulations development. This document discusses the selective retrieval field test and the technologies associated with the field testing.

The scope of the selective retrieval field test is to characterize and selectively retrieve buried waste from a simulated test pit or pits, assay portions of the retrieved waste, and transport a portion of the retrieved waste to a facility for treatment.

The pit(s) and waste to be retrieved will simulate two actual DOE sites and their real problem(s). These sites are the INEL and Brookhaven National Laboratory (BNL). The simulated INEL test pit will consist of metal and cardboard 55-gal drums filled with sludge or other solid items (simulated Rocky Flats waste), 4 x 4 x 4-ft wooden boxes (two each) filled with miscellaneous material (simulated INEL waste), and loose construction material placed throughout the pit. The BNL test pit will consist of the following items:

- 1-gal glass bottles

- Animal bones

- Large empty gas cylinders

- Fence posts (metal and wood)

- Snow fencing

- Short pieces of 2 x 4-in. lumber (12 to 24 in. long)

1.2.1 Site Preparation

Site preparation will consist of installing the North Boulevard Annex (NBA) test pit(s) and the test volatile organic compound (VOC) in the simulated INEL test pit at the NBA, preparing as necessary the INEL cold test pit for use in FY-95, obtaining boxes for temporary storage of retrieved waste, obtaining and placing fire safety and personnel protective equipment in and

around the test pit(s) as required, obtaining a hazard classification determination for the operations to be conducted, and obtaining approved National Environmental Policy Act documentation.

1.2.2 Site Characterization

Site characterization will entail surveying and collecting data on the test pit(s) using electromagnetometer (EM), magnetometer, high-resolution imaging holography impulse radar, and the VOC sensor (the VOC sensor to be used during characterization of the simulated INEL test pit only). Data collected by the EM, magnetometer, ground-penetrating radar, and holography impulse radar will be compared to the design files of the test pit(s) for verification and validation.

1.2.3 Innovative Technology Staging

During the first three quarters of FY-95, equipment to be tested at the NBA test pit will be mobilized, to the test pit, for staging. This equipment will include the waste conveyance system, gantry crane with ancillary equipment, including the vacuum system, and the dig face monitoring equipment. The zone of concern for the simulated INEL test pit will consist of a VOC contained within a leak-proof container that can be released under controlled conditions. The VOC container will be placed in the NBA test pit during construction of the test pit (for test purposes, the exact location of the VOC container will be known only by the field demonstration program manager). For field testing, the VOC will be dispensed up through the overburden to the top of the soil so that the VOC can be detected by the deployed VOC sensors.

1.2.4 Selective Retrieval

In support of the field testing, an imaging infrared interferometer, dig face characterization sensors, and a high-resolution imaging holography impulse radar, will be used to survey the NBA pit to determine the depth to the overburden/waste seam interface and to locate any VOCs. Selective retrieval will be accomplished using the following method and equipment:

The primary deployment platform will be an 80-ft gantry crane having two Z-masts, each fitted with a manipulator (Schilling arm), that work in cooperation with each other, and a 5-ton hoist running on the main beam. The Z-masts or arms will manipulate the soil sundering and vacuum system along with various retrieval end effectors to dig down to and around the "zone of concern." As necessary, the manipulators will also be used to place rigging around oversized objects encountered during the digging operation. Once rigged, the objects will be removed from the dig area by the hoist. In addition, the Z-masts will deploy the dig face characterization sensors.

The hoist will also be used to deploy the "grapple" for lifting objects out of the pit. The retrieved waste will be transported from the retrieval area by one of two methods depending on equipment availability. One method will be to place the waste directly into a dump truck and transport the waste directly to the Idaho Falls landfill. The second method will be to use the self-guided transport vehicle and place the waste in an integrated transport module for transport

out of the retrieval area. Some waste, once removed from the retrieval area, will be placed in separate containers, labeled, and transported for assay or treatment tests.

A portion of the retrieved waste will be transported to the Massachusetts Institute of Technology (MIT) in Cambridge, Mass., for treatment testing using the DC graphite arc melter. The excavated waste assay (EWA) project will add radiation sources to some of the retrieved waste to test the EWA system.

Retrieved waste transported for assay or treatment will be tracked by coding (by hand) the 4 x 4 x 8-ft conveyance waste containers and recording (in the master logbook) information about the waste (characterization data, visual data, and retrieval location information).

Once all testing has been completed, the equipment will be demobilized and the test pit(s) returned to pretest or OTD-directed conditions.

1.3 Purpose and Objectives

1.3.1 Purpose

The purpose of the FY-95 field test is to test and evaluate a suite of technologies for selective retrieval. The tests will provide insight into such issues as personnel safety, dust generation, equipment interference and interactions, and process limitations.

1.3.2 Technical Test Objectives

The establishment of test objectives are necessary to evaluate a process or technology. Test objectives may be qualitative or quantitative, but in either case, they must be specified prior to data collection. If the objectives are data quality objectives (DQOs), they require measurements with defined quality assurance requirements. These measurements then result in comparable data used by Environmental Restoration and others to evaluate a particular remedial alternative. The quality of the test data must correspond proportionately with the implications of the decisions that will be based on those data. The implementation of an appropriate test plan is required to ensure that data of known and documented quality are generated.

Following is a list of OTD test objectives for the FY-95 field test. These test objectives are obtained from and support the program objectives as documented in "Test Goals and Objectives, EGG-WTD-11112, Rev. 0." To support Environmental Restoration and BNL needs, these objectives were developed based on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) criteria. Each objective is marked as being applicable to the INEL or to the BNL or both. (INEL, BNL, BOTH)

1.3.2.1 Overall Protection of Human Health and the Environment.

Objectives

- (a) Evaluate benefits of remote operation over manual operations as determined by potential worker exposure to simulated radioactive and hazardous waste and other

hazards. Overall "benefits" will be determined by a combination factor of time workers would have been exposed to the waste and an assumption of radioactive levels that workers would have been exposed to. (BOTH)

Key Quantitative Aspects:

Two quantitative contamination (hazardous) background measurements will be made during the FY-95 field test (INEL portion only). One measurement will be for VOCs and the other will be for metallic species (rare earth surrogate). Due to the fact that the NBA field tests are to be conducted in the open air, the VOC measurement will be for information only and will be a noncritical measurement. The surrogate measurement will be conducted within an enclosure and will be validated against measurements obtained through traditional laboratory analyses. The surrogate measurement will be a critical measurement.

The time a worker or workers would spend in the retrieval area will be recorded. This measurement will be a critical measurement and will be used in conjunction with the assumed radioactive levels to determine overall expected minimum exposure to workers. Workers who would be working in other than radioactive areas (chemical, biological) would be properly protected (bubble suits, etc.). Therefore, it is assumed that remote operations would be used when additional risk factors exist (potential for explosions, etc.). It is assumed that dust generation during remote operations will be the same as manual operations. It is also assumed that mitigating procedures for lowering dust generation during either operation will be the same.

Nonkey Qualitative Aspects:

"Other hazards" will be a qualitative assessment. They will include heavy equipment hazards, falling objects, etc. These would be incidental hazards that relate to worker safety. These hazards will be recorded in the site logbook and are noncritical measurements. There are no sampling and analytical techniques associated with these "other hazards."

Note: This objective assumes that maintenance by workers would be the same regardless of the retrieval method (remote or manual operation). This will always be somewhat subjective due to operational uncertainty. Therefore, any maintenance operations during the field tests will not be recorded as exposure times.

- (b) Demonstrate the ability of the integrated system to control the generation of dust during removal of soil and waste. This will be determined by measuring the amount of dust generated during system startup, operation, and shutdown with and without contamination control (INEL).

Nonkey Qualitative Aspects:

Dust generation will be observed and recorded in the master field log as qualitative values (the qualitative observation as a "little" or a "lot" of dust generated). These measurements will be considered noncritical.

1.3.2.2 Long-Term Effectiveness and Permanence.

Objectives

- (a) Achieve 95% (by volume) removal of the zone of concern. (BOTH)

Key Quantitative Aspects:

This will be measured by determining the volume of waste removed versus the known amount of waste placed in the pit prior to the field test. These measurements will be considered critical.

DQO: Determine that 95% $\pm$ 5%, by volume, of the waste (zone of concern) has been removed from the pit.

Nonkey Quantitative Aspects:

Demonstrate the ability of the soil sundering/vacuum system to retrieve soil in a production fashion.

DQO: Determine the rate, $\pm$ 20%, that soil can be retrieved using the soil sundering/vacuum technology. The production rate will be measured and documented under two different conditions: overburden removal only and soil removal in and around the waste.

1.3.2.3 Reduction of Toxicity, Mobility, and Volume Through Treatment.

Objectives

- (a) Demonstrate that the durability/leachability of the treated waste form will pass the U.S. Environmental Protection Agency (EPA) toxicity characteristic leaching procedure (TCLP) and the American National Standards Institute (ANSI) simulated radionuclide leachability procedure. (INEL)

Key Quantitative Aspects:

TCLP is a quantitative procedure (SW-846 method 1311). The ANSI Simulated Radionuclide Leachability Procedure is also quantitative. Sampling procedures are described in section 5. These measurements will be considered critical.

DQO: Determine that treated waste passes TCLP/ANSI requirements with a 95% confidence interval.

- (b) Evaluate the volume reduction of the treated waste achieved during DC graphite arc treatment. (INEL)

Key Quantitative Aspects:

The volume of waste after treatment will be measured, and this volume will be compared to the volume of pretreated waste (this will include any secondary generated waste). Volume reduction is waste-type dependent; and for this objective, minimum reduction levels will be required. These measurements will be considered noncritical.

$$\text{Volume reduction} = (1 - [\text{volume of post treated waste} / \text{volume of pretreated waste}]) \times 100$$

DQO: Determine within +/-5%, that a volume reduction of 25% is achieved.

- (c) Determine the percentage of waste (from the zone of concern) treatable by the DC graphite arc treatment system. (INEL)

Key Quantitative Aspects:

These measurements will be considered noncritical.

DQO: Determine with a 95% confidence level that 90% of the waste is treatable.

$$\text{Percent treated} = (\text{Treated waste volume} / \text{pretreated waste volume}) \times 100$$

Key Qualitative Aspects:

Some of the larger objects treated by the system will require documentation of treatment, but volume measurements may be estimated. These measurements will be considered noncritical.

- (d) Determine the waste volume reduction achieved by the overall field tested (integrated) system. This includes change in the waste form itself as well as additional waste volume caused by auxiliary equipment and processes. (INEL)

Key Quantitative Aspects:

The volume of waste after treatment will be measured, and this volume will be compared to the volume of pretreated waste. Waste volume reduction = $(1 - [\text{volume of treated waste} / \text{volume of known waste}]) \times 100$. The volume of pretreated waste will include secondary waste. Volume reduction is waste-type dependent; and for this objective, minimum reduction levels will be required. These measurements will be considered noncritical.

DQO: Determine with a 95% confidence level that the overall field tested (integrated) system could achieve a 20% waste volume reduction.

Key Qualitative Aspects:

The volume of additional waste generated by auxiliary equipment and processes will be documented. This information will be documented in individual technology field test logs. These measurements will be considered noncritical.

1.3.2.4 Implementability.

Objectives

- (a) Determine the combined system rate for characterization and retrieval of the simulated zone of concern. (BOTH)

Key Quantitative Aspects:

Determine the volume of waste characterized and retrieved per unit of time. This will be measured over several time intervals to determine average rate. These measurements will be considered critical.

DQO: Determine rate of characterization and retrieval (yd³ per 8-hour shift) with a 95% confidence level for the overall field tested (integrated) system.

- (b) Determine the performance and reliability of the instrumentation (field sensors) deployed as part of the FY-95 field testing. (BOTH)

Key Quantitative Aspects:

Determine the lower levels of detection and the precision and accuracy that the real-time dust monitor achieved during the field tests. These measurements will be considered critical.

DQO: Determine metallic species in the 0.1–100 ppm concentration ranges and particle sizes in the 0.4–10.0 micron size ranges with a field accuracy that is +/-30% of measurements obtained through traditional laboratory analyses.

Determine the lower levels of detection and the precision and accuracy that the EWA system can achieve during the field testing. These measurements will be considered critical.

DQO: Determine that the EWA system can detect 10 nCi/gm of ²³⁹Pu using the gamma screen (sodium-iodide array) system. The source to be detected will be in 5 in. of uniform INEL soil. The count time will not exceed 100 seconds and the signal-to-noise ratio will be at least 40 to 1. Quantify, with the gamma assay system

(Germanium detector array), that a ^{239}Pu source in 5 in. of uniform INEL soil is less than 100 nCi/gm $\pm 30\%$, with a count time not to exceed 2,150 seconds

DQO: Determine that the full EWA system (x-ray, gamma screen, and gamma assay) can locate a 10 nCi/gm ^{239}Pu source, in 5 in. of INEL soil, with an accuracy of ± 1 in.

Key Qualitative Aspects:

Using the high-resolution imaging holographic impulse radar (GPH), measure the depth of soil overburden to waste object(s). These measurements will be considered critical.

DQO: Measure the depth to, orientation of, and size of any buried object in the NBA test pit. This determination will be made from images generated by the GPH system. These images will be visually compared to the known depth, orientation, and size of the actual waste as detailed in the pit design files. Accuracy will be defined as "best you can obtain."

Determine the presence of the test VOC in the test pit area. The VOC of concern will be isopropyl alcohol. These measurements will be considered critical.

Present, as an image, the orientation, shape, and size of the buried waste using the GPH system.

DQO: Measure the presents of the test VOC in the test pit area. This measurement will be a quantitative (detect or not detect) measurement of the presents of the VOC above background level.

- (c) Determine the maneuverability limitations of each piece of equipment based on other equipment, or other objects that may be set aside. Determine the space requirements for implementation of the overall field tested system. (INEL)

Key Quantitative Aspects:

Demonstrate that the crane and manipulators can be moved in space in a controlled manner, and determine the precision, accuracy, and repeatability of the movements to a location in space with and without a load. These measurements will be considered critical.

DQO: Determine with a 95% confidence level that for any target movement, the variation from expected position in the x, y, and z local coordinate system is no greater than ± 1 in. along each axis both with and without a load.

Determine the precision and accuracy of the navigation system on the self-guided transport vehicle (SGTV). These measurements will be considered critical.

Determine the cycle times to perform specific tasks (time to travel between loading and unloading points, and the time to load and unload the SGTV). These measurements will be considered critical.

Key Qualitative Aspects:

Evaluate the human machine interface. Demonstrate the effectiveness, capacity, and limitations of the SGTV control system. These measurements will be considered noncritical.

Nonkey Quantitative Aspects:

Demonstrate the ability of the system to move in the x, y1, y2, y3, z1, z2, and z3 directions at four speeds (100, 75, 50, and 25% of capacity). These measurements will be considered critical.

DQO: Determine the commanded versus actual speed of movements in the x, y1, y2, y3, z1, z2, and z3 directions in ft/min, +10% -50%.

Determine the operating envelope of the SGTV (turning radius, etc.). Establish a probable rate of waste conveyance using the SGTV. These measurements will be considered noncritical.

Nonkey Qualitative Aspects:

Time to maneuver around objects. Observation and recording of overall problems associated with maneuverability. Video clarity. Recording the number of collisions. Determining the size of enclosure required to cover the equipment and area of operations. These measurements will be considered noncritical.

- (d) Determine the ability to construct, procure, and/or fabricate the overall field tested system. Evaluate incompatibilities among components in the system. (BOTH)

Nonkey Qualitative Aspects:

Document the number of vendors required to obtain components. Document the lead-time required to obtain various components. Estimate time to fabricate system. Estimate time required to fabricate nonstandard items. These measurements will be considered noncritical.

- (e) Document system and system component failures. (BOTH)

Nonkey Qualitative Aspects:

Record system failures and make engineering judgment concerning overall effects of failures. These measurements will be considered noncritical.

- (f) Document the number of glass bottles that break during the retrieval operation. (BNL)

Key Quantitative Aspects:

Record the number of bottles that brake while being retrieved from the BNL simulated waste pit. Breakage could happen during the digging and vacuum operation, during the actual retrieval of the bottle from the pit, or during transport of the bottle away from the pit. Actions that occurred prior to the breakage will also be recorded. These measurements will be considered critical.

- (g) Document the ability of the retrieval system to handle the bottles. (BNL)

Key Qualitative Aspects:

Observe and document the ability of the system (vacuum, Schilling arms, etc.) to manipulate bottles retrieved from the BNL simulated waste pit. These measurements will be considered critical.

- (h) Document the ability of the retrieval system to handle other objects as they are retrieved from the BNL simulated waste pit. (BNL)

Key Qualitative Aspects:

Observe and document the ability of the system (vacuum, Schilling arms, etc.) to manipulate other items (small cans, 5-gal cans, fence posts, gas cylinders, etc.) retrieved from the BNL simulated waste pit. Also, observe and document the ability of the system to retrieve moist (wet) sand from the pit due to liquid spillage (broken bottle). These measurements will be considered critical.

- (i) Demonstrate a method of transporting the waste away from the BNL simulated waste pit. (BOTH)

Nonkey Qualitative Aspects:

Observe and document the ability of the SGTV to safely transport the bottles and other items away from the simulated BNL waste pit. These measurements will be considered noncritical.

1.3.2.5 Cost.

- (a) Establish a cost baseline for the overall field tested system that includes capital, operating, and maintenance costs. (BOTH)

Key Quantitative Aspects:

Cost items include site and facility preparation costs, permitting and regulatory costs, equipment costs, startup and fixed costs, labor costs, supply costs, consumable costs, effluent treatment and disposal costs, residuals and waste shipping, handling, and transport costs, analytical costs, facility modification, repair, and replacement costs, demobilization costs. Cost estimates are assumed to vary by +50% and -30%. These measurements will be considered critical.

1.3.2.6 Lessons Learned.

Objective

- (a) Determine shortcomings and lessons learned from integrated system tests. (BOTH)

Nonkey Qualitative Aspects:

OTD has identified that the FY-95 field tests will have certain technology gaps. These gaps are not being pursued by OTD at this time because either (a) the technology is considered standard, existing, or off-the-shelf, (b) another program is pursuing technology development for that activity, or (c) OTD has demonstrated the technology during previous field tests. These gaps will be fully documented in the Field Test Evaluation Report. A discussion of how these gaps affected the objectives given above will also be provided. These measurements will be considered noncritical.

1.4 Technology Agreement

The technology agreements with OTD include the technical task plans (TTPs) (Table 1).

Table 1. Technical task plans (TTPs).

ID1-4-20-03	Imaging infrared interferometer
AL9-1-12-01	Nonintrusive sensing of environmentally important objects and spec (tensor magnetic gradiometer)
ID1-4-20-02	Real-time monitoring of transuranic-contaminated dust
ID1-3-20-22	3-D dynamic graphic simulation of retrieval configuration options
ID1-4-20-09	Cooperative telerobotic retrieval
RL3-4-20-02	High-resolution imaging of buried waste using holographic impulse
RL3-2-12-11	Graphite DC arc plasma
ID1-4-20-15	EWA
ID1-5-10-05	Hot-spot retrieval/conveyance demonstration

1.5 Needs Satisfied

The result of the integrated field test is the development of a multitude of technologies for effective and efficient remediation of buried waste throughout the DOE complex. OTD evaluates, demonstrates, and validates technologies and transfers this information and equipment to DOE and private industry to support remediation planning and implementation. This integrated field test meets Environmental Restoration and Waste Management needs for the following DOE sites: DOE-AL, DOE-CH, DOE-FN, DOE-ID, DOE-NV, DOE-OR, DOE-RF, DOE-RL, DOE-SF, and DOE-SR.

2. ORGANIZATION AND RESPONSIBILITIES

2.1 Organizational Chart

The Work Breakdown Structure for FY-95 field testing is shown in Figure 1. The organization chart is shown in Figure 2.

2.2 Description of Organizations

2.2.1 Management/Deployment

The DOE OTD effort focuses resources through core areas that are technology- and problem-specific. OTD has established Program Planning Groups and Technical Support Groups to improve strategic planning efforts and technical integrity.

A Program Planning Group has been structured to include representatives of the Environmental Restoration Programs at DOE sites with significant amounts of buried waste and a representative from the EPA, Region 10. This group reports directly to the DOE Headquarters (DOE-HQ) program manager and provides input to the field office through the program manager.

The contractor's office has also established an independent Technical and Academic Review Group (TARG) comprising experts from specific technical areas pertinent to OTD. The members are drawn from organizations throughout private industry and the academic community. TARGs provide the technical expertise to review and evaluate technologies sponsored by OTD. The TARG provides an independent technical evaluation of OTD-sponsored technologies.

Systematic communication between OTD and the INEL Buried Waste Program and development of the systems analysis process have been instituted to ensure that technology gaps are identified, appropriate technology demonstrations are funded, and technology transfer is facilitated.

Formal and informal communication has been established between the INEL project office and principal investigators (PIs). Formal communications include weekly and monthly reports and semiannual technical review meetings.

2.2.1.1 Contractor Coordinator. The contractor coordinator (CC) functions as the focal point for all contacts and correspondence relative to INEL activities. The CC is responsible for ensuring that the OTD programmatic objectives are achieved by recommending technologies and projects to DOE-HQ through DOE-ID. The CC oversees technology evaluations and programmatic direction with the assistance of the Technical Support Groups and TARGs. The CC also functions as the principal interface with other OTD-sponsored programs. Kevin Kostelnik is the CC.

Figure 1. Work Breakdown Structure.

Figure 2. INEL organization.

2.2.1.2 Deployment Program Manager. The deployment program manager (DPM) is responsible for coordinating all required activities for INEL-sponsored field tests. The DPM is responsible for monitoring technical progress, cost, and schedule performance of all participating organizations in accordance with established TTPs. The DPM reports to the CC on programmatic progress, makes recommendations affecting budgets and schedules, and suggests corrective actions as appropriate. The DPM is responsible for assessment of project risk and contingency planning that identifies critical systems, subsystems, and other areas requiring focused analysis and resolution. Risks appear in technical, schedule and cost, quality, environmental, health, safety, regulatory, and utility areas. It is the responsibility of the DPM to ensure that authority is clearly delegated and that accountability for performance is established. The DPM is Bob Heard.

2.2.1.3 Systems Coordinator. The systems research and development program manager (R&DPM) is responsible for coordinating all INEL research and development systems integration and planning. The R&DPM directly supports the CC. The R&DPM is responsible for ensuring that all technology integration opportunities are explored and that all customer needs are well defined and satisfied.

2.2.1.4 Deployment Project/Cost Account Managers. The deployment project/cost account managers directly support the DPM to ensure that all tests are conducted in accordance with this approved test plan and in compliance with all applicable regulations. The deployment project/cost account managers are the focal point for all participating organizations who demonstrate OTD technologies at the INEL. The project/cost account managers are also responsible for ensuring project compliance with DOE and management and operation contractor requirements, orders, and directives. The project/cost account managers must develop and maintain the baseline for the individual TTPs, ensure the TTPs maintain cost, schedule, and scope objectives, and ensure all sponsored work maintains rigor and technical integrity. The project/cost account managers are responsible for providing weekly and monthly reports to OTD on their individual TTPs.

2.2.1.5 Field Engineer. During field testing, a designated representative shall be present while equipment is operating. The field engineer has the responsibility to monitor and shut down operations, if necessary. The field engineer shall observe all operations at the test pit to ensure that the operations do not endanger the safety of any worker or the environment. The field engineer shall also receive copies of all data and logbooks and is responsible for ensuring that these data are properly transmitted to the office database manager to be scanned into the system. The field engineer supports the deployment program manager. The lead field engineer for INEL tests is Larry Watson.

2.2.2 Principal Investigators

2.2.2.1 Principal Investigators. The principal investigators (PIs) are technology developers from throughout the DOE complex, industry, and academia developing and demonstrating technologies in support of OTD. The PIs are responsible for ensuring that the performance of technical work is of the highest quality and that it is consistent with approved work packages. The PIs are responsible for ensuring industry involvement in the technologies

development process. The PIs will drive the technology transfer process to ensure the technologies are implemented and commercialized.

2.2.3 Interface Agreements

An approved Radioactive Waste Management Complex (RWMC) and NBA interface agreement document has been put in place. The document addresses the purpose and scope of the agreement, the building manager system, boundaries of responsibility, operational responsibility and authority, surveillance requirements, quality standards, occurrence reporting, emergency preparedness, environmental protection, safety compliance, budget, contact points, and document control. Support for laborers and equipment operators will be managed, following standard company procedures, by field engineers as required.

2.2.4 Sample Analysis Personnel

An agreement with the INEL ICP Mass Spectrometry Laboratory will be issued for analysis of any dust and rare earth samples taken during the FY-95 field tests.

2.3 Personnel Support

The following support services will be needed during the field test and will be contracted following standard company procedures. The support required includes laborers, equipment operators, heavy equipment operators, crafts personnel, industrial hygienists, safety engineers, quality engineers, environmental personnel, statisticians, and photographers. Any specialized support required by individual technologies will be identified and contracted by that technology.

2.4 Organizational Responsibilities

The DPM is responsible for all activities at either the INEL cold test pit or NBA test pit. The necessary infrastructure will be provided to ensure safe and successful field tests at the test pits. This infrastructure will be developed through internal means or by subcontract. It is the responsibility of every person or organization conducting testing and demonstration at either of the test pits to know and abide by all requirements established.

2.5 Qualifications and Training

2.5.1 Training Responsibilities and Requirements

The Waste Management Operational Support Group has established training requirements and training responsibilities for the RWMC and subcontractor personnel. Minimum requirements, training quality, and general guidance are defined in *Training Requirements and Responsibilities for the Buried Waste Integrated Demonstration at the Radioactive Waste Management Complex*, EGG-WTD-10400. The report contains a personnel training matrix that specifies training to satisfy Federal requirements.

The deployment team and the field test PI are responsible for scheduling and coordinating training well before it is needed to avoid unnecessary field test delays. PIs are responsible for providing and or obtaining training specific to their technology prior to field testing. Individual project funds will bear the costs of any required training for project and subcontractor personnel. Adequacy and appropriateness of the training will be confirmed by the trainer and the project manager (PM).

2.5.2 Access Orientation Training and Facility-Specific Training.

Access orientation training and facility-specific training will be required for testing at the NBA test pit or the INEL cold test pit. Access orientation training for access to the RWMC will be provided by the RWMC Training and Emergency Action Training Unit. Access orientation training includes an introduction to the area to be accessed and optional training in the areas of radiological health and safety, industrial safety and hygiene, emergency preparedness, security program, and unescorted access.

3. DESCRIPTION OF TESTS

3.1 Technology Descriptions

The technologies funded by OTD in FY-95 for the field test(s) are described below. These technologies include imaging infrared interferometer, tensor magnetic gradiometer, dig face characterization, high-resolution imaging of buried waste using holographic impulse radar, real-time monitoring of TRU dust, cooperative telerobotic retrieval, waste conveyance for buried waste retrieval, EWA, and DC graphite arc.

3.1.1 Imaging Infrared Interferometer

Open-path Fourier transform infrared spectrometers can monitor for VOCs and toxic gases. To provide real-time imaging, a standoff system will be developed using a real-time passive infrared imaging interferometer. The interferometer has mirror spacing comparable to the desired transmission wavelength such that continuous images of the field of view are produced with high sensitivity. A computer controls the mirror spacings, alignment, and processing of the infrared images. This approach will allow multispectral imaging of a 15-degree field of view over a 3-5 micrometer and 8-12 micrometer spectral range. The system has been enhanced specifically to monitor volatiles and offgas contaminants from a waste remediation site.

3.1.2 Tensor Magnetic Gradiometer

The tensor magnetic gradiometer will nonintrusively acquire and reduce tensor magnetic data from a waste site in order to perform a site characterization. The system consists of an eight-element magnetometer/gradiometer and supporting software. This technology is expected to offer significant improvements in sensitivity compared with existing instrumentation for nonintrusive characterization of buried waste.

3.1.3 Dig Face Characterization

The dig face characterization system will deploy a suite of sensors to allow intermittent surveillance and screening of a dig face, to characterize remaining waste, and allow for the subsequent application of appropriate remediation equipment to maintain safety and environmental standards. The dig face system will have available for deployment the following type of sensors: radiation, VOC, and geophysical. Actual deployment and testing of the radiation (gamma-neutron) sensor has been conducted at the RWMC (per INEL-95/0171, *Test Plan for a Live Drum Survey Using the Gamma-Neutron Mapper*). Results from these tests will be included in the final FY-95 field test evaluation report.

3.1.4 High-Resolution Imaging of Buried Waste Using Holographic Impulse Radar

The ground-penetrating holographic impulse radar system consists of a 1-m linear array of tapered slot antennae, high-speed switching network, and relatively low-power impulse source operating over a large frequency bandwidth (approximately 2.5 to 7 GHz). The bistatic array system is scanned above the surface, gathers the subsurface target data, and processes the

three-dimensional holographic images in real time. Image length is continuous as the sensor moves across the terrain with the array mounted perpendicular to the scan direction.

3.1.5 Real-Time Monitoring of TRU Dust

Contaminated dust will be monitored with the real-time dust monitor, which is an in situ monitor that can analyze single dust particles and give instantaneous readout. In the device, the optically based measurement techniques of laser-particle scattering and laser-induced breakdown spectroscopy are used to establish particle size, number density, and mass and species of heavy metals.

3.1.6 Cooperative Telerobotic Retrieval

A telerobotic gantry crane will be used during the FY-95 full-scale field test to transport and deploy the robotic manipulators in tandem activities to remove debris around the object and to retrieve the object for subsequent treatment. In addition, a remotely operated ultrasonic cutter and vacuum system will also be deployed to remove soil and debris and carefully clean around buried objects. A control system will be developed to coordinate activities, including required number of motions, the motion of the manipulators, and the operation of the cutting vacuum system. FY-95 activities include demonstrating the ability to deploy the dig face characterization system as well as to perform selective retrieval.

3.1.7 Waste Conveyance for Buried Waste Retrieval

An SGTV developed to allow automated transfer of retrieved waste from the dig face to the processing and packaging area will be tested in FY-95. This technology is being deployed to demonstrate automated waste transport. The SGTV is designed to be amenable to a variety of terrains and hazardous environments.

3.1.8 EWA

This technology involves using a passive gamma-ray spectroscopy system to assay excavated and treated waste material for TRU content. The system measurements will be made by four subsystems designed to optimize the system's capabilities and throughput. The real-time radiograph subsystem determines the average attenuation coefficient, while a very high-sensitivity gross count gamma scanner determines gamma activity. A high-energy-resolution gamma ray spectroscopy system identifies and quantifies TRU waste.

3.1.9 DC Graphite Arc

A portion of the retrieved waste will be sent, for treatment, to the DC graphite arc at MIT. The Mark II furnace is a refractory-lined, carbon steel vessel measuring 23 ft high and 7 ft in diameter, with four soft patch panels around the circumference to provide access for waste feed, glass discharge, and diagnostic equipment. The furnace is designed for semiremote operation, alpha containment, and ability to process at 1-MV-A power giving up to a 1.5 ton/hr processing rate.

The electrode assembly has a unique coaxial arrangement. The outer graphite electrode is 14 in. in outer diameter and 10 in. in inner diameter. The inner electrode is a solid 6-in. piece of graphite. The electrode assembly can be operated in the transferred arc mode or the nontransferred arc mode (arc between parts of the electrode).

3.2 Uncertainty Analyses

An uncertainty analysis will be performed for all measurements and tests relating to the field system performance tests as documented in this document.

The performance of the measurement systems must be evaluated. These uncertainties will be analyzed on the subsystem level through applicable test procedures. Two quantitative performance characteristics of a measurement system are precision and accuracy. These characteristics will be determined for each subsystem either experimentally or by engineering judgment.

The subsystem precision and accuracy of the measurement systems will be estimated from test measurements, and both a best estimate and a 95% confidence level will be given for the precision and for the accuracy. In the event that a particular test is invalid for some reason or the data are lost, best engineering judgment will be used to determine precision and accuracy of the measurement system(s). This will be documented in the final report(s).

3.3 Contingency Plans

Following are the details of contingency currently planned for the field test(s).

Tests will be discontinued in the event of an equipment failure or an accident or emergency at the testing site. The DPM or designee will evaluate the situation to determine the most appropriate method to meet the test objectives.

In the event that testing deviates from this test plan or individual test procedures, the DPM or designee will determine the appropriate course of action. Guidelines for the appropriate course of action are as follows:

If changes to this test plan or individual test procedures do not affect the test objectives or DQOs, then this test plan or individual test procedure(s) will be redlined in the field and initialed by the DPM or designee, the relevant PM(s), and the relevant PI(s). This assumes that the change only affects a single technology.

If changes to this test plan or individual test procedures do not affect the test objectives and or DQOs but will affect other technologies or their test procedures, then the DPM will convene a meeting of all parties affected and lead the team to a resolution of the change. After the resolution is documented and approved by the DPM, this test plan and the effected test procedures will be redlined.

If changes to this test plan or individual test procedures affect the test objectives and or DQOs, then the change must be approved by the Office Change Control Board. This change control board will consist of the following personnel or organizations: CC and DPM, DOE-ID, INEL EM-40.

Each technology demonstrating at either the INEL cold test pit or the NBA test pit shall provide sufficient spare parts to provide for most repairs for cases of equipment failure.

In the event of radio frequency interference, the technology being tested will be identified and analyzed by the DPM and the technology PI to see if the frequencies causing interference can be removed from the area or shielded from the activities.

In the event of prolonged testing, schedule issues may arise. If this should occur, the CC, DPM, DOE-ID program manager, and DOE-HQ program manager will decide how activities should proceed. Options may include deleting certain tests, stretching the schedule to accommodate all tests, or rearranging tests so that some may occur in parallel (which may compromise some test objectives).

4. SEQUENCE OF ACTIVITIES

Figure 3 shows the integrated field test schedule. Note that the individual project schedules are documented in the FY-95 draft TTPs. Figure 4 shows the sequence of activities to accomplish selective retrieval during FY-95.

Figure 3. FY-95 integrated field test schedule.

Figure 4. Logic sequence diagram for zone-of-concern removal.

5. SAMPLING AND DATA

5.1 Sampling Strategy

The primary objective of a sampling strategy is to collect samples in a manner that accurately and precisely characterizes the properties of the pit, the treated waste, and the removed waste. Part of the sampling and data collection is to appropriately document the activities.

Each of the critical measurements for the FY-95 field test requires that representative samples be obtained. This means that appropriate sampling methods must be used and that a statistically significant sample size must be obtained. Sampling methods for each technology are contained within their respective test procedures (Appendix A).

Time will be kept with stop watches. Time should be recorded for all activities to the nearest minute.

Samples for leachability tests will be obtained from the appropriate treated waste. Several samples will be obtained from each test (at least three) to ensure a representative sample has been collected. Each sample will be analyzed separately and stored in a contamination-free area.

The volume of items (objects) will be obtained in two fashions. For large objects, measurements will be made using a surveyors tape (or other appropriately calibrated measure). Height, width, and depth measurements will be taken and the volume will be estimated. It is expected that accuracy of these measurements will be no better than about 20%, particularly for objects that require an estimation of dead space. For smaller items, measurements will be made by placing the appropriate objects in standardized boxes (e.g., 4 x 4 x 8 ft) and measuring the volume contained within the box. No attempt will be made to "stage" a box, and objects will be placed in each box randomly. Accuracy of this measurement will probably be no better than 25%.

All other measurement parameters discussed as part of the project objectives will be documented as described in the individual technology test procedures (Appendix A).

5.2 Sample Preservation and Holding Time

For independent VOC analysis, samples should be stored at 4°C and analyzed within 14 days.

Samples for TCLP analyses require no special storage or holding time.

5.3 Sample Identification

All samples will be given a unique sample identification number, which will identify its sample media type, the date and site where collected, and the sample type (regular, blank, duplicate, etc.). This information will facilitate data manipulation.

5.4 Sample Custody

The possession of samples shall be traceable beginning at the time samples are collected. This will be accomplished through chain-of-custody (COC) procedures. COC forms will accompany the sample shipment and will be shipped in the appropriate shipping container. Copies of the completed COC form will be included in appropriate data validation packages.

A sample is said to be under custody if:

- It is in an individual's physical possession
- It is in the individual's view, after being in his/her possession
- It was in the individual's physical possession and he/she secured it to prevent tampering
- It is placed in a designated secure area.

6. DOCUMENT CONTROL

6.1 Data Management

Each of the technologies being tested will have its own data management system. However, the CC office maintains a file for all data, logbooks, and reports. Each PM is responsible for ensuring that all data taken, lab notebooks, and field logbooks (onsite and offsite) are copied and supplied to the CC office.

6.1.1 Reports

To ensure that the technologies provide useful data, the CC office has issued the following documents:

- *Technology Preparedness and Status Report Guidance*, EGG-WTD-10266, Rev. 1
- *Test Goals and Objectives*, EGG-WTD-11112, Rev. 0
- *Test Plan Guidance*, EGG-WTD-9800, Rev. 1
- *Technology Evaluation Report Guidance*, EGG-WTD-10104, Rev. 2.

To ensure that the field test results are reported to interested parties, the following methods of data reporting will be used:

- **Technology Evaluation Report** — The data generated by the field test, as well as information on the planning and deployment of tests, will be assembled and documented in a Technology Evaluation Report. The Technology Evaluation Report will summarize the tests, test results, and lessons learned, and will provide recommendations for further development. An overall Technology Evaluation Report for the FY-95 field test will be developed with input from each field-tested technology.
- **Publications** — Information on the field tests and results may be submitted for publication to waste management or environmental restoration journals, conferences, and meetings. This is the responsibility of the individual technology PIs.

6.1.2 Video

Video recordings of each technology will be made. These videos will be delivered to the CC office for editing and use as required.

6.2 Test Plan Changes

Change requests to this plan or test procedures may be initiated by management or the involved PMs or PIs. There will be two levels of changes as follows:

Level 1 changes are changes to the configuration of this plan that will nullify previously performed verification and validation efforts. Simply stated, such a change would raise uncertainty as to whether the same test results would be achieved if the test were repeated. Level 1 change requests must be clearly documented. The documentation must specify the reasons for the change, the current condition, the proposed condition following the change, an explanation of the increased/decreased benefits versus the increased/decreased costs, and any secondary changes that will be necessary as a result of the primary change. Level 1 change requests will be reviewed and approved by the affected PI, PM, DPM and CC. Reviews and approvals will be clearly documented. Level 1 changes will require revalidation of the system for testing. Implementation of Level 1 changes and the revalidation of the system for testing will be under the direction of the DPM or designee.

Level 2 changes are those changes to the configuration of this plan that will not nullify the verification and validation achieved during testing. Simply stated, such a change would not raise uncertainty as to whether the same test results would be achieved if the test were repeated. Level 2 changes shall be clearly documented by redlining the test plan or procedures to match the procedure actually followed, initialing the change, and recording the changes in the field logbook. The change shall be recorded and implemented by the PI in accordance with this test plan. The PM and DPM shall approve the change. Level 2 changes will not require revalidation of the system before continuation of testing.

6.3 Project Logbooks

The program shall maintain an overall master field test logbook. This master logbook chronicles all field investigation activities, but does not have the same level of detail as the individual technology logbook(s). It delineates conditions and activities occurring on a given day and references the appropriate technology logbook(s) and forms for specific information. The master logbook is also used to record all field observations along with supporting rationale.

The DPM, or designee, is responsible for completing the master project logbook. Each logbook (master and technology) must be signed and dated by the individual making the entries at the end of each day's entry. Pages will not be removed from the logbooks. All partially used pages must be lined out to prevent data entry at a later date.

The front cover or first page of any logbook(s) must list the project name, number, and dates of use. The following items are to be included, as appropriate, in the master logbook:

- Date
- Weather conditions
- List of all participating technologies
- Reference to any other field logbooks
- Descriptions of site setup

- Field changes or variances
- COC details
- Record of events as specified by the objectives
- Record of quality assurance (QA) problems and corrective actions.

Field logbooks will be used for all participating technologies. Entries in these logbooks will be made as required and are used to detail specific observations for technology-specific test objectives.

6.4 Other Documents

Copies of all test documentation, equipment specifications, or drawings that document the technology configuration during testing will be provided to the CC office.

7. ANALYTICAL METHODS

The selection of appropriate methods to prepare and analyze samples is based on the specific analyses of interest, the sample matrix, and the minimum detectable concentrations needed to verify the technology and meet the test objectives. The references used are:

1. *Test Methods for Evaluating Solid Waste, Volumes 1A-1C: Laboratory Manual, Physical/Chemical Methods*, SW-846, Third Edition, Office of Solid Waste, EPA, Document Control No. 955-001-000000-1, 1992.
2. *American National Standard Measurement of the Leachability of Solidified Low-Level Radioactive Wastes by a Short-Term Test Procedure*, ANSI/ANS-16.1, 1986.

Summarized below are appropriate test methods:

- Leachability by ANSI/ANS-16.1, 1986

This method provides a limited leach test procedure to measure the release of radionuclides or radionuclide tracers from waste forms by leaching at ambient temperatures. It is intended for solidified low-level radioactive waste. The procedure permits accumulation of sufficient data for the determination of a material parameter in short times (days and months) using leach test specimens with simple shapes and finite dimensions. This parameter is used to characterize the leaching of a specific radioactive species from the waste form and is called the "Leachability Index." Discussions of the interpretation and limitations of this index are included in the procedure.

- Leachability by TCLP SW-846, Method 1312

This method provides a leach test to measure the release of metals and specified organics from a solidified mass. It is intended to measure release of contaminants to determine if a waste is suitable for landfill disposal. The procedure uses a weak acid that contacts the waste while tumbling, and the subsequent leachate is analyzed for appropriate analyses. Specific contaminant levels are included in the procedure, indicating acceptable levels for landfill disposal.

8. DATA REDUCTION, VALIDATION, AND VERIFICATION

For data to be scientifically valid, technically defensible, and comparable, valid equations and procedures must be used to prepare it. The following sections describe data reduction, validation, and reporting procedures to be used for field and laboratory data. Specific equations required to bring the data from its raw form to reportable figures are often included as part of the specific collection or analytical method being used. In addition, specific determinations for statistical significance can be included when a test design, including the number of samples and associated confidence level, has been determined.

8.1 Data Reduction

All manual data reduction will be completed as specified in the individual test procedure(s) (Appendix A). Where data reduction is not computerized, calculations will be performed in permanently bound notebooks or on preprinted data reduction pages. The data reduction for some analyses may include analyst interpretations of the raw data and manual calculations. When this is required, the analyst interpretations will be written in ink on the raw data sheets. Any corrections made will be documented as necessary.

8.2 Data Validation

Data validation begins with the analyst or data collector and continues until the data are reported. The individual analysts will sign the appropriate data forms to verify the completeness and correctness of data acquisition and reduction. The laboratory supervisor or the data reduction staff will then review computer and manual data reduction results and will inspect laboratory notebooks and data sheets. These actions will be taken to verify data reduction correctness and completeness and to ensure adherence to the specified analytical method protocols. Laboratory, calibration, and quality control (QC) data will be examined by the individual analysts and the laboratory supervisor or the data reduction staff to verify that all instrument systems are in control and that QA objectives for precision, accuracy, completeness, and method are being met.

The principal criteria that will be used to validate the integrity of data during collection and reporting are as follows:

- Verification by the analyst that all raw data generated for the project have been stored on magnetic tape, disk, and/or on hard copy and that storage locations have been documented
- Examination of the data by the laboratory coordinator or data reduction personnel to verify adequacy of data and proper documentation
- Reporting of all associated blank, standard, and QC data, along with results from analysis of each batch of samples.

Should QC data be outside control limits for precision or accuracy, the laboratory supervisor will investigate the potential cause(s) of the problem. The data will be flagged with the appropriate data qualifier.

8.3 Reporting

Data will be reported in standard units, as described in the QA objective section (9.1). In addition to presenting the analytical or field results or QC data, the evaluation report will provide details regarding any necessary deviations from established protocols. Analytical data will be reported on an "as-received" basis for all samples. Analytical data will be presented in standard units, as specified by the analytical methods.

9. QUALITY ASSURANCE

All project activities shall be in accordance with the Quality Program Plan (QPP), QPP-44. All activities for this project will be Quality Level B. The QPP has been implemented and maintained, consistent with the *Lockheed Martin Idaho Technologies Quality Manual*, the intent of DOE Order 5700.6C on quality assurance, ANSI/American Society of Mechanical Engineers Nuclear Quality Assurance (NQA-1), EPA Office of Solid Waste and Emergency Response Directive 9902.3, and Quality Assurance Management Staff-005/80, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*.

9.1 Data Quality Objectives (DQOs)

Table 2 includes the QA requirements of precision, accuracy, and completeness for each of the critical measurements.

Table 2. QA requirements for critical measurements.^a

Measurement parameter	Matrix	Precision	Accuracy
Time (minutes)	N/A	2%	+/-2%
Volume (cubic feet)	N/A	5%	+/-5%

a. The completeness objective will be 95%, unless there is a specified reason that fewer samples need to be obtained. A statistical evaluation for the determination of completeness and the number of samples needed will be performed and documented in the individual technology test procedure(s).

9.2 Internal Quality Control Checks

Internal quality control checks will be performed during and after testing. These include reviewing completeness and accuracy of the logbooks, executing performance and system audits, and checking to ensure that the established procedures are being followed.

9.3 Performance and System Audits

Performance audits are conducted to quantitatively evaluate the outputs of a measurements system. System audits are conducted to qualitatively evaluate the operational details of a QA program. These audits will be conducted internally by the deployment QA support member.

A system audit to verify that the instrument(s) are operating within expected parameters will be completed before and after the field test(s) by the respective PI. This information will be documented in the PI's logbook.

Technology assessments are performed by the deployment team for all field tests. Technology assessments entail reviewing the project's test procedure, equipment, and instrumentation readiness for testing.

10. EQUIPMENT AND INSTRUMENTS

After approval of the TTPs, the PIs or PMs submit a draft Technology Preparedness and Status Report (TP&SR) and a Preparedness Checklist and Action Plan for review by the deployment team and others. The deployment team consists of support staff with expertise in the areas of facility and operational planning, environmental compliance, safety, health, and quality. Information in the TP&SRs and from interviews conducted with the PIs and PMs is used to establish the deployment support necessary for technology field testing.

A variety of equipment and instruments will be required to perform the field test(s). This includes the instruments and equipment for imaging infrared interferometer, tensor magnetic gradiometer, dig face characterization, high-resolution imaging of buried waste using holographic impulse radar, real-time monitoring of transuranic (TRU) dust, cooperative telerobotic retrieval, waste conveyance for buried waste retrieval, EWA, and DC graphite arc. Each testing technology will supply its specifically needed equipment and instrumentation. The deployment team will supply any commonly needed equipment. Individual technology test procedures will contain specific information on equipment and instrumentation calibration requirements, accuracy and precision, maintenance, and other important factors. Each of these pieces of equipment and instruments are discussed below.

Of concern is radio frequency interference during testing. A number of communication links are planned for the FY-95 field test (Table 3).

Table 3. Communication links planned for the FY-95 field test.

Project/subsystem	Communication links
Imaging infrared interferometer	Tethered
Tensor magnetic gradiometer	Manual—not remote
Dig face characterization	2.4-2.83 GHz Spread Spectrum
High-resolution imaging radar array	Tethered
Real-time monitoring of TRU dust	Tethered
Cooperative telerobotic retrieval	Tethered
Waste conveyance	Emergency Stop—Digital FM 150 MHz at 500 mW; Telemetry—spread spectrum 902-928 MHz at 500 mW; Television—TBD broadcast VHF or UHF

10.1 Imaging Infrared Interferometer

This is a standalone instrumentation and will not require any interfacing equipment to other technologies.

10.2 Tensor Magnetic Gradiometer

This is a standalone instrumentation and will not require any interfacing equipment to other technologies.

10.3 Dig Face Characterization

The dig face characterization equipment will consist of sensing devices that can be remotely mounted to the gantry crane. These sensing devices will be deployed from the gantry crane Z-mast(s). The sensors will consist of an electromagnetic device for detection of metals, a magnetometer for the detection of ferrous metals, and a sensor for VOCs. Other sensors may be deployed depending on budget and schedule. A key element of the dig face characterization system is the ability to define spatially where the sensor is, based on a 3-D coordinate system.

10.4 High-Resolution Imaging of Buried Waste Using Holographic Impulse Radar

The electromagnetic array holography equipment will consist of a single sensing device (antenna). This sensing device will be deployed by the Z-mast on the gantry crane. The sensor will need a power cable routed to it as well as a control/data acquisition cable.

10.5 Real-Time Monitoring of TRU Dust

Following is an equipment list for monitoring TRU dust. In addition, particle standards, mercury lamp standards, and an alpha spectrometer are used to calibrate the system.

1. Diode laser
2. Focusing optics
3. Collection optics
4. Photomultiplier detector
5. Pulse height analyzer
6. Pulsed Nd: YAG laser
7. Spectrometer
8. Programmable gate pulse generator
9. Image-intensified diode array
10. Control software and interfaces

11. Personal computer
12. Laser power meter
13. Recirculating chiller
14. Transportable optical table
15. Fiberoptic cable interfaces.

10.6 Cooperative Telerobotic Retrieval

The gantry crane will consist of a main girder spanning 80 ft. The crane will be mounted on rails and will stand about 30 ft high. The rail system will require foundations and will span 60 ft. There will be three trolleys, mounted on the main girder, two equipped with telescoping Z-masts with Schilling manipulators and the third trolley outfitted with a hoist. Various retrieval tools for the crane and manipulators will be deployed. Movement of the gantry, trolleys, and control of the manipulators and hoist will be by remote control. The crane is electrically powered and will require about 100 kW of power.

10.7 Waste Conveyance for Buried Waste Retrieval

The following equipment is needed to support the waste conveyance system tests: integrated transfer module(s), transport container(s) (4 x 4 x 8-ft wooden box), and forklift.

Because of the short duration of this field test, only the following maintenance should be performed each morning before starting the waste conveyance system.

- Check lubricant and coolant levels on the conveyance vehicle
- Check fuel level.

10.8 EWA

The EWA project will require several pieces of equipment and instruments (Table 4). The calibration and standardization procedures are described in the test procedure (Appendix A).

Each detector channel will be calibrated 0-1.5 MeV over the 8K ADC range. Concurrently gathered pulser data provide continuous validation as well as real-time data validation. The computer equipment and base software associated with the system require maintenance contracts with Digital Equipment Corporation to ensure reliable operation. Front-end equipment and custom software are maintained by Radiation Measurements Laboratory personnel.

Table 4. Equipment and instruments required for the EWA project.

Quantity	Item
6	High-purity germanium detectors with charge-sensitive preamplifiers and calibration pulser
6	High-voltage supplies
6	Spectroscopy-grade amplifiers
6	Analog-to-digital converters
3	Acquisition-interface modules
3	Ethernet drivers-receivers
4	Nuclear instrument module bins and power supplies
1	VAX station 3300, with associated hardware and software

10.9 DC Graphite Arc

The nitrogen system requires eight pressure gages, a pressure regulator, eight solenoid valves, and a O² sensor. The hydraulics system requires eight solenoid valves and eight limit switches. The furnace water cooling system requires 10 temperature gages (Bi-Metal), two thermocouples, a flow meter, two pressure regulators, three pressure gages, two differential pressure transducers, and a centrifugal pump. The electrode control has a DC current power line, four transducer ammeters, three voltmeters, six relays, two ammeters, a position indicator, and two DC motors. The offgas system has seven pressure gages, six temperature gages, two thermocouples, four flow rate meters, two level detectors, two solenoid valves, two bag filters, four centrifugal pumps, and a blower.

In addition to these instruments and equipment, specialized instruments, i.e., a millimeter wave radiometer, isokinetic sampler, gas chromatograph, mass spectrometer, and microwave plasma analyzer, are also required.

The millimeter wave radiometer will be located at the furnace diagnostic port to sample furnace temperatures. The isokinetic sampler will extract samples from the furnace offgas line for chemical and physical analysis. The mass spectrometer will be located in the 6-in. line downstream of the number 1 scrubber to measure the concentration of helium (He) when it is injected into the furnace as a tracer. The gas chromatograph will be located at the same place and will provide data on all gases in the offgas stream.

The data acquisition hardware for furnace diagnostics will consist of Dutec I/O Plexer input boards. Each board is capable of taking up to 16 input signals and digitizing them into a 12-bit digital signal. This signal will be sent to an IBM compatible personal computer running a commercial data acquisition package called Aimax Plus.

The data acquisition hardware has a specified accuracy of $\pm 0.1\%$ full scale for analog inputs such as voltages and currents and typical accuracy of $\pm 3^\circ\text{C}$ on thermocouples. Once the data have been digitized by the data acquisition hardware, no more signal distortion can occur. The data going to the data acquisition system will be verified before testing occurs.

11. FACILITIES AND UTILITIES

The majority of the FY-95 field test(s) will be performed at the NBA test pit. The tensor magnetic gradiometer and the TRU dust monitor will be tested at the INEL cold test pit. The assay portions of the FY-95 field testing will be performed at Idaho State University (ISU). The DC graphite arc treatment testing will be performed at MIT. Facilities and utilities for each of these areas are discussed below.

11.1 Cold Test Pit

Following is a discussion on the facility and utility preparation for the cold test pit area. Figure 5 shows a general layout of the cold test pit and the surrounding area.

Figure 5. Cold test pit and surrounding area.

11.1.1 Site Preparation

Each year, following the winter months, the cold test pit is inspected and repaired as required (mostly erosion damage). Once repaired, the cold test pit is prepared for use by bringing in the necessary power generators, water (drinking, and process as required), sanitation facilities, safety equipment, etc. The following sections detail facilities and utilities available at the cold test pit.

11.1.2 Generators

Once the TP&SRs for each technology have been developed, the deployment team will determine the power needs for those technologies. From these needs, a series of generators, including backup generators, will be located and moved to the cold test pit to support site testing.

Selection of the generators is based on power output required and noise level. UL-listed generators will be used to provide the necessary safety features. A low noise level (whisper-air or equivalent) generator will be specified, with a desired noise level of 15-20 dB. Power requirements will be specified to match the operations with a reasonable amount of spare power capacity and flexibility.

11.1.3 Power Distribution

This effort will include specifying the cabling for distribution of power and selecting power distribution equipment, if required. Routing of the power cable(s) will be coordinated with the routing of instrumentation cabling to eliminate signal interference.

11.1.4 Staging and Laydown Areas

An area for adequate staging and laydown of equipment, consumables, and infrastructure items will be provided. The laydown area(s) will be located so that heavy equipment may access the needed item(s).

11.1.5 Parking

Adequate and safe parking is provided at the cold test site to prevent people from leaving vehicles in unwanted areas. The main parking area is graded, drained, and well graveled, as shown in Figure 6.

11.1.6 Storage Shed

A small storage shed (8 x 14 ft) will be provided and maintained under lock and key for storage of items that otherwise may accumulate in the administration trailer. Small equipment, tools, and consumable items brought out for use in conjunction with the testing can be left in the storage shed. This storage shed is not for storing any hazardous or flammable items.

Figure 6. Cold test pit parking.

11.1.7 Administration Trailer

A trailer to serve as a work area for site management and administration personnel will be provided. A computer and modular phone will be provided, as well as heating, ventilation, air conditioning, and lighting. Hard hats and safety glasses will be stored in this facility. Site sign-in and indoctrination will be conducted at this facility. Site tours will also originate at this location.

11.1.8 Miscellaneous

Other items not mentioned above but important to the infrastructure include provisions for and maintenance of sanitary facilities at the site. The quantity needed will be determined by the expected maximum number of people at the site daily.

Trash removal will be coordinated with facilities and maintenance services (trash such as pop cans, construction debris, paper, etc.). Space will be provided for an INEL dumpster or dumpsters. The trash will be segregated and "bagged and tagged" then surveyed (radiation survey) and removed from the cold test pit to the INEL landfill.

Bottled drinking water will be supplied and located in the administration support trailer. Emergency handwash and eyewash stations are located just outside the administration support trailer.

11.2 NBA

11.2.1 NBA Test Pit

A simulated waste pit, to support testing at the NBA, has been constructed to replicate two different DOE sites (INEL and BNL). This test pit is located under the working area of the gantry crane so as to provide access to the pit from the crane during field testing. The test pit is approximately 40 ft wide by 20 ft long by 12 ft deep. The pit is divided into two sections, with one section filled with simulated INEL waste, approximating the type and volume of waste found at the INEL SDA, and the other section filled with simulated BNL waste, approximating the type of waste found at the BNL chemical and animal pits. Specifics on the NBA test pit can be found in the test pit design files (as built). Figure 7 shows the layout in and around the NBA test pit.

11.2.2 Simulated Zone-of-Concern Development

A simulated "Zone of Concern" (hot spot) was installed in the INEL section of the NBA test pit during pit construction. During the field tests, the participants will be given "historical" information about the zone, such as a certain drum or 4 x 4 x 4-ft box is believed to be the source (VOC). During test pit construction, the simulated zone will be surveyed and documented. This documented information will be part of the design files and will be made available after the tests are complete for use to validate the testing.

Figure 7. NBA test pit area.

11.2.3 Power Distribution and Conditioning

An uninterrupted power supply for the gantry crane control station will be installed at the NBA. The main objective of the uninterrupted power supply is to provide a constant output waveform that is 120 V/60 Hz and sinusoidal, regardless of the input.

11.2.4 Soil and Waste Handling

Soil from overburden removal operations and any "pure" loads of soil excavated during the removal process will be placed aside for future use in restoring the test pit (see section 14.9). As waste is removed from the pit, it will be placed in either the integrated transfer module or a dump truck and transferred to the city land disposal facility. Excavated waste dumped into an integrated transfer module will subsequently be transferred to the dump truck, so that the module may be reused. Watering may be necessary to suppress dust.

11.2.5 Operations Control Area

The NBA will serve as the operations control center for the in-town field testing. Control of the conveyance system, gantry crane, and dig face characterization equipment, and any other interfacing equipment will be executed from this center. There will also be data collection equipment, computers, and related hardware located in the facility. Adequate space, air conditioning, heating, lighting, and furniture will be provided. All control and power cabling for equipment operations will be routed from the NBA control center to the associated equipment.

11.3 ISU

A laboratory at ISU is the site of the EWA system tests. All supplies, utilities, and facilities are provided by ISU. Small tools and maintenance equipment are maintained at the facility to support testing needs.

11.4 MIT

Treatment of a portion of the retrieved waste will be conducted in the NW21 Building at the PCF at MIT. There is 24 MV·A power available, but only a small fraction of this power will be used by the Mark II furnace. Small tools, stationery supplies, and maintenance equipment are maintained at the facility to support a broad range of testing needs.

There is a 10,000-L liquid nitrogen tank outside the building to supply the furnace nitrogen systems. City water serves the building. This water will be used to fill tanks, provide makeup water, and provide emergency cooling if required. There is a process water system on the roof, with a 750-kW heat exchanger that supplies water to the cooling systems. A 10-ton overhead bridge crane is available to provide the necessary lifting requirements.

12. HEALTH AND SAFETY

12.1 Hazard Analysis

In accordance with DOE Order 5481.1B, DOE-ID Order 5481.1B, and the *Lockheed Martin Idaho Technologies Safety Manual*, a hazard classification is required for the integrated field test activities at the cold test pit. The FY-95 field test activities are considered routinely accepted by the public. This determination is based on the activity not involving radioactive waste, ionizing radiation, fissionable materials, x-ray equipment, toxic materials, flammable materials, explosive materials, reactive materials, chemical incompatibility, lasers, high pressures or temperatures, biohazards, and asphxiants. There are no unusual or unique high kinetic energy systems. Less than 600-V power will be required. The equipment being utilized will be operated in compliance with applicable Occupational Safety and Health Administration (OSHA) regulations.

The EWA activities have a hazard classification routinely accepted by the public. The system uses standard commercial detectors to measure waste activity within a waste stream. For testing purposes, the project is using nuclear accident dosimeters for sources (1 gm weapons grade Pu x 14) that are sealed. The detectors used are standard gamma detectors with nitrogen cooling. Laboratory chemicals and standard reagents that may be necessary include, but are not limited to, acetone <1 pt/yr, isopropyl alcohol <1 qt/yr, and vacuum pump oil <1 gal/yr. No radioactive waste will be generated, as radioactive sources are sealed and placed into the simulated buried waste.

12.2 Employee Training

The following training will be required for the field activities at the cold test pit.

- A. *Access Training.* In addition to a DOE clearance, the following training is required for access to the cold test pit:
1. *Environment, Safety, and Health Training.* This annual safety (blue card) training is required for unescorted access to Administratively Controlled Areas such as the cold test pit and can be obtained by contacting Wendy Hernandez at (208) 526-1643. Initial training consists of a 20-minute video. Training is not required if you will be escorted at all times.
 2. *General Employee Radiological Training (GERT).* GERT is required for all employees and unescorted visitors (including subcontractors) who may routinely enter an Administratively Controlled Area (such as the cold test pit) and encounter radiological barriers, postings, or radioactive materials. This training is new and is for the general employee who will probably not be exposed to radiation and radioactive materials. This training DOES NOT fulfill the requirements to be a radiological worker or radiological control technician. You are exempt from this training if you have had recent Radiation Worker Training (annual training) or you will be escorted at all times.

B. *Cold Test Pit Specific Training (contact Larry Watson, 6-2232).* The deployment team will provide all of the following required training for the cold test pit:

1. *Specific Training Requirements for Field Testing.* This is a one-half hour briefing that will touch on the following topics:

- a. DOE Order 5480.19, "Conduct of Operations."
- b. Spill Prevention Countermeasures Control (SPCC) plan, which is Appendix B of the *RWMC Emergency Plan/RCRA Contingency Plan*.
- c. RWMC Emergency Plan/Contingency Plan. These are quick-step procedures that initiate emergency responses. Deployment team personnel are not staffed to provide all of the necessary actions identified. Thus, an interface agreement with the RWMC for operational support services was established.
- d. Escort requirements.
- e. *Procedures Manual*, 1.11, "Identification of Training Requirements."
- f. *Procedures Manual*, 8.12, "Solid Sanitary Waste Segregation and Recycling Procedures for Using the INEL Landfill."
- g. Stop Work Authority.
- h. OSHA. The general OSHA policy adhered to is summarized as follows (this is by no means all encompassing): All employees are required to:
 - 1. Observe the DOE-prescribed OSHA standards applicable to their work.
 - 2. Report promptly to the contractor any condition that may lead to a violation of these standards.
 - 3. Respond to warning signals that may be activated in the event of fire, radiation, or other possible emergencies.
 - 4. Report emergencies using established procedures.

In addition, the general OSHA safety training and education, and fire protection and prevention are contained in 29 CFR 1926.21, 1926.24, and 1910.120 (b).

- i. Cold Test Pit Specific Briefing on Current Hazards and Operations Being Demonstrated.

The following training will be required for the field activities at the NBA test pit.

- A. *Access Training.* In addition to a DOE clearance, the following training is required for access to the NBA:
1. *Environment, Safety, and Health Training.* This annual safety (blue card) training is required for unescorted access to Administratively Controlled Areas such as the NBA. Training consists of a 20-minute video followed by a question-and-answer session. This training will be provided through the deployment program by Mr. Richard Dixon (526-9476).
- B. *NBA Test Pit Specific Training (contact Larry Watson, 526-2232).* The deployment team will provide all of the following required training for the NBA test pit:
1. *Specific Training Requirements for Field Testing.* This is a one-half hour briefing that touches on the following topics:
 - a. DOE Order 5480.19, "Conduct of Operations."
 - b. SPCC plan.
 - c. NBA Emergency Plan/Contingency Plan. These are quick-step procedures that initiate emergency responses.
 - d. Escort requirements.
 - e. *Procedures Manual*, 1.11, "Identification of Training Requirements."
 - f. *Procedures Manual*, 8.12, "Solid Sanitary Waste Segregation and Recycling Procedures for Using the INEL Landfill."
 - g. Stop Work Authority.
 - h. OSHA. The general OSHA policy adhered to is summarized as follows (this is by no means all encompassing): All workers at the NBA are required to:
 1. Observe the DOE-prescribed OSHA standards applicable to their work.
 2. Report promptly any condition that may lead to a violation of these standards.
 3. Respond to warning signals that may be activated in the event of fire or other possible emergencies.
 4. Report emergencies using established procedures.

The general OSHA safety training and education, and fire protection and prevention are contained in 29 CFR 1926.21, 1926.24, and 1910.120 (b).

- i. NBA Test Pit Specific Briefing on Current Hazards and Operations Being Demonstrated.

12.3 Physical Safety

Physical safety entails items such as signs, fences, and barricades. Personnel and visitors will enter the cold test pit from the main road located east of the parking area as shown in Figure 8. The parking area will be fenced off and posted with important safety information (Visitors Proceed to Administration Trailer, No Smoking, Hard Hat Area, etc.). Plans for the layout of these signs are shown in Figure 9. The test area at the NBA has been designated as an equipment development area. Access to the NBA test area is limited to authorized personnel only. Authorization and conditions for access to the NBA test area shall be arranged through the DPM.

The deployment safety engineer shall conduct a safety walk-down of the cold test pit area and the NBA weekly when field tests are being performed. Safety discrepancies and concerns shall be reported to the DPM. Corrections will be funded and completed by the deployment team personnel or by the field test PI, depending on the nature of the identified problem.

All work performed at the INEL cold test pit must be reviewed and approved by a facility health and safety representative and documented in Safe Work Permits. Work performed at the NBA will follow the guidelines established for the equipment development area. Field test personnel and subcontractor personnel are responsible for complying with applicable sections of the *Lockheed Martin Idaho Technologies Safety Manual*, *Industrial Hygiene Manual*, *RWMC Operational Safety Requirements Safety Analysis Report*, *Conduct of Operations Manual*, and *Environmental Restoration Program Generic Health and Safety Plan*. If required, safety-related training is available from centralized safety training at the Central Facilities Area.

12.3.1 Instrumentation and Control Cable Routing

Routing of cabling for equipment operation and any onsite instrumentation cabling will be controlled. The location of instrument cable will be studied on a case-by-case basis. During site planning, an "easement" will be dedicated for this type of cable so that the cable will be located in a temporary trench or conduit and not subject to traffic, people, or other activities that might damage the cables/hoses or interfere with the signal.

12.3.2 Ventilation

Ventilation is required to control industrial hygiene hazards in the workplace. Ventilation is also used to maintain worker comfort and to maintain equipment at proper operating temperatures. Proper ventilation has been installed at the NBA.

Figure 8. Cold test pit access.

⊙ Test in progress

⊞ Service entry only. Contact L. Watson for access.

Figure 9. Cold test pit sign locations.

12.4 Emergency Response Plan

An interface agreement is in place with both the RWMC and the NBA. This agreement addresses the building manager system, boundaries of responsibility, operational responsibility and authority, surveillance requirements, quality standards, occurrence reporting, emergency preparedness, environmental protection, safety compliance, and contact points of activities at the cold test pit. These agreements will serve as the emergency response plan during the FY-95 field testing at either the cold test pit or the NBA test pit.

One modular phone will be provided at the cold test pit for site communications. Radios will also be provided for onsite (cold test pit) communications as well as emergency response.

Emergency response at the NBA will follow standard company procedures for in-town facilities. Individuals participating in the field tests at the NBA and who are not Lockheed Martin Idaho Technologies employees will be briefed on their emergency duties and responsibilities by the DPM or his/her designee.

12.5 Radiation Safety

For the field tests at the NBA or the INEL cold test pit, no radioactive sources will be used. These test pits are constructed to simulate conditions expected during actual waste retrieval. These simulated pits contain no hazardous or radioactive material.

Radioactive sources will be added to the simulated buried waste at ISU for the assay tests. There are 14 Pu sources covered under their U.S. Nuclear Regulatory Commission license. All radiological work will be performed in accordance with the *ISU Radiological Controls Manual* and, when appropriate, in accordance with the *Lockheed Martin Idaho Radiological Controls Manual*. Radiation dosimetry is provided by the Radiation Safety staff at ISU, and the results are forwarded to the Operational Dosimetry Unit of Lockheed Martin Idaho Technologies.

12.6 Chemical Safety and Spill Control

The RWMC emergency response team will be supporting the cold test pit field tests. In the event of a spill (involving hydraulic fluid, engine oil, etc.), the RWMC SPCC procedures will be followed. After the spill is controlled, the deployment team will be responsible for proper disposal of the material. Spills on the ground of <3 gal do not require reporting as an unusual occurrence.

Any maintenance required on a system, where a potential loss of fluids exists, will be performed such that all precaution is taken to prevent leakage of any fluids onto the soil or into the environment.

Material safety data sheets (MSDSs) for each chemical (hydraulic fluid, fuel, etc.) used during the field tests will be onsite and available during field tests. For field tests at the INEL cold test pit, the MSDSs will be located in the administration trailer. For field tests at the NBA,

the MSDSs will be maintained in a properly identified notebook located at the operations control panel.

12.7 Security

Control of keys/locks for the administration trailer is the responsibility of the field engineer. Tool boxes or other items specific to the individual testing technologies shall be the responsibility of the individual PI. Cold test pit security shall be maintained per the RWMC interface agreement. Security at the NBA shall be maintained per standard Lockheed Martin Idaho Technologies procedures for in-town facilities.

13. RESIDUALS MANAGEMENT

13.1 Cold Test Pit

Procedures for disposal of solid wastes are contained in the *Procedures Manual*, 8.12, "Solid Sanitary Waste Segregation and Recycling Procedures for Using the INEL Landfill." There will be a dumpster placed at the cold test pit to receive refuse (e.g., office paper, etc.).

In the event of a leak from a system (hydraulic fluid, oil, or other substance), any contaminated soil or other material will be disposed of in accordance with company regulations for hazardous waste disposal.

13.2 NBA

For the field tests, the only anticipated residuals are the overburden and the simulated waste retrieved from the pit. Some of the simulated waste will be packaged and sent to ISU and MIT for assay and treatment tests, respectively. The rest of the simulated waste will be disposed of in accordance with company procedures.

In the event of a leak from a system, (hydraulic fluid, oil, or other substance) any contaminated soil or other material will be disposed in accordance with company regulations for waste disposal.

13.3 ISU

Any simulated waste sent to ISU will be maintained at the university for future testing. Any radiation sources implanted in the waste will be removable so as to maintain the simulated waste "clean."

13.4 MIT

Fifty-five-gallon drums are used to remove the slag melt from the furnace. After cooling and removing the necessary test samples, these drums will be transferred to the local landfill for permanent disposal. Any offgas filter elements may be recycled through the furnace or disposed of locally. All test residuals are innocuous and present no actual or regulatory threat to the environment.

14. REGULATORY REQUIREMENTS

14.1 National Environmental Policy Act

An environmental checklist has been written to cover the field test activities at the INEL cold test pit, NBA test pit, MIT, and ISU. Appropriate documentation has been prepared to comply with the National Environmental Policy Act.

14.2 OSHA

OSHA regulations affecting the field testing will be limited because the systems being tested are operated remotely, and activities will not be performed in a hazardous environment. Protective gear will be supplied as necessary. Access to the pit during retrieval will be controlled in accordance with the equipment design safety plan requirements. As required for testing at the INEL cold test pit, safe work permits will be developed. The retrieval area will be roped off, and no one will be allowed access.

14.3 RCRA

Any materials that must be disposed of (such as a hydraulic fluid) are controlled by RCRA laws and are covered by the appropriate spill procedure(s). In the event of such a spill, the emergency response team will respond to the accident. After a spill is controlled, the deployment team will be responsible for proper disposal of the waste.

14.4 Conduct of Operations

The Conduct of Operations Plan identifies the procedures and protocol to be observed at the test site(s) on a day-to-day basis for efficient execution of work. All personnel involved in testing at the INEL will follow the company Conduct of Operations Plan.

14.5 Storm Water Pollution Prevention Plan

A required Storm Water Pollution Prevention Plan has been prepared for construction activities at the INEL cold test pit. This document has been reviewed and updated.

14.6 Archeological Survey

Archeological surveys are required of U.S. government agencies before performing any activity that disturbs the ground. The survey checks the area for any archaeologically significant articles and needs to be performed only once for an area. This archeological survey has been completed for the INEL cold test pit.

14.7 Threatened and Endangered Species Survey

Threatened and endangered species surveys have been completed for the INEL cold test pit.

14.8 Clean Water Act

The Clean Water Act applies to Spreading Areas A and B, where soil is obtained to support activities at the INEL cold test pit. A permit is currently being approved for obtaining soils from these areas. In the event the permit is denied, soil will be obtained from Spreading Areas C and D.

Appendix A

Test Procedures

Appendix A

Test Procedures

To be finalized prior to testing.