EGG-WTD-10612

Buried Waste Integrated Demonstration Fiscal Year 1992 Close-Out Report

Patricia G. Cannon
Kevin M. Kostelnik
Katherine J. Owens

Published February 1993

Idaho National Engineering Laboratory
EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Office of Environmental Restoration and Waste Management
Under DOE Idaho Field Office
Contract DE-AC07-76ID01570

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Prepared by

P. G. Cannon, Principal Investigator — 2/3/93 Date

Reviewed by

K. M. Kostelnik, Project Manager
Buried Waste Integrated Demonstration — 2/3/93 Date

Approved by

S. K. Merrill, Coordinator
Buried Waste Integrated Demonstration — 2/3/93 Date

ABSTRACT

The mission of the Buried Waste Integrated Demonstration Program (BWID) is to support the development and demonstration of a suite of technologies that when integrated with commercially-available baseline technologies form a comprehensive remediation system for the effective and efficient remediation of buried waste disposed of throughout the U.S. Department of Energy complex. To accomplish this mission of identifying technological solutions for remediation deficiencies, the Office of Technology Development initiated the BWID at the Idaho National Engineering Laboratory in fiscal year (FY)-91. This report summarizes the activities of the BWID Program during FY-92.

SUMMARY

The mission of the Buried Waste Integrated Demonstration (BWID) Program is to support the development and demonstration of a suite of technologies that when integrated with commercially-available baseline technologies form a comprehensive remediation system for the effective and efficient remediation of buried waste disposed of throughout the U.S. Department of Energy (DOE) complex. To accomplish this mission of identifying technological solutions for remediation deficiencies, the Office of Technology Development (OTD) initiated the BWID at the Idaho National Engineering Laboratory (INEL) in fiscal year (FY)-91. This report summarizes the activities of the BWID Program during FY-92.

The FY-92 budget for the BWID totaled \$19.27M. This level of funding supported 41 Technical Task Plans (TPP) and involved nine DOE field offices. Approximately 56% of the funding was associated with the U.S. Department of Energy Idaho Field Office. Of this \$10.88M, approximately 27% or \$2.96M was subcontracted to private sector and universities. Of the \$8.39M going to other DOE field offices, approximately 17% or \$14.5M was subcontracted to private sector universities. This corresponds to a total of \$4.41M or 23% of the FY-92 funding being distributed to private industry or universities in the form of subcontracts. A major portion of this funding was received in the field late in FY-92, and therefore, a large percentage of funds is listed as carryover.

Several significant field demonstrations took place during FY-92. These demonstrations included characterization, retrieval, and treatment activities. The significant characterization demonstrations involved the Broadband Electromagnetic (EM) and Rapid Geophysical Surveyor (RGS). The significant retrieval activity included the Cryogenic Retrieval demonstration. The treatment activities included performance testing of the Mark I furnace at Massachusetts Institute of Technology with Pacific Northwest Laboratory, Retech Furnace tests with Mountain States Energy, Inc. and Science Applications International Corporation, and near real-time bench-scale tests for contaminated nitrate salts.

The cryogenic retrieval demonstration evaluated how well buried waste can be retrieved and contamination controlled by freezing the ground before retrieval. Sonsub, Inc. of Houston, Texas, performed the demonstration by trickling liquid nitrogen down a series of freeze pipes inserted directly into the soil/waste at the Cold Test Pit located at the Radioactive Waste Management Complex. A series of temperature and moisture probes, also inserted into the soil, were used to monitor the rate of freezing and migration of moisture through the soil. A gantry equipped with a series of overhead crane mounted tools was positioned over the frozen area to remove frozen soil/waste. The results of the demonstration concluded that cryogenic retrieval is feasible. More information about this technology is presented in Section 3.3.2.

A broadband EM device that uses a time domain electromagnetic (TDEM) sensor was demonstrated at several INEL sites by the Grand Junction Project Office. The demonstration was conducted between June and August 1992 to demonstrate the capability of the method as a nonintrusive site characterization technique. The TDEM was used to collect electrical conductivity/resistivity measurements at the Cold Test Pit, Acid Pit, and Pit 9. Although final interpretation of the TDEM data has not been completed, a relationship between the observed induction conductivity and waste pit boundaries at the three surveyed sites was demonstrated. A preliminary review of the data indicates that the depth to the base of the waste pits, thickness and

nature of the capping material, and general contents of the pits can be determined with a high degree of confidence. A report summarizing this demonstration and analysis of data will be published early in FY-93. More information about this technology is presented in Section 3.2.3.

The RGS prototype system was designed and fabricated at the INEL during the summer of 1992. The system was used to collect magnetic data at the Cold Test Pit and Pit 9 within the Subsurface Disposal Area during September 1992. Data were collected at a density of 2.5 in. along survey lines spaced 1 ft apart for a total survey area of 1.7 acres. Over 350,000 data points were collected. This demonstration not only showed the efficient and economical aspects of this system but more importantly provided Environmental Restoration with more detailed information regarding pit boundaries than previously obtained. More information about this technology is presented in Section 3.2.7.

Other substantial accomplishments during FY-92 included the development and implementation of a deployment process based on the Operational Readiness Reviews to ensure successful field deployment of technology demonstrations; development and testing of a Comprehensive Environmental Response, Compensation, and Liability Act, performance-based technology selection filter; publication of numerous technical reports; presentation of posters for BWID-sponsored technologies at numerous conferences and workshops; and development and evaluation of 20 Technology Status Reports during the first quarter of FY-92.

CONTENTS

TABLE

ACRONYMS

AMWAS	Advanced Mixed Waste Assay System
A&P	Active and passive
BWID	Buried Waste Integrated Demonstration
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH	Contact-handled
CT	Computer tomography
CTEN	Combined thermal/epithermal neutron
DOE	U.S. Department of Energy
DOE-HQ	U.S. Department of Energy Headquarters
EM	Electromagnetic
EPA	Environmental Protection Agency
ER	Environmental Restoration
ERWM	Environmental Restoration and Waste Management
FY	Fiscal year
IDC	Integrated Demonstration Coordinator
INEL	Idaho National Engineering Laboratory
ISV	In situ vitrification
LINAC	Linear accelerator
LLW	Low-level radioactive waste
LST	Luminescence spot test
NDA	Nondestructive assay
NDE	Nondestructive examination

OTD	Office of Technology Development
PBTSF	Performance-based Technology Selection Filter
PCB	Polychlorinated biphenyl
PCF	Plasma Centrifugal Furnace
PHP	Plasma Hearth Process
PI	Principal Investigator
RHMMS	Radiological and Hazardous Measurement Monitoring System
RGS	Rapid Geophysical Surveyor
RH	Remote-handled
RTR	Real-time radiography
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
TMG	Tensor Magnetic Gradiometer
TPT	Thermal Processing Technologies
TRU	Transuranic
TSR	Technology Status Report
TTP	Technical Task Plan

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1. INTRODUCTION

1.1 Background

Approximately half of all U.S. Department of Energy (DOE) buried waste was disposed of before 1970. Disposal regulations at that time permitted the commingling of various types of waste [i.e., transuranic (TRU), low-level radioactive (LLW), and hazardous]. As a result, much of the buried waste throughout the DOE complex is presently believed to be contaminated with both hazardous and radioactive materials.

Significant remediation challenges are presented for buried waste, particularly the pre-1970 buried TRU contaminated waste. The DOE Office of Environmental Restoration (ER) is committed to resolving the issues resulting from past disposal practices. The DOE Office of Technology Development (OTD) is committed to supporting these efforts to ensure that appropriate technological solutions are available to accomplish the selected remediation objectives. To address these issues and identify technological solutions for remediation deficiencies, the OTD initiated Buried Waste Integrated Demonstration (BWID) at the Idaho National Engineering Laboratory (INEL) in fiscal year (FY)-91.

The goal of BWID is to determine the threshold of capability for emerging technologies. Technologies have been identified, screened for applicability to the identified needs and requirements, selected for demonstration, and evaluated based on prescribed performance objectives. This effort will determine implementability, effectiveness, potential schedule reduction, and cost savings associated with emerging technology to shape remediation plans and implementation of the environmental restoration of buried waste.

1.2 Purpose

The purpose of this document is to summarize the activities of the FY-92 BWID Program. This summary is not intended to be an extended review of all activities but rather a highlight of significant technical accomplishments for each FY-92 BWID-sponsored Technical Task Plan (TTP). A financial summary of the entire program is also presented. Supporting information, such as the reports produced and list of subcontractors, are included in Appendices A and B.

2. MANAGEMENT APPROACH

To ensure that the project was managed in an efficient and effective manner, a BWID Program Office was organized at the INEL. Management guidance was developed to implement a system that ensured successful deployment of technologies. This approach assumed the responsibility for facilities, operations, and regulatory compliance activities by the BWID Program Office. Centralization of these activities resulted in a reduction in the cost of deploy.nent and provided assurance that technologies would get to the field as planned. The BWID Program Office staff was established as an interdisciplinary team employing numerous quality improvement tools to ensure its effectiveness. This team developed and implemented a deployment process using the Operational Readiness Review method as its basis. This process is discussed further in Section 3.1.

Early in development, it was recognized that effective communication and good project management were key in a successful BWID Program. To ensure effective communication, frequent meetings were held between the U.S. Department of Energy Headquarters (DOE-HQ) Program Manager, U.S. Department of Energy Idaho Field Office (DOE-ID) Technical Program Officer, and BWID Integrated Demonstration Coordinator (IDC). Communication between the Program Office and principle investigators (PIs) improved during FY-92 but was still not adequate. Improvement in this area will be a high priority for the FY-93 program.

3. TECHNICAL ACCOMPLISHMENTS

Three major technical areas, characterization, retrieval, and treatment and one programmatic area were involved with the FY-92 BWID Program. While the technical areas were specific for technology development and demonstration, the programmatic activities provided a more detailed assessment of the DOE complex buried waste problem as well as systematic approaches for satisfying technological deficiencies. A summary of accomplishments for each TTP is provided by technical area in the following sections.

3.1 Characterization

3.1.1 Improved TRU Waste Assay—AL121209

The initial objective of this TTP was to develop a Technology Status Report (TSR). A TSR was issued on November 5, 1991. Following review of the TSR by a Nondestructive Assay (NDA) Peer Review Team in FY-92, funding was issued to this TTP at mid-year to design, build, and demonstrate a field-ready combined thermal/epithermal neutron (CTEN) device. The CTEN system would provide accurate assays even with nonuniform drums by correcting self-shielding effects (in nonmoderating matrices). This NDA system would be capable of accurately certifying TRU waste.

3.1.2 Realtime Monitoring During Retrieval TSR—AL121210

The objective of this TTP was to develop a TSR. This TSR provided an overview of the proposed technology that included a continuous emission monitoring of volatile organics, chlorine containing organics, and other solvents at the Subsurface Disposal Area (SDA) of the Radioactive Waste Management Complex (RWMC) at the INEL. This proposed monitoring will be accomplished by using two types of spectroscopic analysis, fourier-transform infrared absorption and infrared diode laser spectrometry. Each of these types provide near real-time speciation and quantification data on a variety of volatile organic and inorganic materials. Infrared diode laser sensors will be used for real-time, sensitive quantification of selected critical species (e.g., HCl, CH_3CCl_3, $CHClCCl_2$, MEK, and CCl_4). A TSR was issued on November 1, 1991. No additional funding was issued following the TSR review.

3.1.3 Nonintrusive Sensing of Environmentally Important Objects—AL911201

This TTP funded the following tasks:

- Three Dimensional Site Characterization Using Broadband Electromagnetics (EM)

  The objective of this subtask was to adapt current broadband EM technologies and interpretation techniques used in mineral explorations to detection and three-dimensional characterization of shallow targets normally associated with site characterizations. A significant accomplishment for this TTP was demonstration of a time domain EM system at the Cold Test Pit and RWMC, which was 6 months ahead of schedule. The results of this survey were finalized in a December 1992 report.

- Site Characterization and Object Location using a Tensor Magnetic Gradiometer (TMG)

  The objective of this subtask was to develop an improved system for nonintrusive site characterization through the measurement and interpretation of the magnetic gradient tensor. Proof-of-principle experiments have been completed by simulating a TMG with a pair of triaxial ringcore fluxgate magnetometers mounted at the ends of a gimbal-mounted 1-m beam. Together with some numerical modeling experiments, it was determined that a gradiometer system with a sensitivity on the order of 0.1 nT/m can provide useful information for DOE waste site characterization. Initially, problems in magnetometer instrument stability made it doubtful that the required gradient sensitivity could be achieved with ringcore fluxgate magnetometers. However, those stability problems were isolated to a "bug" in the firmware of the magnetometer system. It is believed that these problems can be corrected. Consequently, it was recommended that construction of a TMG proceed using ringcore fluxgate technology.

- Integrated Borehole Geophysical System for Contaminant Identification

  The objective of this subtask was to adapt and optimize existing borehole logging equipment to detect contaminants in situ, especially fissile elements and elements that respond to neutron activation. The logging system was refurbished, and a modern multichannel analyzer was installed and interfaced to the data acquisition system. Computer codes for numerical simulation of the response of the logging system were installed, configured, and tested, and initial simulations were completed.

3.1.4 Nondestructive Examination/Nondestructive Assay Peer Review—CH121201

The objective of this TTP was to perform an independent peer review of the TSRs prepared for NDA projects identified by BWID. The peer review will be used to aid in determining how the FY-92 funding for technology development tasks in this subject area will be distributed to candidate projects. TSRs were reviewed in November 1991; technology evaluations were conducted in December 1992; and final technology selection and funding was completed in January 1992. The results of this peer review have been documented. An additional activity conducted under this TTP was the construction and testing of a new analytical instrument for field measurements of actinides/rare earths. This TTP also supported participation in BWID technical support group activities. Appendix A provides reports published as a result of this TTP.

3.1.5 Nonintrusive Characterization Studies—ID121112

The objective of this TTP was to provide a multidisciplinary approach to high resolution site characterization and compliment other past and proposed RWMC characterization activities. The successful integration of data sets procured through this TTP will lead to a better understanding of how geophysical methods can be applied to the characterization of buried waste sites. Since funding for this project was not baselined until late April 1992, primary activities were in project planning and initiation of vendor contracts. A significant accomplishment is the completion of construction of two additional zones in the INEL Cold Simulated Waste Pit. These additional zones provided two areas specifically designed for the needs of testing characterization and retrieval technologies that could not be adequately met with the existing zones in the pit. These zones included a calibration zone for geophysical sensors and retrieval zone that will be excavated during FY-93 by the Buried Waste Robotics Integrated Program Remote Excavation System.

3.1.6 Radiological and Hazardous Materials Measurement System—ID121212

The initial objective of this TTP was to develop a TSR. Following peer review, funding was issued to develop a technological approach that will meet the requirements of Environmental Restoration and Waste Management (ERWM) and accurately measure TRU and other radioactive material in waste. A major accomplishment for this TTP was the installation of a proton linear accelerator (LINAC) at the Idaho State University physics laboratory. The LINAC is expected to provide significant improvement over the current state of the area measurement systems by improving measurement thresholds and production rates. Additionally, performance and design specifications of the Radiological and Hazardous Measurement Monitoring System (RHMMS) (i.e., a multiple measurement cell integrated measurement system) were documented in a report (see Appendix A). Other accomplishments included

- Poster Sessions
  - "Radiological and Hazardous Measurement Monitoring System" at American Society of Mechanical Engineers World Conference in Washington, DC, June 15, 1992
  - "Radiological and Hazardous Measurement Monitoring System" at DOE Information Exchange Meeting on Characterization, Sensors, and Monitoring Technologies in Dallas, Texas, July 16, 1992
- Meeting Papers
  - "Radiological and Hazardous Measurement Monitoring System" at DOE Information Exchange Meeting on Characterization, Sensors, and Monitoring Technologies in Dallas, Texas, July 16, 1992
  - "Overview of the RHMMS System," "Passive Gamma Assay Results," "Active Neutron Measurement Modeling," "Active Neutron Measurement Results," and "Neutron Production with Low Energy Proton Accelerators" at Transuranic Waste Characterization Conference, Idaho State University, Pocatello, Idaho, August 10-12,1992.

3.1.7 Field Demonstration of Characterization Technologies—ID121213

There are four tasks in this TTP: Rapid Geophysical Surveyor (RGS), Anomaly Signature Model, Imaging, and Safe Step Characterization.

- Rapid Geophysical Surveyor

  The objective of this subtask was to design and construct a prototype device for rapid collection of extremely high density magnetic data at a buried waste site. After a successful field test at the Cold Test Pit, the RGS was used to scan Pits 7 and 9 at the

RWMC. Evaluation of the data collected indicates that the technology is an effective characterization tool and is almost ready for technology transfer to ER. The results of these tests are documented in Appendix A.

- Anomaly Signature Model

  The objective of this subtask was to develop a magnetic modeling algorithm that can be used to compute simulated magnetic anomalies for metallic objects. The algorithm will (a) incorporate induced, remanent, and demagnetization effects; (b) be fully three dimensional; and (c) be capable of simulating total field, vector, and gradient magnetic surveys. The final report was published on the development and implementation of numerical algorithm for permeability objects (see Appendix A). The report indicates that the magnetic methods for characterizing buried metallic waste can be greatly enhanced by using numerical calculations to predict what type of magnetic anomalies correspond to a given buried shape (i.e., a 55-gal drum or box of magnetic metals).

- Imaging

  The objective of this subtask was to demonstrate advanced algorithms, sensors, and data acquisition technologies to improve the ability to distinguish between buried metallic and nonmetallic materials and improve the ability to determine the extent of leakage or migration of uncontained waste or leaking buried containers.

- Safe Step Characterization

  The objective of this subtask was to develop a set of functional and operational requirements for a sensor package that can be used to characterize an active remediation site. A report was published that documents the evaluation of the needed system components, required/potential sensors to be included, and deployment and data analysis methods (see Appendix A).

3.1.8 LINAC-Based Characterization of Remote-handled TRU Waste TSR—OR021201

The objective of this TTP was to generate a TSR on a technology addressing the need to characterize remote-handled (RH)-TRU wastes stored and generated at various DOE facilities. The LINAC-based system would enable characterization of RH-TRU waste to determine fissile and actinide content. Absence of items prohibited by applicable waste acceptance criteria would also be verified through real-time radiography (RTR) examination. It would also be possible to determine toxic, heavy-metal, and elemental content (e.g., mercury, lead, cadmium, etc.) of the waste containers. The proposed system is an nondestructive examination (NDE)/NDA system consisting of a two-stage active neutron and photon interrogation assay system and an RTR examination system. The task would consist of preparing an experimental site; designing and constructing test samples; operational tests of instruments; characterizing simulated and actual RH-TRU wastes; and preparing a final report. The TSR, "LINAC-Based Characterization of RH-TRU Waste" was issued on November 16, 1991. Following review of this TSR, no additional funds were issued to this task.

3.1.9 Rapid and Cost Effective Luminescence Spot Test for Screening Polychlorinated Biphenyls—OR121201

The objective of this TTP was to evaluate and field test a cost-effective and rapid screening technology and fabricate a portable monitor for polychlorinated biphenyls (PCBs). This method is based on a simple luminescence spot test (LST) technology recently developed at Oak Ridge National Laboratory under Environmental Protection Agency (EPA) sponsorship. This task will provide support in rapid remediation and screening of PCBs at DOE hazardous sites. The LST technique offers several unique features: rapid analysis, simple instrumentation and set-up, field applicability, and low per-analysis cost. The instrument is portable and can be easily operated by unskilled workers. Accomplishments included

- Journal Article
  - "Applied Spectroscopy: Improved Methods for Screening of Polychlorinated Biphenyls (PCBs) Using Room Temperature Phosphorescence" (accepted for publication)
- Patent
  - ESID No. 1035 X, "Enhanced Photo-Activated Luminescence for Screening PCBs and Other Chlorinated Compounds" (patent application issued).

3.1.10 Advanced Mixed Waste Assay System TSR—RL321210

The objective of this TTP was to generate a TSR on the applicability of the Advanced Mixed Waste Assay System (AMWAS) for determining whether the contents of a waste barrel are classified as TRU. The AMWAS is a portable system that incorporates gamma-ray and neutron sensors to quantitate radioisotopes present in waste barrels. The AMWAS will support the BWID at the INEL by modifying existing drummed waste assay technology. A TSR was issued November 1991. Following review of this TSR, no additional funds were issued for this effort.

3.1.11 NDA/NDE Characterization of Mixed TRU/LLW Waste TSR—SF221206

The objective of this TTP was to generate a TSR on an active and passive (A&P) computer tomography (CT) drum scanner for contact-handled (CH) wastes. It combines the advantages offered by two well developed NDA technologies: gamma-ray spectrometry and CT. Together, these technologies offer to nondestructively and quantitatively characterize mixed waste forms. A TSR was issued November 1991. Following review of this TSR, funding was issued under TTP SF-221209.

3.1.12 NDA Characterization of TRU/LLW Waste Drums—SF221209

This activity is a follow up to the TSR generated in TTP SF221206. The objective of this TTP was to develop a prototype A&P CT drum scanner for CH wastes. It combines the advantages offered by two well developed NDA technologies: gamma-ray spectrometry and CT. Together, these technologies offer to nondestructively and quantitatively characterize radioactive and mixed waste forms.

3.1.13 SRL Characterization Technology—SR121201

The objective of this TTP was to generate a characterization status report on the applicability of site characterization of gas generation from TRU contaminated waste (see Appendix A). Characterization of the gases and the quantities produced is required to determine appropriate handling, treatment, and disposal technologies. This task will evaluate the gases produced by TRU waste in a controlled test environment. Gases will be sampled and quantified using gas chromography and mass spectrometry. This characterization report, which was published in May 1992, addresses requirements for in situ and onsite treatment processes for the remediation of DOE buried sites containing TRU waste.

3.2 Retrieval

3.2.1 Gas Contamination—AL021201

The objective of the TTP was initially to develop a TSR to the present methods and technical basis for monitoring, evaluating, and mitigating airborne hazards produced by buried waste retrieval operations. A TSR was issued on November 1991. Following review of the TSR, additional funds were issued for this activity. The main tasks included characterization and correlation of aerosol sources with specific BWID and decontamination and decommissioning activities; development of measurement techniques and instrumentation for source term characterization and monitoring; and evaluation and specification of monitoring equipment, evaluation of aerosol mitigation techniques, and development of operating procedures.

3.2.2 Cryogenic Retrieval

The objective of the cryogenic retrieval demonstration was to show how well waste can be retrieved and contamination can be contained by freezing the ground before retrieval. In addition to the freeze pipes, a series of temperature and moisture probes were installed to indicate when the soil/waste was frozen and measure the quantity or movement of moisture in the soil. The demonstration was performed between July and August 1992 at the INEL Cold Test Pit, which is located about 300 ft south of the south fence at the RWMC. The contractor chosen to demonstrate the technology, Sonsub Services, Inc. of Houston, Texas, performed the demonstration by freezing the ground using liquid nitrogen trickled down a series of freeze pipes inserted directly into the soil/waste. A gantry equipped with a series of overhead crane mounted tools (shears, grapple, jackhammer, and hydraulic jack) was positioned over the frozen area and frozen soil/waste ("popsicles") removed. As a result of the demonstration, it was concluded that cryogenic retrieval is feasible technology for buried waste retrieval. Specific conclusions of this demonstration include

- The remote capability of the tools was proven to work well for this application. The camera and video system provided full visual coverage from a remote location. Visual access to all positions in the excavation area was excellent, even in the cryogenic environment. Remote-based system for retrieval activities has been shown to be viable. The tools were positioned and articulated with relative ease. For the most part, the tools performed their intended functions, although there are improvements that could be incorporated into future generations of the hardware (discussed in Section 8.2 of the *Final Report for the Cryogenic Retrieval Demonstration*, EGG-WTD-10397).

- The concept of breaking out large ice columns or "popsicles" in waste with the freeze pipes was shown not to be feasible. However, the jackhammer was successful in loosening and removing the waste and frozen soil so that the grapple could remove the waste. Modifications to the jackhammer, including improved blade design, would be required to speed the removal operation. The shear was successful in cutting stainless steel and carbon steel pipes.

- Although dispersal of rare earth tracers occurred in some of the test pits, from visual observations the aerosolized soil particles did not remain suspended since the air cleared in a manner of seconds. This suggests the spread of respirable (< 5 um) particles was minimized, and the small dust particles were agglomerated by the freezing process. For those areas in the test pits where water was not added, the dust spread was at a maximum. Therefore, adding water not only improves the waste removal process but also reduces dust spread.

- Sensitive air monitoring measurements indicated that minimal amounts of rare earth tracer were dispersed during the excavation. Dysprosium was the only rare earth tracer detected (during excavation of the random dumped barrels pit). The dry side of the excavation showed concentrations well above the established background limit (29 ppm) of about 116 ppm. The wet side showed concentrations of only about 44 ppm. These readings indicated that adding water helped reduce the spread of dust and contamination.

- The specifically designed moisture probes used for the project showed a positive proof of concept. With further refinement, this technology promises to be useful in other retrieval and nonretrieval activities where accurate in situ soil moisture content data are needed.

- Water added to promote cohesion tended to migrate beyond the test pit boundary.

- Only cloth, paper, wood, and sludge were encountered during the demonstration. No metal or large objects were found, primarily because of limitations to the test schedule. The stacked drum region was not frozen and excavated, and the waste in the stacked box zone was compressed to a narrow seam at the bottom of the pit. This was not discovered until after testing was completed. As a result, challenging buried waste forms were not encountered; however, removal and sizing of the freeze pipes provided a good test for working with metal and large objects.

- Equipment reliability improved as testing progressed. Initially, there was poor equipment reliability. The equipment required constant maintenance. This was not due to poor quality, design, or fabrication but a limitation on the amount of time that was spent on shop testing and adjustment of the hardware. Reliability could easily be improved by increased pre-deployment testing. Additional accomplishments included

- Meeting Paper

    - "Buried Transuranic Waste Retrieval Using Cryogenic Techniques" submitted for Waste Management '93 in Tucson, Arizona.

3.2.3 Contamination Control—ID121210

The initial objective of this TTP was to develop a TSR. Following review of this TSR, additional funds were issued to develop and demonstrate contamination control systems to mitigate the spread of TRU contaminants during waste handling operations, such as retrieval of buried TRU waste. A conceptual design of the Rapid Monitoring Unit was completed and most counting equipment for the unit was procured. The unit is composed of four chambers: (1) a receiving and sample preparation room with soil driers and two class-A hoods, (2) an entrance foyer with sample storage, (3) a chamber to house the large area spectrometers, and (4) a chamber to house the U-L-shell X-ray device, central computer, and alpha continuous air monitor station. A conceptual design for the contamination control unit was completed and most essential hardware was procured. Demonstrations during FY-92 included a funnel dump test that used directed air flow to control dust spread during the waste retrieval dumping. This demonstration was completed on May 26-29, 1992. A conceptual design for an electrostatic enclosure was completed. Other accomplishments included

- Journal Article

    - "Rapid Monitoring of Soil, Water and Air Ducts by Direct Large-Area Alpha Spectrometry" submitted to the *Journal of Health Physics*

- Paper

    - "Cryofracture as a Tool for Preprocessing Retrieved Buried and Stored Transuranic Waste" at Waste Management '92 in Tucson, Arizona, March 1-5, 1992.

3.2.4 Paper Study on Inductively Coupled Plasma—CH121202

The objective of this TTP was to complete a literature review of nonradiometric methods for the determination of plutonium and americium. The need for this review was determined during the peer review of the Contamination Control and Retrieval Support TSRs. The literature review was completed by Ames Laboratory. The report was published on March 5, 1992 (see Appendix A).

3.3 Treatment

3.3.1 Super Critical Water Oxidation TSR—AL121208

The objective of this TTP was to generate a TSR on the applicability of using super critical water oxidation to destroy hazardous organics present in aqueous waste streams, storage containers, contaminated soils, and contaminated groundwater in the INEL's SDA at the RWMC. A TSR was issued on November 1991. Following review of this TSR, no additional funds were issued for this effort.

3.3.2 Ultrasonic Process for Detoxifying Groundwater—CH201202

The objective of this TTP was to develop an innovative ultrasonic process for effective destruction of chlorinated carbon compounds and other Resource Conservation and Recovery Act components in soil and groundwater. The project was structured to consist of three main tasks: (1) a laboratory research effort to gain an improved understanding of the process kinetics and identify novel process variations/concepts; (2) a process development effort to systematically acquire engineering data required for scale-up of the process from bench-scale to the demonstration phase and to perform engineering and economic evaluations of the process; and (3) a technical support effort to carry out preparation of technical reports, technology transfer activities, and as application for permits.

During FY-92 research activities were directed to concentrate on soil contaminated with chlorinated hydrocarbons. Most of the investigations conducted in FY-92 involved soil samples spiked with CCL_4, which is a compound found to be very resistant to such conventional technologies as biological treatment, ultraviolet irradiation, and trichloroethylene. Initial results from the bench-scale experiments clearly demonstrated that the concentration of the residual CCL_4 in the soil could be successfully reduced below the 1-ppm level. Subsequent experiments have been completed to generate the kinetic data at several temperature levels and to investigate the effects of process parameters, such as the ultrasonic energy intensity, solid content in the soil slurry, and pH value of the soil slurry. Of the process parameters investigated, the energy intensity and solids concentration have been found to have the greatest effect on the desorption/destruction of the contaminant in the soil samples. For the soil evaluated, it appears an optimal combination exists of these two important process parameters. Other process parameters evaluated, such as the operating temperature and the pH value of the soil slurries, were found to have insignificant effects on the soil detoxification, suggesting that no special pH adjustment or temperature control would be needed to maintain the effectiveness of this process. It was also observed in the settling experiments performed that the coarse sandy materials in the bottom section of the settling column are relatively free from contamination, strongly suggesting that only the small fraction of the light silt/clay materials suspended in the water phase needs detoxification treatment. The inclusion of a simple soil sedimentation operation and simple soil-washing operation would result in a substantial reduction in the amount of soil materials to be treated. This improvement should also lead to substantial reduction in the size of the ultrasonic reaction chamber and power requirement with a corresponding reduction in capital investment for the system.

Other accomplishments in FY-92 included the construction of a bench-scale continuous-flow ultrasonic processing system, which can be operated at pressures up to 10 bars; active interactions and exchange of information with private companies and other Federal agencies occurred that concerned establishing joint cooperative research and development agreements; and

- Journal Article
  - "Ultrasonic Destruction of Chlorinated Compounds in Aqueous Solutions," *Environmental Progress, 11*(3):1950201, August 1992

- Meeting Paper

  - "Ultrasonic Process for Detoxification of Groundwater," American Institute of Chemical Engineers 1991 Annual Meeting, Los Angeles, California, November 18–22, 1991.

3.3.3 In Situ Vitrification—ID111202

The objective of this TTP was to resolve technical issues associated with the vapor release and migration of volatile organics from the in situ vitrification (ISV) melt zone. The completion of three ISV laboratory personnel qualification tests was initiated following several delays. Refinements to the TOUGH code were initiated to predict the extent of contaminant migration around a melt zone. Procurement of the necessary experimental apparatus supporting the TOUGH code and a verification/validation plan for the code was completed. Additional accomplishments were

- Demonstrations

  - Laboratory-scale and personnel qualification tests, ISV Laboratory Testing Facility, INEL Test Area North, August 1992.

3.3.4 Biological Destruction of Nitrates—ID121204

The objective of this TTP was to determine the applicability of the biological denitrification process to buried wastes. This determination will result in data that will enable a cost and treatment capability comparison between this technology and other proposed technologies. Six strains of extremely halophilic (salt-tolerant) denitrifying bacteria were acquired and screened for applicability to this specific processing application. Denitrification is being accomplished at up to 25% salt concentrations (sodium plus potassium) in 1-L continuously stirred tank reactors, using simulated nonradioactive waste. A preliminary process flowsheet, incorporating observations of denitrification capabilities by these extreme halophiles, has been developed with the goal of developing a transportable pilot plant. An additional accomplishment included

- Meeting Paper

  - "Denitrification of Nitrate Waste by Alkalophilic Halophiles," 92nd American Society for Microbiology General Meeting, New Orleans, Louisiana, May 26-30, 1992.

3.3.5 Pad A Treatability—ID121205

The objective of this TTP was to investigate and evaluate treatment and separation technologies applicable to the remediation of the plutonium contaminated salts and soils located at the Pad A at the INEL's RWMC. Additional accomplishments were

- Demonstration

  - "Bench-scale Testing of Pad A Drum Containing Nitrate Salts," NRT, San Diego, California, July 29–31, 1992

- Poster/Paper Session

  - "Pad A Radioactively Contaminated Nitrate Salt Treatment Technologies and Technology Selection Efforts," Spectrum '92, Boise, Idaho, August 26, 1992.

3.3.6 Thermal Processing Methods for TSR—ID121207

The objective of this TTP was to conduct an independent review of on-hold Thermal Treatment TTPs and maintain a holding account for the funding that was redistributed to selected TTPs. Nine candidate TSRs were reviewed for technology evaluation and applicability, and subsequent funding was issued based on the recommendations of the review committee.

3.3.7 Ice Electrodes—ID121211

The objective of this laboratory investigation of the ice electrode was to determine the viability of using an electrode coated with a thin layer of ice in the electrolytic removal of heavy metals from waste solutions. This study focuses on developing an understanding of electrochemical behavior at the ice layer.

A small scale laboratory apparatus was constructed that would allow a thin layer of ice to be formed and maintained on a metal substrate. Electrochemical impedance studies of this ice layer indicated a highly dynamic, rapidly changing surface. Initial ice formation resulted in a frost-like ice that consisted of a network of ice dendrites and unfrozen solution. The ice/solution mixture gradually froze to become a layer of crystal clear ice surrounding the metal substrate.

A variety of metals were electrodeposited at the ice electrode to determine which metals can and cannot be reduced at this surface. Electrodeposition of copper, silver, zinc, cobalt, cadmium, lead, and chromium was easily accomplished at this electrode. The metals electrodeposited as fine grain metal powders that were trapped in the ice layer. The results indicated metals that electrodeposit at typical solid electrodes can also be deposited at an ice electrode.

In addition to the metals listed above, tungsten and uranium, which are difficult to electrodeposit, were removed from solution at the ice electrode by a process described as electroprecipitation. The bright yellow uranium precipitate and blue tungsten precipitate were, like the electrodeposited metals, readily trapped in the ice. The results of these experiments suggested that a potential applied at an ice electrode may alter the local environment so metals that cannot be electrodeposit at typical electrodes may be precipitated without the need to place additional chemicals in the solution.

The results of the various electrochemical studies of the ice electrode indicated that the preferred form of the ice electrode is a metal substrate coated with a thin layer of frost-like ice. In this form, the ice offered little restriction to the normal course of electrodeposition reactions. The ice coating was found to reduce the active surface area of the electrode at the onset of deposition; however, once deposition was initiated, the active surface area increased dramatically because of the particulate nature of the electrodeposit.

The most notable difference between electrodeposition at the ice electrode and a typical solid metal electrode was that deposited metal particulates were trapped in the ice rather than deposited in a smooth layer. This phenomenon had several advantageous effects. The particulate nature of the trapped metal resulted in each growing crystal of metal becoming a new microelectrode that automatically enlarged the active surface area of the electrode. This enlargement assisted in maintaining the deposition rate as the metal concentration declines. The fact that the metal was trapped in the ice, rather than electrodeposited as a smooth layer, meant that metal recovery was a simple matter of allowing the ice to melt. The standard electrodeposition process required further processing to remove the deposited metal from the electrode and renew the electrode surface. A fresh ice electrode surface was easily be obtained by melting and refreezing the ice because the underlying substrate was unaltered by the deposition process.

3.3.8 Evaluation of Joule Melter and Plasma Arc Processes TSR—ID121215

The objective of this TTP was to generate a TSR on the status of the INEL Thermal Processing Technologies (TPT) demonstration project. The TPT demonstration project does not represent a particular thermal technology but is a systems selection and development/demonstration engineering project for an ex situ thermal treatment process. The TPT project was structured to provide a technically thorough and objective identification and evaluation of available thermal processing technologies relative to INEL buried waste treatment needs, followed by the conceptual design, advanced development, and execution of a pilot-scale thermal treatment systems demonstration. Based upon initial thermal technologies screening efforts and buried waste preliminary systems design studies, the initial focus of the TPT project was on evaluation of melter systems technologies. A TSR, entitled "Thermal Processing Technologies," was issued in November 1991. Following review of this TSR, no additional funding was issued to this effort.

3.3.9 Base Catalyzed Destruction of PCBs—OR101202

The objective of this TTP was to determine if base catalyzed destruction of chlorinated carbon compounds is an appropriate technology for treatment of DOE mixed wastes. Laboratory feasibility studies will be done using a surrogate waste containing species representative of DOE mixed waste. The fate of the surrogate radionuclides will be determined, and the destruction of chlorinated carbon compounds will be verified.

3.3.10 Butte Plasma Centrifugal Furnace—PE021201

The objective of this TTP was to generate a TSR on the applicability of using the Retech plasma centrifugal furnace (PCF) to ex situ treat a variety of mixed waste through thermal destruction of organics and immobilize inorganics in a low leachable slag that is suitable for final disposal. A TSR, "Plasma Arc Furnace Experiment," was issued in November 1991. Following review of this TSR, additional funding was issued for this effort under TTP PE021203.

3.3.11 Buried Stored TRU Plasma Treatment Process—PE021202

The initial objective of this TTP was to develop a TSR for the proposed Plasma Hearth Process (PHP). Following review of this TSR, additional funding was issued to demonstrate how the PHP can be adapted to the processing of nearly all DOE wastes, such as site remediation wastes (buried waste), stored waste, and newly generated waste. The PHP demonstration project will be accomplished in several phases. The first phase of the demonstration will evaluate the ability of the PHP to rate a simulated waste material. Phase 2 will be based on the results and recommendations of the Phase 1 tests. Phase 2 will (1) determine the range of applicability of this technology in terms of the types of wastes that can be treated, (2) demonstrate the ability of this technology to meet or exceed existing treatment standards, (3) optimize the process configuration for DOE wastes, and (4) obtain the information required to design a TRU or LLW treatment process. Phase 3 will consist of completing the engineering design for constructing and demonstrating a full-scale, TRU compatible, treatment process. Additional accomplishments were

- Demonstration
  - Plasma test demonstration at Retech facility, Ukiah, California, July 29, 1992
- Report
  - TSR, "Buried/Store TRU Plasma Treatment," issued November 1991.

3.3.12 Butte Plasma Arc Furnace—PE021203

The objective of this TTP was to establish the efficiency of the PCF to destroy organics and immobilize inorganic hazardous and radioactive waste compounds. The PCF can treat heterogenous unconsolidated feeds including organic materials, sludges, metals, rock, concrete, soils, and other types of waste. The PCF can also be used to treat lesser quantities of heterogeneous nonsorted waste directly or can be used as part of an integrated waste treatment system to stabilize final waste from other treatment processes. In addition to treatment of buried mixed waste, the PCF can be used to stabilize (by vitrification) other waste that contains heavy metals and/or radionuclides such as sludges, concentrates from soil treatment, or processing residues. The pretest tasks and facility preparation were completed. Cerium oxide (plutonium surrogate) tests were completed in November 1992 and the results will be made available in mid-January 1993.

3.3.13 Graphite DC Arc Plasma and Glass Melter—RL321211

The initial objective of this TTP was to develop a TSR for the graphite DC arc thermal treatment technology. Following review of the TSR, additional funding was issued to demonstrate (1) the applicability of graphite DC arc thermal treatment equipment specifically for melting and/or vitrifying buried waste at DOE sites and (2) to develop a DC arc graphite electrode pyrolytic plasma/glass melter system in which graphite electrodes technology is combined in an integral system with established glass melter technology, which takes advantage of the capabilities of joule-heated melting. Additional accomplishments were

- Demonstrations
  - 14 test melts, Mark I Engineering Scale DC Arc Melter Furnace at the Massachusetts Institute of Technology, June–August 1992

- Report

    - TSR, "Graphite Electrode DC Arc Plasma and Glass Melter," issued November 1991.

3.3.14 Vitrification of Mixed TRU Waste—RL321212

The initial objective of this TTP was to develop a TSR. Following review of this TSR, additional funding was issued for this effort to complete testing on simulated INEL buried wastes that can be used as a basis for definition of a system applicable to ERWM needs; complete functional and operating requirements that include the results of testing; and provide technical support for assessing vendor proposals. These objectives will be met by two subtasks. Subtask 1, Melting Technology Development and Testing Support, will complete a TSR and melting tests on surrogate wastes and anticipated variations that are crucial for developing melter specifications. Subtask 2, Joule Heated Melter Vendor Selection Support, will support the INEL in selecting suitable commercial suppliers for vitrifying the INEL's buried wastes. A TSR, "Thermal Processing Treatment: Joule Heater Melter," was issued in November 1991.

3.3.15 Treatment Technology for TRU Waste—RL401204

The objective of this TTP was to prepare a TSR for the applicability of establishing a bench-scale screening test program for thermal treatment technologies proposed for inclusion in the BWID or the Mixed Waste Integrated Program process flow sheets. Existing equipment and testing procedures established during FY-91 will provide an array of pretreatment technology test systems for identifying process steps required for specific radioactive mixed waste streams when treated by the various thermal technologies. A technology screening program at the bench-scale will facilitate the screening of the wide variety of thermal treatment technologies that are commercially available or in near-term development status on an expeditious schedule, which enables timely and flexible technology selection decisions for integrated demonstration projects. A TSR, "Thermal Treatment Technologies for Radioactive Mixed Waste," was issued in October 1991. Following review of this TSR, no additional funding was issued for this effort.

3.3.16 Monolithic Confinement—RL421212

The primary objective of this TTP was to test, evaluate, and demonstrate materials capable of encapsulation of contaminants for long-term site closure of the RWMC with application to other similar disposal areas within the DOE complex. The secondary objective is to design, develop, fabricate, test, and demonstrate equipment for placement of encapsulates into fractured and granular contaminated media below the RWMC.

Accomplishments in FY-92 include engineering and procurement of a full-scale field operable pressure injection module. This unit will be coupled with an existing prototype materials transport, homogenization, and pumping system for encapsulant placement. Design and operational modifications were made to the prototype system for operational compatibility with the placement/injection module.

In preparation for testing and demonstration of the coupled system in FY-93, draft documentation and approval documents were written and submitted to the BWID. Site investigations were completed with the task and BWID staff for selection of a demonstration test site. A cold test site was identified for FY-93 demonstration, and a TSR was issued in April 1992. Equipment procurements were initiated during FY-92.

3.3.17 Mechanics in Subsurface—SF121201

The objective of this TTP was to provide an expert consultant to the Monolithic Confinement, TTP RL421212.

3.3.18 Molten Salt-Processing of Mixed TRU/LLW Waste TSR—SF001201

The objective of this TTP was to generate a TSR showing the applicability of using molten salt oxidation technology as a method of treating mixed wastes. The molten salt oxidation process is based on the use of a molten turbulent bed of salt, such as sodium carbonate, as a heat transfer and reaction medium. Because of its very high destruction efficiency, acidic gases, such as hydrochloric acid produced from chlorinated organic compounds, are rapidly neutralized and absorbed by the alkaline salt. An extensive data base exists to demonstrate the ability of this technology to destroy wastes. A TSR, "Molten Salt Waste Oxidation Process," was issued in December 1991. Following review of this TSR, no additional funding was issued to this effort.

3.3.19 TRU Waste Treatment Methodology—SR101202

The objective of this TTP was to develop technologies to prevent the release of TRU contamination during remediation of DOE buried waste sites containing TRU wastes. The application will include development of technologies to contain TRU contaminates during retrieval. A TSR will be generated and submitted to BWID. An additional accomplishment included

- Report
  - TSR, "TRU Waste Treatment Methodology," issued in June 1992.

3.4 Programmatic

3.4.1 BWID Program Coordination—ID111201

The objective of this TTP was to provide support for the general planning, coordination, and management for BWID implementation. The Program Office, referred to in Section 2, was created and organized to accomplish this task. The BWID Plan, Program Management Plan, and other guidance documents were published to communicate to investigators and team members the preferred methods of operation (see Appendix A). The Preparedness Checklist and Action Plan were developed to gather information needed by the BWID support staff to accomplish field deployment. Other accomplishments for this TTP included

- Poster Session
  - BWID poster displayed at Spectrum '92 in Boise, Idaho, August 24, 1992

- Presentations

  - "BWID Overview" at Waste Management '92 in Tucson, Arizona, March 2, 1992

  - "BWID Overview," "Retrieval Needs," and "Treatment/Processing Needs" at the BWID Technology Workshop in Idaho Falls, Idaho, June 23, 1992

  - "BWID Requirements Associated with the Buried Waste Robotics Program" and "DOE Complex Buried Waste Needs" at the Third DOE Industry/University/Lab Forum on Robotics for Environmental Restoration, Waste Management, and Waste Minimization in Albuquerque, New Mexico, July 28-30, 1992

  - "Solving Technology Needs for Retrieval and Processing of Buried Waste Across the DOE Complex" at the American Institute of Chemical Engineers 1992 Summer Meeting, Minneapolis, Minnesota, August 9, 1992

  - "Hazardous Waste Treatment and Remediation" panelist at the National Technology Initiative Environmental Technology Workshop, Las Vegas, Nevada, September 2-4, 1992.

3.4.2 Systems Analysis of DOE Buried Waste—ID121202

The objective of this TTP was to identify and evaluate comprehensive systems for the cradle-to-grave remediation of TRU-contaminated buried wastes. A significant accomplishment for this TTP was the development of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), performance-based technology selection filter (PBTSF). The PBTSF is a tool that represents a formal method for selecting and rating candidate remediation technology process options. Two components applied as part of this method include screening candidate systems against system requirements and conducting tradeoff studies that rate technology process options against performance measures based on CERCLA selection criteria. This approach allows direct comparison between and among various systems and their constituent technologies. This technique was demonstrated on a Superfund remediation site at Teledyne Wah Chang in Albany, Oregon. Appendix A contains a list of reports resulting from this TTP. Other accomplishments included

- Poster Session

  - "BWID System Design Study" Waste Management '92, Tucson, Arizona, March 1-5, 1992

  - "Performance-Based Technology Selection Filter" at Spectrum '92 in Boise, Idaho, August 27, 1992.

- Presentation

  - "Performance-Based Technology Selection Filter Demonstration" at American Institute of Chemical Engineers Summer Meeting, Minneapolis, Minnesota, August 1992

3.4.3 Institutional Assessment: Public Acceptance and Regulatory Feasibility of BWID Technologies—RL321207

The objective of this TTP was to support BWID by evaluating and enhancing the public acceptability and regulatory feasibility of the systems and technologies being developed. Under this project, Battelle evaluated the regulatory requirements for deploying BWID technologies (technical as well as public involvement requirements). In assessing regulatory acceptability and how it can be enhanced, Battelle drew lessons for the EPA's selection or lack of selection of innovative remedial technologies in its Superfund records of decisions. Furthermore, Battelle conducted an analysis of the EPA Superfund feasibility study process. These assessments all support BWID's effort to have its technologies acceptable to the regulatory community and general public, which are two essential criteria to enhance the ultimate deployability of the BWID technologies. Appendix A provides reports published as a result of this TTP.

3.4.4 DOE Complex Buried Waste Assessment—RL421213

The objective of this TTP was to summarize those characteristics for buried waste that establish the technical basis for actions chosen to remediate buried waste. Needs assessments, roadmaps, technical support to BWID from the Hanford Site and DOE complex, and an integrated Hanford team to support the BWID system design study are provided. Appendix A provides reports published as a result of this TTP.

4. FINANCIAL ASSESSMENT

Attached is the funding summary for the FY-92 BWID Program (see Table 1). Data for this summary were obtained from DOE's September Financial Plan and September Progress Tracking Report. Values were validated for the INEL TTPs as of December 1992. Validation of the remaining TTPs was not possible before publication of this document.

Table 1. BWID FY-92 financial summary.

BWID FY92 FINANCIAL SUMMARY					
TTP NO.	TTP TITLE	SITE	FY92 FUNDS	FY92 COSTS	CARRY OVER
AL021201	Gas Contamination	ITRI	225	152	73
AL121208	Super Critical Water Oxidation (TSR)	LANL	25	18	7
AL121209	Improve TRU Waste Assay	LANL	825	797	28
AL121210	Realtime Monitoring (TSR)	LANL	25	22	3
AL221202	Electrostatic Aerosol TSR	SNL	25	5	20
AL911201	Non-Intrusive Sensing	Geo	456	456	0
CH121201	NDE/NDA Peer Review	Ames	160	88	72
CH121202	Paper Study on ICP	Ames	15	15	0
CH201202	Ultrasonic Detoxifying Groundwater	ANL	177	174	3
ID111201	BWID Program Coordination	INEL	3388	3128	260
ID111202	In Situ Vitrification	INEL	369	339.1	29.9
ID121112	Non-Intrusive Characterization Studies	INEL	372	70	302
ID121202	Systems Analysis of DOE Buried Waste	INEL	900	799.2	100.8
ID121203	Cryogenic Retrieval	INEL	2500	2385	115
ID121204	Biological Destruction of Nitrates	INEL	200	194.7	5.3
ID121205	Pad A Treatability Study	INEL	400	317	83
ID121207	Thermal Processing Methods for TSR	INEL	180	0	180
ID121210	Contamination Control	INEL	960	828	132
ID121211	Ice Electrodes	INEL	350	281	69
ID121212	RHMMS	INEL	600	575	25
ID121213	Field Demonstration of Char.Technologies	INEL	635	195	440
ID121215	Evaluation of Joule Melter a (TSR)	INEL	27	27	0
OR021201	Linac-Based Characterization (TSR)	ORNL	25	9	16
OR101202	Base Catalyzed Destruction of PCBs	ORNL	394	168	226
OR121201	Luminescence Spot Test (LST)	ORNL	280	239	41
PE021201	Butte Centrifugal Plasma Furnace	MSE	430	291	139
PE021202	Buried Stored TRU Plasma Treatment	MSE	1275	14	1261
PE021203	Butte Plasma Arc Furnace	MSE	1020	12	1008
RL321207	Regulatory and Public Acceptance	PNL	120	105	15
RL321210	Advanced Mixed Waste Assay System	PNL	20	15	5
RL321211	Graphite DC Arc Plasma & Glass Melter	PNL	656	273	383
RL321212	Vitrification of Mixed TRU Waste	PNL	475	523	-48
RL401204	Treatment Techology for TRU Waste	WHC	77	48	29
RL421212	Monolithic Confinement	WHC	445	122	323
RL421213	DOE Complex Buried Waste Assessment	WHC	400	321	79
SF001201	Molten Salt-Processing	LLNL	10	10	0
SF121201	Mechanics in Subsurface	LLNL	5	5	0
SF221206	NDA/NDE Characterization TSR	LLNL	25	59	-34
SF221209	NDA Characterization TRU/LLW	LLNL	500	346	154
SR101202	TRU Waste Treatment Methodology	WSRC	100	44	56
SR121201	SRL Characterization Technology	WSRC	200	155	45
	TOTALS		19271	13625	5646
Note: Values are in $1000s					
Note: Values are from September Progress Tracking Reports					
Note: Idaho Values have been corrected as of December 1, 1992					

Appendix A

Buried Waste Integrated Demonstration FY-92 Reports

Appendix A

Buried Waste Integrated Demonstration
FY-92 Reports

TTP #	TTP TITLE	REPORT #, TITLE, ABSTRACT, and DATE
ID-111201	BWID COORDINATION	EGG-WTD-9752 Buried Waste Integrated Demonstration: Selection of Potential Demonstration Locations. The first step towards identifying primary Buried Waste Integrated Demonstration locations is the selection of potential demonstration sites within the Subsurface Disposal Area. The sites selected are Pits 4, 5, 6, and 9, containing transuranic waste of Rock Flats origin, the Acid Pit, and Pad A. The criteria and methodology for selection of these sites, as well as a description of the wastes present in each area, are included in this report. At a later date, technology-specific demonstration locations will be selected from these six potential sites. The selected locations will be used as necessary to demonstrate technologies whose potential abilities may be optimal on waste forms present at these identified locations. November 1991.
		EGG-WTD-9800 Buried Waste Integrated Demonstration Program Technology Test Plan Guidance. The Technology Test Plan Guidance provides instructions for principal investigators preparing test plans to demonstrate technologies supported by the Buried Waste Integrated Demonstration Program. February 1992.
		EGG-WTD-9870 Buried Waste Integrated Demonstration Plan, September 1991, December 1991. The plan of activities for BWID to support the environmental restoration objectives of the Department of Energy, including objectives, organization, roles and responsibilities, and the process for implementing and managing BWID including project planning and control. Key functions in support of demonstrations are also presented.
		EGG-WTD-10081 Buried Waste Integrated Demonstration Configuration Management Plan, February 1992. This document defines plans for the configuration management requirements for the BWID Program. Since BWID is managed programmatically by the WTDD, WTDD Program Directive 1.5 (Document Preparation, Review, Approval, Publication, Management, and Change Control) is to be followed for all internal EG&G Idaho, Inc., BWID programmatic documentation.
		EGG-WTD-10104 Buried Waste Integrated Demonstration Program Technology Evaluation Report Guidance, February 1992. The Technology Evaluation Report Guidance provides instructions for preparing technology evaluation reports for demonstrations supported by the BWID Program. This guidance will ensure completeness in the development of the technology evaluation report. Principal investigators are responsible for the development of the technology evaluation report in accordance with this guidance.
		EGG-WTD-10105 Integrated Test Schedule for Buried Waste Integrated Demonstration, May 1992. The Integrated Test Schedule incorporates the various schedules the Buried Waste Integrated Demonstration (BWID) supports into one document. This document contains the Federal Facilities Agreement and Consent Order schedules for the INEL, Hanford Reservation, Oak Ridge Reservation, and Fernald Environmental Materials Center. Included in the Integrated Test Schedule is the BWID "windows of opportunity" schedule. Schedules for the BWID sponsored technology task plans are categorized by technology area and divided by current fiscal year and out-year. Total estimated costs for BWID technology task plans for FY-92 through FY-97 are $74.756M.

TTP #	TTP TITLE	REPORT #, TITLE, ABSTRACT, and DATE
ID-111201	BWID Coordination (Continued)	EGG-WTD-10143 Facilities Evaluation Report, May 1992. The Buried Waste Integrated Demonstration (BWID) is a program of the Department of Energy Office of Technology Development whose mission is to evaluate different new and existing technologies and determine how well they address DOE community waste remediation problems. Section 1 of this report describes the tasks supported by BWID, determines if a technical demonstration is proposed, and if so, identifies the support requirements requested by the TTP Principal Investigators. Section 2 is an evaluation identifying facility characteristics of existing INEL facilities that may be considered for use in BWID technology demonstration activities.
		EGG-WTD-10266 Buried Waste Integrated Demonstration Technology Preparedness and Status Report Guidance, June 1992, A Technology Preparedness and Status Report is required for each Technical Task Plan funded by the Buried Waste Integrated Demonstration. This document provides guidance for the preparation of that report. Major sections of the report are: (1) Need for the technology, (2) Objective of the demonstration, (3) Technology description and readiness evaluation, (4) Demonstration requirements, and (5) Preparedness checklist and action plan.
		WTD-92-038 Buried Waste Integrated Demonstration Project Management Plan, May 1992, This document presents the plan of activities for the Buried Waste Integrated Demonstration (BWID) Program which supports the environmental restoration (ER) objectives of the DOE complex. This plan discussed the objectives, organization, roles and responsibilities, and the processes for implementing and managing BWID.
		WTD-92-040 Buried Waste Integrated Demonstration Waste Minimization Plan, May 1992, The BWID Program is in full support of the INEL pollution prevention objective to minimize all forms of waste, including hazardous waste. The present objective of the BWID Program with respect to waste minimization is to conduct operations to minimize the generation of waste in all BWID activities, including procurement of hazardous material, test operations, and waste handling disposal. This plan is intended to be a living document with the ability to change as technologies are added to the program and as demonstrations of existing technologies are completed.
		EGG-WTD-9928 Buried Waste Integrated Demonstration Technology Integration Process, April 1992.
		EGG-WTD-10400 Training Requirements and Responsibilities for the Buried Waste Integrated Demonstration at the Radioactive Waste Management Complex, September 1992.
RL-321207	Institutional Assessment: Public Acceptability and Regulatory Feasibility of BWID Technologies	BHARC-800/92/005 Regulatory Requirements for Deploying Integrated Demonstration Technologies, February 1992. This report describes the regulatory requirements (both technical and public involvement) for deployment of technologies developed through BWID.
		Selection of Innovative Remedial Technologies: Lessons from EPA Superfund Records of Decision, June 1992
		Selection of Innovative Remedial Technologies: An analysis of the EPA Superfund Feasibility Study Process, June 1992
RL-421213	DOE Complex Buried Waste Assessment	PNL-XXX Technology Needs for Remediation: Hanford and Other DOE Sites, May 1992

TTP #	TTP TITLE	REPORT #, TITLE, ABSTRACT, and DATE
ID-121210	Contamination Control	EGG-WTD-10255 Electrostatic Curtain Studies, May 1992. This report presents the results of experiments using electrostatic curtains (ESCs) as a transuranic (TRU) contamination control technique. Three experiments were conducted. The first was with uncontaminated INEL soil, the second used contaminated soil containing plutonium-239, and the third was uncontaminated INEL soil spiked with plutonium-239. Results of the ESC material study indicated that grounded conductive materials collect less dust and plutonium than grounded antistatic or insulative materials.
		Contamination Control, Technology Status Report, November 1991, Contamination control during TRU waste-handling operations, including technology description, research-to-date, readiness for demonstration, projected performance, regulatory and public acceptance, and demonstration requirements.
		EGG-WTD-10314 Sensitivities of Five Alpha Continuous Air Monitors for Detection of Airborne ^{239}Pu, July 1992, Results of measurements of the sensitivities of five alpha continuous air monitors (CAMs) for detection of airborne ^{239}Pu are presented. Four commercially available alpha CAMs (Kurz model 8311, Merlin Gerin Edgar, RADeCO model 452, and Victoreen model 758) and a prototype alpha CAM currently in use at Argonne National Laboratory-West (ANL-W) were tested sampling natural ambient air and laboratory-generated atmospheres laden with either blank dust or dust containing nCi/g concentrations of ^{239}Pu. Cumulative alpha spectra were stored at 30 or 60 minute intervals during each sampling and were subsequently analyzed using three different commonly used alpha spectrum analysis algorithms. The effect of airborne dust concentration and sample filter porosity on detector resolution and sensitivity for airborne ^{239}Pu are described. When airborne dust concentrations were below 0.008 $\mu g/L$ and one-hour long counting intervals were used, the ANL-W and Kurz CAMs had by far the best sensitivities for airborne ^{239}Pu. The average lower limit of detection (LLD) concentrations for these two CAMs were 0.00045 and 0.003 pCi/L, respectively. The best average LLDs for the Merlin Gerin, RADeCO, and Victoreen CAMs under these same conditions were all approximately a factor of twenty higher than the LLD for the ANL-W CAM. While the LLDs of the ANL-W and Kurz CAMs were unaffected by the choice of analysis algorithm, the LLDs for the RADeCO and Victoreen CAMs showed some dependence on which algorithm was used for analysis. The two-stage virtual impactor installed in the ANL-W CAM and the inertial plate impactor installed in the Kurz CAM are responsible for their remarkably low detection limits. However, in the case of the Kurz CAM, which collects particulates directly on the face of a solid-state silicon detector, only about 18% of the airborne ^{239}Pu activity that entered the Kurz CAM remained fixed to the surface of the silicon detector following the completion of sampling. The inferior particle retention efficiency of the Kurz CAM makes it a poor candidate for quantitative measurements of airborne ^{239}Pu. Based on its excellent sensitivity for airborne ^{239}Pu and extensive use at ANL-W, the ANL-W CAM is recommended for monitoring air quality during future waste retrieval operations conducted at the Idaho National Engineering Laboratory Radioactive Waste Management Complex.

TTP #	TTP TITLE	REPORT #, TITLE, ABSTRACT, and DATE
ID-121210	Contamination Control (Continued)	EGG-WTD-10360 Fugitive Dust Control Experiments Using Directed Airflow in Dumping Operations, July 1992. Experiments were conducted to evaluate the degree of dust control for using directed airflow in a funnel during dumping operations. Retrieved buried transuranic waste or overburden soils are expected to require focusing the retrieved material into a transporter box with a funnel and control of transuranic-contaminated dust at the funnel is mandatory. In these experiments, the Idaho National Engineering Laboratory soil was dumped into a full-scale funnel (capable of focusing waste into a 4 x 4 x 8 ft box) that was specially equipped with a directed airflow into the funnel. The degree of dust control was determined by comparing collected dust on filters in high volume samplers (strategically located) for a baseline case with no airflow to cases with airflow. Tests involving airflow into the funnel spanned a range of airflows at the opening between 15-100 linear feet per minute. The basic result is that the directed airflow concept is adequate to control dust spread during dumping.
		EGG-WTD-10080 Rapid Monitoring of Soil, Smears, and Air Dusts by Direct Large-Area Alpha Spectrometry, January 1992. Experimental conditions to permit rapid monitoring of soils, smears, and air dusts for transuranic (TRU) radionuclides under field conditions are described. The monitoring technique involves direct measurement of alpha emitters by alpha spectrometry using a large-area detector to identify and quantify the radionuclides present. The direct alpha spectrometry employs a circular gridded ionization chamber 35 cm in diameter which accommodates either a circular sample holder 25 cm in diameter or a rectangular one 20 by 25 cm (8 x 10 in). Some results obtained are described.
		Design Input Document for Local Ventilation System to Minimize Contamination Spreaduring Waste Retrieval, Letter Report, April 1992.
		EGG-WTD-10354 Fugitive Dust Control Experiments Using Soil Fixatives on Vehicle Traffic Surfaces, August 1992.
		EGG-WTD-10450 Pre-Conceptual Design Report for the Electrostatic Enclosure, September 1992.
		Preliminary Design Specification for the Rapid Monitoring Unit, Letter Report, September 1992.
		Preliminary Design Specification for the Contamination Control Unit Engineering Design File, Letter Report, September 1992.
		WTDCC0001-003 Contamination Control Unit (CCU) Engineering Design File, September 1992.
		Design Features of the Rapid TRU Monitoring Laboratory, Letter Report, September 1992.
ID-121205	Pad A Treatability Study	WTD-91-030, Final Technology and Vendor Evaluation Report Pad A Treatability Study Project, October 1991. Identification of technologies to support the RI/FS activities and selection of technologies to be deployed in the Pad A Treatability Study Project, based on methods and evaluations discussed in WTD-91-029.

TTP #	TTP TITLE	REPORT #, TITLE, ABSTRACT, and DATE
ID-121205	Pad A Treatability Study (Continued)	WM-ERP-92-013 Rev. 0, Test Plan for Sampling Pad A Nitrate Salt Drum, March 1992.
ID-121212	Radiological and Hazardous Measurements Systems	Radiological and Hazardous Material Measurement System, Technology Status Report, November 1991
		EGG-WTD-10256 Rapid Assay of Plutonium in Soils by Passive L X-Ray Counting, May 1992.
		A Slow Neutron Interrogation Facility, Letter Report, May 1992.
		A Preliminary Design Specification for Passive Gamma Screening of Radioactive and Hazardous Material, Letter Report, June 1992.
		A Preliminary Design Specification for Passive Gamma Screening of Radioactive and Hazardous Material, Letter Report, July 1992.
		Radiological and Hazardous Material Measurement System Thermal Neutron Capture Design Specification, Letter Report, August 1992.
		Radiological and Hazardous Material Measurement System Passive/Active Neutron Design Specification, Letter Report, August 1992.
		EGG-WTD- Radiological and Hazardous Material Measurement System, September 1992.
ID-121202	Systems Analysis	EGG-WTD-9594, Preliminary Systems Design Study Assessment Report, Volume 4: Leach Resistant/High Integrity Structure Concepts, October 1991, Three system concepts that produce a stabilized and confined waste form achieved by in-place treatment techniques, known as Waste Form 2, are described, assessed and evaluated. Melting and Incineration with Low-Level Waste Presort Systems, Melting and Incineration with Low-Level Waste Postsorting Systems, and In Situ Vitrification and Retrieval Processing Systems fall in this category. Volume 5: Land Disposal Compliance and Hydrogen Generation Restricted Concepts, November 1991, Outlined in Volume 1. Volume 6: Waste Isolation Pilot Plant and Transportation Package Acceptable Concepts, January 1992, Outlined in Volume 1. Volume 7: Subsystem Concepts, January 1992, The SDS results are published in eight volumes. Volume I contains an executive summary. Volumes III through VII contain detailed descriptions of twelve system and four subsystem concepts. Volume 8: Appendixes, January 1992, Volume VII contains the appendixes for Volumes I through VII.
		Systems Analysis Technology Design Files, SA-2.0, Rev. 1, System Requirements, January 1992; SA-3.1, Retrieval/Ex Situ Thermal Treatment Configuration Options, January 1992; SA-3.2, Retrieval/Chemical Oxidation and Solidification Configuration Option, February 1992; SA-3.3, In Situ Vitrification/Retrieval configuration Option, February 1992.
		EGG-WTD-9989 Performance-Based Technology Selection Filter Description Report, May 1992.

TTP #	TTP TITLE	REPORT #, TITLE, ABSTRACT, and DATE
ID-121202	Systems Analysis (Continued)	EGG-WTD-10194 Performance-Based Technology Selection Filter Application Report for Teledyne Wah Chang Albany Operable Unit Number One, May 1992.
		EGG-WTD-10204 INEL Operable Unit 7-13 Retrieval/Ex Situ Thermal Treatment configuration Options, August 1992.
ID-121203	Cryogenic Retrieval	EGG-WTD-10061, Conceptual Design Report for Cold Test Pit Weather Shield, February 1992, The buried waste Cold Test Pit, located about 700 ft south of the Idaho National Engineering Laboratory (INEL) Radioactive Waste Management Complex (RWMC), was developed in 1988. The purpose of the Cold Test Pit is to provide a test bed for the demonstration and study of buried waste retrieval technologies in a nonhazardous and nonradioactive environment. Buried at the pit are waste types such as barrels and boxes filled with construction debris, trash, plastics, wood, concrete, brick, glass, tools, and sludge. The waste is intended to simulate conditions expected within the Subsurface Disposal Area (SDA) at the RWMC. This study determines if the proposed conceptual design can be completed within the stated cost guidelines.
		WTD-91-031 Technical Evaluation of Cryogenic Retrieval Proposals, February 1992.
		EGG-WTD-10320 Test Plan for Air Monitoring During the Cryogenic Retrieval Demonstration, June 1992.
		EGG-WTD-10397 Final Report for the Cryogenic Retrieval Demonstration, September 1992.
AL-121210	Realtime Monitoring	Realtime Monitoring During Retrieval, Technology Status Report, November 1991. Use of two analytical spectroscopies for continuous emission monitoring of volatile organics, chlorine containing organics, and other solvents at the SDA of the RWMC. Continuous monitoring is required for emergency response in the event of inadvertent release, calculation of the amount emitted, and for archival purposes in documenting safe long-term operation.
AL-021201	Gas Contamination	Gas Contamination, Technology Status Report, November 1991, Methods and technical basis for monitoring, evaluating, and mitigating airborne hazards produced by buried waste retrieval methods.
AL-121209	Improved TRU Waste Assay	Improved TRU Waste Assay Instruments: CTEN & TGS, Technology Status Report, November 1991.
PE-021201	Butte Plasma Arc Furnace	Plasma Arc Furnace Experiment, Technology Status Report, November 1991, A thermal treatment process that utilizes the Retech Plasma Centrifugal Furnace to treat heterogenous unconsolidated feeds including organic materials, sludges, metals, rock, concrete, soils, and other types of waste. The furnace can also stabilize other waste that contains heavy metals and/or radionuclides.
ID-121215	Evaluation of Joule Melter and Plasma Arc Processes	Thermal Processing Technologies, Technology Status Report, November 1991, A systems selection and development/demonstration engineering project for an ex situ thermal treatment process, including identification and evaluation of available technologies applicable to the INEL, followed by conceptual design, advanced development, and demonstration through pilot-scale tests of melter systems technologies.

TTP #	TTP TITLE	REPORT #, TITLE, ABSTRACT, and DATE
AL-121208	Supercritical Water Oxidation	Supercritical Water Oxidation, Technology Status Report, November 1991, Destruction or reduction of hazardous organics present in aqueous waste streams, storage containers, contaminated soils, and contaminated ground water in the SDA.
RL-401204	Treatment Technology for TRU Waste	Thermal Treatment Technologies for Radioactive Mixed Waste, Technology Status Report, November 1991 Basis for testing of Thermally-heated Vitrification, High Temperature Steam Destruction, and acid digestion of mixed wastes.
RL-321211	Graphite Electrode DC Arc Plasma and Glass Melter	Graphite Electrode DC Arc Plasma and Glass Melter, Technology Status Report, November 1991, A thermal treatment technology that combines graphite electrode DC arc and joule-heated glass melter technologies specifically for melting and/or vitrifying DOE buried waste, and for taking full advantage of the capabilities of joule-heated melting.
ID-111202	In Situ Vitrification	Summary of TOUGH Code Evaluation and Development for modeling ISV Vapor Release Phenomena, Letter Report.
		WTD-92-047 In Situ Vitrification-Laboratory Test Program/Test Procedure: ISV Lab Test Series 1, September 1992, This test procedure provides detailed preparation, operations, data collection, and sampling information unique to the three ISV Lab Tests that are a part of ISV Lab Test Series 1.
		WTD-92-048 Start-up of the In Situ Vitrification Lab Test Facility at the Idaho National Engineering Laboratory, September 1992, A series of three in situ vitrification (ISV) Lab Tests were conducted in FY-92, on the recently installed ISV Lab Test Facility, located in Room 9 of Test Area North, Building 633, at the Idaho National Engineering Laboratory (INEL). The primary purpose of these tests were to train ISV Lab Test Operations Staff to operate the ISV lab test equipment, along with other test equipment associated with the ISV Lab Test Facility. Qualitative information on the effectiveness of the lab test facility in resolving the contaminant migration issue was also obtained during the three tests.
ID-121213	Field Demonstration of Characterization Technologies	Pit 9 Boundary Survey, Letter Report, September 1992.
		Magnetic Modeling Including Demagnetization and Remanent Magnetization Effects (South Dakota School of Mines), September 1992.
		EGG-EELS-002 Preliminary Design for a Safe Step Remediation System, September 1992.
OR-021201	Linac-Based NDA/NDE of Remote Handled TRU Waste	Linac-Based Characterization of RH-TRU Waste, Technology Status Report, November 1991.
PE-021202	Buried Stored TRU Plasma Treatment Process	Buried/Stored TRU Plasma Treatment Process, Technology Status Report, November 1991.
RL-321212	Vitrification of Mixed TRU Waste	Thermal Processing Treatment: Joule Heated Melter, Technology Status Report, November 1991.
RL-321210	Advanced Mixed Waste Assay	Advanced Mixed Waste Assay System, Technology Status Report, November 1991.

TTP #	TTP TITLE	REPORT #, TITLE, ABSTRACT, and DATE
SF-001201	Molten Salt Processing	Molten Salt Waste Oxidation Process, Technology Status Report, December 1991.
SF-221206	NDA/NDE Characterization of Mixed TRU Waste	Non-Destructive and Quantitative Characterization of TRU and LLW Mixed Waste Using Active and Passive Gamma Ray Spectrometry and Computed Tomography, Technology Status Report, November 1991.
S-121201	SRL Characterization Technology	WSRC-RP-92-729 Demonstration Characterization Technology Characterization Status/Applicability Report , May 1992.
S-101202	TRU Waste Treatment Methodology	WSRC-TR-92-343 TRU Waste Treatment Methodology, June 1992.
CH-121202	Paper Study on ICP	Application of Non-Radiometric Methods to the Determination of Plutonium, March 1992, A review of non-radiometric methods of Pu analysis.
CH-201202	Ultrasonic Process for Detoxifying Groundwater	Ultrasonic Process for Detoxifying Groundwater, Interim Research And Development Report, May 1992.
ID-121211	Ice Electrodes	EGG-WTD-10509 Ice Electrode, September 1992, The use of an "ice electrode" for the electrolytic Removal of heavy metals from waste solutions was evaluated using a variety of electrochemical techniques. It was determined that a thin coating of frost-like ice on a metal substrate requires a higher starting voltage to initiate electrodeposition. Once initiated, deposition voltages are little different from typical solid electrodes. However, unlike solid electrodes, metal deposits on an ice electrode as small particles are trapped in the growing ice layer. The particulate nature of the elctrodeposit provides a steady increase in the active surface area of the electrode on which to continue the process. It was determined that all platable metals are candidates for removal from solution at an ice electrode. In addition, non-platable metals such as uranium and tungsten can be precipitated as salts at an ice electrode.
RL-421212	Monolithic Confinement	Monolithic Confinement Cold Demonstration, Technology Status Report, August 1992.

Appendix B

List of FY-92 Subcontractors
(Private Industry and Universities)

BWID FY92 SUBCONTRACTOR SUMMARY

TTP NO.	TTP TITLE	SITE	FY92 FUNDS	SUBC FUNDS	SUBCONTACTORS
AL021201	Gas Contamination	ITRI	225		
AL121208	Super Critical Water Oxidation (TSR)	LANL	25		
AL121209	Improve TRU Waste Assay	LANL	825		
AL121210	Realtime Monitoring (TSR)	LANL	25		
AL221202	Electrostatic Aerosol TSR	SNL	25		
AL911201	Non-Intrusive Sensing	Geo	456	30	Highland Scientech
CH121201	NDE/NDA Peer Review	Ames	160		
CH121202	Paper Study on ICP	Ames	15		
CH201202	Ultrasonic Detoxifying Groundwater	ANL	177		
ID111201	BWID Program Coordination	INEL	3388	130	CSM/Geotech/MMES
ID111202	In Situ Vitrification	INEL	369		
ID121112	Non-Intrusive Characterization Studies	INEL	500	327	SDSMT/USGS/UofUStanford
ID121202	Systems Analysis of DOE Buried Waste	INEL	900		
ID121203	Cryogenic Retrieval	INEL	2500	1700	Sonsub
ID121204	Biological Destruction of Nitrates	INEL	200		
ID121205	Pad A Treatability Study	INEL	400	314	NRT/PNL
ID121207	Thermal Processing Methods for TSR	INEL	180		
ID121210	Contamination Control	INEL	960		
ID121211	Ice Electrodes	INEL	350		
ID121212	RHMMS	INEL	600	117	Delta K/ISU/Accsystems
ID121213	Field Demonstration of Char.Technologies	INEL	635	375	CSM/Techniscan
ID121215	Evaluation of Joule Melter a (TSR)	INEL	27		
OR021201	Linac-Based Characterization (TSR)	ORNL	25		
OR101202	Base Catalyzed Destruction of PCBs	ORNL	394		
OR121201	Luminescence Spot Test (LST)	ORNL	280		
PE021201	Butte Centrifugal Plasma Furnace	MSE	430	375	Retech
PE021202	Buried Stored TRU Plasma Treatment	MSE	1275	311	SAIC/Retech
PE021203	Butte Plasma Arc Furnace	MSE	1020		

BWID FY92 SUBCONTRACTOR SUMMARY Continued

TTP NO.	TTP TITLE	SITE	FY92 FUNDS	SUBC FUNDS	SUBCONTACTORS
RL321207	Regulatory and Public Acceptance	PNL	120		
RL321210	Advanced Mixed Waste Assay System	PNL	20		
RL321211	Graphite DC Arc Plasma & Glass Melter	PNL	656	625	MIT/EPI
RL321212	Vitrification of Mixed TRU Waste	PNL	475		
RL401204	Treatment Techology for TRU Waste	WHC	77		
RL421212	Monolithic Confinement	WHC	445		
RL421213	DOE Complex Buried Waste Assessment	WHC	400		
SF001201	Molten Salt-Processing	LLNL	10		
SF121201	Mechanics in Subsurface	LLNL	5		
SF221206	NDA/NDE Characterization TSR	LLNL	25		
SF221209	NDA Characterization TRU/LLW	LLNL	500		
SR101202	TRU Waste Treatment Methodology	WSRC	100	9	Accudraft Engineering
SR121201	SRL Characterization Technology	WSRC	200	100	ANL
	TOTALS		19399	4413	

Note values are in $1000s

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DATE
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7/9/93