**Buried Waste Integrated Demonstration
Commercialization Action Plans
Volume 1**

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a. Advanced Sciences, Inc.

MASTER

Buried Waste Integrated Demonstration Commercialization Action Plans Volume 1

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ABSTRACT

The Buried Waste Integrated Demonstration (BWID) is sponsored by the U.S. Department of Energy (DOE) Office of Technology Development. BWID supports the development and demonstration 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. BWID evaluates, validates, and demonstrates technologies and transfers this information throughout DOE and private industry to support DOE remediation planning and implementation activities. This report documents commercialization action plans for five technologies with near-term commercialization/ implementation potential as well as provides a status of commercial and academic partners for each technology.

SUMMARY

The Buried Waste Integrated Demonstration (BWID) is sponsored by the U.S. Department of Energy (DOE) Office of Technology Development. BWID supports the development and demonstration 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. BWID evaluates, validates, and demonstrates technologies and transfers this information throughout DOE and private industry to support DOE remediation planning and implementation activities. In fulfilling the BWID mission, three objectives are integral to technology commercialization and implementation. They include:

- **Technology Infusion.** Transferring technology from industry, universities, and other Federal agencies for integration into the BWID process. This is referred to as partnering.
- **Technology Adoption.** Sharing demonstrated technology among DOE laboratories, integrated demonstrations, and programs. This is referred to as Environmental Restoration/Waste Management implementation.
- **Technology Diffusion.** Transferring demonstrated technology from BWID to industry. This is referred to as commercialization.

BWID has adopted a two-fold strategy to commercialize technologies. The first part of the strategy is to concentrate efforts on technologies with very near-term commercial potential. The second part of the strategy is to ensure that technologies in the early stages of development are paired with industrial or academic partners to guide their development. This report documents commercialization action plans for five technologies and provides a status of partnerships with industry or academia.

BWID went through several steps to choose five technologies for action plans. This included a preliminary review, a market assessment, and a technology ranking. Five technologies were chosen for commercialization action plans: Rapid Transuranic Monitoring Laboratory, Cryogenic Cutting System, Rapid Geophysical Surveyor, Contamination Control Unit, and Active Millimeter Wave Radiometer Diagnostic.

The other part of BWID's commercialization strategy—locating industrial and academic partners for technologies in the early stages of development is progressing quite well. In FY-94, there are a total of 36 industry/university partnerships. This number has increased from FY-93 where there were a total of 16 industry/university partnerships.

Future actions include implementing the five commercialization action plans, choosing five additional technologies each quarter for which to develop action plans, and continuing to locate industry and academic partners for technologies that currently do not have a collaborator. BWID will provide assistance and facilitation that are necessary to the technology transfer leads (INEL ORTA, Ames ORTA, etc.) to meet the goals set forth in these action plans. Quarterly reports will describe progress and will include five additional action plans.

CONTENTS

ABSTRACT	iii
SUMMARY	v
1. OVERVIEW	1
2. METHODOLOGY	2
2.1 Preliminary Review	2
2.2 Market Assessment	3
2.3 Technology Ranking	3
3. COMMERCIALIZATION ACTION PLANS	5
3.1 Rapid Transuranic Monitoring Laboratory	5
Description	5
Market Overview	5
Customers	5
Competitors/Competitive Advantage	6
Intellectual Property	7
Status of Technology Transfer Activity to Date	7
Action Plan	7
3.2 Cryogenic Cutting System	8
Description	8
Market Overview	8
Customers	8
Competitors/Competitive Advantage	9
Intellectual Property	9
Status of Technology Transfer Activity to Date	9
Action Plan	9
3.3 Rapid Geophysical Surveyor	10
Description	10
Market Overview	10
Customers	10
Competition/Competitive Advantage	10
Intellectual Property	10
Status of Technology Transfer Activity to Date	10
Action Plan	11

3.4	Contamination Control Unit	11
	Description	11
	Market Overview	11
	Customers	11
	Competitors/Competitive Advantage	12
	Intellectual Property	12
	Status of Technology Transfer Activity to Date	13
	Action Plan	13
3.5	Active Millimeter Wave Radiometer Diagnostic	13
	Description	13
	Market Overview	14
	Customers	14
	Competitors/Competitive Advantage	14
	Intellectual Property	14
	Status of Technology Transfer Activity to Date	14
	Action Plan	15
4.	STATUS OF OTHER TECHNOLOGIES	16
5.	CONCLUSION	17
6.	REFERENCES	18

BWID Commercialization Action Plans

1. OVERVIEW

The Buried Waste Integrated Demonstration (BWID) is sponsored by the U.S. Department of Energy (DOE) Office of Technology Development. BWID supports the development and demonstration 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. BWID evaluates, validates, and demonstrates technologies and transfers this information throughout DOE and private industry to support DOE remediation planning and implementation activities. In fulfilling the BWID mission, three objectives are integral to technology commercialization and implementation. They include:

- **Technology Infusion.** Transferring technology from industry, universities, and other Federal agencies for integration into the BWID process. This is referred to as partnering.
- **Technology Adoption.** Sharing demonstrated technology among DOE laboratories, integrated demonstrations, and programs. This is referred to as Environmental Restoration/Waste Management implementation.
- **Technology Diffusion.** Transferring demonstrated technology from BWID to industry. This is referred to as commercialization.

BWID technologies are in various stages of infusion, adoption, and diffusion and, as such, require different actions to complete them in terms of commercialization and/or implementation. The strategy that BWID has adopted is to concentrate efforts on those technologies with very near-term commercialization/implementation potential. Simultaneously, BWID will ensure that technologies in the early stages of development are paired with a commercial or academic partner to guide the technologies both scientifically and commercially. This report documents commercialization action plans for five technologies with near-term commercialization/implementation potential as well as providing a status of technologies associated with a commercial or academic partner.

Principal investigators (PIs) in the BWID program have been selected for their knowledge of a technology and their demonstrated ability to lead a team of engineers and scientists in producing products which meet Environmental Restoration and Waste Management (EM) needs. Producing products that are also ready for commercialization is a new requirement in DOE research. It is not expected the PIs will immediately have the knowledge necessary to meet this requirement. Commercialization/implementation action plans will aid the PIs in achieving this objective.

2. METHODOLOGY

2.1 Preliminary Review

The Federal Government is extremely good at creating knowledge and developing new technology. However, our declining market share in many industries points to a weakness in our ability to successfully commercialize new discoveries. Many theories relate to the barriers that exist in moving technology from the Federal development sector to the private user sector. The basic underpinnings of the majority of these theories are based on the fact that the industry must "pull" the technology from the development agency—the development agency cannot "push" the technology into the industry. However, in order for market pull to be present, the technology must be demonstrated and also be known to industry. Industry must also have a need for the technology, and the public should accept the technology.

In following this market pull approach, BWID assembled a team of qualified experts including representatives from the Office of Research and Technology Application (ORTA), Advanced Sciences, Inc. (ASI), and BWID to conduct a preliminary review of the suite of BWID technologies. BWID subcontracted with ASI, a firm with expertise in technology transfer especially in legal issues, industry contacts, and broad-based technology knowledge to assist with this effort.

Although numerous technologies are sponsored by BWID, not all are capable of immediate transfer. Different reasons exist for this, most notably the lack of maturation of the technology, legal constraints, and the lack of an identifiable, existing commercial market. However, several technologies emerged from the review that seemed quite viable. The technologies are listed below (see Appendix A for a complete list of TTP numbers and descriptions):

Contamination Control Unit	Active Millimeter Wave Radiometer Diagnostic
Dig-Face Characterization	Radiological Hazardous Materials Measurement System
Rapid Geophysical Surveyor	Rapid TRU Monitoring Laboratory
Remote Excavation System	Assay of Contaminated Soils
Cryogenic Cutting System	Electrothermal Hollow Cathode
Field Demonstration of Characterization Technologies	Imaging Infrared Interferometer
Monolithic Confinement	Nondestructive Assay of Characterization of Transuranic (TRU)/Low-Level Radioactive Waste (LLW)
Nonintrusive Sensing of Environmentally Important Objects	Secondary Treatment of Offgas
System Health Monitoring	Very Early Time Electromagnetic (VETEM) System
Virtual Environment Generation of BW	Microwave Torch Trace Metals Diagnostic

2.2 Market Assessment

In conjunction with the review of the technologies, a cursory market assessment was conducted. A great deal of market data was gathered at the BWID sponsored DOE/EPA/Private Sector Meeting held in Seattle on December 7-8, 1993. Industry interest in technologies for commercial application was gauged at this meeting. Also, market information on Environmental Restoration needs was gathered. The meeting provided an excellent opportunity for BWID's commercialization team to interface with the PI's and learn more about the technologies and their applications.

2.3 Technology Ranking

The next step was to rank the technologies in order to select five from which a commercialization/action plan would be developed. The philosophy behind technology transfer—that of pairing and sharing between DOE and other agencies, universities, private business—allows for many different arrangements and relationships. BWID technologies fall into several categories, each of which has advantages and barriers to certain types of transfer. The following lists the types of transfers by which BWID technologies can be classified:

- **Category A.** Technologies that are in the most incipient stages. The PIs have developed ideas and plans, and have often received funding, but the technology is not yet developed. These technologies would have an Action Plan that focuses on every step of the commercialization process. This could include identifying commercial markets and commercially desirable and feasible modifications early in the technology development to allow for "clean" commercialization of the product.
- **Category B.** Technologies developed under the BWID program that directly compete with other technologies to perform the same functions. Action Plans to commercialize one of these technologies over the other requires very careful analyses of economic factors and other market factors not necessary in other categories of technologies. This becomes particularly critical when there is not only competition, but also conflicts of interest.
- **Category C.** Technologies that are most transferable by taking the technology from one DOE or Department of Defense (DOD) site and transferring it to another site, in essentially a lease arrangement. Procurement hurdles are reduced and training of receiving site personnel is part of the overall funding concern.
- **Category D.** Technologies that are completed. There are no legal barriers to transfer, but there are no commercial markets unless there is collaboration, either with another BWID technology or with a commercial product, to produce a commercially saleable product.
- **Category E.** Technologies that are completed. Commercial markets are identified, but the legal/intellectual property status is not yet resolved.
- **Category F.** Technologies that are completed. These technologies have shown a successful demonstration. Also the intellectual property status is well defined and patents/copyrights/trademarks all have an identifiable owner.

See Table 1 for the ranking of technologies.

Table 1. Technology rankings.

Technology	Category
Imaging Infrared Interferometer	A
Electrothermal Hollow Cathode	A
Radiological Hazardous Materials Measurement System	A
Assay of Contaminated Soils from Buried Waste	A
Virtual Environment Generation of Buried Waste	A
Monolithic Confinement of Contaminated Waste	C
Very Early Time Electromagnetic System	A
System Health Monitoring	A
Nondestructive Assay Characterization	C
Cryogenic Cutting System	F
Rapid Geophysical Surveyor	D, F
Active Millimeter Wave Radiometer Diagnostic	E
Microwave Torch Trace Metals Diagnostic	E
Rapid Transuranic Monitoring Laboratory	F
Remote Excavation System Intuitive Hand Controller	F
Dig-Face Characterization	A
Nonintrusive Sensing of Environmentally Important Objects	B, D
Contamination Control Unit	C, D
Field Demonstration of Characterization Technology	A
Secondary Treatment of Offgas	A

3. COMMERCIALIZATION ACTION PLANS

From the ranking, the team chose five technologies for which to develop commercialization action plans. Three criteria were used by the team to select the technologies. The first criterion was the status of the technology with respect to its immediate use in the field—technical maturity. The second criterion was the availability of a near-term opportunity to market or transfer the technology—business potential. The third criterion was an initial assessment of whether legal or other barriers existed that made the technology difficult to transfer immediately. The overriding strategy in the selection process was picking technologies that could be commercialized in the very near-term.

The five selected technologies include: Rapid Transuranic Monitoring Laboratory, Cryogenic Cutting System, Rapid Geophysical Surveyor, Contamination Control Unit, and Active Millimeter Wave Radiometer Diagnostic. Each plan includes a short description of the technology, a market overview, a list of potential customers, a description of competitors and the technology's competitive advantage, the status of intellectual property, the status of technology transfer, and a table of action items.

3.1 Rapid Transuranic Monitoring Laboratory

Description

The Rapid Transuranic Monitoring Laboratory (RTML) can continuously monitor airborne TRU concentration and rapidly analyze soil, smear, and air filter samples for TRU isotopes, fission, and activation products in a cost-effective manner. The RTML is contained in two trailers, which are 8 × 24 ft and 8 × 48 ft in size. The smaller trailer houses a sample preparation laboratory. The larger trailer contains (a) one terminal that controls and displays spectral data from four alpha continuous air monitors (CAMs), (b) two Ordela large-area ionization chamber alpha spectrometers, (c) one thin-window gamma ray spectrometer and automatic sample changer, (d) one VAX 4000 Model 100 computer, and (e) computer terminals and two printers used to display and generate reports of analysis results.

Market Overview

The RTML is appropriate for any situation where there is a major problem with transuranic contamination that requires mitigation. The RTML can quickly evaluate situations and allow rapid remediation action to be performed that will prevent a situation from growing further out of control. As such, the market for the RTML potential has numerous potential customers.

Customers

- INEL
Environmental Restoration—Online monitoring of Pit-9 retrieval, sitewide soil survey, SDA bore hole analysis, sitewide remediation efforts.

Waste Management—Online monitoring for TSA-RE project; emergency response; WIPP certification.

- **Hanford**
Environmental Restoration—TRU-trench retrieval; expedited retrieval efforts.
- **Fernald**
Environmental Restoration—contaminated soils (uranium) removal (screening).
- **Mound**
Environmental Restoration—screening of soil samples for release.
- **SRP**
Environmental Restoration—plutonium recovery.
- **Los Alamos**
Potential recovery of thousands of pounds of plutonium in explosion test shafts.
- **Rocky Flats**
Waste Management/Environmental Restoration—decontamination and decommissioning of entire complex; soil cleanup.
- **States**
Independent verification of DOE complex cleanup.
- **International Atomic Energy Agency**
Verification of weapons production.
- **Commercial Nuclear Power Plants**
Decontamination and decommissioning of U.S. commercial plants.
- **European Nuclear Power Plants**
Decontamination and decommissioning of foreign plants.
- **Russian Weapon Complex**
Potential cleanup of Russian bomb factories.

Competitors/Competitive Advantage

The RTML has no direct competitors and is the only field-deployable laboratory capable of performing analysis on transuranics. There are two types of indirect competitors—fixed radiochemistry laboratories and health physics hand-held instruments. Hand-held instruments can provide gross alpha measurement on surface soils. This technique is insufficient in measuring transuranics to ensure that safety and operating limits are not breached. The health physics techniques are more amenable to emergency response where spill levels may be in the tens of nCi/g. The RTML provides data at much greater sensitivities than hand-held instruments.

Fixed radiochemistry laboratories can provide lower levels of detection than the RTML. However, the RTML can provide near-real time analysis as compared to a fixed laboratory when turnaround times may be days or even weeks. A quick response capability is absolutely necessary to ensure safety when performing cleanup operations. Additionally, down-time costs are alleviated when

using the RTML because analytical results are available onsite rather than shutting down operations and waiting for fixed laboratory results.

The RTML also has a competitive advantage over fixed laboratories in terms of cost. Samples can be processed in less than 1 hour for about \$30 per sample using a technician-driven system. This compares to fixed laboratory results with radiochemists analyzing several samples per day at \$200 to \$300 per sample. The unit can process over 100 samples per day of soils, filters, and smears in a field setting. Additionally, the RTML is capable of operating in remote locations where power, water, and waste treatment systems will not be available.

Intellectual Property

EG&G Idaho, Inc. Patent No. 5,206,174. PI553.

Status of Technology Transfer Activity to Date

At the DOE/EPA/Private Sector Meeting held in Seattle December 7-8, 1993, Enseco, Inc. expressed a strong interest in the RTML. Enseco, a subsidiary of Corning Inc., is the largest environmental testing laboratory in the United States. After several meetings including two site visits to view the RTML, Enseco is pursuing a licensing agreement with the INEL for the RTML.

Discussions are currently being held on the best method and mechanisms to transfer this technology. It is anticipated that a draft license agreement will be in place by the end of March. It will also be necessary to train Enseco personnel about how to use the equipment. This may be a part of the license agreement or may be under a separate agreement. Also, it has been suggested that BWID and Enseco collaborate on a small demonstration of the RTML. One method to accomplish this would be through the Western Governors' Association (WGA). As an aside, the RTML has previously been chosen by the WGA for demonstration. This and other options will continue to be explored. Also, according to DOE Legal, the equipment can be loaned to Enseco on a yearly basis as long as two conditions are met: (1) temporarily there is not a need for the equipment, and (2) the scope fits within the mission of DOE.

Discussions have also occurred with EG&G Ortec to license the ion chambers for manufacture. This does not represent a problem with Enseco since they are interested in providing an analytical service with the RTML and not in manufacturing analytical equipment.

Action Plan

Action item	Target completion date	Lead
Complete license agreement with Enseco	3/31/94	INEL ORTA
Transition equipment to Enseco	7/31/94	INEL ORTA/BWID
Participate in short demonstration—WGA	4th Qtr. FY-94	BWID/Enseco
Complete license agreement with EG&G Ortec	4/30/94	INEL ORTA

3.2 Cryogenic Cutting System

Description

This system uses high pressure liquid nitrogen and solid carbon dioxide to perform cutting and abrading without the introduction of a secondary waste stream due to cutting media. The effort is focused on deploying an adaptation of the highly effective waterjet techniques used in cutting or surface abrading. This adaptation removes the secondary waste-stream water, which makes waterjet cutting an undesirable option for most waste management and environmental restoration activities. The cryogenic cutting technology will enhance existing fluid systems to deliver high pressure liquid nitrogen and solid carbon dioxide to a sophisticated nozzle. The benefits of this technology are the addition of no secondary or new wastes in the process of cutting as the nitrogen and carbon dioxide are atmospheric gases.

Market Overview

The INEL ORTA conducted an extensive market assessment and found the cryogenic cutting system to have a wide variety of potential applications. Fields of use include cutting contaminated materials; decontaminating the surfaces of materials; stripping paint from buildings, airplanes, ships, or bridges; cleaning surfaces prior to the application of new coatings; cutting textiles; processing logs into lumber/value-added products; processing frozen foods; cleaning and wash down where the use of water causes a problem; drilling as it may be applied to manufacturing and geological processes; and cutting or drilling composites.

Customers

Market segment	Potential customers
Lumber production	Lumber production facilities and mills; specialty millwork.
Wood veneer production	Wood veneer mills and other specialty wood manufacturing facilities.
Metal fabrication	Foundries, job shops, and specialty metal fabrication facilities.
Paint removal	Airlines, shipping industry, commercial and residential construction, and automotive painting industry.
Textile manufacturing	Textile producers and apparel manufacturers.
Food processing	Large food processing firms.
Government	Decontamination and decommissioning—DOE/DOD; Environmental restoration—size reduction; Waste management—volume reduction, waste minimization.

Competitors/Competitive Advantage

While there may be competitors within each industry segments, waterjet technology presents the greatest competitive challenge to cryogenic cutting. Waterjet systems have been increasingly used across a broad range of industrial sectors, particularly the manufacturing industries. However, the cryogenic cutting system has a key competitive advantage over the waterjet technology in the area of zero-added waste. Many applications, including decontamination and decommissioning, have zero-added waste as a requirement. Increasingly, many industrial applications also have this requirement. Examples include industrial cleanup near water sources such as cleaning bridges or descaling and cleaning external surfaces of ships.

Intellectual Property

A patent application has been filed.

Status of Technology Transfer Activity to Date

Four Cooperative Research and Development Agreements (CRADAs) are under negotiation for continued development of the cryogenic cutting system. The four private firms involved in the CRADAs include CS&D Cryogenics, Cimetrix, PCI Energy Services, and Hydro-Pac. A letter of intent has been received from all four companies. PIs also have been identified at each of the private firms. Statements of work are in the final stages. The ORTA office received comments on the proposed CRADAs from one company and is expecting the other three to respond soon. When the CRADAs are completed, licensing discussions will begin.

Cable News Network (CNN) aired a 4-minute segment about the cryogenic cutting system on four different dates in 1993—December 21, 22, 25, and 26. The segment gave a broad overview of the work to date and anticipated future applications. The airing of this segment has resulted in at least six industrial contacts. Two inquiries were about using the system in DOD weapons dismantling. Another was a large furniture/cabinetry manufacturer who wanted to know more information about the application of the system in this industry. Another contact was made regarding the use of the system for steel bridge construction and maintenance, particularly for stripping rebar. A carbon dioxide/water pellet blaster manufacturer from the Netherlands also asked about the invention. The discussion resulted in the individual requesting the purchase of one the machines as soon as they become available, regardless of operational status.

Action Plan

Action item	Target completion date	Lead
Scopes of work completed	4/15/94	INEL ORTA
CRADAs completed	4/31/94	INEL ORTA
Begin licensing discussions	5/15/94	INEL ORTA
Complete license agreements	9/30/94	INEL ORTA

3.3 Rapid Geophysical Surveyor

Description

The Rapid Geophysical Surveyor (RGS) is a hand-pushed, nonferrous vehicle that carries multiple cesium total field magnetometers, a data logger, and data storage hardware and software. The unit can be easily adapted to accommodate different magnetic sensors. Magnetic data are collected automatically and stored at user-specified intervals as close as 2-in. apart as the unit is pushed along survey profile lines. The resulting database is very high resolution and can identify individual metallic objects, object orientation, shape, and depth of burial.

Market Overview

The Center for Applied Development of Environmental Technology (EG&G CADET, Inc.) conducted a market survey. It was determined that the best way to enter the market would be to provide the service rather than attempting to manufacture and market the system. The RGS can be used at any DOE or industrial facility that has buried hazardous waste or radioactive waste. The DOE complex has a number of hazardous, mixed hazardous, and radioactive waste sites that require remediation and restoration to comply with Federal and state environmental regulations. Many of these sites are approaching 50 years in age and historical records of the burial sites are often sketchy and inaccurate. Spatially dense data sets like those collected with the RGS are required to fully characterize buried waste sites and begin to answer the questions about burial depth, object size, and orientation. The RGS may also be used to locate buried utility lines and underground storage tanks. The RGS could also prove to be useful in screening surveys prior to land sales to ensure that prospective buyers do not inherit an unknown environmental liability.

Customers

Potential customers include DOE, DOD, and geophysical contractors interested in characterizing waste sites.

Competition/Competitive Advantage

Competition includes hand-held instruments. The RGS can perform high resolution geophysical magnetic surveys more quickly (30-300 times faster) and more economically (20 times cheaper per data point) than hand-held instruments. Also, since the RGS is an automated system, the RGS can collect spatially denser data sets than previously thought possible, thereby providing a higher resolution picture of the buried waste or object.

Intellectual Property

A patent has been applied for. PI568.

Status of Technology Transfer Activity to Date

The inventors of the RGS, Nick Josten and Glen Carpenter, are creating a spin-off company, Sage Earth Sciences, to provide geophysical services using the RGS technology. An exclusive, royalty bearing license has been approved by DOE-ID and will be granted to the inventors. The INEL

ORTA office is awaiting a transmittal letter to this effect. After receiving this letter of transmittal, EG&G senior management will finalize the agreement. The OWTD office will then conduct a license signing ceremony and distribute press releases to the media.

Action Plan

Action item	Target completion date	Lead
Receive transmittal letter	2/22/94	DOE-ID
Finalize and sign-off on agreement	2/25/94	INEL ORTA
Hold licensing ceremony	3/11/94	OWTD

3.4 Contamination Control Unit

Description

The Contamination Control Unit (CCU) suppresses dust and fixes soil, thereby inhibiting the spread of contamination during retrieval operations of buried wastes. The CCU provides a reliable, simple-to-use, easily deployable system to control dust. Use of the CCU improves personnel safety and reduces the risk of contamination spread by airborne dust. The CCU is capable of dispensing soil fixatives, dust suppression agents, and misted water, and uses a vacuum system to control contamination spread. All dust control products are nonhazardous and can be disposed of in sanitary landfills.

Market Overview

Although a full market assessment has not been completed yet on the CCU, potential markets could include national and international sites requiring excavation, remediation, or regrading of contaminated surface areas, buried waste pits or trenches, pipelines, trench drains, or earth-moving activity in soil containing hazardous or radioactive material. While the individual components of the CCU do not have a unique application in the hazardous waste industry in the United States, the idea of a system that contains all of this equipment, which is housed in mobile trailers to use site-to-site is potentially very marketable.

Customers

Potential customers could include:

- DOE sites throughout the U.S.
- CERCLA and RCRA sites throughout the U.S.
- DOD sites throughout the world.

- Foreign government controlled hazardous or radioactive sites such as Chernobyl in the Ukraine and Maralinga in Australia.

Other potential private sector markets could include geotechnical consultants in the following fields:

- Hazardous/nuclear waste cleanup contracts
  - National laboratories
    - Transuranic waste retrieval operations
    - Low-level waste disposal facility operators
  - Emergency response teams
  - Superfund site contractors
  - Underground storage tank removal contractors
  - Manufacturers of safety equipment
- Mining industry
  - Open pit mine operators
  - Mining equipment manufacturers
  - Sand and gravel operators
- Archaeological equipment suppliers.

Competitors/Competitive Advantage

Competitors may include manufacturers of emergency response equipment or dust suppression equipment. However, this type of equipment can house and dispense only one type of substance at a given time. More information about competitive products needs to be gathered for verification.

Once the CCU equipment is in production and in a supply catalog, the competition (other equipment suppliers) may attempt to circumvent patent protection through slight modification in equipment setup or configuration of the equipment. Methods of market protection could include an aggressive marketing strategy and/or a continuous patent upgrade as new concepts are developed.

Intellectual Property

Patent issued 5,203,644; S-71,122. DOE remains assignee on the patent.

Status of Technology Transfer Activity to Date

This technology is ready for a commercial partner to manufacture and market the system. However, it will be necessary for the assignee, DOE, to give EG&G the right to elect title to the system in order to license the technology to a private sector firm. Also the market for the CCU needs to be verified and potential partners to market the system need to be found. Partner interest can be solicited through a broad dissemination of notice to the local governments, academic institutions, trade associations, industry publications, and professional societies.

Once potential partners are found, they should be evaluated according to several objective criteria to select a firm to commercialize the CCU. The criteria may include technical expertise; financial and human resources, market position; and domestic/foreign ownership. A license agreement can then be negotiated, accepted, and completed.

Action Plan

Action item	Target completion date	Lead
DOE allows EG&G to elect title ^a	7/31/94	BWID/INEL ORTA
Conduct market assessment	5/31/94	BWID/INEL ORTA
Solicit partner interest	6/15/94	BWID/INEL ORTA
Evaluate potential partners	7/31/94	BWID/INEL ORTA
Select partner	8/15/94	BWID/INEL ORTA
Complete license agreement	9/30/94	INEL ORTA

a. All action items except for the market assessment are dependent on completion of election of title.

3.5 Active Millimeter Wave Radiometer Diagnostic

Description

This technology is part of the DC graphite arc project and will be incorporated in to the Mark II furnace, which has been modified to incorporate a variety of diagnostic systems to characterize performance, optimize operation, and control the plasma arc furnace. Among these systems is the Active Millimeter Wave Radiometer (AMWR). The millimeter wave radiometer, which measures furnace and glass temperatures, is more transparent to the furnace environment than infrared pyrometers.

The plasma arc technology can treat any type of buried waste—hazardous, low-level, and TRU—along with any contaminated soils and containers. Organics are destroyed and metals (both

radioactive and hazardous) are stabilized in a suitable final waste form. Ash and secondary waste and soil can be treated. The new diagnostic systems are believed to be crucial to the success of the furnace, since any new waste remediation technology must be an improvement over older technologies, and absolutely safe for the environment.

Market Overview

This technology, once fully developed, should have widespread applicability on DOE, DOD, CERCLA, RCRA, and private sector sites wherever spatial temperature monitoring of high temperature plasmas are necessary.

This technology has been used for some time in the biotechnical and light measurement fields. Unlike some of the radiometers currently in the commercial market place, this modification to the radiometer technology appears to be unique at this point in time. The concept of long-wave utilization to overcome the atmospheric effects of smoke and haze within the furnace and negating the requirement for clean optical views of the plasma surface have considerable merit. These points make the product very saleable or transferable.

The technology could be unique when fully developed, and its apparent application widespread. To accurately identify and quantify the potential near- and long-term markets for this technology, it would be necessary to conduct a more in-depth market analysis.

Customers

DOE; DOD; CERCLA and RCRA sites; and manufacturers and major users of VOC products; manufacturers of incinerators and melters.

Competitors/Competitive Advantage

More in-depth market information is needed for verification of competitive advantage. However, this technology is innovative and, as such, does not have a direct competitor. A substitute for using this technology would be to send samples out for analytical results. The Active Millimeter Wave Radiometer provides real-time information because it is an online system. This results in immediate information that allows the operating parameters of the furnace to be adjusted accordingly. Furthermore, on a per-sample basis comparison, the Active Millimeter Wave Radiometer provides results at a lower cost than fixed analytical methods.

Intellectual Property

MIT has applied for a patent on the AMWR and has listed Ken Wittle of EPI, and Jeff Surma of Pacific Northwest Laboratory (PNL) as co-inventors. The patent has not yet been approved.

Status of Technology Transfer Activity to Date

A three-party collaboration was established between PNL, the Massachusetts Institute of Technology (MIT), and EPI to develop graphite electrode DC plasma arc technology for the treatment of buried wastes. An initial Mark I (100-lb batch) furnace was built and successfully tested at MIT. Construction of the Mark II (a 500-lb per hour continuous feed furnace) is in progress at MIT and demonstration should be complete within the next 6 months. Currently, there is

disagreement over the intellectual property and licensing strategy. EPI is interested in acquiring the licensing rights to the technology (diagnostics and furnace). However, MIT would like the opportunity to license the technology to a company that it believes has better financial resources, manufacturing and marketing capabilities, and is thus better able to ensure the success of the technology and to generate larger royalties.

EG&G's legal counsel indicated that since all three parties are listed as co-inventors, any one of them has the right to license the technology independently of the other co-inventors. However, it would be best for all parties involved to collectively reach agreement on a licensing strategy. The PNL ORTA and legal office should take the lead in initiating these discussions. BWID staff could help facilitate this meeting. Agreement on these issues should be reached to ensure the best route for commercialization for this technology. Once a licensing strategy is developed and agreed upon, an action plan for commercialization can be devised.

Action Plan

Action item	Target completion date	LEAD
Mediation discussions—PNL, MIT, EPI, BWID	4/30/94	PNL ORTA/LEGAL
Complete licensing strategy	7/31/94	PNL ORTA

4. STATUS OF OTHER TECHNOLOGIES

Another portion of BWID's technology transfer strategy is to seek industrial and academic partnerships to help guide technology development early on in the cycle. For FY-94, there are a total of 36 industry/university partnerships. (See Appendix B). This number has increased from the previous year where FY-93 had 16 industry/university partnerships. Several additional partnerships are in the process of being formed. First, a CRADA is currently being pursued with Lampson, Inc., for work on the Contaminated Material Excavation and Handling System. Second, a scope of work is being drafted for a CRADA with SEG, a subsidiary of Westinghouse, for the Radiological and Hazardous Material Measurement System. Finally, Dan Williams of the Ames ORTA office and Principal Investigator Stephan Weeks are meeting to find a commercial partner for the Electrothermal Hollow Cathode Discharge Spectrometry technology.

5. CONCLUSION

Efforts will continue to find industry or academic partners for technologies that currently do not have a collaborator. Implementation of the five technology action plans will ensure commercialization progress. BWID will provide assistance and facilitate these actions to meet the goals set forth in the action plans. Future plans include a quarterly report of commercialization/implementation progress and selection of five additional technologies per quarter for action plan generation and implementation.

6. REFERENCES

ASI Commercialization Action Plans, 1994.

ASI Preliminary Market Assessment, 1993.

ASI Technology Ranking for Action Plans, 1993.

BWID FY-94 Program Report.

ProTech Technology Information Profile, Contamination Control Unit, 1993.

ProTech Technology Information Profile, Cryogenic Jetting, 1993.

ProTech Technology Information Profile, Rapid Geophysical Surveyor, 1992.

ProTech Technology Information Profile, Rapid Transuranic Monitoring Unit, 1993.

Rapid Geophysical Surveyor Market Assessment, EG&G CADET, Inc., 1993.

Zero Added Waste Cutting, Abrading, and Drilling Market Assessment, Scott Wolf, EG&G Idaho, 1994.

Appendix A
Technology Descriptions

Appendix A

Technology Descriptions

TTP	TTP No.	Application
Field Demonstration of Characterization Technologies	ID121213	Locate metallic and nonmetallic buried objects, possibly plumes, with a three-dimensional scanner using a ground-penetrating radar system with inverse scattering processing.
Very Early Time Electromagnetics (VETEM)	ID142004	Nonintrusive characterization using a high resolution electromagnetic imaging system for shallow environmental problems (less than 10 meters).
Imaging Infrared Interferometer	ID142003	Detect air emission of organics by imaging plumes using a passive variable wave-length infrared imaging system. For standoff site characterization and remediation monitoring.
Rapid TRU Monitoring Laboratory	ID121210	Incorporate beta screening capability into existing Rapid TRU Monitoring Laboratory for increased site monitoring flexibility.
Nonintrusive Sensing of Environmentally Important Objects	AL911201	Nonintrusive site characterization including (a) object location using a tensor magnetic gradiometer, (b) three-dimensional characterization using broadband electromagnetics, and (c) electromagnetic methods for dig-face monitoring.
Dig-Face Characterization	ID132003	Multisensor characterization during retrieval using geophysical, chemical, radiological, and environmental sensors to provide constant surveillance and screening of hazards at the dig-face.
Virtual Environment Generation of Buried Waste	ID142005	Data interpretation/display for various sensor data. Computer-generated virtual environment for buried waste sites.
Radiological and Hazardous Material Measurement System	ID121212	Waste container assay using multiple measurement cells. A passive gamma spectrometer detects radiological decay of the gamma nuclides; neutron interrogation is used for the detection of fissile material, Pu-239 and U-235; and capture gamma is used for monitoring hazardous materials.

TTP	TTP No.	Application
Electrothermal Hollow Cathode Discharge Spectrometry	CH121201	Onsite waste characterization for radioactive/hazardous metals using an electrothermal hollow cathode discharge spectrometry system.
NDA Characterization	SF221209	Waste container assay using an active and passive computed tomography system on low-level radioactive waste and TRU waste contained in 55-gal drums.
Cryogenic Cutting System	ID142019	Size reduction of contaminated objects using high pressure liquid nitrogen to perform cutting operations without the introduction of a secondary waste stream due to the cutting media.
Machine Health Monitoring and Prediction	ID142020	Sensors and computer algorithms for monitoring system health and predicting potential system failures.
Remote Excavation Demonstration at ORNL	OR142003	Hot retrieval of high radiation waste casks using a small remote excavator.
Secondary Treatment of BWID Offgases	AL142012	Treatment of offgas and VOCs using a nonthermal plasma process.
Graphite DC Arc and In Situ Real-Time Measurements	RL321211 ^a	Vitrification and volume reduction of waste and soil using a graphite-electrode DC arc furnace, and real-time furnace diagnostics for high temperature treatment of mixed wastes and soils.
Monolithic Confinement of Basalt	RL421212	A jet-grouted barrier to waste migration and confinement of contaminants below buried waste sites in a basaltic field environment.
In Situ Encapsulation of Buried Waste	ID142012	In situ encapsulation of buried waste using calcium carbonate precipitating solutions. For in situ stabilization of buried waste pits and trenches.
Assay of Contaminated Soils from Buried Waste	ID142015	Passive gamma-ray spectroscopy system to assay excavated and treated waste material for TRU content and use a neutron activation method to measure its hazardous material content.
Contamination Control Unit	NA-FY-93 Project	An easily deployed mobile unit to efficiently and inexpensively suppress contaminated dust during excavation of buried waste.

TTP	TTP No.	Application
Rapid Geophysical Surveyor	NA-FY-93 Project	Device to quickly and inexpensively characterize buried waste by collecting high quality, dense sets of magnetic data.

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a. Active Millimeter Wave Radiometer Diagnostic and the Microwave Torch Trace Metals Diagnostic are included in TTP RL321211.

Appendix B

Technology Transfer Status Matrix

3/31/94

Technology Transfer Status Matrix

TTP Name/Title	Lead Lab	Partners			Mechanism	Product/Service	Status/Comments
		Industry	Academia	Other Agencies			
Nonintrusive Site Characterization ID 121112	INEL		South Dakota School of Mines and Technology		Subcont/EG&G	Determine reasons for lack of success of GRP surveys; optimize GRP equipment for INEL specific rock and soil; obtain images of buried objects at the Cold Test Pit	No commercial potential. (No hardware or software is being developed.)
				USGS	Interagency fund transfer	Evaluation of magnetic and electromagnetic data sets	No commercial potential. (No hardware or software is being developed.)
Field Demo. of Characterization Tech. ID121213	INEL	TechniScan			Subcont/EG&G Carryover	Apply geophysics data to a proprietary algorithm	TechniScan would like to commercialize the technology
			University of Utah		Subcont/EG&G	Facility and equipment	Ongoing work
Geophysics Platforms Evaluation ID142017	INEL			USGS	Interagency fund transfer	Evaluation of platforms (co-PI's)	In process
Imaging Infrared Interferometer ID142003	INEL	Physical Sciences, Inc.			\$28K In-kind Service (Informal CRADA)	Design/construction of Fabry-Perot imaging interferometer system	Work on getting subcontract in place
Gravity Field Measurements ID142011	INEL	Bell Aerospace Textron			Subcont/EG&G	Simulations and demonstration	Simulations completed. RFP for demonstration in process.
GPR Consortium ID142018	INEL						No commercial potential. (No software or hardware is being developed.)
Geophysics Workshop ID132019	INEL						No commercial potential. (No software or hardware is being developed.)

3/31/94

Technology Transfer Status Matrix

TTP Name/Title	Lead Lab	Partners			Mechanism	Product/Service	Status/Comments
		Industry	Academia	Other Agencies			
Nonintrusive Sensing of Environmentally Important Objects AL911201	Grand Junction	Hadley & Hollingsworth	University of Utah		Memorandum Purchase Order	Date analysis	Work is in progress
					Memorandum Purchase Order	Date analysis	Work is in progress
				Lawrence Berkeley Lab	Memorandum Purchase Order	Date analysis	Work is in progress
VETEM ID142004, ID042002	INEL		University of Utah		Subcont/USGS	Multidimensional forward modeling and interpretational software to be modified and refined for detailed shallow surface mapping (downward continuation)	Work is in progress
			University of California, Berkeley		Subcont/USGS	Multidimensional forward modeling and interpretational software to be modified and refined for detailed shallow surface mapping (systems analysis)	Work is in progress
			University of Arizona		Subcont/USGS	Multidimensional forward modeling and interpretational software to be modified and refined for detailed shallow surface mapping (administrative, coordination, and technology transfer)	Work is in progress
				USGS	Inter-agency fund transfer	Field testing; numerical modeling; system integration	Work is in progress
				SNL	Inter-agency fund transfer	Modeling; code development	Work is in progress

3/31/94

Technology Transfer Status Matrix

TTP Name/Title	Lead Lab	Partners			Mechanism	Product/Service	Status/Comments
		Industry	Academia	Other Agencies			
VETEM ID142004, ID042002 cont.		RUST Geotech		ORNL	Inter-agency fund transfer	Data acquisition	Work is in progress
					TTP AL911201	Experimentation; modeling	Work is in progress
		Sensors & Software			Potential CRADA	Informal oversight	Discussions in progress
		Geonics			Potential CRADA	Informal oversight	Discussions in progress
		Newmont Mining			Potential CRADA	Informal oversight	Discussions in progress
		Zonge Engineering			Potential CRADA	Informal oversight	Discussions in progress
				Lawrence Berkeley Laboratory	Inter-agency fund transfer	Modeling development	Work is in progress
High Resolution Imaging RL342030	PNL					Holographic subsurface GPR imaging system	PI collaboration with small business service profiling for SBIR to build commercial unit
EM Imaging ID132018	INEL		Colorado School of Mines		Subcont/EG&G	Demonstrate state-of-the-art electromagnetic processing and imaging in delineation and characterization of buried waste	Ongoing work
			University of Utah		Subcont	Evaluate data	Ongoing work
		James Consulting			Subcont	Report and 3 types of imaging	Ongoing work

3/31/94

Technology Transfer Status Matrix

TTP Name/Title	Lead Lab	Partners			Mechanism	Product/Service	Status/Comments
		Industry	Academia	Other Agencies			
Digface Characterization ID132003	INEL	Mechanical Technology, Inc.			ROA (DOE Morgantown)	Data interpretation	Technical interface in progress between MTI, Digface Project, Virtual Environment Project
		RUST Geotech, Inc.			TTP AL911201	Sensor development for digface deployment	Technical interface in progress between MTI, Digface Project, Virtual Environment Project
				USGS	Inter-agency fund transfer	Trench data interpretation	Technical interface in progress between MTI, Digface Project, Virtual Environment Project
Virtual Environment Generation142005	INEL		University of Arizona		Subcont/EG&G	Neural net application to data interpretation	Initial discussions in progress; Potential Partners Assessment due 4/1/94
		Mechanical Technology Inc.			ROA (DOE Morgantown)	Data interpretation	Technical interface in progress between MTI, Digface Project, Virtual Environment Project
Radiological and Hazardous Material Measurement System ID121212	INEL		Idaho State University		Subcont/EG&G	Procurement, installation, operation, and space lease	Work will continue throughout FY-94
		SEG			Subcont/EG&G	Test machine	If test works, a CRADA may be initiated
Digital Radiography ID142016	INEL		ISU		Subcont/EG&G	Test machine	Discussions initiated to get subcontract in place
		Scientific Measurement Systems, Inc.			Subcont/EG&G	High-speed digital radiography and computed tomography of waste drums	Work is in progress

3/31/94

Technology Transfer Status Matrix

TTP Name/Title	Lead Lab	Partners			Mechanism	Product/Service	Status/Comments
		Industry	Academia	Other Agencies			
Electrothermal Cathode CH121202	Ames Lab		Iowa State University		Subcont/Ames	Materials and services	Work is in progress
		Aurora Instruments			Subcont/Ames	Materials and services	Delay in obtaining capital equipment money for FANES system
Combined Thermal/Epithermal Neutron (CTEN) AL132012	LANL	Pajarito Scientifica Corp.			Potential CRADA	Commercialization	Discussion taking place
NDA Characterization SF221209	LLNL	Bio Imaging Research, Inc.	University of Calif. at San Francisco		Leasing equipment and software	Equipment and software	Provided equipment and software for demonstration
					PRDA Morgantown	Portable instrument and consulting	Work is in progress
				Lawrence Livermore Natl. Laboratory	TTP funding	R&D	LLNL is acting as a consultant to Bio Imaging Research, Inc.
Waste Conveyance ID142006	INEL	TBD			Subcont/EG&G	Develop and demonstrate an automated conveyance waste conveyance system to transport waste containers from the digface to a pretreatment area	RFP issued 2/7/94; contract award 3/15
Innovative End Effector ID142007	INEL	TBD			Subcont/EG&G	Develop and demonstrate an integrated system to reduce dust generation and remove workers from dust generation area	RFP issued 2/7/94

3/31/94

Technology Transfer Status Matrix

TTP Name/Title	Lead Lab	Partners			Mechanism	Product/Service	Status/Comments
		Industry	Academia	Other Agencies			
Innovative End Effector ID142007 cont.			Colorado School of Mines		TTP Funding	Technical support	Ongoing work
Full-Scale Remote Retrieval ID142008	INEL			Wright Laboratory	Inter-agency agreement	Develop and demonstrate a remotely operated excavator for retrieval of buried waste	Ongoing work
				ORNL	MPO	Develop and demonstrate a remotely operated excavator for retrieval of buried waste	Ongoing work
Cryogenic Cutting ID142019	INEL	CS&P Cryogenics			CRADA		Completing scope of work
		Cimetrix			CRADA		Completing scope of work
		PCI Energy Services			CRADA		Completing scope of work
		Hydro-Pac			CRADA		Completing scope of work
Cooperative Retrieval ID142009	INEL	TBD				Provide gantry crane for delivery of retrieval equipment to digface	RFP in draft
		TBD				Provide robotic manipulator to operate vacuum and perform selective retrieval at digface	RFP in draft
Machine Health Monitoring ID1442020	INEL		Colorado School of Mines		Subcont/EG&G	Operate test bench for data collection	Ongoing work
Machine Health Monitoring ID1442020 cont.		TBD				Provide data algorithms for implementation in system health monitoring	Looking for partner

3/31/94

Technology Transfer Status Matrix

TTP Name/Title	Lead Lab	Partners			Mechanism	Product/Service	Status/Comments
		Industry	Academia	Other Agencies			
3-D Simulation ID132022	INEL		Colorado School of Mines		Subcont/EG&G	Develop system for simulation of buried waste retrieval configuration and operations	Ongoing work
ORNL Remote Excavation System OR142003	ORNL						Informal discussions with industry under way
Contaminated Material Handling RL342001	PNL	Oceaneering Lampson			CRADA	Conceptual design refocusing on hotspot retrieval for mobile retrieval system apparatus	Completing joint statements of work
Arc Melter Vitrification ID132011	INEL	Amer. Soc. of Mech. Eng.				Facility	Work completed
				Bureau of Mines		Facility	Using Bureau of Mines facility; Bureau of Mines has provided some funding
Modeling of Plasma Arc ID142010	INEL					Code development	Code can be used by arc furnace vendors
Off-Gas Treatment AL142012	LANL		University of Illinois		Collaborative effort	Theoretical modeling	Ongoing work
				EPRI	CRADA	Demonstration of technology aimed at industrial air toxics	Ongoing work
STRATEX CH242002	ANL-E	LVW Associates				Patent holder and consultant to Argonne	Ongoing work
Graphite DC Arc RL321211	PNL	Electro Pyrolysis, Inc.			Subcont/MIT	Furnace development and testing	Intellectual property and licensing strategy need to be agreed to by all involved parties
			MIT		Subcont/PNL	Furnace testing and development	Intellectual property and licensing strategy need to be agreed to by all involved parties
Innovative Grout Demo ID142014	INEL	BRISTAR			MPO to WHC	Grout fracturing product supplier	Ongoing work

3/31/94

Technology Transfer Status Matrix

TTP Name/Title	Lead Lab	Partners			Mechanism	Product/Service	Status/Comments
		Industry	Academia	Other Agencies			
Monolithic Confinement RL421212	WHC	3M		BNL		Polymer/formulation test	Ongoing work
Preparation of Rapid TRU Monitoring Lab ID121210	INEL	Enseco			License agreement, CRADA, MOU, Lease	License agreement, CRADA, and MOU completed by 4/31/94; lease in effect by summer '94	Licensing discussions continue. BWID/Enseco looking for a site to perform a demonstration
		EG&G Ortec			License agreement-Ion Chambers	License agreement	Licensing discussions just initiated
In Situ Encapsulation ID142012	INEL						No partners at this time
Excavated Waste Assay ID142015	INEL		ISU		Subcont/EG&G	Facilities/providing research student	Work is ongoing
Chemical Assay ID132021	INEL						Work completed
Real-Time Monitoring of TRU Dust ID142002	INEL	Aculight					Potential commercial interest