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Rev. 1

Commercial Treatability Study Capabilities for Application to the U.S. Department of Energy's Anticipated Mixed Waste Streams

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Prepared for Lockheed Idaho Technologies Company
Mixed Waste Focus Area
and for the
U.S. Department of Energy
Assistant Secretary for Environmental Management
Under DOE Idaho Operations Office
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DISCLAIMER

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ACRONYMS/ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
kg	kilogram(s)
LDR	land disposal restrictions
MTU	mobile treatment unit
MWFA	Mixed Waste Focus Area
NEPA	National Environmental Policy Act
NRC	U.S. Nuclear Regulatory Commission
PCB	polychlorinated biphenyl(s)
ppm	parts per millions
RCRA	Resource Conservation and Recovery Act
TSCA	Toxic Substances Control Act
VISITT	Vendor Information System for Innovative Treatment Technologies (Database)

EXECUTIVE SUMMARY

According to the data developed for the proposed site treatment plans, the U.S. Department of Energy (DOE) mixed low-level and mixed transuranic waste inventory was estimated at 181,000 cubic meters comprised of approximately 2,000 waste streams. Many of these streams are unique and require new technologies to facilitate compliance with Resource Conservation and Recovery Act (RCRA) disposal requirements. Because almost all waste streams are unique, a demonstration of the selected technologies is justified. Evaluation of commercially available or innovative technologies in a treatability study is a cost-effective method of providing a demonstration of the technology and supporting decisions on technology selection.

This document provides DOE waste managers with a list of commercial providers with mixed-waste treatability study capabilities and the technologies available at those facilities. The list was compiled by a survey of commercial providers using available databases and a *Commerce Business Daily* announcement. The survey identified 106 treatment processes offered by 33 commercial providers. The technologies address 21 general treatment categories and include straightforward application of standard technologies (such as pyrolysis) as well as proprietary technologies developed specifically for mixed waste.

DOE mixed-waste treatability studies, conducted in accordance with RCRA, are subject to numerous other federal and state regulations as well as DOE orders. Treatability studies dealing with environmental restoration wastes generated at sites regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) will be subject to CERCLA requirements. If the treatability study involves polychlorinated biphenyls, requirements of the Toxic Substances Control Act will be applicable. If the study involves radionuclides, the facility must have a radioactive materials license from the U.S. Nuclear Regulatory Commission (NRC). Waste samples transported to off-site facilities by common carriers must meet packaging requirements of RCRA, the NRC, and the U.S. Department of Transportation. The DOE is also responsible for complying with the provisions of the National Environmental Policy Act.

Recommendations for the conduct of mixed-waste treatability studies were compiled from several U.S. Environmental Protection Agency guidance manuals, discussions with DOE waste managers who have contracted for off-site treatability studies, and reports generated by the DOE. Twelve separate management steps were identified, starting with a basis question on the need of a treatability study and progressing to identification of data quality objectives and finally to filing the final report.

1. INTRODUCTION

The U.S. Department of Energy (DOE) has established the Mixed Waste Focus Area (MWFA), which represents a national effort to develop and coordinate treatment solutions for mixed waste among all DOE facilities. The hazardous waste component of mixed waste is regulated under the Resource Conservation and Recovery Act (RCRA), while the radioactive component is regulated under the Atomic Energy Act, as implemented by the DOE, making mixed waste one of the most complex types of waste for the DOE to manage. The MWFA has the mission to support technologies that meet the needs of the DOE's waste management efforts to characterize, treat, and dispose of mixed waste being generated and stored throughout the DOE complex. The technologies to be supported must meet all regulatory requirements, provide cost and risk improvements over available technologies, and be acceptable to the public.

The most notable features of the DOE's mixed-waste streams are the wide diversity of waste matrices, volumes, radioactivity levels, and RCRA-regulated hazardous contaminants. Table 1-1 is constructed from data from the proposed site treatment plans developed by each DOE site and submitted to DOE Headquarters. The table shows the number of mixed-waste streams and their corresponding volumes. This table illustrates that the DOE has a relatively small number of large-volume mixed-waste streams and a large number of small-volume mixed-waste streams. There are 1,033 mixed-waste streams with volumes less than 1 cubic meter; 1,112 mixed-waste streams with volumes between 1 and 1,000 cubic meters; and only 61 mixed-waste streams with volumes exceeding 1,000 cubic meters.

Table 1-2 shows the number of DOE mixed-waste streams with various types of RCRA-regulated hazardous wastes identified by waste matrix type and radioactivity classification (low level, transuranic, and high level). This table shows that the largest number of mixed low-level waste streams are in the following mixed low-level waste types:

- Organic liquids containing hazardous organics
- Particulates and sludges containing hazardous metals
- Particulates and sludges containing "other" mixed low-level waste
- Debris and soils/debris containing hazardous metals
- Debris and soils/debris containing "other" mixed low-level waste
- Inherently hazardous waste containing hazardous metals.

The greatest number of mixed transuranic waste streams are composed of particulates/sludges, debris, and debris plus soils with potentially similar distributions of RCRA-regulated hazardous waste types.

Table 1-1
Number of U.S. Department of Energy Mixed-Waste Streams Summarized by Volume

WASTE TYPE	<1 m^3	1–10 m^3	10–1,000 m^3	>1,000 m^3	Total Number
Mixed Low-Level Waste	909	487	392	34	1,822
Mixed Transuranic Waste	122	102	127	14	365
Mixed High-Level Waste	2	0	4	13	19
TOTAL	1,033	589	523	61	2,206

m^3 = cubic meters.

Table 1-2
Number of U.S. Department of Energy Mixed-Waste Streams Categorized by RCRA-Regulated Hazardous Waste Type

WASTE MATRIX	HAZARDOUS WASTE TYPE IN MIXED LOW-LEVEL WASTE					MIXED TRU[a] WASTE	MIXED HIGH-LEVEL WASTE
	RCRA Toxicity Characteristic/ Listed Organics	RCRA Toxicity Characteristic Metals	RCRA-Regulated Metals and Organics	RCRA-Regulated Mercury	"Other"		
Aqueous Liquids/Slurries	1	61	0	1	90	6	12
Organic Liquids	165	0	94	0	11	4	2
Particulates/Sludges	81	177	32	12	135	109	4
Soils	1	21	0	2	40	0	1
Debris and Soil/Debris	95	231	86	15	153	221	0
Special Waste	6	23	1	3	58	5	0
Inherently Hazardous	1	132	0	11	83	20	0

[a]TRU = Transuranic.

Treatability studies represent an available vehicle for DOE waste managers to evaluate and demonstrate mixed-waste treatment technologies. The MWFA initiated this survey to facilitate the widest possible use of treatability studies by DOE facilities. The intent of this document is to provide a compilation of commercial treatability study providers and their capabilities for consideration in addressing DOE's small- and large-volume mixed-waste streams.

Chapter 2 presents the results of a survey of commercial mixed-waste treatability study providers with licenses and systems that can accept mixed waste. (University-affiliated providers would be considered commercial providers for the purpose of this survey.) The information is compiled in several formats to facilitate access to companies offering capability in any of 21 mixed-waste treatment technology categories. The MWFA notes that the information compiled in this survey should be regarded as a snapshot in time, as the commercial capability for handling mixed waste is developing and changing at a rapid pace.

The MWFA did not attempt to compile mixed-waste treatability study providers resident within DOE. These sources are relatively well known or can be readily obtained by those in the DOE system, whereas the commercial sources were not widely known. Many DOE facilities have already reported treatability studies and have available systems and regulatory arrangements to conduct treatability studies with surrogates, site-generated mixed wastes, or off-site waste samples. The MWFA can provide specific technical contacts on these technologies for those interested.

Chapters 3 and 4 of this document are included for those not familiar with the use of treatability studies for mixed waste. This information is intended as guidance that does not supplant regulator discussions or direct contact with those skilled in treatability study execution.

Chapter 3 provides a summary of regulatory provisions pertaining to treatability studies and the requirements for conducting them. It includes summaries of relevant sections of RCRA, the Toxic Substances Control Act (TSCA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), U.S. Nuclear Regulatory Commission (NRC) laws, U.S. Department of Transportation (DOT) requirements, DOE Orders, and the National Environmental Policy Act (NEPA).

Chapter 4 is a very brief introduction to the management steps necessary for identifying, specifying, and procuring a treatability study demonstration from a commercial provider. Information in this chapter has been compiled from numerous U.S. Environmental Protection Agency (EPA) guidance documents and published "lessons learned" on treatability study experience at several DOE facilities. This chapter is intended for those unfamiliar with the steps and nuances of managing a successful treatability study.

2. TREATABILITY STUDY SURVEY RESULTS

2.1 Survey Methodology

The survey of commercial providers with mixed-waste treatability study capabilities involved identification of candidate firms, contact with the firms to ascertain capability and interest, and compilation of resultant information. Candidate commercial providers were compiled from four sources of information. The EPA's Vendor Information System for Innovative Treatment Technologies (VISITT) database (EPA, 1994) was queried for firms with a background in the treatment of both hazardous and radioactive waste. Secondly, the DOE Tech-Con database, resident at Argonne National Laboratory, was also reviewed. In addition, the Idaho National Engineering Laboratory published their *Review of Private Sector Treatment, Storage, and Disposal Capacity for Radioactive Waste* in January 1995 (Smith et al., 1995). Finally, Lockheed Martin Idaho Technologies, Inc., published an announcement in the *Commerce Business Daily* to identify any new sources.

Over 100 commercial providers were identified from these four sources, and a representative from the MWFA contacted all firms by phone to determine whether they had current capability and interest in participating in the survey. Subsequently, the interested firms were sent questionnaires to characterize their capability and history in mixed-waste treatability studies. To identify and confirm each provider's specific capability, a questionnaire was developed that asked for the following:

- Name of facility and facility contact
- Technologies available through that firm
- Waste matrices/hazardous waste types treated by that provider
- Copies of radioactive material licenses (to identify Curie limits for acceptance)
- Relevant limits of their waste acceptance criteria
- Demonstration unit capacity
- Treatability study history
- Lists of publications or technical papers presented on the results of that firm's treatability studies.

The complete questionnaire is included as Attachment 1.

2.2 Survey Results

Information from the survey forms has been compiled into a database and presented in several forms in this report. Attachment 2 includes one page summaries of the questionnaire responses by each firm for each technology. Table 2-1 compiles all commercial providers responding with capabilities in each of 21 general treatment technology categories. This table also includes the contact names and telephone numbers.

Table 2-1
Technology Capabilities of Treatability Study Commercial Providers

Technology by Category	Company	Rad Mat License	Contact	Phone
AMALGAMATION				
Amalgamation	IT Corporation	Yes	Ed Alperin	(423) 690-3211
BIODEGRADATION				
Air Sparging/Soil Vapor Extraction	Brown and Root Environmental	Yes	Richard Ninesteel	(412) 921-8746
Excavated Soil Biotreatment (BIOFAST)	IT Corporation	Yes	Ed Alperin	(423) 690-3211
Modified Activated Sludge	Maxim Technologies, Inc.	Yes	Robert Bessent	(314) 426-0880
Natural Attenuation	IT Corporation	Yes	Ed Alperin	(423) 690-3211
Research and Development	Radian Corporation	Yes	Rick Strickert	(512) 244-0855
CHEMICAL OXIDATION				
Chemical Photolysis	Institute for Environmental Health and Safety	Yes	Solomon Leung	(208) 236-2524
Fenton's Reagent Oxidation	Institute for Environmental Health and Safety	Yes	Solomon Leung	(208) 236-2524
In-situ Chemical Treatment	Brown and Root Environmental	Yes	Richard Ninesteel	(412) 921-8746
Research and Development	Radian Corporation	Yes	Rick Strickert	(512) 244-0855
UV Photolysis	IT Corporation	Yes	Ed Alperin	(423) 690-3211
CONTAINMENT				
Fracturing to Increase Premeability in Bedrock	Brown and Root Environmental	Yes	Richard Ninesteel	(412) 921-8746
Pressure Grouting of Soil and Fractured Bedrock	Brown and Root Environmental	Yes	Richard Ninesteel	(412) 921-8746
Soil Saw Barrier System	Brown and Root Environmental	Yes	Richard Ninesteel	(412) 921-8746
DEACTIVATION				
Compressed Gases	Earth Resources Corporation	No	Michael Miller	(407) 877-0877
Deactivation	IT Corporation	Yes	Ed Alperin	(423) 690-3211
DEBRIS WASHING				
Debris Decontamination	IT Corporation	Yes	Ed Alperin	(423) 690-3211
EXTRACTION				
Electrochemical Ion Exchange (EIX)	Selentec	No	Michael Dunn	(770) 640-7059
INCINERATION				
Disposal of Liquid Organics	Perma-Fix Environmental Services	Yes	Bernhardt (Ben) Warren	(352) 395-1352
Fluid-Bed Calcination	Energy and Environmental Research Center	No	Edward Steadman	(701) 777-5157
Incineration	IT Corporation	Yes	Ed Alperin	(423) 690-3211
Industrial boiler used for energy recovery	Chemical Waste Management, Inc.	Yes	Richard Dabolt	(423) 376-0084

Table 2-1 *(Continued)*
Technology Capabilities of Treatability Study Commercial Providers

Technology by Category	Company	Rad Mat License	Contact	Phone
LSV Processing	Perma-Fix Environmental Services	Yes	Bernhardt (Ben) Warren	(352) 395-1352
Pyrolysis	Energy and Environmental Research Center	No	Edward Steadman	(701) 777-5157
MACROENCAPSULATION				
Macroencapsulation	Envirocare of Utah, Inc.	Yes	Kevin Fuller	(801) 532-1330
Macroencapsulation	IT Corporation	Yes	Ed Alperin	(423) 690-3211
ORGANIC DESTRUCTION				
Base Catalyzed Decomposition (BCD)	IT Corporation	Yes	Ed Alperin	(423) 690-3211
Chemical Dehalogenation	IT Corporation	Yes	Ed Alperin	(423) 690-3211
DECHLOR®	WMX Technologies Inc.	Yes	Edward Wannemacher	(864) 646-2413
H2O2/Ozone Treatment of Liquid Waste	Maxim Technologies, Inc.	Yes	Robert Bessent	(314) 426-0880
Incineration/Combustion/Calcining/Roasting	Hazen Research Inc.	Yes	Rodney Hodgson	(303) 279-4501
Molten Salt Oxidation	WMX Technologies Inc.	Yes	Edward Wannemacher	(864) 646-2413
Permeable treatment bed installation	Brown and Root Environmental	Yes	Richard Ninesteel	(412) 921-8746
PO*WW*ER®	WMX Technologies Inc.	Yes	Edward Wannemacher	(864) 646-2413
Steam Reforming	Scientific Ecology Group, Inc.	Yes	Tom Snyder	(423) 376-8321
UV Photolysis/Chemical Oxidation	IT Corporation	Yes	Ed Alperin	(423) 690-3211
PHYSICAL SEPARATION				
Segmented Gate System	Thermo NUtech	No	Jeff Brown	(423) 481-0683
RECOVERY OF METALS				
Activated Carbon	Energy and Environmental Research Center	No	Edward Steadman	(701) 777-5157
Centrifugal Membrane Filtration	Energy and Environmental Research Center	No	Edward Steadman	(701) 777-5157
CHEMIC™	Atomic Energy of Canada Limited (AECL)	Yes	Leo Buckley	(613) 584-8811
Chemical Leaching	Hazen Research Inc.	Yes	Rodney Hodgson	(303) 279-4501
Diphonix Ion Exchange	Eichrom Industries, Inc.	No	James Harvey	(708) 963-0320
Electro-Chemical Separation	IT Corporation	Yes	Ed Alperin	(423) 690-3211
Freeze Separation	WMX Technologies Inc.	Yes	Edward Wannemacher	(864) 646-2413
MAG*SEP	Selentec	No	Michael Dunn	(770) 640-7059
Precipitation	IT Corporation	Yes	Ed Alperin	(423) 690-3211

Table 2-1 *(Continued)*
Technology Capabilities of Treatability Study Commercial Providers

Technology by Category	Company	Rad Mat License	Contact	Phone
Quantum - Catalytic Extraction Processing	M4 Environmental Management Inc.	Yes	Robert Sameski	(423) 220-5017
Reverse Osmosis	IT Corporation	Yes	Ed Alperin	(423) 690-3211
Solvent Extraction	Hazen Research Inc.	Yes	Rodney Hodgson	(303) 279-4501
RECOVERY OF ORGANICS				
Adsorption Media	IT Corporation	Yes	Ed Alperin	(423) 690-3211
Chemical Extraction, with or without chelants	IT Corporation	Yes	Ed Alperin	(423) 690-3211
Liquified Gas Solvent Extraction (LG-SX)	CF Systems	Access	Michael Finton	(216) 523-5286
Thermal Desorption	Hazen Research Inc.	Yes	Rodney Hodgson	(303) 279-4501
VAC*TRAX™	WMX Technologies Inc.	Yes	Edward Wannemacher	(864) 646-2413
RETORTING FOR MERCURY				
Low Temperature Thermal Desorption	IT Corporation	Yes	Ed Alperin	(423) 690-3211
Retorting for Mercury	Hazen Research Inc.	Yes	Rodney Hodgson	(303) 279-4501
Retorting for Mercury	Nuclear Fuel Services, Inc.	Yes	R. David Wise	(423) 743-1795
SOIL WASHING				
Acid Extraction of Soil/Sediment	Maxim Technologies, Inc.	Yes	Robert Bessent	(314) 426-0880
ACT*DE*CON	Selentec	No	Michael Dunn	(770) 640-7059
Materials Handling/Soil Washing/Gravity Separation	Hazen Research Inc.	Yes	Rodney Hodgson	(303) 279-4501
Soil Screening/Washing	Babcock & Wilcox, A McDermott Company		Nicholas Mravich	(330) 829-7662
Soil Washing	Alternative Remedial Technologies	No	Michael Mann	(813) 264-3571
Soil Washing	Nuclear Fuel Services, Inc.	Yes	R. David Wise	(423) 743-1795
Soil Washing	Westinghouse Science and Technology Center	Yes	Nancy Ulerich	(412) 256-2198
Soil Washing/Flushing	IT Corporation	Yes	Ed Alperin	(423) 690-3211
SOIL*EX™	WMX Technologies Inc.	Yes	Edward Wannemacher	(864) 646-2413
Terra-Kleen Solvent Extraction System	Terra-Kleen Response Group, Inc.		Alan Cash	(619) 558-8762
TVIES	TVIES	No	Myron Kuhlman	(713) 447-5544
STABILIZATION				
Aquaset/Petroset	Fluid Tech, Inc.	Yes	Thomas Murarik	(702) 871-1884
Auger Mixing System	Brown and Root Environmental	Yes	Richard Ninesteel	(412) 921-8746
Cement Stabilization	Scientific Ecology Group, Inc.	Yes	Marty Brownstein	(423) 376-8321
CHEM MATRIX	WMX Technologies Inc.	Yes	Edward Wannemacher	(864) 646-2413

Table 2-1 *(Continued)*
Technology Capabilities of Treatability Study Commercial Providers

Technology by Category	Company	Rad Mat License	Contact	Phone
Chemical Stabilization	Nuclear Fuel Services, Inc.	Yes	R. David Wise	(423) 743-1795
High Shear Waste Immobilization	Westinghouse Science and Technology Center	Yes	Nancy Ulerich	(412) 256-2198
Jet Grouting	Brown and Root Environmental	Yes	Richard Ninesteel	(412) 921-8746
Magnesium Oxide Cement Stabilization	Scientific Ecology Group, Inc.	Yes	Marty Brownstein	(423) 376-8321
Non-Thermal Stabilization	Envirocare of Utah, Inc.	Yes	Kevin Fuller	(801) 532-1330
Perma-Fix Process	Perma-Fix Environmental Services	Yes	Bernhardt (Ben) Warren	(352) 395-1352
Phoenix Ash Technology (TIDE Bricks)	WMX Technologies Inc.	Yes	Edward Wannemacher	(864) 646-2413
Polyethylene Stabilization	Scientific Ecology Group, Inc.	Yes	Marty Brownstein	(423) 376-8321
Research and Development	Perma-Fix Environmental Services	Yes	Bernhardt (Ben) Warren	(352) 395-1352
Research and Development	Radian Corporation	Yes	Rick Strickert	(512) 244-0855
Soil Rake	Brown and Root Environmental	Yes	Richard Ninesteel	(412) 921-8746
Stabilization/ Solidification	IT Corporation	Yes	Ed Alperin	(423) 690-3211
Superset	Carlo Environmental Technologies, Inc.	No	Keith Flemingloss	(810) 468-9580
Thermoplastic Epoxy Stabilization	Scientific Ecology Group, Inc.	Yes	Marty Brownstein	(423) 376-8321
Thermoset Epoxy Stabilization	Scientific Ecology Group, Inc.	Yes	Marty Brownstein	(423) 376-8321
Vinyl Ester Stabilization	Scientific Ecology Group, Inc.	Yes	Marty Brownstein	(423) 376-8321
STEAM STRIPPING				
Organic Phase Transfer	Maxim Technologies, Inc.	Yes	Robert Bessent	(314) 426-0880
Steam/Air Stripping	IT Corporation	Yes	Ed Alperin	(423) 690-3211
THERMAL DESORPTION				
Terrachem IRV-100	McLaren-Hart Inc.		Jeff Oham	(704) 587-0003
VITRIFICATION				
Cold Crucible Vitrification	WMX Technologies Inc.	Yes	Edward Wannemacher	(864) 646-2413
Cyclone Furnace Vitrification	Babcock & Wilcox, A McDermott Company		Michael Holmes	(330) 829-7662
DC Graphite Arc Melter	Electro-Pyrolysis, Inc.	Access	J. Kenneth Wittle	(610) 687-9070
Enviroglass	Vectra		Paul Denault	(803) 781-0426
In Situ Vitrification (ISV)	Geosafe Corporation	Access	Matthew Haass	(509) 375-0710
Joule-Heated Melter	Scientific Ecology Group, Inc.	Yes	Tom Snyder	(423) 376-8321

Table 2-1 *(Continued)*
Technology Capabilities of Treatability Study Commercial Providers

Technology by Category	Company	Rad Mat License	Contact	Phone
Joule-Heated Melters	WMX Technologies Inc.	Yes	Edward Wannemacher	(864) 646-2413
Plasma	Westinghouse Science and Technology Center	Yes	Nancy Ulerich	(412) 256-2198
Plasma Centrifugal Furnace	MSE Technology Applications, Inc.	No	Jeff Ruffner	(406) 494-7412
Plasma Hearth Process	Science Applications International Corporation	No	Gary Leatherman	(208) 528-2179
Plasma-Driven Reactor	Scientific Ecology Group, Inc.	Yes	Tom Snyder	(423) 376-8321
Vitrification	IT Corporation	Yes	Ed Alperin	(423) 690-3211
WASTE SEPARATION				
Bulking, Profiling for Disposal or Incineration	Perma-Fix Environmental Services	Yes	Bernhardt (Ben) Warren	(352) 395-1352
WET OXIDATION				
Hydrothermal Boiler	Energy and Environmental Research Center	No	Edward Steadman	(701) 777-5157
Wet Air Oxidation	IT Corporation	Yes	Ed Alperin	(423) 690-3211

Note that Table 2-1 includes an indication of whether the commercial providers possess radioactive materials licenses. This is a key item because technology demonstrations under RCRA require only notification of the cognizant agency (see Chapter 3 for details). Therefore, the radioactive material license is a key indicator of the ability to accept mixed-waste treatability study samples. Column 3 of Table 2-1 indicates a few commercial providers with "access" to licensed facilities. In this case, the respondents indicated that they do not have their own licensed facilities, but they have arrangements with other commercial or government facilities with appropriate licenses and permits. An alternative by at least one commercial provider is that it has agreements with DOE sites for radioactive material treatment demonstrations.

A second tabulation, Table 2-2, compiles all treatment technologies available from each commercial provider tabulated by company. Aside from the contact information, the table includes the level of technology maturity (discussed in the next paragraph), the type of waste acceptable at the facility or suitable for the technology, and the regulatory status of resultant treatment residues. (This latter information is important, as will be described in Chapter 4.) The residues from treatability studies undergo a hazardous waste determination, and the customers must plan for whether the treatment residues are radioactive waste, mixed waste meeting disposal requirements, or mixed waste requiring further treatment. A third table, Table 2-3, provides waste-matrix information for each technology offered by each commercial provider tabulated by company and technology.

In Table 2-2, the maturity level of the technologies is given as bench scale, pilot scale, or commercial scale. In general, the level was determined by the commercial provider. In making the assignment, the term "bench scale" describes a process demonstrated on a small scale, and usually only the single-unit operation was demonstrated. Capacities of liters or liters per day is common for bench scale apparatus. The term "pilot scale" refers to a process demonstrated on an integrated pilot plant scale where the scale of operation is in the gallons-per-day range. Pilot plants usually include some degree of automatic control. "Commercial scale" processes have been operated using purchased commercial equipment or by a commercial service supplier. This scale typically involves drum-size quantities of waste or more.

A review of the information in Tables 2-1 through 2-3 and the accompanying commercial provider/technology questionnaire response summaries in Attachment 2 reveals several groupings of survey respondents:

- Commercial technology suppliers with a few technologies who typically do not have available mixed-waste treatability study facilities.

- Commercial technology suppliers with licenses for mixed-waste treatability studies and many technologies available.

Table 2-2
Treatability Study Commercial Providers Capabilities

			Waste Accepted			Residuals		
Alternative Remedial Technologies		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Soil Washing	Soil Washing	Commercial	✓			✓		
Atomic Energy of Canada Limited (AECL)		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Recovery of Metals	CHEMIC™	Pilot	✓			✓	✓	
Babcock & Wilcox, A McDermott Company		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Soil Washing	Soil Screening/Washing	Commercial	✓			✓	✓	✓
Vitrification	Cyclone Furnace Vitrification	Commercial	✓			✓		
Brown and Root Environmental		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Biodegradation	Air Sparging/Soil Vapor Extraction	Commercial	✓	✓				
Chemical Oxidation	In-situ Chemical Treatment	Commercial	✓	✓				
Containment	Fracturing to Increase Premeability in Bedrock	Commercial	✓	✓				
Containment	Pressure Grouting of Soil and Fractured Bedrock	Commercial	✓	✓				
Containment	Soil Saw Barrier System	Commercial	✓	✓	✓			
Organic Destruction	Permeable treatment bed installation	Pilot	✓	✓				
Stabilization	Auger Mixing System	Pilot	✓	✓				
Stabilization	Jet Grouting	Commercial	✓	✓				
Stabilization	Soil Rake	Commercial	✓	✓				
Carlo Environmental Technologies, Inc.		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Stabilization	Superset	Pilot	✓			✓		

Table 2-2 *(Continued)*

Treatability Study Commercial Providers Capabilities

			Waste Accepted			Residuals		
CF Systems		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Recovery of Organics	Liquified Gas Solvent Extraction (LG-SX)	Commercial	✓	✓	✓	✓		
Chemical Waste Management, Inc.		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Incineration	Industrial boiler used for energy recovery	Commercial	✓	✓		✓	✓	
Earth Resources Corporation		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Deactivation	Compressed Gases	Commercial	✓			✓	✓	
Eichrom Industries, Inc.		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Recovery of Metals	Diphonix Ion Exchange	Commercial	✓			✓		
Electro-Pyrolysis, Inc.		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Vitrification	DC Graphite Arc Melter	Pilot				✓		✓
Energy and Environmental Research Center		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Incineration	Fluid-Bed Calcination	Bench				✓		
Incineration	Pyrolysis	Pilot					✓	
Recovery of Metals	Activated Carbon	Pilot	✓					
Recovery of Metals	Centrifugal Membrane Filtration	Commercial	✓	✓	✓	✓	✓	✓
Wet Oxidation	Hydrothermal Boiler	R & D	✓				✓	

Table 2-2 *(Continued)*

Treatability Study Commercial Providers Capabilities

			Waste Accepted			Residuals		
Envirocare of Utah, Inc.		**Maturity Level**	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Macroencapsulation	Macroencapsulation	Commercial	✓	✓		✓		
Stabilization	Non-Thermal Stabilization	Commercial	✓	✓		✓		
Fluid Tech, Inc.		**Maturity Level**	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Stabilization	Aquaset/Petroset	Commercial	✓	✓			✓	
Geosafe Corporation		**Maturity Level**	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Vitrification	In Situ Vitrification (ISV)	Commercial	✓	✓		✓		
Hazen Research Inc.		**Maturity Level**	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Organic Destruction	Incineration/Combustion/Calcining/Roasting	Pilot	✓			✓	✓	✓
Recovery of Metals	Chemical Leaching	Pilot	✓			✓	✓	✓
Recovery of Metals	Solvent Extraction	Pilot	✓			✓	✓	✓
Recovery of Organics	Thermal Desorption	Pilot	✓			✓		✓
Retorting for Mercury	Retorting for Mercury	Commercial	✓			✓	✓	✓
Soil Washing	Materials Handling/Soil Washing/Gravity Separation	Pilot	✓			✓	✓	✓
Institute for Environmental Health and Safety		**Maturity Level**	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Chemical Oxidation	Chemical Photolysis	Bench						✓
Chemical Oxidation	Fenton's Reagent Oxidation	Bench						✓

Table 2-2 *(Continued)*

Treatability Study Commercial Providers Capabilities

IT Corporation		Maturity Level	Waste Accepted			Residuals		
			Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Amalgamation	Amalgamation	Commercial	✓	✓		✓		✓
Biodegradation	Excavated Soil Biotreatment (BIOFAST)	Commercial	✓	✓		✓	✓	✓
Biodegradation	Natural Attenuation	Commercial	✓	✓		✓		✓
Chemical Oxidation	UV Photolysis	Commercial	✓	✓		✓		✓
Deactivation	Deactivation	Commercial	✓	✓		✓	✓	✓
Debris Washing	Debris Decontamination	Commercial	✓	✓		✓		✓
Incineration	Incineration	Commercial	✓	✓		✓	✓	✓
Macroencapsulation	Macroencapsulation	Commercial	✓	✓		✓		✓
Organic Destruction	Base Catalyzed Decomposition (BCD)	Commercial	✓	✓		✓		✓
Organic Destruction	Chemical Dehalogenation	Commercial	✓	✓		✓	✓	✓
Organic Destruction	UV Photolysis/Chemical Oxidation	Commercial	✓	✓		✓		✓
Recovery of Metals	Electro-Chemical Separation	Bench	✓	✓		✓	✓	✓
Recovery of Metals	Precipitation	Commercial	✓	✓		✓	✓	✓
Recovery of Metals	Reverse Osmosis	Commercial	✓	✓		✓	✓	✓
Recovery of Organics	Adsorption Media	Commercial	✓	✓		✓		✓
Recovery of Organics	Chemical Extraction, with or without chelants	Commercial	✓	✓		✓	✓	✓
Retorting for Mercury	Low Temperature Thermal Desorption	Commercial	✓	✓		✓	✓	✓
Soil Washing	Soil Washing/Flushing	Commercial	✓	✓		✓	✓	✓
Stabilization	Stabilization/ Solidification	Commercial	✓	✓		✓		✓
Steam Stripping	Steam/Air Stripping	Commercial	✓	✓		✓	✓	✓
Vitrification	Vitrification	Bench	✓	✓		✓		✓
Wet Oxidation	Wet Air Oxidation	Commercial	✓	✓		✓	✓	✓

M4 Environmental Management Inc.		Maturity Level	Waste Accepted			Residuals		
			Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Recovery of Metals	Quantum - Catalytic Extraction Processing	Commercial	✓			✓		

Table 2-2 *(Continued)*

Treatability Study Commercial Providers Capabilities

			Waste Accepted			Residuals		
Maxim Technologies, Inc.		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Biodegradation	Modified Activated Sludge	Bench	✓					✓
Organic Destruction	H2O2/Ozone Treatment of Liquid Waste	Bench	✓					✓
Soil Washing	Acid Extraction of Soil/Sediment	Bench	✓					✓
Steam Stripping	Organic Phase Transfer	Bench	✓					✓
McLaren-Hart Inc.			Waste Accepted			Residuals		
		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Thermal Desorption	Terrachem IRV-100	Commercial	✓	✓		✓		
MSE Technology Applications, Inc.			Waste Accepted			Residuals		
		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Vitrification	Plasma Centrifugal Furnace	Pilot				✓	✓	
Nuclear Fuel Services, Inc.			Waste Accepted			Residuals		
		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Retorting for Mercury	Retorting for Mercury					✓		
Soil Washing	Soil Washing					✓		
Stabilization	Chemical Stabilization					✓		
Perma-Fix Environmental Services			Waste Accepted			Residuals		
		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Incineration	Disposal of Liquid Organics	Commercial	✓	✓		✓		
Incineration	LSV Processing	Commercial	✓	✓		✓		
Stabilization	Perma-Fix Process	Commercial	✓	✓		✓	✓	
Stabilization	Research and Development	Bench	✓	✓		✓	✓	✓
Waste Separation	Bulking, Profiling for Disposal or Incineration	Commercial	✓	✓		✓	✓	

Table 2-2 *(Continued)*

Treatability Study Commercial Providers Capabilities

			Waste Accepted			Residuals		
Radian Corporation		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Biodegradation	Research and Development	Bench	✓	✓				✓
Chemical Oxidation	Research and Development	Bench	✓	✓				✓
Stabilization	Research and Development	Bench	✓	✓				✓
Science Applications International Corporation		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Vitrification	Plasma Hearth Process	Pilot				✓		
Scientific Ecology Group, Inc.		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Organic Destruction	Steam Reforming	Commercial	✓	✓	✓	✓		
Stabilization	Cement Stabilization	Commercial	✓	✓		✓		
Stabilization	Magnesium Oxide Cement Stabilization	Commercial	✓	✓		✓		
Stabilization	Polyethylene Stabilization	Pilot	✓			✓		
Stabilization	Thermoplastic Epoxy Stabilization	Commercial	✓				✓	
Stabilization	Thermoset Epoxy Stabilization	Pilot	✓				✓	
Stabilization	Vinyl Ester Stabilization	Pilot	✓			✓		
Vitrification	Joule-Heated Melter	Commercial	✓	✓	✓		✓	
Vitrification	Plasma-Driven Reactor	Commercial	✓	✓	✓	✓		
Selentec		Maturity Level	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Extraction	Electrochemical Ion Exchange (EIX)	Pilot	✓	✓				
Recovery of Metals	MAG*SEP	Pilot	✓	✓		✓		
Soil Washing	ACT*DE*CON	Pilot	✓	✓			✓	

Table 2-2 *(Continued)*
Treatability Study Commercial Providers Capabilities

			Waste Accepted			Residuals		
Terra-Kleen Response Group, Inc.		**Maturity Level**	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Soil Washing	Terra-Kleen Solvent Extraction System	Commercial	✓	✓		✓		
Thermo NUtech		**Maturity Level**	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Physical Separation	Segmented Gate System	Commercial	✓	✓		✓		
TVIES		**Maturity Level**	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Soil Washing	TVIES	Commercial	✓			✓		
Vectra		**Maturity Level**	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Vitrification	Enviroglass	Commercial	✓	✓		✓		
Westinghouse Science and Technology Center		**Maturity Level**	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Soil Washing	Soil Washing	Commercial	✓					
Stabilization	High Shear Waste Immobilization	Commercial	✓			✓		
Vitrification	Plasma	Commercial	✓			✓		
WMX Technologies Inc.		**Maturity Level**	Low Level Waste	Trans-uranic Waste	High Level Waste	Ready to Dispose	Need Treat-ment	Returned to Gen.
Organic Destruction	DECHLOR®	Pilot	✓				✓	
Organic Destruction	Molten Salt Oxidation	Pilot	✓	✓	✓		✓	
Organic Destruction	PO*WW*ER®	Commercial	✓	✓				✓
Recovery of Metals	Freeze Separation	Bench	✓			✓	✓	✓
Recovery of Organics	VAC*TRAX™	Pilot	✓	✓				✓
Soil Washing	SOIL*EX™	Pilot	✓	✓		✓	✓	✓

Table 2-2 *(Continued)*

Treatability Study Commercial Providers Capabilities

Stabilization	CHEM MATRIX	Commercial	✓	✓		✓		
Stabilization	Phoenix Ash Technology (TIDE Bricks)	Bench	✓	✓		✓		
Vitrification	Cold Crucible Vitrification	Pilot	✓	✓	✓	✓		
Vitrification	Joule-Heated Melters	Commercial	✓	✓	✓	✓		

Table 2-3
Treatability Study Commercial Provider Waste Matrix Capabilities

Alternative Remedial Technologies	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
Soil Washing						✓	✓							

Atomic Energy of Canada Limited (AECL)	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
CHEMIC™	✓	✓		✓		✓								

Babcock & Wilcox, A McDermott Company	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
Cyclone Furnace Vitrification	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓	✓
Soil Screening/Washing						✓								

Brown and Root Environmental	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
Air Sparging/Soil Vapor Extraction	✓					✓								
All Technologies	✓	✓	✓	✓	✓	✓	✓		✓					
Auger Mixing System				✓	✓	✓	✓							
Fracturing to Increase Premeability in Be	✓													
In-situ Chemical Treatment						✓								
Jet Grouting						✓								
Permeable treatment bed installation	✓													
Pressure Grouting of Soil and Fractured						✓								
Soil Rake		✓		✓	✓	✓								
Soil Saw Barrier System						✓								

Carlo Environmental Technologies, Inc.	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
Superset				✓	✓	✓	✓							

Table 2-3 *(Continued)*

Treatability Study Commercial Provider Waste Matrix Capabilities

	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
CF Systems														
Liquified Gas Solvent Extraction			✓		✓	✓								
Chemical Waste Management, Inc.														
Industrial boiler used for energy recovery	✓		✓							✓				
Earth Resources Corporation														
Compressed Gases	✓		✓								✓			
Eichrom Industries, Inc.														
Diphonix Ion Exchange	✓													
Electro-Pyrolysis, Inc.														
DC Graphite Arc Melter				✓	✓	✓	✓	✓	✓					
Energy and Environmental Research Center														
Activated Carbon	✓													
Centrifugal Membrane Filtration	✓	✓	✓	✓	✓									
Fluid-Bed Calcination	✓	✓	✓			✓								
Hydrothermal Boiler	✓	✓	✓	✓	✓	✓								
Pyrolysis			✓		✓				✓	✓				
Envirocare of Utah, Inc.														
Macroencapsulation								✓	✓					
Non-Thermal Stabilization				✓	✓	✓	✓	✓	✓					

Table 2-3 *(Continued)*

Treatability Study Commercial Provider Waste Matrix Capabilities

	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
Fluid Tech, Inc.														
Aquaset/Petroset	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Geosafe Corporation														
In Situ Vitrification (ISV)			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Hazen Research Inc.														
Chemical Leaching	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
Incineration/Combustion/Calcining/Roast	✓	✓	✓	✓	✓	✓	✓		✓			✓		
Materials Handling/Soil Washing/Gravity		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
Retorting for Mercury	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
Solvent Extraction	✓	✓		✓	✓	✓	✓		✓					
Thermal Desorption					✓	✓	✓					✓		
Institute for Environmental Health and Safety														
Chemical Photolysis	✓	✓				✓	✓							
Fenton's Reagent Oxidation	✓	✓				✓	✓							
IT Corporation														
Adsorption Media	✓	✓	✓											
Amalgamation				✓		✓						✓		
Base Catalyzed Decomposition (BCD)	✓	✓	✓		✓	✓	✓							
Chemical Dehalogenation			✓											
Chemical Extraction, with or without che	✓	✓	✓	✓	✓	✓	✓							
Deactivation	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓
Debris Decontamination							✓	✓	✓					

Table 2-3 *(Continued)*

Treatability Study Commercial Provider Waste Matrix Capabilities

	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
Electro-Chemical Separation	✓													
Excavated Soil Biotreatment (BIOFAST)						✓	✓							
Incineration	✓	✓	✓	✓	✓	✓	✓			✓				
Low Temperature Thermal Desorption	✓	✓		✓	✓	✓	✓					✓		
Macroencapsulation				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Natural Attenuation	✓	✓	✓		✓	✓	✓							
Precipitation	✓	✓	✓											
Reverse Osmosis	✓	✓												
Soil Washing/Flushing				✓	✓	✓	✓							
Stabilization/ Solidification	✓	✓	✓	✓	✓	✓	✓						✓	✓
Steam/Air Stripping	✓	✓	✓	✓	✓	✓	✓					✓		
UV Photolysis	✓	✓	✓		✓	✓	✓							
UV Photolysis/Chemical Oxidation	✓	✓	✓	✓	✓	✓								
Vitrification	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓
Wet Air Oxidation	✓	✓	✓		✓	✓	✓							

M4 Environmental Management Inc.	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
Quantum - Catalytic Extraction Processin			✓	✓	✓	✓	✓	✓	✓					✓

Maxim Technologies, Inc.	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
Acid Extraction of Soil/Sediment				✓	✓	✓	✓	✓						
H2O2/Ozone Treatment of Liquid Waste	✓		✓											
Modified Activated Sludge	✓	✓	✓											
Organic Phase Transfer	✓		✓											

Table 2-3 *(Continued)*

Treatability Study Commercial Provider Waste Matrix Capabilities

	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
McLaren-Hart Inc.														
Terrachem IRV-100				✓	✓	✓	✓					✓		
MSE Technology Applications, Inc.														
Plasma Centrifugal Furnace			✓	✓	✓	✓	✓	✓	✓					
Nuclear Fuel Services, Inc.														
Chemical Stabilization														
Retorting for Mercury														
Soil Washing														
Perma-Fix Environmental Services														
Bulking, Profiling for Disposal or Inciner	✓	✓		✓	✓	✓	✓	✓	✓					
Disposal of Liquid Organics	✓	✓	✓		✓					✓				
LSV Processing	✓		✓							✓				
Perma-Fix Process		✓				✓	✓	✓	✓			✓		
Research and Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Radian Corporation														
Research and Development	✓	✓		✓		✓								
Research and Development	✓	✓		✓		✓								
Research and Development	✓	✓		✓		✓								
Science Applications International Corporation														
Plasma Hearth Process		✓	✓	✓	✓	✓	✓	✓	✓	✓				

Table 2-3 *(Continued)*

Treatability Study Commercial Provider Waste Matrix Capabilities

	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
Scientific Ecology Group, Inc.														
Cement Stabilization	✓	✓	✓	✓	✓	✓	✓							
Joule-Heated Melter		✓		✓	✓	✓	✓							
Magnesium Oxide Cement Stabilization	✓	✓	✓	✓	✓	✓	✓		✓					
Plasma-Driven Reactor		✓	✓	✓	✓	✓	✓	✓	✓		✓			
Polyethylene Stabilization	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Steam Reforming	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Thermoplastic Epoxy Stabilization		✓		✓	✓	✓	✓	✓	✓					
Thermoset Epoxy Stabilization	✓	✓	✓	✓	✓	✓	✓							
Vinyl Ester Stabilization	✓	✓	✓	✓	✓	✓	✓							

	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
Selentec														
ACT*DE*CON				✓		✓								
Electrochemical Ion Exchange (EIX)	✓													
MAG*SEP	✓	✓												

	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
Terra-Kleen Response Group, Inc.														
Terra-Kleen Solvent Extraction System					✓	✓	✓	✓	✓	✓				

	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
Thermo NUtech														
Segmented Gate System						✓								

	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
TVIES														
TVIES				✓	✓	✓	✓					✓		

	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
Vectra														
Enviroglass	✓	✓	✓	✓	✓	✓	✓		✓	✓				

Table 2-3 *(Continued)*

Treatability Study Commercial Provider Waste Matrix Capabilities

Westinghouse Science and Technology Center	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
High Shear Waste Immobilization	✓	✓	✓	✓	✓	✓	✓							
Plasma	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Soil Washing						✓	✓						✓	

WMX Technologies Inc.	Aq Liquid	Aq Slurry	Org Liquid	Inorg Sludge	Org Sludge	Soils	Soil Debris	Metal Debris	Other Debris	Lab Packs	React Metal	Hg	Pb Bat	Cd Bat
CHEM MATRIX				✓	✓	✓	✓							
Cold Crucible Vitrification	✓	✓	✓	✓	✓	✓								
DECHLOR®			✓		✓	✓	✓							
Freeze Separation	✓													
Joule-Heated Melters	✓	✓	✓	✓	✓	✓	✓							
Molten Salt Oxidation	✓	✓	✓		✓						✓			
Phoenix Ash Technology (TIDE Bricks)	✓	✓	✓	✓	✓	✓								
PO*WW*ER®	✓	✓	✓											
SOIL*EX™				✓	✓	✓	✓					✓		
VAC*TRAX™					✓	✓	✓					✓		

- Commercial mixed-waste treatment facilities that can perform treatability studies under their existing permits and licenses.

- Environmental restoration technology suppliers with experience at radioactive sites but that do not typically have their own mixed-waste treatability study facilities.

2.3 Use of Summary Tables

To use the results of this survey, the MWFA recommends a review of the data in Tables 2-1 and 2-2 to locate commercial providers with reported capability in the technologies of interest. Table 2-3 can then be used to evaluate whether the waste matrix can be treated by that provider/technology. Subsequently, review of the permit and license information reported in Attachment 2 is useful in determining whether the waste activity levels are compatible with the license limits. It should be noted that some commercial providers report that minor radioactive materials license modifications are quickly obtained, so the license limits given in Attachment 2 should be regarded as approximate. Lastly, telephone discussions with the listed contact can confirm the match of the waste problem with the technology/provider.

The following conclusions result from the data presented:

- One hundred six processes are offered by thirty-three firms for treatability studies in twenty-one of the EPA's general technology categories.

- Responses have included both waste management and environmental restoration technologies.

- Several commercial providers expect an NRC or state radioactive materials license very soon.

- Many commercial providers responded positively to the telephone screen but did not return the completed questionnaire.

- Radioactive license limits are typically radionuclide specific, but radioactive material possession as high as 10 Curies is available. The supplier must be consulted to ensure that all radionuclides are within license limits.

- Two commercial suppliers identified the ability to accept plutonium in gram quantities.

3. REGULATORY PROVISIONS

DOE mixed-waste treatability studies, conducted in accordance with RCRA, are potentially subject to numerous other federal and state regulations, as well as DOE Orders. Treatability studies dealing with environmental restoration wastes generated at sites regulated under CERCLA will be subject to CERCLA requirements. If the treatability study involves polychlorinated biphenyls (PCB), requirements of TSCA will be applicable. If the study is conducted at a commercial treatability study laboratory or treatment facility, the facility must have a radioactive materials license from the NRC or applicable state agency. Waste samples transported to off-site facilities by common carriers must meet packaging requirements of the NRC and the DOT. The DOE is also responsible for complying with the provisions of the NEPA.

Regulatory issues related to treatability studies are depicted on a flow chart in Figure 3-1. If a treatability study is to be conducted off site, the generator should contact the off-site facility for specific regulatory protocols to be followed. The following discussion presents a more detailed review of regulations and requirements impacting treatability studies.

3.1 Resource Conservation and Recovery Act

3.1.1 The Treatability Study Exemption

RCRA provides for a treatability study exemption (in accordance with Title 40, Code of Federal Regulations, Part 261, Section 4, paragraph [e] {40 CFR 261.4[e]}) for generators. Generators that produce samples of RCRA-regulated hazardous waste for the purpose of having treatability studies performed on the samples are exempt from the requirements of 40 CFR 262, "Standards Applicable to Generators of Hazardous Waste," as well as from the requirements of 40 CFR 261 and 263 and RCRA notification requirements. Other requirements would apply, including transportation requirements, recordkeeping requirements, and biennial report preparation (for large-quantity generators or RCRA permitted facilities). Further, 40 CFR 261.4(d) provides exemptions for samples being tested to assess characteristics or composition.

In accordance with 40 CFR 261.4(e)(2)(I) and (ii), quantity limits do apply for treatability studies for each process being evaluated for each generated waste stream. These quantity limits may be exceeded if approved by the EPA Regional Administrator or the authorized state. It should be noted that the quantity limits stipulated by RCRA may or may not have been adopted and promulgated by the applicable states. State environmental regulations for both the DOE location where the waste originates and the location where the treatability study will be conducted may have more restrictive provisions than federal RCRA requirements (even including the absence of treatability study sample exemptions). Local regulations must be researched before shipment of the sample.

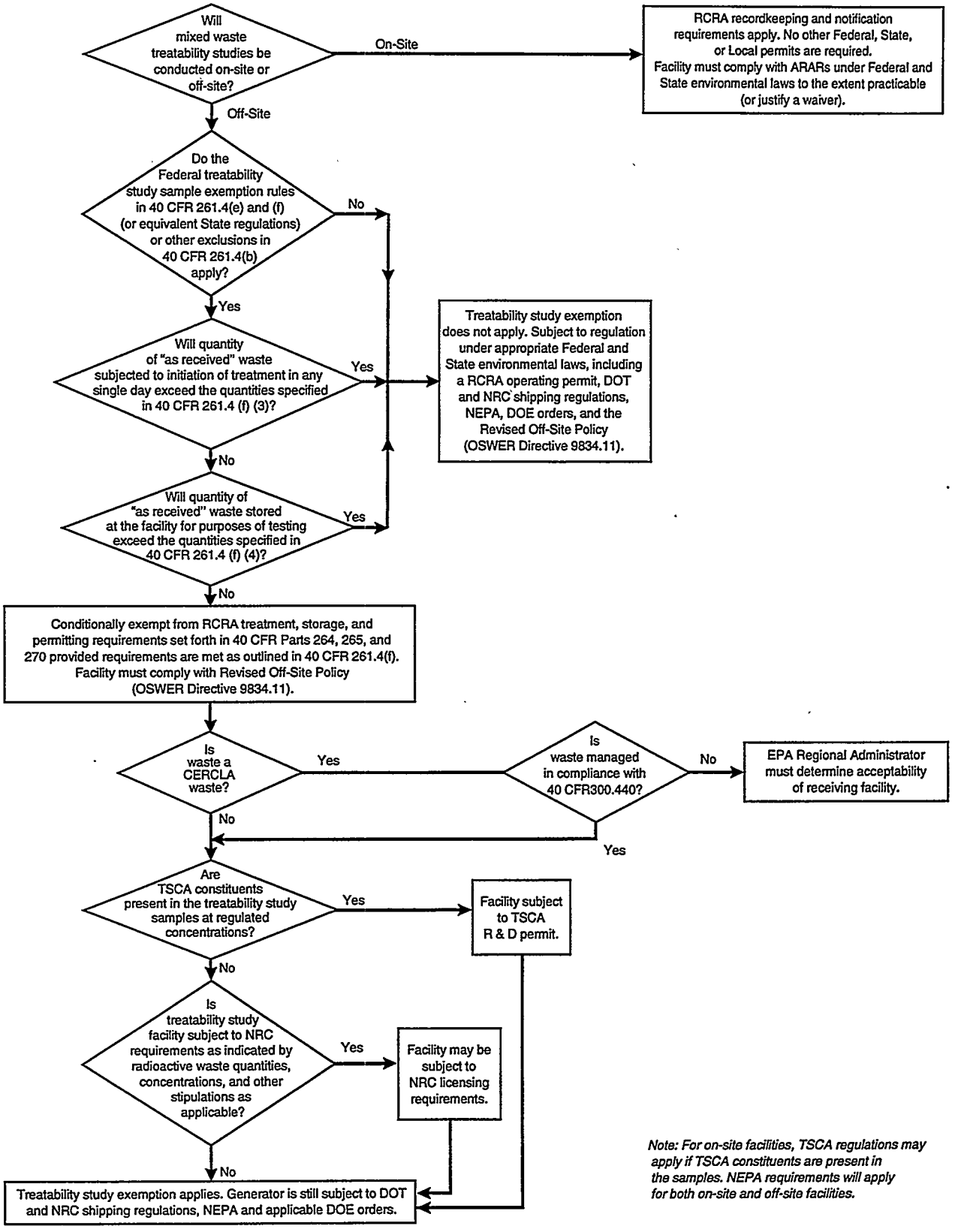

Figure 3-1
Treatability Study Regulatory Issues

RCRA regulations in 40 CFR 261.4(e) stipulate that the generator or treatability study provider use (for treatability studies) "no more than 10,000 kilograms (kg) of media contaminated with nonacute hazardous waste, 1,000 kg of nonacute hazardous waste other than contaminated media, 1 kg of acute hazardous waste, or 2,500 kg of media contaminated with acute hazardous waste for each process being evaluated for each generated waste stream." (Acute hazardous waste is given an "H" designation in accordance with 40 CFR Subpart D and is designated by EPA Hazardous Waste Numbers on the P-List of hazardous wastes as well as in F020, F021, F022, F023, F026, and F027.) The mass of each sample shipment must not exceed 10,000 kg. The 10,000-kg quantity may include media contaminated with nonacute hazardous waste, or may include a combination of the following—a total of 2,500 kg of media contaminated with acute hazardous waste, a total of 1,000 kg of hazardous waste (other than contaminated media), and a total of 1 kg of acute hazardous waste.

Further, in accordance with 40 CFR 261.4(f)(3), quantity limits per day on waste subjected to treatability studies must also be observed by the treatability study testing facility. Under this regulation, no more than a total of 10,000 kg of "as-received" media contaminated with nonacute hazardous waste, 2,500 kg of "as-received" media contaminated with acute hazardous waste, or 250 kg of other "as-received" hazardous waste may be subject to initiation of treatment in all treatability studies in any single day. "As-received" waste is defined by RCRA as the waste as received in the shipment from the generator or sample collector. Per 40 CFR 261.4(f)(4), the total quantity of "as-received" waste stored at the testing facility may not exceed 10,000 kg. Mobile treatment units (MTU) can qualify as testing facilities. Where a group of MTUs are located at the same site, the storage limit applies to all MTUs collectively (as though they were one unit). Exceedance of stipulated quantity limits by the generator or treatability study facility will subject either to RCRA treatment, storage, and disposal facility regulations governing management of hazardous waste.

The testing facility must either return the unused samples or residues to the sample originator within 90 days of completing the treatability study, or within 1 year of the date of shipment of the treatability study samples to the testing facility, or within 2 years for treatability studies involving bioremediation. Otherwise, the testing facility will become subject to regulations governing management of hazardous waste (if, in fact, the samples and residues are hazardous).

In accordance with 40 CFR 261.4(f), samples undergoing treatability studies at laboratories and testing facilities are not subject to the requirements of 40 CFR 268 land disposal restrictions (LDR) as long as several criteria are met. These criteria include notification and reporting requirements, maintenance of records, maintenance of the treatability study contract, maintenance of shipping papers, receipt of an EPA Identification Number, and quantity limitations on how much waste can be treated per-unit-time, as well as stored per-unit-time. The criteria also specify that no hazardous waste may be placed on land or undergo open burning, and any unused samples or generated residues must either be managed as hazardous waste (if it is in fact hazardous) or returned to the sample originator, who must then manage the waste accordingly.

3.1.2 Implications of Hazardous Waste Determination

It is only after the treatability study has been completed that the RCRA requirements for treatment, storage, and disposal facility operation in 40 CFR 261–270, including the LDRs in 40 CFR 268, may become an issue for either the testing facility or the sample originator. In accordance with the provisions of 40 CFR 261.4(f)(10), unused samples and treatability study residues must be evaluated by the testing facility to determine whether the residues or unused samples are hazardous or the testing facility may return the samples and residues to the sample originator (40 CFR 261.4[f][10]). The criteria set forth in 40 CFR 261 would be used to determine whether the samples and residues were hazardous. If the testing facility returned the unused samples and residues to the sample originator, then the originator would become responsible for determining whether or not the samples and residues were hazardous in accordance with 40 CFR 262.11, "Hazardous Waste Determination." Samples and residues would then be defined as RCRA-regulated hazardous wastes and would need to be managed as such, including full compliance with the LDRs. The exemption from the generator requirements in 40 CFR 261.4(e) would no longer be applicable.

A determination must be made as to whether or not unused samples or residues are hazardous after the completion of a treatability study, whether the testing facility or the sample originator is making the determination. A characteristic hazardous waste may be rendered nonhazardous by the treatability study and therefore may be managed accordingly. A listed hazardous waste, although it would retain its hazardous status in accordance with 40 CFR 261.3, could conceivably be treated to a low enough concentration that it could be land disposed in accordance with the requirements of 40 CFR 268.

3.1.3 Generator Requirements

If treatability study samples are returned to the waste generator and a determination has been made that the samples are hazardous in accordance with 40 CFR 261.3, then the generator of the samples becomes a generator of hazardous waste and is subject to the requirements of 40 CFR 262, "Standards Applicable to Generators of Hazardous Waste." Among the generator requirements for the management of hazardous waste (including treatment, storage, transport, and disposal) are the following:

- The generator must obtain an identification number from the EPA.
- If the generator intends to transport hazardous waste for off-site treatment, storage, or disposal, a manifest must be prepared by the generator in accordance with the provisions of 40 CFR 262.20, 262.21, 262.22, and 262.23.
- If the hazardous waste is to be transported under the circumstances described above, the generator must comply with requirements for packaging, labeling, placarding, and accumulation time in accordance with 40 CFR 262.30 through 262.34.

- The generator must comply with the recordkeeping requirements stipulated in 40 CFR 262.40, "Recordkeeping." Requirements include the maintenance of copies of manifests, biennial reports and exception reports, test results, waste analyses, and required time periods for maintenance of records.

- Hazardous waste accumulation times must be observed in accordance with 40 CFR 262.34 (less than 90-day accumulation period).

In summary, DOE waste managers must be aware of the following issues when contracting for off-site treatability study services:

- The treatability study facility must have obtained an EPA Identification Number for treatability studies from either the state or the EPA region.

- The quantity limits are 1,000 kg of hazardous (nonacute) waste, 10,000 kg of media contaminated with nonacute hazardous waste, 1 kg of acute hazardous waste, or 2,500 kg of media contaminated with acute hazardous waste for each treatment process being evaluated for each generated waste stream.

- The daily throughput of the treatability study system can be no more than 10,000 kg of as-received media contaminated with nonacute hazardous waste, 2,500 kg of media contaminated with acute hazardous waste, or 250 kg of other as-received hazardous waste.

- The storage limit for any facility equals the daily throughput.

- If treatability study residues are returned to the generator, the generator must determine if the residues are hazardous in accordance with 40 CFR 261.3 and must dispose of them appropriately.

The facility must maintain records and manage residues according to applicable requirements. The EPA Regional Administrator must be notified in writing by the treatability study facility of the intent to conduct a treatability study no less than 45 days before conducting the treatability study.

3.2 Toxic Substances Control Act

3.2.1 Applicability to Research and Development Facilities

Treatability studies are not specifically addressed under TSCA. Further, the issue of what constitutes a research and development facility in accordance with TSCA is not clearly defined. A definition for "small quantities for research and development" can be found in 40 CFR 761.3 in reference to PCBs, and the language implies that laboratory testing qualifies as research and development. Therefore, treatability studies have been addressed under TSCA within the context of laboratory testing in a research and development facility.

3.2.2 Exemptions for Research and Development Facilities

Under 40 CFR 761.65(I), a laboratory that holds samples for eventual disposal is exempt from the notification and approval requirements for commercial storers. The sample is exempt from manifesting requirements if it is being transported to a laboratory for testing or back to the sample originator after testing (applicable DOT or U.S. Postal Service regulations do apply). However, TSCA distinguishes between samples sent to an analytical laboratory for the purpose of determining PCB concentrations and samples sent to research and development facilities to determine if a disposal method is suited for the waste (EPA, 1991a). The latter situation is interpreted by the EPA to include treatability study samples. Only samples sent to laboratories for determination of PCB concentrations may be exempt from the notification and manifesting requirements. Other types of samples, including treatability study samples, are subject to notification and manifesting requirements. Violation of proper manifesting procedures could result in enforcement action not only for the generator, but also the transporter, and possibly to the research and development facility if an Unmanifested Waste Report (40 CFR 761.211) is not completed.

Under 40 CFR 761.65(j), states and the federal government are exempt from the requirements of closure cost estimates and financial assurance for closure that are otherwise applicable to commercial storers of PCBs. PCB activities that are non-totally enclosed may be authorized by provisions under 40 CFR 761.30. While 40 CFR 761.20 ("Prohibitions") Subpart B ("Manufacturing, Processing, Distribution in Commerce and Use of PCBs and PCB Items") describes prohibitions against using PCBs or PCB items in any manner other than totally enclosed (except as indicated otherwise), 40 CFR 761.30(j) states that PCBs may be used in small quantities for research and development in a manner other than totally enclosed.

The DOE should be aware that the EPA is taking a position against shipping PCB-contaminated waste back to the sample originator after the completion of a treatability study. This position appears to contradict the provisions of RCRA, TSCA, and DOE Order 5820.2A. However, the EPA's position on this subject was discussed in two different letters from the EPA Office of Prevention, Pesticides, and Toxic Substances (EPA, 1995a; EPA, 1995b). The EPA believes that the only way to ensure proper management and disposal of PCB-contaminated waste is to require the permitee (the research and development facility) to assume responsibility for waste disposal. The EPA indicates that it may deviate somewhat on this policy on a case-by-case basis. Examples whereby a PCB waste may be returned to the originator include the originator agreeing to keep the returned waste separate and distinct from other wastes until disposal, a legal document that mandates the return of the waste to the originator, or the waste having been treated to below 2 parts per million (ppm) for nonaqueous media and 3 parts per billion for aqueous media.

Since mixed waste containing PCBs presents some unique management issues, the DOE may wish to pursue an agreement involving the DOE, the EPA Office of Prevention, Pesticides, and Toxic Substances, and the treatability study facility. The agreement can stipulate whether or not the waste will be returned to the originator and how it will be managed.

3.2.3 TSCA Permits

Permits, at least as they are known in the RCRA arena, are not discussed in the TSCA regulations. However, the EPA still requires that a permit to store PCB waste be obtained from the PCB Regional Coordinator representing the particular EPA region in which PCB waste storage is desired. The requirements for the permit are to be coordinated at the regional level. Other TSCA-related activities may also require permits, including permits for alternate disposal and treatment methods solicited from the PCB Regional Coordinator and a permit for a research and development facility. This permit stipulates specific conditions under which the facility may operate. TSCA-regulated activities that are conducted in more than one region require permitting from the Director, Exposure Evaluation Division.

Research and development into PCB disposal methods using a total of less than 500 pounds of PCB material, regardless of PCB concentration, will be reviewed and approved by the appropriate Regional EPA Administrator. Research and development efforts involving 500 pounds or more of PCB material will be reviewed and approved by the Director, Exposure Evaluation Division.

It should be noted that storage areas at RCRA-permitted facilities may be exempt from separate TSCA storage permitting if it can be demonstrated to the EPA Regional Administrator's satisfaction that the facility's existing RCRA closure plan is substantially equivalent to the closure plan standards of 40 CFR 761.65(e).

3.2.4 Manifesting Issues

In accordance with 40 CFR 761.65(I)(4), manifesting of samples for disposal must be performed by either the testing facility or by the sample originator if the sample is returned to the sample originator after testing. Manifest requirements for off-site storage or off-site disposal are summarized in 40 CFR 761.207 and 761.208. The requirements include stipulations for the identification of the type of PCB waste, weight in kilograms, container identification number or serial number for a PCB article, and designation of off-site facility to receive the waste, as well as specific procedures regarding use of the manifest.

3.2.5 Disposal Considerations

PCB treatability study samples become subject to PCB disposal regulations once research and development efforts on PCB samples have been concluded. 40 CFR 761, Subpart D, describes disposal requirements, as well as requirements for storage for disposal. In general, PCBs with a concentration of 50 ppm or greater must be disposed of in an incinerator, in compliance with the provisions of 40 CFR 761.70. Under 40 CFR 761.60(e), requests for alternate methods of PCB destruction for PCBs that are required to be incinerated as a means of disposal that will result in a level of performance equivalent to the provisions of 40 CFR 761.70 may be submitted to the Administrator for consideration. The applicable Regional EPA Administrator will

be contacted for alternate methods to be utilized in one EPA region only. The Director, Exposure Evaluation Division, will be contacted to request alternate disposal methods that will be used in more than one region.

Liquid PCBs at a concentration greater than 50 ppm but less than 500 ppm may be disposed of in an incinerator, a chemical waste landfill that complies with the requirements of 40 CFR 761.75, or a high-efficiency boiler, according to 40 CFR 761.60. Nonliquid PCBs at a concentration greater than 50 ppm in the form of contaminated soil, rags, or debris may be disposed of in an incinerator or a chemical waste landfill that complies with 40 CFR 761.75.

3.2.6 TSCA Versus RCRA

PCBs are regulated not only under TSCA but are also referenced under RCRA in 40 CFR 261.8 and in the LDRs, 40 CFR 268.42 (liquid PCB waste concentrations greater than 50 ppm). A medium such as water, soil, debris, etc., contaminated only with PCBs is not a hazardous waste under RCRA unless it is hazardous by virtue of meeting the criteria for being characteristic per 40 CFR 261.21 through 261.24 or 261.31 through 261.33. If it can be determined that the PCB waste is characteristically hazardous, then the next step is to refer to 40 CFR 261.8, to determine if this waste can be excluded from regulation under RCRA, which provides for the exclusion of dielectric fluids containing PCBs if they are hazardous only because they fail toxicity characteristic leaching procedure levels for D018 through D043 constituents. PCB waste that meets this criteria would be regulated under TSCA, not RCRA. It should be noted that where RCRA authority has been granted to states, the DOE will need to communicate with state regulatory authorities concerning RCRA issues. However, states have not been granted TSCA authority. TSCA issues are handled by the PCB Regional Coordinator representing the particular EPA region in which a particular DOE facility or treatability study facility is located.

Assuming that the PCB waste still meets the criteria for being regulated under RCRA, then the LDRs become an issue. Under the RCRA LDRs, liquid PCB wastes with a PCB concentration greater than 50 ppm are prohibited from land disposal. Referring back to the TSCA regulations, 40 CFR 761.1(e) states that the PCB regulations in Part 761 do not preempt other more stringent federal statutes and regulations. Therefore, although 40 CFR 761.60 states that liquid PCB wastes may be land disposed in a chemical waste landfill, it is possible that the EPA Regional Administrator will take the more stringent RCRA position that all PCB waste will be incinerated or otherwise thermally treated. The DOE should be prepared to discuss disposal options with the PCB Regional Coordinator and also the EPA Regional Administrator if the LDRs are applicable.

In summary, the TSCA regulations do not specifically identify or regulate treatability studies, but the following issues should be understood:

- Small quantities of PCB samples can be used in research and development and are exempt from certain TSCA requirements such as totally enclosed systems, but they are not exempt from notification and manifesting requirements.

- Storage facilities in accordance with RCRA requirements may be acceptable for TSCA wastes, but the EPA Regional Administrator's approval is required.

- The EPA generally requires that research and development facilities assume responsibility for final waste disposition, although the EPA may be receptive to negotiating this issue if the waste containing PCBs also contains hazardous and radioactive constituents.

- Research and development activities on less than 500 pounds of PCB material require an approval by the EPA Regional Administrator.

- If PCB-contaminated waste is returned to the originator and the originator desires an alternate method of PCB disposal other than incineration, an approval must be obtained from the EPA Regional Administrator if only one EPA region is involved, or from the Administrator at the Headquarters level if more than one EPA region is involved.

- RCRA requirements apply in some situations, and the interaction should be carefully reviewed.

3.3 CERCLA Off-Site Rule

CERCLA authority extends beyond closed or abandoned facilities. If a facility owner/operator fails to implement RCRA due to recalcitrance or bankruptcy on the part of the owner/operator, or if there is an immediate environmental threat, CERCLA authority may prevail.

In accordance with 40 CFR 300.440, "Procedures for Planning and Implementing Off-Site Response Actions," off-site response actions refer to remedial or removal actions involving the off-site transfer of hazardous substances, pollutants, or contaminants as defined under CERCLA sections 101(14) and (33) that are fund-financed or taken pursuant to CERCLA authority, or jointly between CERCLA and another authority. The off-site rule stipulates provision for the acceptance of CERCLA materials at off-site locations, and other provisions as applicable. Off-site transfers of the following laboratory samples and treatability study samples from CERCLA sites are exempt from the requirements of the off-site rule: (1) RCRA hazardous waste being transported from a CERCLA site for treatability studies and that also meet the exemption for treatability study waste specified in 40 CFR 261.4(e); (2) non-RCRA wastes transferred from a CERCLA site for treatability studies and that are below the quantity threshold established in 40 CFR 261.4(e)(2); and (3) samples of CERCLA wastes sent to a laboratory for characterization. Waste samples or residues may not be returned to the CERCLA site unless the remedial project manager or on-site coordinator gives approval and assures their proper management.

3.4 Nuclear Regulatory Commission Summary

The NRC was established by the Energy Reorganization Act of 1974, as amended, which abolished the Atomic Energy Commission. It also transferred to the NRC all the licensing and related regulatory functions assigned to the Atomic Energy Commission by the Atomic Energy Act of 1954, as amended (10 CFR 1.1). In general, the DOE is self-regulating and therefore is not subject to NRC requirements with respect to management of radioactive waste and nuclear facilities and nuclear constituents. DOE policy makes off-site shipments to NRC-licensed facilities subject to NRC packaging and transportation requirements. Any non-DOE commercial facility that performs treatability studies on DOE mixed wastes is subject to the NRC requirements.

3.4.1 Commercial Treatability Study Facility License Requirements

The type of NRC license required for a commercial treatability study facility is dependent upon the type of radioactive material contained in the mixed-waste treatability study sample. For example, the licensing requirements of 10 CFR 30, 31, and 33 would apply to treatability study facilities accepting mixed waste containing by-product material. The licensing requirements of 10 CFR 40 would apply to treatability study facilities accepting mixed waste containing source material. The licensing requirements of 10 CFR 70 would apply to treatability study facilities accepting mixed waste containing special nuclear material.

10 CFR 20 identifies the radiation protection standards that apply to treatability study facilities accepting mixed-waste samples and holding an NRC license. Treatability study facilities accepting mixed-waste samples must establish and maintain the following programs (10 CFR 20):

- A radiation protection program commensurate with the scope and extent of licensed activities in compliance with 10 CFR 20, Subpart B
- A program to monitor and comply with occupational dose limits in compliance with 10 CFR 20, Subpart C
- A program to monitor and comply with radiation dose limits for individual members of the public in compliance with 10 CFR 20, Subpart D
- Radiation survey and monitoring programs in compliance with 10 CFR 20, Subpart F
- A program to control the exposure from external sources in restricted areas in compliance with 10 CFR 20, Subpart G
- Respiratory protection and controls to restrict internal exposure in restricted areas in compliance with 10 CFR 20, Subpart H
- Storage and control programs for licensed materials in compliance with 10 CFR 20, Subpart I

- Precautionary procedures in compliance with 10 CFR 20, Subpart J
- A waste disposal program in compliance with 10 CFR 20, Subpart K
- A records management system in compliance with 10 CFR 20, Subpart L
- A reporting system in compliance with 10 CFR 20, Subpart M.

DOE waste managers contracting for treatability study services should ensure that the facility has these programs in place.

3.4.2 Packaging and Transportation of Radioactive Material

The requirements for packing, preparation for shipment, and transportation of licensed material, and the procedures and standards for NRC approval of packaging material are established in 10 CFR 71. The packaging and transportation requirements of licensed material are also subject to 10 CFR 20, 21, 30, 39, 40, 70, and 73, and to the regulations of the DOT and the U.S. Postal Service. A brief summary of DOT requirements is provided in Section 3.5.

Requirements to consider when preparing a mixed-waste treatability study sample for transportation to a treatability study facility are listed below:

- General licenses are required to transport or to deliver to a carrier any NRC-licensed material in compliance with 10 CFR 71, Subpart C.
- Package approval applications must be completed and approved in compliance with 10 CFR 71, Subpart D.
- Packages must meet the approval standards listed in 10 CFR 71, Subparts E and F.
- The originating organization and transporter must have established operating controls and procedures in compliance with 10 CFR 71, Subpart G.
- The originating organization and transporter must have an established quality assurance program in compliance with 10 CFR 71, Subpart H.

In addition, transportation of special nuclear material must also comply with the requirements of 10 CFR 73, which apply to the establishment and maintenance of a physical protection system for special nuclear material in transit. Topics to be considered include planning and scheduling, export/import shipments, security organization, driver training, contingency and response plan procedures, transfer and storage of special nuclear material for domestic shipment, access control and procedures, test and maintenance programs, transportation

modes (10 CFR 73.26), and notification requirements (10 CFR 73.27). 10 CFR 74 requires material control and accounting of special nuclear material. Individuals who receive special nuclear material must also comply with the requirements of 10 CFR 75.

The requirements related to the export of mixed-waste treatability study samples are complicated and must comply with 10 CFR 110.

3.5 U.S. Department of Transportation Summary and Guidance

The DOT regulations listed in 49 CFR relate to the transportation of materials. The regulations applicable to the transportation of mixed-waste treatability study samples from an originating organization to a treatability study facility are listed in 49 CFR 171 through 180, which are summarized below and in Table 3-1. Most of these requirements relate to the method used by the originating organization to package the material for shipment. Other requirements are the responsibility of the transportation company and relate to how the material is physically moved from the originating organization to the treatability study facility. The originating organization is responsible for verifying that the transporter is qualified; there are no specific transportation requirements for the treatability study facility that will receive the mixed-waste treatability study sample. These regulations should be consulted for additional information.

The requirements of 49 CFR 171 relate to general information, regulations, and definitions for the transportation of hazardous materials. The requirements of 49 CFR 172 relate to the preparation of shipping papers; marking, labeling, and placarding packagings and transportation vehicles; emergency response information; and training requirements.

The requirements of 49 CFR 173 relate to the general requirements for shipments and packages for shippers. Some of the requirements relate to the preparation of hazardous materials for shipment (49 CFR 173, Subpart B) and the classification of materials and packaging requirements (49 CFR 173, Subparts C, D, E, F, G, and I).

The requirements of 49 CFR 174, 175, 176, and 177 relate to the specific modes of transportation chosen and should be consulted by the originating organization prior to shipment of the mixed-waste treatability study sample to the treatability study facility.

The requirements of 49 CFR 178 provide the specifications for packaging, including the manufacturing and testing specifications for packaging and containers used for the transportation of hazardous materials in commerce. The requirements of 49 CFR 179 provide the specifications for tank cars that are to be mounted on or from part of a tank car, and which are used for the transportation of hazardous materials in commerce. The requirements of 49 CFR 180 relate to the continuing qualification and maintenance of packaging. The requirements of 40 CFR 178, 179, and 180 are the responsibility of the originating organization.

Table 3-1
U.S. Department of Transportation Requirements Applicable to Mixed-Waste Treatability Study Samples

Topic	*Applicable Regulation*
Packaging	*49 CFR 173, Subparts A and B and 173.401 through 173.478*
Marking and labeling	*49 CFR 172, Subpart D and 172.400 through 172.207; 172.436 through 172.440*
Placarding	*49 CFR 172.500 through 172.519; 172.556; Appendices B and C*
Monitoring	*49 CFR 172, Subpart C*
Accident Reporting	*49 CFR 171.15 and 171.16*
Shipping Papers	*49 CFR 172*
Training	*49 CFR 172, Subpart H*
Additional Requirements for Modes of Transportation	
Rail	*49 CFR 174, Subparts A through D and K*
Air	*49 CFR 175, Subparts A through D and M*
Vessel	*49 CFR 176, Subparts A through D and M*
Public Highway	*49 CFR 177*

CFR = Code of Federal Regulations

In general, the DOT requirements are complex, but DOE sites have shipping and receiving expertise that can support these activities. Those personnel should be consulted to ensure that packaging, marking, and labeling are in compliance and that licensed shippers are used.

3.6 DOE Order 5820.2A

DOE Order 5820.2A establishes policies, guidelines, and minimum requirements for management of radioactive and mixed waste at DOE facilities. Radioactive and mixed waste must be managed to ensure protection of human health and safety, DOE and contractor employees, and the environment. Generation, treatment, storage, transportation, and disposal of radioactive and mixed waste must minimize waste generation and comply with all applicable federal, state, and local environmental, safety, and health laws and regulations, as well as DOE requirements. Policies are also developed by waste type. Waste storage requirements, recordkeeping and reporting, and waste transport including packaging, labeling, marking, and manifests are all discussed. This DOE Order should be consulted prior to preparing a mixed-waste treatability study sample for shipment. In some instances, a readiness review may be appropriate prior to shipment of mixed-waste treatability study samples.

3.7 National Environmental Policy Act

In accordance with Volume 57 of the *Federal Register* (57 FR 15122), waste treatability study activities performed by the DOE must undergo NEPA review to determine if new NEPA documentation for a particular DOE activity is necessary or if the activity is captured under an existing NEPA document. Documentation of NEPA status is the responsibility of the organization wishing to conduct the action or categorical exclusion. This decision regarding the appropriate level and adequacy of coverage is made by the DOE NEPA Compliance Officer with authority over the DOE site desiring to perform the activity.

4. TREATABILITY STUDY MANAGEMENT ISSUES

Mixed-waste management is particularly perplexing because of the multiple regulatory agencies associated with the combined radioactive and hazardous constituents of the waste. Although the treatability study exemption is well understood and widely applied by developers of hazardous waste treatment technologies, a limited number of firms have the capability and licenses for the management of mixed waste.

Conducting a treatability study in compliance with applicable regulations and guidance and in a manner that provides the desired data requires careful planning and coordination. The EPA published guidance for conducting treatability studies under CERCLA in October 1992 (EPA, 1992a). Specific guidance on three soil cleanup technologies was also published by the EPA (EPA 1992b; EPA 1991b; EPA 1991c). There has not been specific guidance for treatability studies under RCRA, but the CERCLA guidance is readily adapted to RCRA waste treatability study issues. Jolley, Morris, and Singh from Martin Marietta Energy Systems published a guidance document on conducting technology demonstrations in the DOE's Oak Ridge facilities (Jolley et al., 1991). This document provides a step-by-step discussion of the management actions to conduct either on-site or off-site technology demonstrations under the DOE management structure.
Since the referenced guidance already exists, only key mixed-waste treatability study management steps and issues are highlighted in this document, with liberal reference to original sources of information. Both the EPA treatability study document (EPA, 1992a) and the Oak Ridge guidance document (Jolley et al., 1991) include complete logic diagrams indicating treatability study management steps and decisions. A simplified logic diagram (Figure 4-1) has been developed for this document to highlight major treatability study actions and to facilitate discussion of the steps of treatability study conduct. The chapter subsections discussing each element on the logic diagram are indicated beside the block on Figure 4-1.

4.1 Is a Treatability Study Needed?

Clearly, the first question is whether a treatability study should be considered at all. Many treatability studies have been conducted by DOE facilities, and some have been reported in the literature. Identification of those treatability studies can determine if previous results provide data that meet the objectives of the proposed investigation. However, general experience suggests that almost any waste/technology combination is a candidate for demonstration. Even minor variations in chemical composition can influence the effectiveness of some treatment processes, and a simple treatability test can determine if there is a problem and remedy the problem.

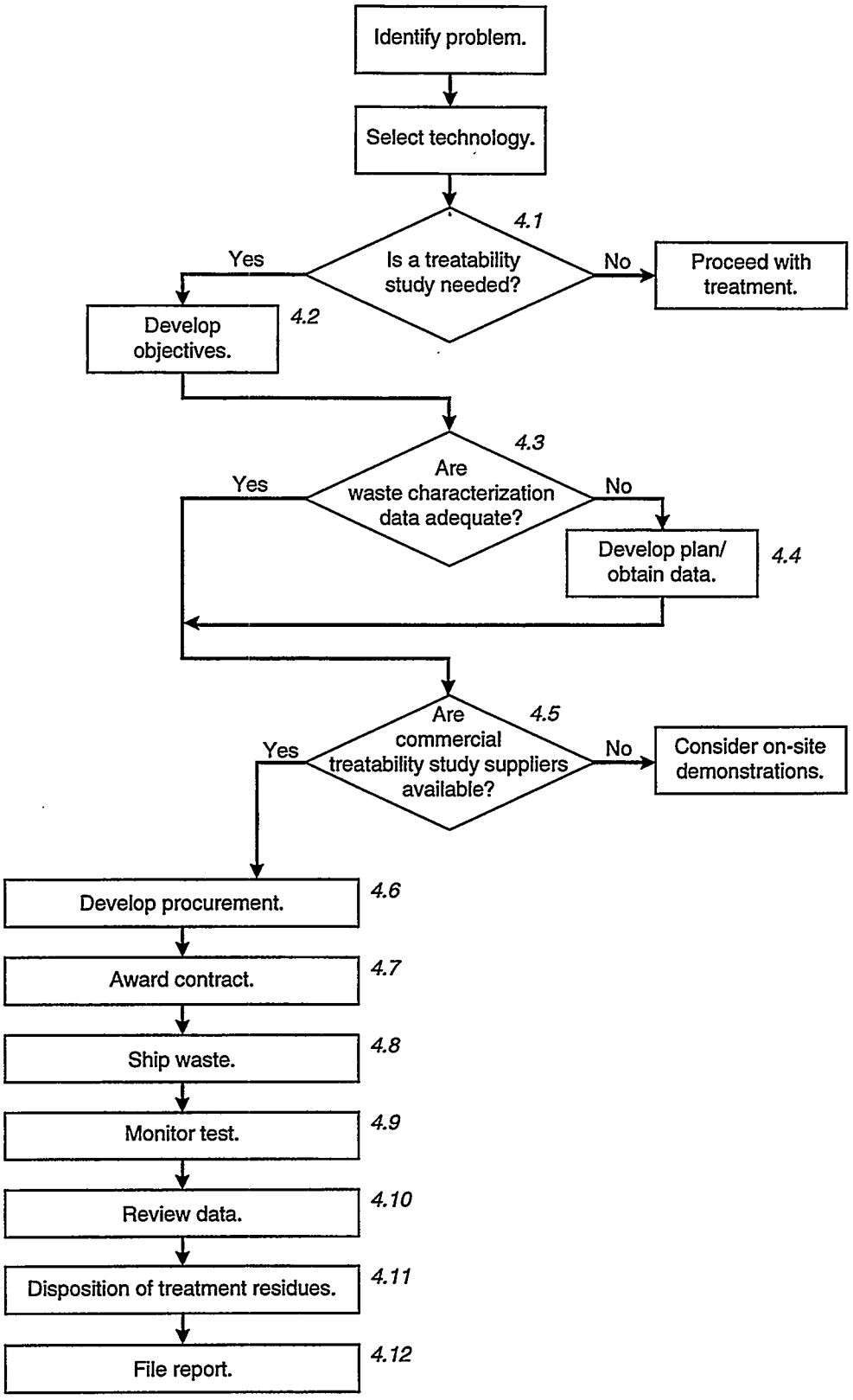

Figure 4-1
Treatability Study Management Issues

In addition to the technical benefits of a treatability study, there can be valuable schedular benefits in demonstrating the advantages/disadvantages of technologies to stakeholders. Visual or quantitative analyses of the performance of a technology can be an integral part of community interaction programs.

4.2 Develop Data Quality Objectives

The obvious objective of a treatability study is demonstration of waste treatment meeting the process or waste form performance specified in the applicable regulations. However, as a project proceeds from simple feasibility testing to development of process design data, increasing levels of quality control data come into play. One definition of data quality objectives is "qualitative and quantitative statements that specify the quality of the data required to support decisions concerning remedy selection and implementation" (EPA, 1992b). Development of data quality objectives was addressed in detail in an EPA guidance document (EPA, 1987). The reader is referred to that guidance for a complete discussion of the process. Table 4-1 shows elements of a simple phased approach for development of data quality objectives.

Unquestionably, DOE's larger waste streams and expected environmental restoration wastes are candidates for treatability studies and application of data quality objectives. Even then, the level of quality control on the data must be graded according to whether the technology application is in the simple screening phase (can the technology meet the regulatory requirements?), the technology selection phase (is this the best technology for the application?), or the final phase of collection of process design data.

However, DOE's small waste streams present different issues for development of the objectives. Invoking complete sampling and analytical quality control protocols for remedy design studies for very small volume waste streams may be unwarranted. Analytical costs could easily exceed the potential benefit of the study. Alternatively, some sites have considered the use of small volume wastes as surrogates to demonstrate treatment for larger waste streams or expected future wastes. In this way, the cost of the analytical data is justified.

4.3 Are Waste Characterization Data Adequate?

Collection of all available characterization data on the waste stream is necessary to support both shipment and treatment of the waste. The characterization data should be reviewed against the possible uses, which include the following:

- Developing handling procedures
- Supporting shipping designations
- Providing information to meet the supplier's waste acceptance criteria
- Providing process information necessary for the specific treatment technology.

Table 4-1
Summary of Three-Stage Data Quality Objectives Development Process[a]

Stage 1
Identify data users (include stakeholder concerns).
Consult data sources for applicable performance data.
Identify available waste characterization data.
Identify the treatability study objectives and goals.
Stage 2
Identify data uses.
Identify data to be taken (waste analyses, process parameters, residues properties, secondary waste characteristics).
Identify data quality needs.
Identify data quantity needs.
Evaluate sampling and analysis options.
Review precision, accuracy, representativeness, completeness, and comparability parameters.
Stage 3
Determine data quality objectives; select method for obtaining data of acceptable quality and quantity.
Incorporate data quality objectives into the sampling and analysis plan and the work plan

[a]Source: EPA, 1992a.

Appendix B of the EPA's "Guide for Conducting Treatability Studies Under CERCLA" (EPA, 1992a) provides a list of required characterization data for several treatment technologies. The lengthy lists in that document address physical and chemical characterization that is necessary to ensure proper treatment and to ensure that the resultant treatability data can be used to define treatment process acceptance limits.

4.4 Develop Plan/Obtain Data

If it is determined that the necessary waste characterization data are not available, then plans for obtaining the data must be developed. A formal sampling and analysis plan may be required to ensure that the data collected are representative and complete. Components of a sampling and analysis plan are described in numerous guidance documents, including two by the EPA (EPA 1991b; EPA 1991c).

4.5 Are Commercial Treatability Study Providers Available?

The list of suppliers presented in Chapter 2 can be reviewed to determine if suppliers have technologies that potentially satisfy the RCRA requirements and if they have capabilities for mixed waste. It is also important to identify whether the radioactive materials licenses are consistent with the radioactive waste types of the treatability study samples. Transuranic wastes are one example of those that will be difficult to demonstrate in commercial facilities, as few facilities provide the multiple confinement barriers required for these wastes.

4.6 Develop Procurement

There are many procurement scenarios for obtaining treatability study services. Several sites (and at least one DOE Field Office) have recently developed broad scope contracts to facilitate mixed-waste treatment, and the source of the waste is not specific to the site developing the contract. These national contracts may offer an alternative to a time-consuming competitive procurement. Two methods of identification of these national contracts are offered. For general information, the DOE Environmental Management web site is under development and may provide useful contacts. This information is found at http://www.em.doe.gov; then select "crosscut" and then "privatization." Specific contract information may also be available from the local DOE field office.

Jolley et al. (1991) recommended that procurement packages for commercial demonstrations should include the following:

- Objectives of the treatability study
- All available characterization data
- Definition of specific tasks/phases in the treatability study

- Definition of deliverables, including work plans, sampling and analysis plans, health and safety plans, and final reports

- Expected schedule.

An additional item of concern is the disposition of the treatability study residues.

4.7 Award Contract

An on-site review of the treatability study supplier's facilities is warranted to ensure that all required permits are in place and that practices and procedures indicate that the treatability study objectives will be met. Recommended items to review include the following:

- Specific permits, including RCRA, NRC, or state licenses; air permits; and discharge permits
- Inspection records of regulatory authorities
- Documentation of previous treatability studies done on the site, including all required records
- Radiation safety provisions
- Quality assurance/quality control procedures if on-site analytical facilities are used
- Posting in compliance with RCRA requirements.

4.8 Ship Waste

Chapter 3 of this document summarizes the general requirements for transport of treatability study samples. In summary, there are requirements for placarding, labeling, and packaging of the samples. Knowledgeable site personnel with expertise in the transportation of radioactive samples should be contacted to ensure all proper procedures are followed.

4.9 Monitor Test

It is recommended that at least one phase of the treatability study testing should be monitored to confirm that all elements of the sampling plan and the health and safety plan are being followed. It is particularly important to ensure compliance with test plans if the treatability study is being used to support technology selection or to develop design data. In these cases, a simple confirmation that tests were run according to plan is warranted should questions arise during community relations discussions.

Procedures should be established to facilitate rapid approval/disapproval of requested test plan changes that may arise during conduct of the test. Jolley et al. (1991) recommended assignment of responsible personnel for ready access by the treatability study supplier to address test plan changes.

4.10 Review Data

Compliance with test objectives is best determined by review of the test data. The importance is amplified if the data will be used to introduce the technology to stakeholders or cognizant regulators. A data validation review is recommended, in addition to a quantitative check of parameters that confirm compliance with the test objectives.

4.11 Disposition of Treatment Residuals

Disposition of the residuals should be identified in the contract. Section 3.1.2 of this report discusses this issue in detail. Depending on the original regulatory status of the sample, the residues may be considered a new waste or simply the residue from treatment of a listed waste. It would also be prudent to ensure that secondary wastes are appropriately addressed by the supplier.

4.12 File Report

The treatability study report should become part of the project file. More significantly, the results should be reported at DOE meetings to ensure that all interested DOE sites have access to the data for possible use at those sites. Alternatively, distribution to the responsible technology development managers at each site would benefit the DOE complex.

5. CONCLUSIONS

The DOE's mixed-waste streams are diverse and present unique management issues. Treatability studies may be utilized as an integral part of the DOE's mixed-waste management program. Commercial treatability study suppliers have been identified that either have current capability in their own facilities or have access to licensed facilities owned by others. Facilities owned by others may have access to a broader range of technologies, which would facilitate the mixed-waste management process.

Numerous federal and state regulations, as well as DOE Order 5820.2A, impact the performance of treatability studies. Generators, transporters, and treatability study facilities are subject to regulation. From a mixed-waste standpoint, a key requirement is that the treatability study facility must have an NRC or state license that allows it to possess radioactive materials. From a RCRA perspective, the facility must support treatability study activities with the applicable plans, reports, and documentation. If PCBs are present in the waste, TSCA will also be an issue. The requirements of CERCLA may apply, and both DOT and NRC regulations will impact the transportation of DOE mixed waste to an off-site treatment facility. DOE waste managers will need to be cognizant of all applicable regulations as mixed-waste treatability study programs are initiated.

6. REFERENCES

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U.S. Environmental Protection Agency (EPA), 1995b, Letter from the EPA Office of Prevention, Pesticides, and Toxic Substances, Washington, D.C., July 19, 1995.

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U.S. Environmental Protection Agency (EPA), 1991b, "Guide for Conducting Treatability Studies Under CERCLA: Soil Vapor Extraction," *EPA/540/2-91/019a*, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1991c, "Guide for Conducting Treatability Studies Under CERCLA: Soil Washing," *EPA/540/2-91/020a*, U.S. Environmental Protection Agency, Washington, D.C.

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ATTACHMENT 1

MIXED WASTE TREATABILITY STUDY
TECHNOLOGY QUESTIONNAIRE

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONNAIRE

TECHNOLOGY NAME	PRIMARY TECHNOLOGY CATEGORY (SELECT FROM LIST ON PAGE 2)	NAME OF INDIVIDUAL COMPLETING FORM PHONE NUMBER DATE COMPLETED
PARENT COMPANY NAME AND ADDRESS		CONTACT NAME PHONE NUMBER FAX NUMBER
FACILITY NAME AND ADDRESS		YEAR OF RCRA PERMIT RCRA PERMIT EXPIRATION DATE
TECHNOLOGY DESCRIPTION (IN THIS SPACE DESCRIBE THE PROCESS OR ATTACH A PROCESS DESCRIPTION) (ATTACH PHOTOGRAPH OF THE SYSTEM)		

FACILITY DESCRIPTION

SYSTEM CAPACITY (HOURLY THROUGHPUT AND ANNUAL TREATMENT CAPACITY)	OTHER MIXED WASTE TECHNOLOGIES AT THIS FACILITY	ESTIMATED AVAILABILITY (EXCESS CAPACITY AVAILABLE OR% OF TIME AVAILABLE)

TECHNOLOGY STATUS AND CAPABILITY
(CIRCLE APPLICABLE ITEMS)

TECHNOLOGY MATURITY	MEDIA TREATED	MIXED WASTE CATEGORIES ACCEPTED
R&D ONLY	AQUEOUS LIQUIDS	LOW LEVEL WASTE
BENCH SCALE DEMONSTRATION	AQUEOUS SLURRIES	TRANSURANIC WASTE
PILOT PLANT DEMONSTRATION	ORGANIC LIQUIDS	HIGH LEVEL WASTE
COMMERCIAL IMPLEMENTATION	INORGANIC SLUDGES	
DOE/GOV'T EXPERIENCE	ORGANIC SLUDGES	
	SOILS	RESIDUALS
	SOILS/DEBRIS	
TECHNOLOGY AVAILABILITY	METAL DEBRIS	SOLID RESIDUALS
	NON-METAL DEBRIS	READY FOR DISPOSAL
CURRENTLY AVAILABLE	LAB PACKS	SOLID RESIDUALS REQUIRE
SCHEDULED AVAILABILITY	REACTIVE METALS	ADDITIONAL TREATMENT
	ELEMENTAL MERCURY	SECONDARY WASTES RETURNED
	ELEMENTAL LEAD	TO GENERATOR
	LEAD BATTERIES	
	CADMIUM BATTERIES	

NOTE THAT INFORMATION SUPPLIED ON THIS PAGE IS FOR MIXED WASTE FOCUS AREA FILE INFORMATION ONLY

TECHNOLOGY NAME	**PRIMARY TECHNOLOGY CATEGORY** (SELECT FROM LIST BELOW)	**NAME OF INDIVIDUAL COMPLETING FORM** PHONE NUMBER DATE COMPLETED
AGE OF PARENT ORGANIZATION AGE OF TREATMENT FACILITY	**NUMBER OF EMPLOYEES**	**ANNUAL REVENUE**

RADIOACTIVE MATERIALS LICENSE LIMITS
(ATTACH COPY OF LICENSE OR A SUMMARY OF THE LICENSE)

HAZARDOUS WASTE PERMITS
(ATTACH COPY OF PERMIT OR SUMMARY OF PERMIT)

OTHER WASTE ACCEPTANCE CRITERIA LIMITS
(ATTACH A COPY OF THE FACILITY WASTE ACCEPTANCE CRITERIA OR A SUMMARY)

PRIMARY TECHNOLOGY CATEGORY OPTIONS

AMALGAMATION	ORGANIC DESTRUCTION
BIODEGRATATION	RETORTING FOR MERCURY
CHEMICAL OXIDATION	RECOVERY OF METALS
CHEMICAL REDUCTION	RECOVERY OF ORGANICS
DEACTIVATION	SOIL WASHING
VITRIFICATION	STABILIZATION
INCINERATION	STEAM STRIPPING
MACROENCAPSULATION	WET OXIDATION

Please attach copies of journal articles or presentations given on treatability studies on this system.
Please attach customer references (name and phone number) for treatatility studies on this system

ATTACHMENT 2

SUMMARIES OF TREATABILITY STUDY SUPPLIER QUESTIONNAIRE RESPONSES

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Soil Washing	Soil Washing	

Company Name and Address:	Contact:
Alternative Remedial Technologies 14497 North Dale Mabry Highway Suite 140 Tampa, FL 33618	Mr. Michael Mann **Phone:** (813) 264-3571 **Fax:** (813) 962-0867

Age of Company:	Number of Employees:	Annual Revenue:
108 years	4,854	$473 million

Facility Name and Address:	Age of Facility: N/A
Mobile Treatment Facility	RCRA Treatment Permit Date: Exp:
	Rad Mat #: None

Technology Description:

The ART/Heidimij soil washing system is based upon proven principles and equipment from the mining and mineral processing businesses. The key to successful soil washing is partially in the arrangement and configuration of unit processes, but more importantly in the characterization and understanding of the soil matrix/contaminant relationship. This "know-how" is the most important attribute to the ART/Heidimij team. This approach to soil washing is simple: separate and treat the oversize and sand fractions so that they may be placed back on the site as clean backfill, while concentrating the contaminants in the fines for further treatment or disposal.

System Capacity:	25 tph	Excess Capacity:	Availability is dependent upon current project commitments.

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
CHEMIC™	Recovery of Metals	

Company Name and Address:	Contact:
Atomic Energy of Canada Limited (AECL) Chalk River Laboratories Chalk River, Ontario K0J1J0	Mr. Leo Buckley Phone: (613) 584-8811 Fax: (613) 584-8107

Age of Company:	Number of Employees:	Annual Revenue:
44 years	4,000	$335 million CDN

Facility Name and Address:	Age of Facility: 52 years
Atomic Energy of Canada Limited Chalk River Laboratories Chalk River, Ontario K0J1J0	RCRA Treatment Permit Date: Exp: Rad Mat #: NRTE 1/94

Technology Description:

The direct contacting of the waste solution with chemicals (pH adjustment) precipitants and low-cost powdered adsorbent/ion exchange materials in concert with dewatering steps involving cross-flow microfiltration and standard filterpressing offers an efficient way to remove contaminant species from complex waste solutions. In this mode of operation, there exists sufficient flexibility to use mixtures of chemicals and powdered sorbents to suit specific applications and to control the dynamics of the process as the waste influent characteristics change. CHEMIC is a trademark of Atomic Energy of Canada Limited.

System Capacity:	Excess Capacity:
5 - 20 L/h; in 1995 processed 3.5 million L of ground water	System designed to handle groundwater flows seasonal flucuations

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: **Cyclone Furnace Vitrification**	**Technology Category:** **Vitrification**	
Company Name and Address: Babcock & Wilcox, A McDermott Company 1010 T Common Street New Orleans, LA 70122		**Contact:** Mr. Michael Holmes **Phone:** (330) 829-7662 **Fax:** (330) 829-7283
Age of Company: 100 years	**Number of Employees:** 26,000	**Annual Revenue:** 3 billion
Facility Name and Address: Cyclone Furnace Pilot Facility Babcock & Wilcox 1562 Beeson Street Alliance, OH 44601		**Age of Facility:** **RCRA Treatment Permit** **Date:** **Exp:** **Rad Mat #:** SUB-1259, 34-03043-03

Technology Description:

Three primary systems make up the cyclone furnace vitrification technology. These systems include the feed system, the cyclone melter system, and the flue gas system. The feed system provides feed preparation, transport, and injection into the cyclone. In the cyclone furnace process, natural gas and preheated combustion air enter the cyclone burner tangentially with the soil matrix. The soil is captured and melted, and organics are destroyed in the gas phase or in the molten slag layer formed and retained on the furnace barrel wall by centrifugal action. The soil melts, exits the cyclone furnace form the tap at the cyclone throat, and is dropped into a water-filled quench tank where it solidifies. The solids are then readied for disposal. A small quantity of soil also exits as flyash with the flue gas and is collected in the baghouse. Acid gases, volatile species, and solids are then collected using a series of flue gas cleanup equipment. This process is housed at the Cyclone Furnace Pilot Facility.

System Capacity: 300 lb/hour pilot scale	**Excess Capacity:**

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☑ Non-metal debris
- ☑ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☑ Elemental lead
- ☑ Lead batteries
- ☑ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Soil Screening/Washing

Technology Category: Soil Washing

Company Name and Address:
Babcock & Wilcox, A McDermott Company
1010 T Common Street
New Orleans, LA 70122

Contact:
Mr. Nicholas Mravich
Phone: (330) 829-7662
Fax: (330) 829-7283

Age of Company: 100 years

Number of Employees: 26,000

Annual Revenue: 3 billion

Facility Name and Address:
Soil Screening/Washing Facility
Babcock & Willcox 1562 Beeson Street
Alliance, OH 44601

Age of Facility: 6 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: SUB-1259, 34-03043-03

Technology Description:

Soil is feed from a storage bin to the vibrating feeder. Soil is then delivered to the center of the top screen. The vibrating screen system is equipped with an adjustable eccentric flywheel, which is used to adjust screening motion between circular and oscillating. The reagent pump supplies water to the spray nozzle on the screen assembly. The screen system vibrates until material either passes through the screen or is kicked off through the discharge opening. Material passing through the discharge is collected for further processing. Fines and spent rinse water pass through the lower discharge chute either directly to a waste water reservoir or into settling pans. This process is housed at the Soil Screening/Washing Facility.

System Capacity: 120 - 240 lbs/hour

Excess Capacity: 100%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Air Sparging/Soil Vapor Extraction	Biodegradation	

Company Name and Address:	Contact:
Brown and Root Environmental 661 Andersen Drive Pittsburgh, PA 15220	Mr. Richard Ninesteel Phone: (412) 921-8746 Fax: (412) 921-4040

Age of Company:	Number of Employees:	Annual Revenue:
67 years	51,000	$2.996 billion

Facility Name and Address:	Age of Facility:
NUS Laboratory 5350 Campbells Run Road Pittsburgh, PA 15205	RCRA Treatment Permit Date: Exp: Rad Mat #: PA-0523 and 37-17937-03

Technology Description:

Injection of air into the saturated zone and recovery of soil vapors from the vadose zone. Organics are removed by volatilization and/or enhanced biodegradation. Applicable to chlorinated and non-chlorinated organics.

System Capacity:	Excess Capacity:
In-situ treatment system capacity based on site-specific conditions	System operated In-situ

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
All Technologies		

Company Name and Address:	Contact:
Brown and Root Environmental 661 Andersen Drive Pittsburgh, PA 15220	Mr. Richard Ninesteel Phone: (412) 921-8746 Fax: (412) 921-4040

Age of Company:	Number of Employees:	Annual Revenue:
67 years	51,000	$2.996 billion

Facility Name and Address:	Age of Facility:
NUS Laboratory 5350 Campbells Run Road Pittsburgh, PA 15205	RCRA Treatment Permit Date: Exp: Rad Mat #: PA-0523 and 37-17937-03

Technology Description:

Brown and Root Environmental offers the unique combination of an in-house full-service laboratory with an NRC license and a staff of hundreds of engineers and scientists experienced in the evaluation, design, and implementation of remedial technologies. With these capabilities, we are able to plan and perform bench-scale and pilot-scale treatability studies to evaluate numerous technologies. In addition to our proprietary technologies (air sparging/soil vapor extraction and stabilization), Brown and Root Environmental engineers have performed treatability studies using the following technologies:

Soil Washing; Biodegradation (bacterial and fungal); Air stripping; Activated Carbon Adsorption; Solvent Extraction; UV/ozone Oxidation; Chlorination; Ozonation; Chemical Precipitation; Dewatering; Filtration; Clarification; Biological Treatment (fixed-film and suspended growth)

System Capacity: N/A	Excess Capacity: N/A

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Auger Mixing System

Technology Category: Stabilization

Company Name and Address:
Brown and Root Environmental
661 Andersen Drive
Pittsburgh, PA 15220

Contact:
Mr. Richard Ninesteel
Phone: (412) 921-8746
Fax: (412) 921-4040

Age of Company: 67 years

Number of Employees: 51,000

Annual Revenue: $2.996 billion

Facility Name and Address:
NUS Laboratory
5350 Campbells Run Road
Pittsburgh, PA 15205

Age of Facility:

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: PA-0523 and 37-17937-03

Technology Description:
The auger mixing system is an excavator based system. Grout or other stabilization chemical is mixed with the soil by the augers. Maximum depth of operation is 34 ft.

System Capacity: Variable depending on site conditions

Excess Capacity: System operated in-situ

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Fracturing to Increase Premeability in Bedrock

Technology Category:
Containment

Company Name and Address:
Brown and Root Environmental
661 Andersen Drive
Pittsburgh, PA 15220

Contact:
Mr. Richard Ninesteel
Phone:
(412) 921-8746
Fax:
(412) 921-4040

Age of Company: 67 years

Number of Employees: 51,000

Annual Revenue: $2.996 billion

Facility Name and Address:
NUS Laboratory
5350 Campbells Run Road
Pittsburgh, PA 15205

Age of Facility:

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: PA-0523 and 37-17937-03

Technology Description:
Oil field technologies are utilized to increase the permeability of bedrock utilzing hydraulic pressure and injection of proprietary fracturing fluids. Higher permeability zones are used for recovery of contaminated groundwater.

System Capacity: In-situ treatment capability based on site-specific conditions

Excess Capacity: Systems operated in-situ

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☑ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
In-situ Chemical Treatment	Chemical Oxidation	

Company Name and Address:	Contact:
Brown and Root Environmental 661 Andersen Drive Pittsburgh, PA 15220	Mr. Richard Ninesteel Phone: (412) 921-8746 Fax: (412) 921-4040

Age of Company:	Number of Employees:	Annual Revenue:
67 years	51,000	$2.996 billion

Facility Name and Address:	Age of Facility:
NUS Laboratory 5350 Campbells Run Road Pittsburgh, PA 15205	RCRA Treatment Permit Date: Exp: Rad Mat #: PA-0523 and 37-17937-03

Technology Description:

Jet grouting equipment is used to inject aqueous treatment chemicals into subsurface soils to treat soils in-situ. Treatment can include, but is not limited to, chemical oxidation, chemical reduction, pH adjustment, and metals precipitation. Any aqueous chemical reagent can be injected to depths up to 120 feet.

System Capacity:	Excess Capacity:
In-situ treatment system capacity based on site-specific conditions	System operated in-situ

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Jet Grouting	Stabilization	

Company Name and Address:	Contact:
Brown and Root Environmental 661 Andersen Drive Pittsburgh, PA 15220	Mr. Richard Ninesteel Phone: (412) 921-8746 Fax: (412) 921-4040

Age of Company:	Number of Employees:	Annual Revenue:
67 years	51,000	$2.996 billion

Facility Name and Address:	Age of Facility:
NUS Laboratory 5350 Campbells Run Road Pittsburgh, PA 15205	RCRA Treatment Permit Date: Exp: Rad Mat #: PA-0523 and 37-17937-03

Technology Description:

Jet grouting mixes a cement slurry into the soil under high-energy conditions to produce a thorough in-situ mixture of soil and cement, refered to as soil-cement or "soilcrete". Columns of 24 to 48 inches in diameter to depth up to 175 feet can be created. Unlike slurry wall construction, jet grout wall construction does not require excavation.

System Capacity:	Excess Capacity:
Variable depending on site conditions	System operated in-situ

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Permeable treatment bed installation

Technology Category:
Organic Destruction

Company Name and Address:
Brown and Root Environmental
661 Andersen Drive
Pittsburgh, PA 15220

Contact:
Mr. Richard Ninesteel
Phone:
(412) 921-8746
Fax:
(412) 921-4040

Age of Company: 67 years

Number of Employees: 51,000

Annual Revenue: $2.996 billion

Facility Name and Address:
NUS Laboratory
5350 Campbells Run Road
Pittsburgh, PA 15205

Age of Facility:

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: PA-0523 and 37-17937-03

Technology Description:
Jet grouting equipments is used to inject treatment bed chemicals to form a permeable treatment bed. Groundwater flowng through permeable treatment bed is treated for the target compounds. Experience includes using jet grouting equipment to inject chemicals for treatment of chlorinated organics.

System Capacity: In-situ treatment capacity based on site-specific conditions

Excess Capacity: System operated in-situ

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☑ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Pressure Grouting of Soil and Fractured Bedrock

Technology Category:
Containment

Company Name and Address:
Brown and Root Environmental
661 Andersen Drive
Pittsburgh, PA 15220

Contact:
Mr. Richard Ninesteel
Phone:
(412) 921-8746
Fax:
(412) 921-4040

Age of Company:
67 years

Number of Employees:
51,000

Annual Revenue:
$2.996 billion

Facility Name and Address:
NUS Laboratory
5350 Campbells Run Road
Pittsburgh, PA 15205

Age of Facility:

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: PA-0523 and 37-17937-03

Technology Description:
Pressure grouting is the practice of forcibly injecting chemical grouting fluids, cement grout, or other material into fractured bedrock and unconsolidated soils. Chemical grouting fluids can be adjusted for the permeability and porosity characteristics of the receiving formation.

System Capacity: In-situ treatment system capacity based on site-specific conditions

Excess Capacity: System operated in-situ

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Soil Rake

Technology Category: Stabilization

Company Name and Address:
Brown and Root Environmental
661 Andersen Drive
Pittsburgh, PA 15220

Contact: Mr. Richard Ninesteel
Phone: (412) 921-8746
Fax: (412) 921-4040

Age of Company: 67 years

Number of Employees: 51,000

Annual Revenue: $2.996 billion

Facility Name and Address:
NUS Laboratory
5350 Campbells Run Road
Pittsburgh, PA 15205

Age of Facility:

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: PA-0523 and 37-17937-03

Technology Description:
In-situ injection of cement slurries for stabilization of sludges, slurries and soil.

System Capacity: Variable depending on site soil conditions

Excess Capacity: System operated in-situ

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☐ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Soil Saw Barrier System	Containment	

Company Name and Address:

Brown and Root Environmental
661 Andersen Drive
Pittsburgh, PA 15220

Contact:
Mr. Richard Ninesteel
Phone:
(412) 921-8746
Fax:
(412) 921-4040

Age of Company:	Number of Employees:	Annual Revenue:
67 years	51,000	$2.996 billion

Facility Name and Address:

NUS Laboratory
5350 Campbells Run Road
Pittsburgh, PA 15205

Age of Facility:

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: PA-0523 and 37-17937-03

Technology Description:

The Soil Saw barrier system is used to construct in-situ containment barriers. The current configuration can construct walls 1 ft thick to depths up to 65 ft in unconsolidated materials. Permeabilities less than 1 x 10-6 cm/sec are readily obtained. Continuity of the barrier is assured because the cutting implement passes through 100% of the barrier material.

System Capacity: Variable depending on site soil conditions

Excess Capacity: System operated in-situ

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☑ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Superset

Technology Category: Stabilization

Company Name and Address:
Carlo Environmental Technologies, Inc.
44907 Trinity Drive
Clinton Township, MI 48038

Contact:
Mr. Keith Flemingloss
Phone:
(810) 468-9580
Fax:
(810) 468-9589

Age of Company: 6 years

Number of Employees: 35

Annual Revenue: $ 11 million

Facility Name and Address:
Mobile Treatment Facility

Age of Facility: N/A

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: None

Technology Description:
Carlo Environmental Technologies, Inc. is presenting a proprietary stabilization technology to remediate mixed waste streams. Our reagent facilitates the stabilization of organic waste along with inorganic materials through microencapsulation of the organic materials in "micelles". This allows pozzolanic encapsulation to be utilized in the next stage.

System Capacity: N/A

Excess Capacity: N/A

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Liquified Gas Solvent Extraction (LG-SX)	**Recovery of Organics**	

Company Name and Address:	Contact:
CF Systems c/o Morrison Knudsen Corporation 1500 W 3rd Street Cleveland, OH 44113	Mr. Michael Finton **Phone:** (216) 523-5286 **Fax:** (216) 523-5201

Age of Company:	Number of Employees:	Annual Revenue:
None given	None given	$ 5 million

Facility Name and Address:	Age of Facility: 35 years
Hazen Research Inc. 4601 Indiana Street Golden, CO 80403	**RCRA Treatment Permit** Date: Exp: **Rad Mat #:** CO 77-02

Technology Description:

Liquid Gas Solvent Extraction (LG-SX) technlogy is a totally enclosed system designed to extract organic contaminants from various media including soils, oil dry, paper, plasitc, filter media, etc. Liquified gas, usually propane or dimethyl ether, is used to remove organic contaminants in a reaction vessel. The liquified gas is recycled through a distillation process and used again for subsequent extraction stages. Organic free media is then removed from the reaction vessel in a water slurry and filtered. Treated media is ready for replacement as fill or sent to land disposal.

System Capacity:	Excess Capacity:
Pilot at 100 lb/day Commercial at 250 tons/day	65% of time available (96)

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☑ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Industrial boiler used for energy recovery

Technology Category:
Incineration

Company Name and Address:
Chemical Waste Management, Inc.
c/o Diversified Scientific Services, Inc.
657 Gallaher Road
Kingston, TN 37763

Contact:
Mr. Richard Dabolt
Phone:
(423) 376-0084
Fax:
(423) 376-0087

Age of Company: 17 yrs

Number of Employees: 72

Annual Revenue: Not relevant

Facility Name and Address:
Diversified Scientific Services, Inc. (DSSI)
657 Gallaher Road
Kingston, TN 37763

Age of Facility: 6 yrs

RCRA Treatment Permit
Date: 08/04/89 **Exp:** 08/04/99

Rad Mat #: R-73014-K98

Technology Description:
DSSI provides a very important service to the nation because its one-of-a-kind industrial boiler facility burns an unstable liquid waste form (mixed, hazardous, and/or radioactive) for energy recovery, thereby destroying the liquid. Hazardous liquids are inherently unstable due to their mobility in the environment and specific handling requirements. DSSI's thermal treatment process destroys (burns) the liquid waste form and reduces the potential risk to workers, the public health, and the environment. The resulting residue from the thermal treatment process is considered DSSI generated waste, and is disposed of by DSSI at an appropriately licensed and pemitted disposal faciltiy. DSSI can accept all RCRA hazardous waste codes (except D003, F020, F021, F022, F023, F026, and F027) including waste containing small quantities of radioisotopes with atomic numbers 1 through 83, 88, 90, 92, 94, and 95.

System Capacity: Current throughput of 14.5 million BTU per hour. Annual capacity of 1,000,000 gal.

Excess Capacity: The unused capacity available at DSSI is approximately 50%.

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☐ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☑ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Compressed Gases	Deactivation	

Company Name and Address:

Earth Resources Corporation
1227 Marshall Farms Road
Ocoee, FL 34761

Contact:
Mr. Michael Miller
Phone:
(407) 877-0877
Fax:
(407) 877-3622

Age of Company:	Number of Employees:	Annual Revenue:
17 years	40	Not provided

Facility Name and Address:

Mobile Treatment Facility

Age of Facility: N/A

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: None

Technology Description:

ERC provides on-site sampling and analysis of cylinders with inoperable valves, unknown contents, and radiological contamination. Contents can be recontainerized or treated on-site. Systems are enclosed in mobile trailers.

System Capacity:	Excess Capacity:
Not provided	Not provided

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☐ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☑ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Diphonix Ion Exchange

Technology Category:
Recovery of Metals

Company Name and Address:
Eichrom Industries, Inc.
8205 South Cass Avenue
Suite 107
Darien, IL 60561

Contact:
Mr. James Harvey
Phone:
(708) 963-0320
Fax:
(708) 963-0381

Age of Company: 5 years

Number of Employees: 30

Annual Revenue: Not provided

Facility Name and Address:
Eichrom Industries, Inc.
8205 South Cass Avenue Suite 107
Darien, IL 60561

Age of Facility: NA

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: None

Technology Description:

Eichrom Industries Diphonix (trademark) resin is a high performace, gel-type cation resin with special selectivity for metal ions in water and process solutions. The resin is constructed of a polystyrene/divinylbenzene matrix in a spherical bead form. The resin is made with two distinct functional groups, each contributing to the resin's performance characteristics. The primary exchange group is a geminally substituted diphosphonic acid, which forms extremely stable complexes with a number of metal ions. Resin activity is exceptional in acidic solutions where Diphonix resins retains complexed metals under conditions that for most ion exhagers would effect resin regeneration. The secondary exchange sites on Diphonix resin are comprised of sulfonic acid groups. This makes the resin very hydrophilic with the result of greatly enhanced exchange kinetics.

System Capacity: Variable

Excess Capacity: Not provided

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
DC Graphite Arc Melter	Vitrification	

Company Name and Address:	Contact:
Electro-Pyrolysis, Inc. 996 Old Eagle School Road Wayne, PA 19087	Dr. J. Kenneth Wittle Phone: (610) 687-9070 Fax: (610) 964-8570

Age of Company:	Number of Employees:	Annual Revenue:
13	30	N/A

Facility Name and Address:	Age of Facility: 20 years
Technology Development Laboratory 304 Directors Dr. Knoxville, TN 37923	RCRA Treatment Permit Date: Exp: Rad Mat #: TN R-01060-J95

Technology Description:

A DC Graphite Arc Furnace is a simple system in which electricity is used to generate the heat necessary to vitrify the material and thermally decompose organic matter which may be found in the waste stream. Examples of this type of waste would be protective clothing, resins and grit blast materials produced in the nuclear industry. The various DOE complexes produce similar low level waste streams.

System Capacity: 50 kg/hr.	Excess Capacity: Variable depending on workload from 0 to 100%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☐ DOE/Gov experience

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☐ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Activated Carbon	Recovery of Metals	

Company Name and Address:	Contact:
Energy and Environmental Research Center University of North Dakota 15 North 23rd Street Grand Forks, ND 58202	Mr. Edward Steadman Phone: (701) 777-5157 Fax: (701) 777-5181

Age of Company:	Number of Employees:	Annual Revenue:
Not provided	Not provided	Not provided

Facility Name and Address:	Age of Facility: Not provided
Energy & Environmental Research Ctr University of North Dakota, 15 North 23rd Street Grand Forks, ND 58202	RCRA Treatment Permit Date: Exp: Rad Mat #: None

Technology Description:

The wastewater treatment process directly addresses the remediation of heavy metal- and radionuclide-contaminated wastewater and groundwater sources. This process adsorbs heavy metals from wastewater streams onto a bed of granular activated carbon (GAC) pretreated with a proprietary conditioning treatment. The concentrated heavy metals and radionuclides are stripped from the GAC with a selected regenerant and recovered. This process is superior to existing technologies for treating heavy metal- and radionuclide-contaminated waste streams because EPA-quality effluent is produced, minimum hazardous waste is generated, and a recycleable metallic product is recovered at substantial cost savings over existing technologies.

System Capacity:	Excess Capacity:
Not provided	75%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☐ DOE/Gov experience

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Centrifugal Membrane Filtration	**Recovery of Metals**	

Company Name and Address:	Contact:
Energy and Environmental Research Center University of North Dakota 15 North 23rd Street Grand Forks, ND 58202	Mr. Edward Steadman Phone: (701) 777-5157 Fax: (701) 777-5181

Age of Company:	Number of Employees:	Annual Revenue:
Not provided	Not provided	Not provided

Facility Name and Address:	Age of Facility: Not provided
Energy & Environmental Research Ctr University of North Dakota, 15 North 23rd Street Grand Forks, ND 58202	RCRA Treatment Permit Date: Exp: Rad Mat #: None

Technology Description:

The SpinTek filtration unit combines ultrafiltration with centrifugal force to remove suspended and dissolved solids from liquid waste streams. Feed water is introduced into a stationary pressure vessel and flows across rotating membrane disks while pressures up to 150 psig push the water through the membrane. The process can remove dissolved solids to about 1,000 molecular weight.

System Capacity:	5 - 15 lb/hr treated permeate depending on waste being treated and overall process	Excess Capacity:	Would be on-site unit

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☑ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Fluid-Bed Calcination	Incineration	

Company Name and Address:	Contact:
Energy and Environmental Research Center University of North Dakota 15 North 23rd Street Grand Forks, ND 58202	Mr. Edward Steadman Phone: (701) 777-5157 Fax: (701) 777-5181

Age of Company:	Number of Employees:	Annual Revenue:
Not provided	Not provided	Not provided

Facility Name and Address:	Age of Facility: Not provided
Energy & Environmental Research Ctr University of North Dakota, 15 North 23rd Street Grand Forks, ND 58202	RCRA Treatment Permit Date: Exp: Rad Mat #: None

Technology Description:

The process is based on a fluidized bed reactor to solidify low- and intermediate-level radioactive liquid waste. The current process is designed to optimize the calcination process of high-sodium content liquid wastes at the Idaho Chemical Processing Plant.

System Capacity:	Excess Capacity:
200 lb/hr 400,000 lb/hr	75%

Technology Maturity:

- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ DOE/Gov experience

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☐ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Hydrothermal Boiler

Technology Category: Wet Oxidation

Company Name and Address:
Energy and Environmental Research Center
University of North Dakota
15 North 23rd Street
Grand Forks, ND 58202

Contact:
Mr. Edward Steadman
Phone:
(701) 777-5157
Fax:
(701) 777-5181

Age of Company: Not provided

Number of Employees: Not provided

Annual Revenue: Not provided

Facility Name and Address:
Energy & Environmental Research Ctr
University of North Dakota, 15 North 23rd Street
Grand Forks, ND 58202

Age of Facility: Not provided

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: None

Technology Description:
The hydrothermal boiler uses a two-stage oxidation of a mixture of mixed-waste and water. Organic vapor leaving the reactor is cleaned and cooled before being oxidized with air at low pressure. The hydrothermal boiler can be designed for zero liquid discharge and for clean flue gas discharge to the atmosphere.

System Capacity: 300 lb/hr 500,000 lb/hr

Excess Capacity: 75%

Technology Maturity:
- [x] R and D
- [ ] Bench Scale
- [ ] Pilot Scale
- [ ] Commercial

Pick the best one

- [ ] **DOE/Gov experience**

Technology Availability:
- [ ] Currently available
- [x] Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- [x] Aqueous liquids
- [x] Aqueous slurries
- [x] Organic liquids
- [x] Inorganic sludges
- [x] Organic sludges
- [x] Soils
- [ ] Soils and debris
- [ ] Metal debris
- [ ] Non-metal debris
- [ ] Lab packs
- [ ] Reactive metals
- [ ] Elemental mercury
- [ ] Elemental lead
- [ ] Lead batteries
- [ ] Cadmium batteries

Select all that apply

MW Categories Accepted:
- [x] Low level waste
- [ ] Transuranic waste
- [ ] High level waste

Select all that apply

Residuals:
- [ ] Residuals ready for disposal
- [x] Residuals need additional treatment
- [ ] Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Pyrolysis	Incineration	

Company Name and Address:	Contact:
Energy and Environmental Research Center University of North Dakota 15 North 23rd Street Grand Forks, ND 58202	Mr. Edward Steadman Phone: (701) 777-5157 Fax: (701) 777-5181

Age of Company:	Number of Employees:	Annual Revenue:
Not provided	Not provided	Not provided

Facility Name and Address:	Age of Facility: Not provided
Energy & Environmental Research Ctr University of North Dakota, 15 North 23rd Street Grand Forks, ND 58202	RCRA Treatment Permit Date: Exp: Rad Mat #: None

Technology Description:

Waste is heated in a fluidized-bed reactor to a temperature of 450 to 600 degrees C in the presence of an alkaline bed material to remove radionuclides. Polymers such as polypropylene (PP) and polyethylene (PE) are thermally decomposed to produce an oil with a boiling point range between that of No. 2 diesel fuel and JP-4 (commercial jet fuel). Condensation polymers (i.e., PET) hydrolyze to form terephthalic or benzoic acid. Chlorine species evolved during processing are captured and removed from the process stream via reaction with the alkaline bed material.

System Capacity:	Excess Capacity:
100 lb/hr	75%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☑ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☑ Non-metal debris
- ☑ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☐ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Macroencapsulation	Macroencapsulation	

Company Name and Address:

Envirocare of Utah, Inc.
46 West Broadway
Suite 240
Salt Lake City, UT 84101

Contact:
Mr. Kevin Fuller
Phone:
(801) 532-1330
Fax:
(801) 537-7345

Age of Company:	Number of Employees:	Annual Revenue:
8 years	70	N/A

Facility Name and Address:

Envirocare of Utah, Inc.
US I-80, Exit 49 Tooele County
Clive, UT 84029

Age of Facility: 1year

RCRA Treatment Permit
Date: 01/01/90 Exp: 11/30/00

Rad Mat #: UT 2300240

Technology Description:

Elemental lead pieces/articles and debris are acceptable for Macroencapsulation. An LDPE extruder is used to completely surround the waste by a minimum of two (2) inches of encapsulant.

System Capacity: 150 tons/day

Excess Capacity: 100% Availability

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☑ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Non-Thermal Stabilization

Technology Category: Stabilization

Company Name and Address:

Envirocare of Utah, Inc.
46 West Broadway
Suite 240
Salt Lake City, UT 84101

Contact: Mr. Kevin Fuller
Phone: (801) 532-1330
Fax: (801) 537-7345

Age of Company: 8 years

Number of Employees: 70

Annual Revenue: N/A

Facility Name and Address:

Envirocare of Utah, Inc.
US I-80, Exit 49 Tooele County
Clive, UT 84029

Age of Facility: 1year

RCRA Treatment Permit
Date: 01/01/90 **Exp:** 11/30/00

Rad Mat #: UT 2300240

Technology Description:

Mixed wastes are accepted into the facility in either containers or bulk. If necessary waste is sized and shredded. Waste is combined with reagents in a mixer according to treatment formula. Sampling and verification are conducted prior to disposal.

System Capacity: 150 tons/day

Excess Capacity: 100% Availability

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☑ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Aquaset/Petroset	Stabilization	

Company Name and Address:

Fluid Tech, Inc.
4335 W. Tropicana
Suite 3
Las Vegas, NV 89103

Contact:
Mr. Thomas Murarik
Phone:
(702) 871-1884
Fax:
(702) 871-3629

Age of Company:	Number of Employees:	Annual Revenue:
10 years	43	$3.6 million

Facility Name and Address:

Fluid Tech, Inc.
4335 W. Tropicana, Suite 3
Las Vegas, NV 89103

Age of Facility:

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: 03-11-0339-01

Technology Description:

Fluid Tech, Inc. uses patented stabilizing agents (Aquaset, Petorset, Petroset-H, Aquaset II, Aquaset II-H, Petorset II) for stabilizing and solidifying hazardous, radioactive and mixed wastes, as either aqueous or organic solutions, sludges, debris, filter cakes, solids, powders or soils. The base materials for the stabilization agents consists of modified naturally occuring clays. These clays have large, highly reactive surface areas which are capable of adsorbing large amounts of hazardous cationic metals.

System Capacity:	Excess Capacity:
Bench scale treatability studies only	80%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☑ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☑ Elemental lead
- ☑ Lead batteries
- ☑ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
In Situ Vitrification (ISV)	Vitrification	

Company Name and Address:	Contact:
Geosafe Corporation 2950 George Washington Way Richland, WA 99352	Mr. Matthew Haass Phone: (509) 375-0710 Fax: (509) 375-7721

Age of Company:	Number of Employees:	Annual Revenue:
7 years	25	$5 - 10 Million

Facility Name and Address:	Age of Facility: 7 years
Geosafe Corporation Test Site 3105 Horn Rapids Rd. Richland, WA 99352	RCRA Treatment Permit Date: Exp: Rad Mat #: Access to PNL

Technology Description:

Geosafe's In Situ Vitrification (ISV) Technology is applicable to the treatment of contaminated soil, sludge, mine tailings, incinerator ash, concrete, brick and other types of earthen debris. A key benefit to using ISV is that it will destory all types of organic compounds while permanently immobilizing metals (including radionuclides) and other inorganics in a leach-resistant vetrifed product that is similar to volcanic obsidian. ISV can be operated in a stationary batch mode which provides capabilities that are similar to ex-situ vitrification. ISV is a robust technology that can withstand variations in contaminants, contaminant concentrations, media and moisture conditions that would be unacceptable for other thermal or immobilization technologies.

Geosafe Corporation has a RCRA Treatability Study exemption.

System Capacity:	Excess Capacity:
No information given	No information given

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☑ Lab packs
- ☑ Reactive metals
- ☑ Elemental mercury
- ☑ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Chemical Leaching	Recovery of Metals	

Company Name and Address:	Contact:
Hazen Research Inc. 4601 Indiana Street Golden, CO 80403	Mr. Rodney Hodgson Phone: (303) 279-4501 Fax: (303) 278-1528

Age of Company:	Number of Employees:	Annual Revenue:
35 yrs	135	$ 10 Million

Facility Name and Address:	Age of Facility: 35 years
Hazen Research Inc. 4601 Indiana Street Golden, CO 80403	RCRA Treatment Permit Date: Exp: Rad Mat #: CO 77-02

Technology Description:

Various Reagents have been utilized for the recovery of metal contaminants from various media, including soil. Technology includes recovery of metals for recycle. Selection of the most appropriate reagents follow a thorough characterization of the matrix.

System Capacity:	Excess Capacity:
5- 10 Kg/Hr depending on process	Up to treatability study limits.

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☑ Elemental lead
- ☑ Lead batteries
- ☑ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Incineration/Combustion/Calcining/Roasting	Organic Destruction	

Company Name and Address:

Hazen Research Inc.

4601 Indiana Street

Golden, CO 80403

Contact:

Mr. Rodney Hodgson

Phone:

(303) 279-4501

Fax:

(303) 278-1528

Age of Company:	Number of Employees:	Annual Revenue:
35 yrs	135	$ 10 Million

Facility Name and Address:

Hazen Research Inc.

4601 Indiana Street

Golden, CO 80403

Age of Facility: 35 years

RCRA Treatment Permit

Date: **Exp:**

Rad Mat #: CO 77-02

Technology Description:

Evaluations and demonstrations to generate design data for processes involving calcination, drying, low-temperature thermal desorption, chemical decomposition and conversion, waste incineration, and combustion. Testing systems range from laboratory- and bench-scale research units (used to perform process development investigations) to larger pilot plant units (for demonstration and to provide design data for commercial systems). The test units demonstrate various technology options. The assortment of test systems available, together with ready access to analytical backup, provide the capability to perform a wide variety of thermal treatment studies. Programs range in scope from examining process design parameters to the development of engineering design data.

System Capacity:	Varies with equipment size	Excess Capacity:	Up to treatability study limits

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☑ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Materials Handling/Soil Washing/Gravity Separation

Technology Category:
Soil Washing

Company Name and Address:

Hazen Research Inc.

4601 Indiana Street

Golden, CO 80403

Contact:

Mr. Rodney Hodgson

Phone:

(303) 279-4501

Fax:

(303) 278-1528

Age of Company: 35 yrs

Number of Employees: 135

Annual Revenue: $ 10 Million

Facility Name and Address:

Hazen Research Inc.

4601 Indiana Street

Golden, CO 80403

Age of Facility: 35 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: CO 77-02

Technology Description:

Evaluation and demonstration of various separation technologies based upon physical characteristics of the waste. These include gravity, magnetic, electrostatic, surface properties, particle size, and specific gravity. Crushing, grinding and other comminution services available.

System Capacity: Varies by waste stream

Excess Capacity: Not provided

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☑ Elemental lead
- ☑ Lead batteries
- ☑ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Retorting for Mercury	Retorting for Mercury	

Company Name and Address:	Contact:
Hazen Research Inc. 4601 Indiana Street Golden, CO 80403	Mr. Rodney Hodgson Phone: (303) 279-4501 Fax: (303) 278-1528

Age of Company:	Number of Employees:	Annual Revenue:
35 yrs	135	$ 10 Million

Facility Name and Address:	Age of Facility: 35 years
Hazen Research Inc. 4601 Indiana Street Golden, CO 80403	RCRA Treatment Permit Date: Exp: Rad Mat #: CO 77-02

Technology Description:

1). The retort is typically equipped with stainless steel trays on which the waste is placed. Heating is carried out using gas, oil, or resistance elements or by induction. The charge is heated under negative pressure for several hours to about 350 degrees F to remove water. The charge is further heated for a maximum of about 16 hours to drive off the mercury, then cooled (about 4 hours). A typical retort operating cycle lasts about 24 hours.

2.) Combinations of K-106 and D-009 wastes are incinerated to oxidize the organics and volatilize the mercury. Exhausted gas scrubbing captures all mercury and neutralizes acid gases.

System Capacity:	Excess Capacity:
Various	Not provided

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☑ Elemental lead
- ☑ Lead batteries
- ☑ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Solvent Extraction

Technology Category: Recovery of Metals

Company Name and Address:
Hazen Research Inc.
4601 Indiana Street
Golden, CO 80403

Contact:
Mr. Rodney Hodgson
Phone:
(303) 279-4501
Fax:
(303) 278-1528

Age of Company: 35 yrs

Number of Employees: 135

Annual Revenue: $ 10 Million

Facility Name and Address:
Hazen Research Inc.
4601 Indiana Street
Golden, CO 80403

Age of Facility: 35 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: CO 77-02

Technology Description:

1) Metals Recovery - Hazen Research, Inc. has been closely involved with the development of solvent extraction processes for the mineral industry for the past 30 years. The process development for the world's first copper solvent-extraction/electrowinning (SX/EW) plant at the Bluebird Mine in Arizona was accomplished on site in Golden, Colorado. The company has served clients in all aspects of this technology starting with laboratory shake-out tests, pilot plants, basic design criteria, review of engineering design, startup assistance, and toubleshooting for operating plants.

2) Organics Recovery - Hazen has experience in evaluating various solvents at the bench and pilot level for removal of organic contaminants from soil and debris.

System Capacity: Various

Excess Capacity: Varies

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Thermal Desorption

Technology Category: Recovery of Organics

Company Name and Address:

Hazen Research Inc.
4601 Indiana Street
Golden, CO 80403

Contact:
Mr. Rodney Hodgson
Phone:
(303) 279-4501
Fax:
(303) 278-1528

Age of Company: 35 yrs

Number of Employees: 135

Annual Revenue: $ 10 Million

Facility Name and Address:

Hazen Research Inc.
4601 Indiana Street
Golden, CO 80403

Age of Facility: 35 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: CO 77-02

Technology Description:

Thermal desorption is an ex-situ process that uses direct or indirect heat to vaporize and remove organic contaminants from soils, sludges, and other solid material. Air or inert gas is normally used to convey the vaporized organic compounds from the contaminated medium, but combustion gas can also be used. Thermal desorption technology is intended to physically separate the organic contaminants from the medium, while minimizing organic decomposition. This physical separation process distinguishes thermal desorption technology from incineration, because incineration is intended to fully decompose the organic contaminants to form carbon dioxide and water.

System Capacity: Various

Excess Capacity: Varies

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Chemical Photolysis

Technology Category: Chemical Oxidation

Company Name and Address:
Institute for Environmental Health and Safety
Idaho State University, College of Engineering
P. O. Box 8060
Pocatello, ID 83209-8300

Contact: Mr. Solomon Leung
Phone: (208) 236-2524
Fax: (208) 236-4476

Age of Company: Not provided

Number of Employees: Not provided

Annual Revenue: Not provided

Facility Name and Address:
Idaho State University
College of Engineering, P. O. Box 8060
Pocatello, ID 83209

Age of Facility:

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: NRC 11-27380-01

Technology Description:
Light excitation of titanium dioxide aqueous dispersions leads to emission of an electron and formation of oxygen and hydroxide radicals in solution. Laboratory experiments were conducted to measure the destruction of urea.

System Capacity: Not provided

Excess Capacity: 40%

Technology Maturity:
- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☐ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Fenton's Reagent Oxidation	Chemical Oxidation	

Company Name and Address:	Contact:
Institute for Environmental Health and Safety Idaho State University, College of Engineering P. O. Box 8060 Pocatello, ID 83209-8300	Mr. Solomon Leung Phone: (208) 236-2524 Fax: (208) 236-4476

Age of Company:	Number of Employees:	Annual Revenue:
Not provided	Not provided	Not provided

Facility Name and Address:	Age of Facility:
Idaho State University College of Engineering, P. O. Box 8060 Pocatello, ID 83209	RCRA Treatment Permit Date: Exp: Rad Mat #: NRC 11-27380-01

Technology Description:

Fenton's reagent is a mixture of hydrogen peroxide and ferrous iron. The hydrogen peroxide oxidizes the ferrous iron releasing a hydroxide radical. Experiments show that the hydroxide radical is effective at rapidly destorying tetrachloroethylene (PCE) and polychlorinated biphenyls (PCB).

System Capacity:	Excess Capacity:
Not provided	40%

Technology Maturity:

- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☐ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Adsorption Media	Recovery of Organics	

Company Name and Address:	Contact:
IT Corporation Technology Applications Laboratory 312 Directors Drive Knoxville, TN 37923	Mr. Ed Alperin Phone: (423) 690-3211 Fax: (423) 694-9573

Age of Company:	Number of Employees:	Annual Revenue:
42 years	2,500	$ 420 Million (FY-95)

Facility Name and Address:	Age of Facility: 20 years
Technology Development Laboratory 304 Directors Dr. Knoxville, TN 37923	RCRA Treatment Permit Date: Exp: Rad Mat #: TN R-01060-J95

Technology Description:

Carbon absorption is used to remove organic, and to a limited extent inorganic, compounds from aqueous and gaseous waste streams. Carbon absorption is a physical process where the compounds are physically attracted to the carbon active absorption sites by condensation in capillaries, in a process similar to ion exchange resins. Different types of carbon have different absorption capacities and properties, depending on the source of the carbon and the manner in which it has been treated. The used carbon can be regenerated and reused, but it is often more cost effective to dispose of the spent carbon.
Treatability study capabilties include: evaluating different carbon sources and generating absorption isotherms, column treatment studies and in-house analysis of untreated and treated waste.

System Capacity:	Excess Capacity:
Bench-scale: 20 to 160 mL/min Pilot-scale: 20 gal/day	Variable depending on Workload to 100%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Amalgamation

Technology Category:
Amalgamation

Company Name and Address:
IT Corporation
Technology Applications Laboratory
312 Directors Drive
Knoxville, TN 37923

Contact:
Mr. Ed Alperin
Phone:
(423) 690-3211
Fax:
(423) 694-9573

Age of Company: 42 years

Number of Employees: 2,500

Annual Revenue: $ 420 Million (FY-95)

Facility Name and Address:
Technology Development Laboratory
304 Directors Dr.
Knoxville, TN 37923

Age of Facility: 20 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: TN R-01060-J95

Technology Description:
Amalgation is a treatment process which coverts elemental mercury to a mercury/metal amalgam, followed by fixation or stabilization, to convert elemental mercury to a less toxic and less leachable form suitable for disposal. Amalgamation is available to elemental mercury only. Treatability study capabilities include: evaluation of amalgamation agents, process parameters, and in-house analysis of untreated and treated wastes.

System Capacity: Bench-scale: 5 lbs/day
Pilot-scale: 1-55 gal drum/day

Excess Capacity: Variable depending upon workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Base Catalyzed Decomposition (BCD)

Technology Category:
Organic Destruction

Company Name and Address:
IT Corporation
Technology Applications Laboratory
312 Directors Drive
Knoxville, TN 37923

Contact:
Mr. Ed Alperin
Phone:
(423) 690-3211
Fax:
(423) 694-9573

Age of Company: 42 years

Number of Employees: 2,500

Annual Revenue: $ 420 Million (FY-95)

Facility Name and Address:
Technology Development Laboratory
304 Directors Dr.
Knoxville, TN 37923

Age of Facility: 20 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: TN R-01060-J95

Technology Description:
Destruction of hazardous organic chlorinated compounds such as PCP, PCBs, and PCDDs/PCDFs is accomplished using a patented EPA chemical process, which uses petroleum stocks as solvent, a catalyst, sodium hydroxide and the application of heat. The reaction is usually conducted at 300 to 350 degrees C. The reaction displaces the chlorine atoms in the hazardous compounds with a hydrogen atom producing nontoxic unchlorinated compounds and chloride salts as byproducts. IT has experience using the process to destroy PCB compounds in low temperature thermal desorption condensates. Treatability study capabilities include: evaluation of batch BCD process conditions and effectiveness, and in-house analysis of treated and untreated waste as well as special analytical capabilities to analyze for by products.

System Capacity: Bench-scale: 2 liter/batch; Pilot-scale: 10 gal/batch

Excess Capacity: Variable depending on workload

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Chemical Dehalogenation	Organic Destruction	

Company Name and Address:	Contact:
IT Corporation Technology Applications Laboratory 312 Directors Drive Knoxville, TN 37923	Mr. Ed Alperin Phone: (423) 690-3211 Fax: (423) 694-9573

Age of Company:	Number of Employees:	Annual Revenue:
42 years	2,500	$ 420 Million (FY-95)

Facility Name and Address:	Age of Facility: 20 years
Technology Development Laboratory 304 Directors Dr. Knoxville, TN 37923	RCRA Treatment Permit Date: Exp: Rad Mat #: TN R-01060-J95

Technology Description:

Destruction of hazardous organic chlorinated compound such as pesticides, PCBs and PCDDs/PCDFs in organic or solid wastes is accomplished using chemical reagents and in some cases, the application of heat. The reagents used are typically basic compounds which supply a nucleophilic species, such as hydroxide, to displace the chloride atoms in the hazardous compound. The products of reaction are typically nucleophilic substituted compounds and chloride salts. The substituted compounds are much less or nontoxic, and in many cases are water soluble so they can be removed by extraction. IT has extensive experience studying reagent destruction of PCBs and PCDDs/PCDFs on solid surfaces and in transformer oils and organic wastes. Treatability study capabilties include: evaluation of chemcial dehalogenation reagents and processes, evaluation of secondary waste treatment options, and analysis of treated and untreated waste as well as special analytical capabilties to analyze for byproducts. IT's TOSCA permit prohibits return of TOSCA regulated materials to the generator. Special arrangements must be made for mixed waste.

System Capacity:	Excess Capacity:
Bench-scale: 10 L batch Pilot-scale: 10 gallon batch	Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Chemical Extraction, with or without chelants

Technology Category:
Recovery of Organics

Company Name and Address:

IT Corporation
Technology Applications Laboratory
312 Directors Drive
Knoxville, TN 37923

Contact:
Mr. Ed Alperin
Phone:
(423) 690-3211
Fax:
(423) 694-9573

Age of Company: 42 years

Number of Employees: 2,500

Annual Revenue: $ 420 Million (FY-95)

Facility Name and Address:

Technology Development Laboratory
304 Directors Dr.
Knoxville, TN 37923

Age of Facility: 20 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: TN R-01060-J95

Technology Description:

Chemical extraction can involve either converting the contaminants of concern to insoluble forms (in the case of liquid wastes) or to soluble forms (when dealing with solid wastes), and separating the solids from the liquid, or causing the contaminant of concern to transfer from a waste liquid into a solvent which can be separated from the original waste. Extracted contaminants can often be recycled or may be disposed. Disposal may require further treatment. Treatability study capabilities include: evaluation of chemical extractants and extraction processes, evaluation of chelating agents, evaluation of separation systems, evaluation of process reagent recycling, and in-house analysis of untreated and treated waste.

System Capacity: Bench-scale: 10 L batch/continuous
Pilot-scale: 10 gal batch/continuous

Excess Capacity: Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Deactivation	Deactivation	

Company Name and Address:	Contact:
IT Corporation Technology Applications Laboratory 312 Directors Drive Knoxville, TN 37923	Mr. Ed Alperin Phone: (423) 690-3211 Fax: (423) 694-9573

Age of Company:	Number of Employees:	Annual Revenue:
42 years	2,500	$ 420 Million (FY-95)

Facility Name and Address:	Age of Facility: 20 years
Technology Development Laboratory 304 Directors Dr. Knoxville, TN 37923	RCRA Treatment Permit Date: Exp: Rad Mat #: TN R-01060-J95

Technology Description:

Deactivation is any acceptable process which will reduce a waste's hazardous property to meet Land Disposal Requirements. Hazards such as igniteability, corrosivity, toxicity or reactivity can be treated by deactivation. There are many treatment technologies that may be applied to deactiviation, including pH adjustments, precipitation, oxidation, to name a few. Treatability study capabilities include: evaluation of treatment alternatives, bench- and pilot-scale testing of treatment alternatives, coupling with other treatment alternatives, to provide a complete treatment process, and in-house analysis of untreated and treated waste.

System Capacity:	Excess Capacity:
Bench-scale: 1 L or 4 lbs per day Pilot-scale: 10 L or 40 lbs per day	Varialbe depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☑ Reactive metals
- ☑ Elemental mercury
- ☑ Elemental lead
- ☑ Lead batteries
- ☑ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Debris Decontamination

Technology Category: Debris Washing

Company Name and Address:

IT Corporation
Technology Applications Laboratory
312 Directors Drive
Knoxville, TN 37923

Contact: Mr. Ed Alperin
Phone: (423) 690-3211
Fax: (423) 694-9573

Age of Company: 42 years

Number of Employees: 2,500

Annual Revenue: $ 420 Million (FY-95)

Facility Name and Address:

Technology Development Laboratory
304 Directors Dr.
Knoxville, TN 37923

Age of Facility: 20 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: TN R-01060-J95

Technology Description:

Waste sites generally contain equipment, piping and other debris which can be decontaminated and recovered, recycled or disposed of as nonradioactive/nonhazardous material at a considerable cost savings. IT designed, constructed, and tested a pilot-scale and full-scale debris washing system, capable of processing up to 120 tons of debris per day. The system was sucessfully field tested several times. Treatability study capabilties include: evaluation of surfactant and other decontamination aids efficiency and in-house analysis of untreated and treated materials.

System Capacity: Variable depending on material

Excess Capacity: Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Electro-Chemical Separation	Recovery of Metals	

Company Name and Address:	Contact:
IT Corporation Technology Applications Laboratory 312 Directors Drive Knoxville, TN 37923	Mr. Ed Alperin Phone: (423) 690-3211 Fax: (423) 694-9573

Age of Company:	Number of Employees:	Annual Revenue:
42 years	2,500	$ 420 Million (FY-95)

Facility Name and Address:	Age of Facility: 20 years
Technology Development Laboratory 304 Directors Dr. Knoxville, TN 37923	RCRA Treatment Permit Date: Exp: Rad Mat #: TN R-01060-J95

Technology Description:

Electo-Chemical Separation is a process whereby soluble metals are selectively removed from liquid waste streams by means of electrical current. The positively charged metal ions are attracted to a negatively charged series of plates immersed in a flow through cell. Metals require specific pH conditions for the electro-chemical separation process to be effective. Pretreatment of the waste stream is often required to adjust pH and remove solid or oily contaminants. Metals can be recovered from the plates for recyclying or disposal. Treatability study capabilities include: evaluation of electro-chemical separation process parameters, evaluation of metal recycling cost effectiveness and in-house analysis of untreated and treated waste.

System Capacity:	Excess Capacity:
Variable depending on waste stream	Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Excavated Soil Biotreatment (BIOFAST)

Technology Category:
Biodegradation

Company Name and Address:

IT Corporation
Technology Applications Laboratory
312 Directors Drive
Knoxville, TN 37923

Contact:
Mr. Ed Alperin
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(423) 690-3211
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(423) 694-9573

Age of Company: 42 years

Number of Employees: 2,500

Annual Revenue: $ 420 Million (FY-95)

Facility Name and Address:

Technology Development Laboratory
304 Directors Dr.
Knoxville, TN 37923

Age of Facility: 20 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: TN R-01060-J95

Technology Description:

BIOFAST (Biological Forced Air Soil Treatment) is a patented technology for ex-situ treatment of contaminated soil. BIOFAST (registered trade mark) systems provide effective unobtrusive treatment of organic contaminants in soil using biopiles that require a minimal amount of land space. The technology is derived from conventional bioremediation applications, where indigenous bacteria in the soil are stimulated by providing oxygen, moisture, and nutrients. IT's Biotechnology Applications Laboratory provides bioassessment testing of the contaminated soil, including the following assays: micorbial enumerations, microbial stimulation testing, background nutrient concentrations, soil moisture, and soil solution pH.

System Capacity: Variable depending on site conditions.

Excess Capacity: Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Incineration

Technology Category: Incineration

Company Name and Address:

IT Corporation
Technology Applications Laboratory
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Knoxville, TN 37923

Contact: Mr. Ed Alperin
Phone: (423) 690-3211
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Age of Company: 42 years

Number of Employees: 2,500

Annual Revenue: $ 420 Million (FY-95)

Facility Name and Address:

Technology Development Laboratory
304 Directors Dr.
Knoxville, TN 37923

Age of Facility: 20 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: TN R-01060-J95

Technology Description:

Incineration destroys organic wastes by direct combustion. Process parameters that need to be understood include combustion temperature, waste residence time in the combustion chamber, exhaust treatment, material feed characteristics, secondary waste generation (as well as treatment and disposal), and emergency conditions, as well as a variety of permitting issues. IT has built and successfully operated numerous mobile incineration systems based on IT's HTTS patented design, and has a very good understanding of what it takes to design, build, test and operate a hazardous/mixed waste incinerator. IT has made significant contributions to the design, operation and maintenance of DOE's mixed waste incinerator at the K-25 plant in Oak Ridge, TN. Treatability study capabilities include: evaluation of time and temperature operating profiles, evaluation of off gas treatment technology options, evaluation of material feed characteristics, evaluation of secondary waste treatment options, and in-house analysis of untreated and treated wastes.

System Capacity: Bench-scale: 1-2 kg batches

Excess Capacity: Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☑ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Low Temperature Thermal Desorption

Technology Category: Retorting for Mercury

Company Name and Address:

IT Corporation
Technology Applications Laboratory
312 Directors Drive
Knoxville, TN 37923

Contact: Mr. Ed Alperin
Phone: (423) 690-3211
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Age of Company: 42 years

Number of Employees: 2,500

Annual Revenue: $ 420 Million (FY-95)

Facility Name and Address:

Technology Development Laboratory
304 Directors Dr.
Knoxville, TN 37923

Age of Facility: 20 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: TN R-01060-J95

Technology Description:

The IT low temperature thermal desorption (LTTD) unit can indirectly heat soils, sludges, and debris to a temperature sufficient to desorb volatile organic and volatile inorganic compounds from soils. The pilot-scale system is composed of a feed system, rotary calciner, treated solids handling system, off gas cleaning system, and control systems, and is capable of processing up to 150 lbs/hr. IT's bench-scale Rotary Thermal Apparatus (RTA) is designed to provide information regarding LTTD treatment parameters such as residence time and temperature. Static tray tests may also be conducted to provide similar information. The LTTD and RTA are flexible, allow evaluation of numerous off gas treatment technologies, and mimic IT's full-scale thermal treatment operation. Treatability study capabilities inlcude: static tray desorption tests (0.5 kg batch), RTA desorption tests (2 kg batch), LTTD tests (up to 150 lb/hr), and a variety of off gas treatment technologies.

System Capacity: Bench-scale: 1-2 kg/batch; Pilot-scale up to 150 lbs/hr.

Excess Capacity: Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Macroencapsulation	Macroencapsulation	

Company Name and Address:

IT Corporation
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(423) 694-9573

Age of Company:	Number of Employees:	Annual Revenue:
42 years	2,500	$ 420 Million (FY-95)

Facility Name and Address:

Technology Development Laboratory
304 Directors Dr.
Knoxville, TN 37923

Age of Facility: 20 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: TN R-01060-J95

Technology Description:

Macroencapsulation is used to immobilize/stabilize chemically hazardous and radionuclide contaminants on debris and equipment. Generally speaking, it involves surroundinding and encasing the waste items in a fluid media that hardens and retards dissolution or leaching of material. Commonly used macroencapsulation agents include cement, grout polymer cements, waxes and plastics. Treatability study capabilities include: evaluation of macroencapsulation agents and analysis of untreated and treated materials.

System Capacity: Dependent on waste material

Excess Capacity: Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☑ Lab packs
- ☑ Reactive metals
- ☑ Elemental mercury
- ☑ Elemental lead
- ☑ Lead batteries
- ☑ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Natural Attenuation

Technology Category: Biodegradation

Company Name and Address:

IT Corporation
Technology Applications Laboratory
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Knoxville, TN 37923

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Age of Company: 42 years

Number of Employees: 2,500

Annual Revenue: $ 420 Million (FY-95)

Facility Name and Address:

Technology Development Laboratory
304 Directors Dr.
Knoxville, TN 37923

Age of Facility: 20 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: TN R-01060-J95

Technology Description:

Also known as intrinsic bioremediation, natural attenuation is a risk management strategy that invokes intrinsic biodegradation, dilution, dispersion, sorption, and other physical loss mechanisms to control exposure of receptors to contaminants and restore the environment. When critical issues are considered and favorable, natural attenuation is a very cost effective and practical bioremediation technology alternative for soil and groundwater. Treatability study capabilities include: aerobic/anaerobic microbial degradation (50 samples per batch), groundwater geochemistry (50 samples per batch), natural attenuation rate modeling, degradation rate calculation, enhancement testing (24 cases per batch).

System Capacity: Variable depending on site conditions.

Excess Capacity: Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Precipitation	Recovery of Metals	

Company Name and Address:	Contact:
IT Corporation Technology Applications Laboratory 312 Directors Drive Knoxville, TN 37923	Mr. Ed Alperin Phone: (423) 690-3211 Fax: (423) 694-9573

Age of Company:	Number of Employees:	Annual Revenue:
42 years	2,500	$ 420 Million (FY-95)

Facility Name and Address:	Age of Facility: 20 years
Technology Development Laboratory 304 Directors Dr. Knoxville, TN 37923	RCRA Treatment Permit Date: Exp: Rad Mat #: TN R-01060-J95

Technology Description:

Precipitation is normally used on liquid inorganic waste streams to minimize waste volume or recover metals. Precipitation involves converting the constituents of concern into nonsoluble forms, causing the individual particles to coagulate, and separating the solid precipitate from the treated liquid. In some cases the treated liquid can be directly disposed without further treatment. IT owns a patent on a process for the precipitation of beryllium. Treatability study capabilites include: evaluation of precipitation and coagulation agents, process optimization, liquid-solid separation, and in-house analysis of untreated and treated waste.

System Capacity:	Excess Capacity:
Bench-scale: 20 L batch/continuous Pilot-scale: 20 gal batch/continuous	Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Reverse Osmosis

Technology Category: Recovery of Metals

Company Name and Address:

IT Corporation
Technology Applications Laboratory
312 Directors Drive
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Contact: Mr. Ed Alperin
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Age of Company: 42 years

Number of Employees: 2,500

Annual Revenue: $ 420 Million (FY-95)

Facility Name and Address:

Technology Development Laboratory
304 Directors Dr.
Knoxville, TN 37923

Age of Facility: 20 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: TN R-01060-J95

Technology Description:

Reverse osmosis is a process for obtaining purified water and a solute concentrate from an aqueous stream containing soluble contaminants. The process uses a permeable membrane that can withstand pressure. On one side of the membrane is the contaminated aqueous stream, and on the other side is the treated or purified water. A pressure differential is created across the membrane due to the difference in solute concentration on either side of the membrane. When pressure exceeding the pressure differential is applied to the side containing the solutes, water permeates across the membrane to produce purified water until the osmotic pressure approaches that of the applied pressure. The solute concentrate stream can then be used for the recovery of dissolved compounds. Treatability study capabilities include: evaluation of treatment process, conditions and effectiveness and in-house analysis for organics as well as inorganics: metal, cations and anions.

System Capacity: Bench-scale: Variable; Pilot-scale: 1 to 2 gpm

Excess Capacity: Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Soil Washing/Flushing	Soil Washing	

Company Name and Address:	Contact:
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Age of Company:	Number of Employees:	Annual Revenue:
42 years	2,500	$ 420 Million (FY-95)

Facility Name and Address:	Age of Facility: 20 years
Technology Development Laboratory 304 Directors Dr. Knoxville, TN 37923	RCRA Treatment Permit Date: Exp: Rad Mat #: TN R-01060-J95

Technology Description:

Soil washing/flushing is a physical process whereby heavy metal particles are removed and separated from soil particles, or other contaminants are physically flushed from the soil. Using a heavy liquid separator, heavy metal particles can be separated from lighter soil particles. This process usually involves physical preteatment of the contaminated soil to separate soil particles by size and physically separate (scrub) the heavy particles adhering to soil particles. Heavy metal contamination is often found in discrete particle size limits within the contaminated soil. By identifying the particle size limits where the majority of contamination occurs, the amount of material to be treated is greatly reduced. Soil flushing is a technolgy that can be applied in-situ, or ex-situ. A nonhazardous solvent is used to desorb and flush contaminants from the soil. The spent solvent can often be regenerated and recycled, further minimizing the amount of residuals requiring further treatment or disposal. Treatability study capabilities include: size separation of soil, attrition scrubbing of contaminated soil particles, heavy liquid separation, solvent flushing, solvent regeneration, and in-house analysis of untreated and treated waste.

System Capacity:	Excess Capacity:
Bench-scale: 2 kg/day Pilot-scale: 50 kg/day	Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Stabilization/ Solidification

Technology Category:
Stabilization

Company Name and Address:

IT Corporation
Technology Applications Laboratory
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Contact:
Mr. Ed Alperin
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(423) 690-3211
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Age of Company: 42 years

Number of Employees: 2,500

Annual Revenue: $ 420 Million (FY-95)

Facility Name and Address:

Technology Development Laboratory
304 Directors Dr.
Knoxville, TN 37923

Age of Facility: 20 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: TN R-01060-J95

Technology Description:

Stabilization converts waste into a matrix that prevents hazardous/radioactive materials from leaching significant amounts into the environment. Stabilization includes: encapsulation, pH adjustment, and incorporation of waste into a low permeability material. There are many different reagent additives in stabilization testing. Portland cement, polymer cements, blast furnace slag, lime, fly ash, and kiln dust are the most common reagents. Additional reagents may be required to convert some contaminants to less soluble forms, or to overcome the adverse effects of some compounds on the cementitious/pozzolanic reaction. Stabilization is most applicable to waste streams with low (less than 5%) organic content, but has been successfully applied to waste streams with higher organic content. IT owns a patent on the stabilization of arsenic. Treatabiltiy study capabilities include: treatability study matrix design, bench- and pilot-scale treatability studies, in-house analysis of untreated/treated waste and leachates for physical/chemical parameters, combining other treatment technologies to pretreat waste prior to stabilization.

System Capacity: Bench-scale: 50 waste streams at once; Pilot-scale: 1 ton/day

Excess Capacity: Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☑ Lead batteries
- ☑ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Steam/Air Stripping	Steam Stripping	

Company Name and Address:	Contact:
IT Corporation Technology Applications Laboratory 312 Directors Drive Knoxville, TN 37923	Mr. Ed Alperin Phone: (423) 690-3211 Fax: (423) 694-9573

Age of Company:	Number of Employees:	Annual Revenue:
42 years	2,500	$ 420 Million (FY-95)

Facility Name and Address:	Age of Facility: 20 years
Technology Development Laboratory 304 Directors Dr. Knoxville, TN 37923	RCRA Treatment Permit Date: Exp: Rad Mat #: TN R-01060-J95

Technology Description:

Steam and air stripping is a process where volatile compounds are stripped from a waste stream by passing steam or an air stream through the waste. The equipment and technology for both types of stripping are similar. These technologies are normally used with liquid waste streams, but can be adapted to slurries and solids. The contaminated air or steam is treated to remove the volatile contaminants, usually by carbon absorption. In the case of steam stripping, the condensed water can be recycled into the process, minimizing process residuals. Treatability study capabilities include: evaluation of process kinetics and cost effectiveness, evaluation of various column packing media and configurations, and in-house analysis of untreated and treated waste.

System Capacity:	Excess Capacity:
Bench-scale: 10 L per batch/continuous Pilot-scale: 10 gal per batch/continuous	Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
UV Photolysis	**Chemical Oxidation**	

Company Name and Address:	Contact:
IT Corporation Technology Applications Laboratory 312 Directors Drive Knoxville, TN 37923	Mr. Ed Alperin Phone: (423) 690-3211 Fax: (423) 694-9573

Age of Company:	Number of Employees:	Annual Revenue:
42 years	2,500	$ 420 Million (FY-95)

Facility Name and Address:	Age of Facility: 20 years
Technology Development Laboratory 304 Directors Dr. Knoxville, TN 37923	RCRA Treatment Permit Date: Exp: Rad Mat #: TN R-01060-J95

Technology Description:

UV Photolysis is a process which uses the energy of UV radiation to break chemical bonds and degrade organic compounds. The process can be performed in batch reaction or in flow through systems such as thin film reactors or by direct substrate irradiation. Photolysis is commonly performed on aqueous solutions, but can also be applied to organic solutions to destroy UV absorbing compounds as long as the solvent has low UV absorption. Aqueous UV photolysis systems can also be aided by the addition of hydrogen peroxide or ozone to increase the rate of UV initiated oxidation. Organic compounds are often oxidized to carbon dioxide and water, however, in some cases oxygenated intermediate products persist. IT has extensive experience with studying direct UV irradiation of soil and concrete surfaces for the destruction of PCBs and PCDDs/PCDFs. and has conducted pilot- and full-scale UV treatment of organic solutions for the destruction of herbicide orange compounds and PCDDs/PCDFs. Treatability study capabilities inlcude: evaluation of UV photolysis processes, conditions and effectiveness, and in-hous analysis of treated and untreated waste as well as special analytical capabilities to analyze byproducts.

System Capacity:	Excess Capacity:
Variable depending on waste and system used.	Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
UV Photolysis/Chemical Oxidation	**Organic Destruction**	

Company Name and Address:	Contact:
IT Corporation Technology Applications Laboratory 312 Directors Drive Knoxville, TN 37923	Mr. Ed Alperin Phone: (423) 690-3211 Fax: (423) 694-9573

Age of Company:	Number of Employees:	Annual Revenue:
42 years	2,500	$ 420 Million (FY-95)

Facility Name and Address:	Age of Facility: 20 years
Technology Development Laboratory 304 Directors Dr. Knoxville, TN 37923	RCRA Treatment Permit Date: Exp: Rad Mat #: TN R-01060-J95

Technology Description:

Hypochlorite or other oxidizing solution reagents provide for oxidation to degrade or destroy toxic constituents in aqueous waste. This technology has proven to be an effective and cost effective treatment for the destruction of cyanide in wastewaters. This process is usually conducted at or near ambient pressure and temperature, and at a pH of 7.5 to 12. The products of oxidation are dependent on the starting materials, but are generally nonhazardous gases such as carbon dioxide and oxygen, chloride salts, and in some cases nonhazardous oxygenated organic intermediates. Treatability study capabilities include: evaluation of processes, conditions and effectiveness, and in-house analysis of treated and untreated waste as well as special analytical capabilities to analyze for byproducts.

System Capacity:	Excess Capacity:
Bench-scale: 20 liter/batch Pilot-scale: 20 gal/batch	Variable depending on workload to 100%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Vitrification

Technology Category:
Vitrification

Company Name and Address:

IT Corporation
Technology Applications Laboratory
312 Directors Drive
Knoxville, TN 37923

Contact:
Mr. Ed Alperin
Phone:
(423) 690-3211
Fax:
(423) 694-9573

Age of Company: 42 years

Number of Employees: 2,500

Annual Revenue: $ 420 Million (FY-95)

Facility Name and Address:

Technology Development Laboratory
304 Directors Dr.
Knoxville, TN 37923

Age of Facility: 20 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: TN R-01060-J95

Technology Description:

Vitrification technology has been developed for the purpose of stabilizing radioactive and mixed waste for storage or disposal. During vitrification, waste material is enclosed in a low permeability glass matrix, reducing the ability of the waste to leach into the environment. Applicable waste forms include dry active wastes, ion exchange media, chemical cleaning and decontamination solutions, organic and inorganic sludges and slurries, and mixed wastes. Treatability study capabilities include: determining what and how much glass forming agents and fluxes should be added, optimum time and temperature profiles, and in-house analytical capabilities for untreated and treated wastes.

System Capacity: Bench-scale: 10 waste streams at any one time

Excess Capacity: Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☑ Reactive metals
- ☐ Elemental mercury
- ☑ Elemental lead
- ☑ Lead batteries
- ☑ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Wet Air Oxidation	Wet Oxidation	

Company Name and Address:	Contact:
IT Corporation Technology Applications Laboratory 312 Directors Drive Knoxville, TN 37923	Mr. Ed Alperin Phone: (423) 690-3211 Fax: (423) 694-9573

Age of Company:	Number of Employees:	Annual Revenue:
42 years	2,500	$ 420 Million (FY-95)

Facility Name and Address:	Age of Facility: 20 years
Technology Development Laboratory 304 Directors Dr. Knoxville, TN 37923	RCRA Treatment Permit Date: Exp: Rad Mat #: TN R-01060-J95

Technology Description:

Wet air oxidation and catalyzed wet air oxidation processes use oxygen and water at elevated temperature and pressures to provide the energy needed to cause oxidation of organics. Temperatures of 175 to 320 degrees C and pressures of 300 to 3000 psig are used. Catalyzed wet air oxidation uses the addition of low concentrations of bromide and nitrate salts to cause oxidation at low tempertures, 150 degrees C and pressures, 500 to 1000 psig. Reaction products are usually nonhazardous oxygenated organics such as carboxylic acids. Treatability study capabilities include: evaluation of process conditions and effectiveness, in-house analysis of untreated and treated waste and special analytical capabilities for product and byproduct determination.

System Capacity:	Excess Capacity:
Bench-scale: 2 L batch/continuous Pilot-scale: 10 gal batch/continuous	Variable depending on workload

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Quantum - Catalytic Extraction Processing	Recovery of Metals	

Company Name and Address:	Contact:
M4 Environmental Management Inc. 1000 Clearview Court Oak Ridge, TN 37830	Mr. Robert Sameski Phone: (423) 220-5017 Fax: (423) 220-5047

Age of Company:	Number of Employees:	Annual Revenue:
21 months	350	N/A

Facility Name and Address:	Age of Facility: 9 months
M4 Technolgy Center 1000 Clearview Court Oak Ridge, TN 37830	RCRA Treatment Permit Date: Exp: Rad Mat #: Yes

Technology Description:

Catalytic Extraction Processing (CEP) uses the catalytic and solvent properties of molten metal to break down wastes to their elements. Wastes are introduced into a bath of molten metal, which dissolves molecular bonds and leaves disassociated elements. By adding chemical reactants such as lime, these elements are reconfigured into commodity gases, ceramics, and metals - safe, useful raw materials that are sold to estabilished markets. Because CEP completely destroys hazardous and toxic compounds it exceeds regulatory standards for emissions and residuals. A related technology, Quantum-CEP (registered trademark), handles radioactive waste, separating out radionuclides and encasing them in a stable material for disposal. The process typically reduces the volume of complex radioactive materials by more the 30:1 and simple radioactive materials by as much as 1000:1.

System Capacity:	Excess Capacity:
1,000 to 3,000 ton per year depending on waste stream.	Not provided

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☑ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Acid Extraction of Soil/Sediment	Soil Washing	

Company Name and Address:	Contact:
Maxim Technologies, Inc. 1980 Innerbelt Business Center Drive St. Louis, MO 63114	Mr. Robert Bessent Phone: (314) 426-0880 Fax: (314) 426-4212

Age of Company:	Number of Employees:	Annual Revenue:
16 years	1,262	$100 million

Facility Name and Address:	Age of Facility: 8 years
Maxim Technologies, Inc. 1908 Innerbelt Business Center Drive St. Louis, MO 63114	RCRA Treatment Permit Date: Exp: Rad Mat #: NRC 24-17152-02

Technology Description:

Metal impacted soil or sediment is mixed with a water/acid solution under controlled reactor conditions. Depending on conditions, the water/acid solution can either be hot or cold. The constant mixing of the soil or sediment particles under acidic conditions leads to a transfer of many metal species (contamination) from the solid phase to the liquid phase. Treated soil or sediment is subsequently dewatered while the acid requires subsequent treatment steps. Typically, soil goes through a physical separation unit operation to reduce the volume of waste to require treatment. Maxim uses its in-house analytical chemistry laboratory to assess the performance of this technology.

System Capacity:	Excess Capacity:
Bench scale quantities of waste treated	100% Maxim will construct or fabricate reactor vessels as required by client

Technology Maturity:

- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
H2O2/Ozone Treatment of Liquid Waste	Organic Destruction	

Company Name and Address:	Contact:
Maxim Technologies, Inc. 1980 Innerbelt Business Center Drive St. Louis, MO 63114	Mr. Robert Bessent Phone: (314) 426-0880 Fax: (314) 426-4212

Age of Company:	Number of Employees:	Annual Revenue:
16 years	1,262	$100 million

Facility Name and Address:	Age of Facility: 8 years
Maxim Technologies, Inc. 1908 Innerbelt Business Center Drive St. Louis, MO 63114	RCRA Treatment Permit Date: Exp: Rad Mat #: NRC 24-17152-02

Technology Description:

H2O2, ozone, or a combination of both are added to a liquid waste under controlled contractor conditions (reactor time, temperature, pressure, etc.) H2O2 or ozone contact with the liquid waste contributes to oxidation of many organic compounds thus reducing associated wasteloads. Maxim uses its in-house analytical chemistry laboratory to assess the performance of this technology.

System Capacity:	Excess Capacity:
Bench scale quantities of waste treated	100% Maxim will construct or fabricate reactors as required by client

Technology Maturity:

- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☐ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: **Modified Activated Sludge**	**Technology Category:** **Biodegradation**	
Company Name and Address: Maxim Technologies, Inc. 1980 Innerbelt Business Center Drive St. Louis, MO 63114		**Contact:** Mr. Robert Bessent **Phone:** (314) 426-0880 **Fax:** (314) 426-4212
Age of Company: 16 years	**Number of Employees:** 1,262	**Annual Revenue:** $100 million
Facility Name and Address: Maxim Technologies, Inc. 1908 Innerbelt Business Center Drive St. Louis, MO 63114		**Age of Facility:** 8 years **RCRA Treatment Permit** **Date:** **Exp:** **Rad Mat #:** NRC 24-17152-02

Technology Description:

Impacted wastewater or groundwater is mixed, under aerobic conditions, with an acclimated population of microorganisms in a controlled reactor environment. The microorganisms within the reactor then use the organic contaminants in the liquid waste as substrate (carbon source). Maxim uses its in-house analytical chemistry laboratory to assess the performance of this technolgy.

System Capacity: Bench scale quantites of waste treated	**Excess Capacity:** 100% Maxim will construct or fabricate bioreactors as required by client

Technology Maturity:

- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Organic Phase Transfer	Steam Stripping	

Company Name and Address:	Contact:
Maxim Technologies, Inc. 1980 Innerbelt Business Center Drive St. Louis, MO 63114	Mr. Robert Bessent Phone: (314) 426-0880 Fax: (314) 426-4212

Age of Company:	Number of Employees:	Annual Revenue:
16 years	1,262	$100 million

Facility Name and Address:	Age of Facility: 8 years
Maxim Technologies, Inc. 1908 Innerbelt Business Center Drive St. Louis, MO 63114	RCRA Treatment Permit Date: Exp: Rad Mat #: NRC 24-17152-02

Technology Description:

Hot air (steam) is bubbled through a liquid waste stream in a counter current manner through a tower apparatus. Organics within the liquid waste stream are transferred from the liquid phase to the gas phase based on Henry's Law Theory. Effluent from the stripping tower thus has a reduced organic wasteload after being exposed to the steam/hot air. Maxim uses its in-house analytical chemistry laboratory to assess the performance of this technology.

System Capacity:	Excess Capacity:
Bench scale quantities of waste treated	100% Maxim will construct or fabricate stripping equipment, as required

Technology Maturity:

- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☐ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Terrachem IRV-100	Thermal Desorption	

Company Name and Address:	Contact:
McLaren-Hart Inc. 9323 Stockport Place Charlotte, NC 28273	Mr. Jeff Oham Phone: (704) 587-0003 Fax: (704) 587-0693

Age of Company:	Number of Employees:	Annual Revenue:
20 years	562	$ 97 million

Facility Name and Address:	Age of Facility: N/A
Mobile Treatment Facility	RCRA Treatment Permit Date: Exp:
	Rad Mat #: None

Technology Description:

Patented IRV-100 low-vacuum low-temperature thermal desorption system. The system consists of a unique configuration using a combination of high efficiency air (HEAF) filters, high efficiency particulate air (HEPA) filters, tube and fin condensers, and granulated activated carbon (GAC) filters for emmission control of targeted VOCs and radionuclides. Unit heats the waste matrix with infrared heat using convection and conduction. Contaminates are then stripped with 3000 CFM vacuum pumps. Cooling air then condenses contaminants.

System Capacity:	Excess Capacity:
Modular system. We have 26 units each capable of treating 7 tons per batch	Available immediately

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Plasma Centrifugal Furnace	Vitrification	

Company Name and Address:

MSE Technology Applications, Inc.

P.O. Box 4078

Butte, MT 59702

Contact:

Mr. Jeff Ruffner

Phone:

(406) 494-7412

Fax:

(406) 494-7230

Age of Company:	Number of Employees:	Annual Revenue:
20 years	400	$28 million

Facility Name and Address:

Western Environmental Technology Office

Industrial Park

Butte, MT 59701

Age of Facility: 15 years

RCRA Treatment Permit

Date: **Exp:**

Rad Mat #: None

Technology Description:

The Plasma Arc Centrifugal Treatment System is a transferred and non-tansferred electric arc process designed to destroy organic material through high temperature oxidation and to immobilize inorganic material into a low-leachable glass ceramic matrix. The process uses a rotating reactor well (tub) inside a primary chamber. Feedstock containing hazardous materials is fed into the reactor well and heated by a continuous electric arc in an oxygen-rich atmosphere. Air is used as the torch gas, and additional oxygen is introduced into the primary chamber to ensure organics are fully oxidized. Inorganic wastes become molten and are fully oxidized in the primary chamber; a secondary combustion chamber uses a natural gas-fired afterburner to ensure complete combustion before the gas exits the furnace and is drawn through the off-gas system. The off-gas system removes acid gases, moisture, and particulates. A selective catalyst reduction system for oxides of nitrogen is used.

System Capacity:	Excess Capacity:
300 - 500 lbs/hr	50%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☐ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Chemical Stabilization

Technology Category:
Stabilization

Company Name and Address:
Nuclear Fuel Services, Inc.
1205 Banner Hill Road
P. O. Box 337
Erwin, TN 37650

Contact:
Mr. R. David Wise
Phone:
(423) 743-1795
Fax:
(423) 743-0140

Age of Company: No information

Number of Employees: No information

Annual Revenue: No information

Facility Name and Address:
Advanced Recovery Systems
1219 Banner Hill Road
Erwin, TN 37650

Age of Facility: No information

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: R-86008-D97

Technology Description:

System Capacity: No information

Excess Capacity: No information

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☐ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Retorting for Mercury	Retorting for Mercury	

Company Name and Address:	Contact:
Nuclear Fuel Services, Inc. 1205 Banner Hill Road P. O. Box 337 Erwin, TN 37650	Mr. R. David Wise Phone: (423) 743-1795 Fax: (423) 743-0140

Age of Company:	Number of Employees:	Annual Revenue:
No information	No information	No information

Facility Name and Address:	Age of Facility: No information
Advanced Recovery Systems 1219 Banner Hill Road Erwin, TN 37650	RCRA Treatment Permit Date: Exp: Rad Mat #: R-86008-D97

Technology Description:

System Capacity: No information	Excess Capacity: No information

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☐ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Soil Washing	Soil Washing	

Company Name and Address:

Nuclear Fuel Services, Inc.
1205 Banner Hill Road
P. O. Box 337
Erwin, TN 37650

Contact:
Mr. R. David Wise
Phone:
(423) 743-1795
Fax:
(423) 743-0140

Age of Company:	Number of Employees:	Annual Revenue:
No information	No information	No information

Facility Name and Address:

Advanced Recovery Systems
1219 Banner Hill Road
Erwin, TN 37650

Age of Facility: No information

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: R-86008-D97

Technology Description:

System Capacity: No information

Excess Capacity: No information

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☐ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Bulking, Profiling for Disposal or Incineration

Technology Category:
Waste Separation

Company Name and Address:
Perma-Fix Environmental Services
1940 N. W. 67th Place
Gainesville, FL 32653

Contact:
Mr. Bernhardt (Ben) Warren
Phone:
(352) 395-1352
Fax:
(352) 372-8963

Age of Company: 4 years

Number of Employees: 45

Annual Revenue: $50 million

Facility Name and Address:
Perma-Fix of Florida, Inc.
1940 N. W. 67th Place
Gainesville, FL 32653

Age of Facility: 13 years

RCRA Treatment Permit
Date: 01/01/88 **Exp:** 09/01/95

Rad Mat #: FL 2598-1

Technology Description:
Receive packages containing sludges mixed with solids and liquids. Process includes separation of liquids and solids, shipping solids to an authorized landfill for US DOE (NTS, Envirocare), liquids to DSSI for treatment (thermal) if hazardous, if not stabilization for burial.

RCRA Treatment Permit is under timely renewal.

System Capacity: 5 drums/hour, 2,000 drums/year

Excess Capacity: 75%

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Disposal of Liquid Organics

Technology Category:
Incineration

Company Name and Address:
Perma-Fix Environmental Services
1940 N. W. 67th Place
Gainesville, FL 32653

Contact:
Mr. Bernhardt (Ben) Warren
Phone:
(352) 395-1352
Fax:
(352) 372-8963

Age of Company: 4 years

Number of Employees: 45

Annual Revenue: $50 million

Facility Name and Address:
Perma-Fix of Florida, Inc.
1940 N. W. 67th Place
Gainesville, FL 32653

Age of Facility: 13 years

RCRA Treatment Permit
Date: 01/01/88 Exp: 09/01/95

Rad Mat #: FL 2598-1

Technology Description:
Broader scope of bulking radiologically contaminated organics, performing radiological analysis and transporter to authorized burner. (DSSI)

RCRA Treatment Permit is under timely renewal.

System Capacity: 5/hour 2000/year

Excess Capacity: 25%

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☑ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☑ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: LSV Processing

Technology Category: Incineration

Company Name and Address:
Perma-Fix Environmental Services
1940 N. W. 67th Place
Gainesville, FL 32653

Contact:
Mr. Bernhardt (Ben) Warren
Phone: (352) 395-1352
Fax: (352) 372-8963

Age of Company: 4 years

Number of Employees: 45

Annual Revenue: $50 million

Facility Name and Address:
Perma-Fix of Florida, Inc.
1940 N. W. 67th Place
Gainesville, FL 32653

Age of Facility: 13 years

RCRA Treatment Permit
Date: 01/01/88 Exp: 09/01/95

Rad Mat #: FL 2598-1

Technology Description:
Receipt and processing of liquid scintillation vials. Vials are shredded, rinsed according to USEPA standards; fluids and rinsate radiologically tested for acceptability; fluids bulked and transported for controlled buring. G/P shredded vials are burned for heat recovery.

RCRA Treatment Permit is under timely renewal. Previously, as Quadrex Environmental Co. Processing LSV since 1983.

System Capacity: 10 drums/hour, 20,000 drums/year

Excess Capacity: 50%

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☑ Aqueous liquids
- ☐ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☑ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Perma-Fix Process	Stabilization	

Company Name and Address:

Perma-Fix Environmental Services

1940 N. W. 67th Place

Gainesville, FL 32653

Contact:

Mr. Bernhardt (Ben) Warren

Phone:

(352) 395-1352

Fax:

(352) 372-8963

Age of Company:	Number of Employees:	Annual Revenue:
4 years	45	$50 million

Facility Name and Address:

Perma-Fix of Florida, Inc.

1940 N. W. 67th Place

Gainesville, FL 32653

Age of Facility: 13 years

RCRA Treatment Permit

Date: 01/01/88 **Exp:** 09/01/95

Rad Mat #: FL 2598-1

Technology Description:

The Perma-fix process incorporates a waste-specific formulation that takes into consideration whether the waste must be chemically pre-treated with oxidizing or reducing agents or chemical polymers and the most appropriate treatment method. Perma-Fix has both in-drum and bulk mixers that have the capability of simply and throughly mixing specific proportions of appropriate reagents. These reagents treat and solidify various kinds of waste; such as, RCRA Characteristic, Mixed RCRA-Low Level Radioactive, Low-Level Radioactive Wastes, and special Industrial wastes.

RCRA Treatment Permit is under timely renewal.

System Capacity:	Excess Capacity:
5 drums/hours 10,000 drums/year	75%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☑ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Research and Development	Stabilization	

Company Name and Address:

Perma-Fix Environmental Services

1940 N. W. 67th Place

Gainesville, FL 32653

Contact:

Mr. Bernhardt (Ben) Warren

Phone:

(352) 395-1352

Fax:

(352) 372-8963

Age of Company:	Number of Employees:	Annual Revenue:
4 years	45	$50 million

Facility Name and Address:

Perma-Fix of Florida, Inc.

1940 N. W. 67th Place

Gainesville, FL 32653

Age of Facility: 13 years

RCRA Treatment Permit

Date: 01/01/88 **Exp:** 09/01/95

Rad Mat #: FL 2598-1

Technology Description:

R&D License previously authorized by Quadrex and currently applied for by Perma-Fix is performing R&D on various mixed waste. R&D includes stabilization, fixation, chelating, solidification, etc.

RCRA Treatment Permit is under timely renewal.

System Capacity: Limited

Excess Capacity: 10%

Technology Maturity:

- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date: 07/01/96

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☑ Lab packs
- ☑ Reactive metals
- ☑ Elemental mercury
- ☑ Elemental lead
- ☑ Lead batteries
- ☑ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Research and Development	Chemical Oxidation	

Company Name and Address:	Contact:
Radian Corporation P.O. Box 201088 Austin, TX 78720	Mr. Rick Strickert Phone: (512) 244-0855 Fax: (512) 244-0160

Age of Company:	Number of Employees:	Annual Revenue:
26 years	2,000	$ 210 million

Facility Name and Address:	Age of Facility: 16 years
Radian Corporation 8301 MoPac Boulevard Austin, TX 78759	RCRA Treatment Permit Date: Exp: Rad Mat #: LO1692

Technology Description:

Licensed laboratory for conducting R&D treatability studies including biodegradation, chemical oxidation and stabilization, and radioanalyses on radioactive materials and mixed wastes. Counting equipment available for measuring and quantifying alpha, beta, and gamma activity.

System Capacity:	Excess Capacity:
Research and Development	To be determined

Technology Maturity:

- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Research and Development

Technology Category:
Stabilization

Company Name and Address:
Radian Corporation
P.O. Box 201088
Austin, TX 78720

Contact:
Mr. Rick Strickert
Phone:
(512) 244-0855
Fax:
(512) 244-0160

Age of Company: 26 years

Number of Employees: 2,000

Annual Revenue: $ 210 million

Facility Name and Address:
Radian Corporation
8301 MoPac Boulevard
Austin, TX 78759

Age of Facility: 16 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: LO1692

Technology Description:
Licensed laboratory for conducting R&D treatability studies including biodegradation, chemical oxidation and stabilization, and radioanalyses on radioactive materials and mixed wastes. Counting equipment available for measuring and quantifying alpha, beta, and gamma activity.

System Capacity: Research and Development

Excess Capacity: To be determined

Technology Maturity:
- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Research and Development	Biodegradation	

Company Name and Address:

Radian Corporation

P.O. Box 201088

Austin, TX 78720

Contact:

Mr. Rick Strickert

Phone:

(512) 244-0855

Fax:

(512) 244-0160

Age of Company:	Number of Employees:	Annual Revenue:
26 years	2,000	$ 210 million

Facility Name and Address:

Radian Corporation

8301 MoPac Boulevard

Austin, TX 78759

Age of Facility: 16 years

RCRA Treatment Permit

Date: **Exp:**

Rad Mat #: LO1692

Technology Description:

Licensed laboratory for conducting R&D treatability studies including biodegradation, chemical oxidation and stabilization, and radioanalyses on radioactive materials and mixed wastes. Counting equipment available for measuring and quantifying alpha, beta, and gamma activity.

System Capacity: Research and Development

Excess Capacity: To be determined

Technology Maturity:

- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Plasma Hearth Process

Technology Category: Vitrification

Company Name and Address:

Science Applications International Corporation

545 Shoup Avenue

Idaho Falls, ID 83402

Contact: Mr. Gary Leatherman

Phone: (208) 528-2179

Fax: (208) 528-2194

Age of Company: 26 years

Number of Employees: 20,000

Annual Revenue: N/A

Facility Name and Address:

Science and Technology Applications Research Ctr

3671 Romrell Avenue

Idaho Falls, ID 83401

Age of Facility: 1.5 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: None

Technology Description:

The Plasma Hearth Process is a 200 kW plasma furnace system, complete with an air pollution control system (APCS). This system is a vitrification process which produces a very stable, glass-like, waste form that is leach resistant. The APCS consists of a partial quench, full quench, acid gas, and particulate scrubber, demister, reheater, and High Efficiency Particulate Air (HEPA) filter. In addition to the conventional APSC, a "closed loop" system is available.

System Capacity: 30 lbs/hr, 10,000 lbs/year

Excess Capacity: 40%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date: 01/01/98

Media Treated:

- ☐ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☑ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☐ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Cement Stabilization	Stabilization	

Company Name and Address:	Contact:
Scientific Ecology Group, Inc. P.O. Box 2530 1560 Bear Creek Road Oak Ridge, TN 37830	Mr. Marty Brownstein Phone: (423) 376-8321 Fax:

Age of Company:	Number of Employees:	Annual Revenue:
10 years	1300	$150 M

Facility Name and Address:	Age of Facility:
Scientific Ecology Group, Inc. 1560 Bear Creek Rd. Oak Ridge, TN 37830	RCRA Treatment Permit Date: Exp: Rad Mat #: R-73016-F96

Technology Description:

Cement solidification is a key tool for remediating hazardous wastes. The technique consists of entrapping the wastes within a solid matrix having high structural integrity, which minimizes the risk of escape by leaching. The cement stabilization process involves several steps. First the waste is pretreated to remove the non-contaminated debris. Second the volume is reduced to 40 - 50% solids. The solids are batched and pH adjusted, then fed into the processor for mixing with cement binder.

System Capacity:	Excess Capacity:
500 lbs/hr 110,000 lbs/annually	80%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Joule-Heated Melter

Technology Category: Vitrification

Company Name and Address:
Scientific Ecology Group, Inc.
P.O. Box 2530
1560 Bear Creek Road
Oak Ridge, TN 37830

Contact: Dr. Tom Snyder
Phone: (423) 376-8321
Fax:

Age of Company: 10 years

Number of Employees: 1300

Annual Revenue: $150 M

Facility Name and Address:
Scientific Ecology Group, Inc.
1560 Bear Creek Rd.
Oak Ridge, TN 37830

Age of Facility:

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: R-73016-F96

Technology Description:
Our joule-heated melter is a state-of-the-art, Envitco-manufactured melter capable of processing non-reactive waste without a pretreatment, or reactive waste with pretreatment, at temperatures up to 1200 degrees C. Sludges, solids and ash and residue from our thermal processes are the primary waste feed for this unit. In this melter, wet wastes can be dried and vitrified in one step, which allows minimal dewatering pretreatment and reduces the overall processing costs.

System Capacity: 160 lbs/hr, 266,240 lbs/annually

Excess Capacity: 50%

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☐ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☑ High level waste

Select all that apply

Residuals:
- ☐ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: **Magnesium Oxide Cement Stabilization**	**Technology Category:** **Stabilization**	
Company Name and Address: Scientific Ecology Group, Inc. P.O. Box 2530 1560 Bear Creek Road Oak Ridge, TN 37830		**Contact:** Mr. Marty Brownstein **Phone:** (423) 376-8321 **Fax:**
Age of Company: 10 years	**Number of Employees:** 1300	**Annual Revenue:** $150 M
Facility Name and Address: Scientific Ecology Group, Inc. 1560 Bear Creek Rd. Oak Ridge, TN 37830		**Age of Facility:** **RCRA Treatment Permit** **Date:** **Exp:** **Rad Mat #:** R-73016-F96

Technology Description:

SEG currently uses magnesium oxide (Oxymag) as the media of choice to solidify mixed wastes generated during SEG porcess operations. Oxymag effectively stabilizes waste types like incinerator ash, mixed waste fly ash, baghouse dust, and furnace waste that have heretofore defied solidification and stabilization in concrete in any significant quanitity. Oxymag cement is blended with a mixture of waste, potable or contaminated water, and magnesium sulfate in a rotary mixer at ambient temperature and pressure. The resultant concrete produced is pH adjusted to 9.75 by the magnesium oxide. The result is a cement that provides the desired stabilization of the waste form and provides a pH level that optimizes the insoulubility of any heavy metals bound in the matrix. The stable pH of the Oxymag cement allows waste loadings of 50 - 60 wt% waste, thus minimizing the disposal volume of the stabilized waste form.

System Capacity: 500 lbs/hr 110,000 lbs/annually	**Excess Capacity:** 80%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Plasma-Driven Reactor	Vitrification	

Company Name and Address:

Scientific Ecology Group, Inc.
P.O. Box 2530
1560 Bear Creek Road
Oak Ridge, TN 37830

Contact:
Dr. Tom Snyder
Phone:
(423) 376-8321
Fax:

Age of Company:	Number of Employees:	Annual Revenue:
10 years	1300	$150 M

Facility Name and Address:

Scientific Ecology Group, Inc.
1560 Bear Creek Rd.
Oak Ridge, TN 37830

Age of Facility:

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: R-73016-F96

Technology Description:

SEG has adapted a commercially available plasma-driven reactor to process LLRW. The Plasma Torch Waste Processing Facility processes drummed, high organic wastes, slag, refractories, EAF dust, soils, burial wastes, reprocessing wastes, salts, metals, and even chemical/biological warfare wastes, using localized temperatures of up to 5,000 degrees C. At this temperature, the hazardous chemistry is decoupled from the waste. Reaction and stabilization occur in a single step. The process uses plasma, a high temperature, ionized, conductive gas created within the plasma torch by the interaction of a gas with an electrical arc. This interaction disassociates the gas into electrons and ions which enables the gas to become both thermally and electrically conductive. Plasma systems offer a means of achieving the high temperatures required for the safe destruction of many toxic and hazardous wastes, including PCBs, dioxin, DDT, furans, halogenated hydrocarbons, and RCRA wastes which, untreated, pose serious problems to the environment and to the public.

System Capacity: 160 lbs/hr, 266,240 lbs/annually

Excess Capacity: 80%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☑ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☑ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Polyethylene Stabilization	Stabilization	

Company Name and Address:	Contact:
Scientific Ecology Group, Inc. P.O. Box 2530 1560 Bear Creek Road Oak Ridge, TN 37830	Mr. Marty Brownstein Phone: (423) 376-8321 Fax:

Age of Company:	Number of Employees:	Annual Revenue:
10 years	1300	$150 M

Facility Name and Address:	Age of Facility:
Scientific Ecology Group, Inc. 1560 Bear Creek Rd. Oak Ridge, TN 37830	RCRA Treatment Permit Date: Exp: Rad Mat #: R-73016-F96

Technology Description:

SEG has tested a polyethylene process developed by Brookhaven National Laboratory (BNL). Improvements in waste loading and waste form performance have been demonstrated through bench-scale development and testing. Maximum waste loadings of up to 70 dry wt% mixed waste nitrate salt were achieved. Polyethylene (thermoplastic polymer) required a volume reduction step that removes virtually all moisture content. The aqueous product is then co-fed to an extruder where the mixture is taken through a series of pressure and temperature excursions.

System Capacity:	Excess Capacity:
500 lbs/hr 110,000 lbs/annually	80%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☐ DOE/Gov experience

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☑ Lab packs
- ☑ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Steam Reforming	Organic Destruction	

Company Name and Address:	Contact:
Scientific Ecology Group, Inc. P.O. Box 2530 1560 Bear Creek Road Oak Ridge, TN 37830	Dr. Tom Snyder Phone: (423) 376-8321 Fax:

Age of Company:	Number of Employees:	Annual Revenue:
10 years	1300	$150 M

Facility Name and Address:	Age of Facility:
Scientific Ecology Group, Inc. 1560 Bear Creek Rd. Oak Ridge, TN 37830	RCRA Treatment Permit Date: Exp: Rad Mat #: R-73016-F96

Technology Description:

The SEG Steam Reformer (SSR) is a thermal treatment process which uses steam reforming chemistry to convert organic compounds to CO, H2, CO2, H2O, and some CH4. It is most applicable to wastes high in organics and wastes containing TSCA-regulated constituents (PCBs) and can be used as a pretreatment to vitrification and stabilization technologies or as a stand-alone treatment method.

System Capacity:	500 grams/hr	Excess Capacity:	60%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☑ Lab packs
- ☑ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☑ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Thermoplastic Epoxy Stabilization

Technology Category:
Stabilization

Company Name and Address:
Scientific Ecology Group, Inc.
P.O. Box 2530
1560 Bear Creek Road
Oak Ridge, TN 37830

Contact:
Mr. Marty Brownstein
Phone:
(423) 376-8321
Fax:

Age of Company: 10 years

Number of Employees: 1300

Annual Revenue: $150 M

Facility Name and Address:
Scientific Ecology Group, Inc.
1560 Bear Creek Rd.
Oak Ridge, TN 37830

Age of Facility:

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: R-73016-F96

Technology Description:

Epoxy stabilization provides a sound waste form for materials containing heavy metal constituents and selected radionuclides. Use of an epoxy binder has proven to be a cost effective process method when dealing with relatively high disposal costs where a higher volumetric efficiency is a very important factor. The method employs a proven and available technology and is operated and maintained with little down time. Thermoplastic epoxy requires a volume reduction step that completely removes moisture while simultaneously adding a binder that forms a pelletized macroencapsulated waste form.

System Capacity: 500 lbs/hr
110,000 lbs/annually

Excess Capacity: 80%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Thermoset Epoxy Stabilization

Technology Category:
Stabilization

Company Name and Address:
Scientific Ecology Group, Inc.
P.O. Box 2530
1560 Bear Creek Road
Oak Ridge, TN 37830

Contact:
Mr. Marty Brownstein
Phone:
(423) 376-8321
Fax:

Age of Company: 10 years

Number of Employees: 1300

Annual Revenue: $150 M

Facility Name and Address:
Scientific Ecology Group, Inc.
1560 Bear Creek Rd.
Oak Ridge, TN 37830

Age of Facility:

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: R-73016-F96

Technology Description:

Epoxy stabilization provides a sound waste form for materials containing heavy metal constituents and selected radionuclides. Use of an epoxy binder has proved to be a cost effective process method when dealing with relatively high disposal costs where a higher volumetric efficiency is a very important factor. The method employs a proven and available technology and is operated and maintained with little down time. Thermoset Epoxy stabilization requires a volume reduction step that produces a dry material prior to stabilization.

System Capacity: 500 lbs/hr
110,000 lbs/annually

Excess Capacity: 80%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Vinyl Ester Stabilization	Stabilization	

Company Name and Address:	Contact:
Scientific Ecology Group, Inc. P.O. Box 2530 1560 Bear Creek Road Oak Ridge, TN 37830	Mr. Marty Brownstein Phone: (423) 376-8321 Fax:

Age of Company:	Number of Employees:	Annual Revenue:
10 years	1300	$150 M

Facility Name and Address:	Age of Facility:
Scientific Ecology Group, Inc. 1560 Bear Creek Rd. Oak Ridge, TN 37830	RCRA Treatment Permit Date: Exp: Rad Mat #: R-73016-F96

Technology Description:

This stabilization process uses readily available chemicals that are easily handled in a safe manner. This system is a Dow system based on a Dow proprietary process to form stable water-in-resin emulsions which are chemically cured to form hard, solid monoliths. Liquid or slurry waste is stirred with a low viscosity liquid solution of vinyl ester in styrene monomer until a stable water-in-oil emulsion is formed. The mixture is cured by the addition of a free radical yielding peroxide catalyst and a tertiary amine promoter. The final result is a dispersion of small spherical liquid particles (fine droplets) in a continuous matrix of cured resin. The solidification process is relatively simple and works equally well for aqueous wastes in the pH range from 2.5 to 11.0 and wastes containing dispersed solids such as ion exchange resins or filter aid materials.

System Capacity:	Excess Capacity:
500 lbs/hr 110,000 lbs/annually	80%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: ACT*DE*CON

Technology Category: Soil Washing

Company Name and Address:

Selentec
8601 Dunwoody Place
Suite 302
Atlanta, GA 30350

Contact:
Mr. Michael Dunn
Phone:
(770) 640-7059
Fax:
(770) 640-9305

Age of Company: 5 years

Number of Employees: 11

Annual Revenue: $3 Million

Facility Name and Address:

Selective Environmental Technologies, Inc.
8601 Dunwoody Place, Suite 302
Altanta, GA 30350

Age of Facility: Planned for 1996

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: None

Technology Description:

ACT*DE*CON (registered service mark) is a non-hazardous chemical leaching technology to dissolve and recover radionuclides and some heavy metals from soil. The treated soil can be returned to the site with only contaminants and ACT*DE*CON chemicals for disposal.

System Capacity: Up to 100,000 cubic yards/year

Excess Capacity: Performed on-site with dedicated equipment

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Electrochemical Ion Exchange (EIX)

Technology Category:
Extraction

Company Name and Address:
Selentec
8601 Dunwoody Place
Suite 302
Atlanta, GA 30350

Contact:
Mr. Michael Dunn
Phone:
(770) 640-7059
Fax:
(770) 640-9305

Age of Company: 5 years

Number of Employees: 11

Annual Revenue: $3 Million

Facility Name and Address:
Selective Environmental Technologies, Inc.
8601 Dunwoody Place, Suite 302
Altanta, GA 30350

Age of Facility: Planned for 1996

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: None

Technology Description:
Electochemical Ion Exchange (EIX) selectively recovers and destroys nitrates from aqueous solutions. There is no waste product.

System Capacity: 18,000 GPH per unit
> 100 MGPY

Excess Capacity: Performed on-site with dedicated equipment

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☑ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: MAG*SEP

Technology Category: Recovery of Metals

Company Name and Address:
Selentec
8601 Dunwoody Place
Suite 302
Atlanta, GA 30350

Contact:
Mr. Michael Dunn
Phone:
(770) 640-7059
Fax:
(770) 640-9305

Age of Company: 5 years

Number of Employees: 11

Annual Revenue: $3 Million

Facility Name and Address:
Selective Environmental Technologies, Inc.
8601 Dunwoody Place, Suite 302
Altanta, GA 30350

Age of Facility: Planned for 1996

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: None

Technology Description:
MAG*SEP (registered trade mark) selectively recovers heavy metals and radionuclides from aqueous solutions. The contaminants are recovered on small particles (50 to 100 u). The particles can be chemically regenerated and reused.

System Capacity: Up to 120,000 GPH per vessel. Annual capacity >800 MGPY per vessel.

Excess Capacity: Performed on-site with dedicated equipment

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:
- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
Terra-Kleen Solvent Extraction System

Technology Category:
Soil Washing

Company Name and Address:
Terra-Kleen Response Group, Inc.
3970 Sorrento Valley Blvd
Suite B
San Diego, CA 92121

Contact:
Mr. Alan Cash
Phone:
(619) 558-8762
Fax:
(619) 558-8759

Age of Company: 3 years

Number of Employees: 12

Annual Revenue: $ 2 million

Facility Name and Address:
Mobile Treatment Facility

Age of Facility: N/A

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: None

Technology Description:
The Terra-Kleen Solvent Extraction System is a full-scale commercially permitted mobile facility to remove PCBs from low-level radioactive solids.

System Capacity: Varies, each mobile unit has a 12,000 ton annual capacity

Excess Capacity: varies

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☑ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Segmented Gate System	**Physical Separation**	

Company Name and Address:	Contact:
Thermo NUtech 601 Scarboro Road Oak Ridge, TN 37830	Mr. Jeff Brown Phone: (423) 481-0683 Fax: (423) 483-4621

Age of Company:	Number of Employees:	Annual Revenue:
25 years	Not provided	Not provided

Facility Name and Address:	Age of Facility: 1 year
Thermo NUCLEAN Mobile Facility at 601 Scarbor Road Oak Ridge, TN 37830	RCRA Treatment Permit Date: Exp: Rad Mat #: None

Technology Description:

The segmented gate system separates radiologically contaminated soil from non contaminated soil through detection via one of 30 detectors monitoring a conveyer belt. Then it utilizes the segmented gates to selectively extract the radioactive soil segment as it falls of the belt.

System Capacity:	Excess Capacity:
150 cubic yd/day	We can add systems as the demand requires

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
TVIES	Soil Washing	

Company Name and Address:

TVIES
440 Benmar
Suite 2250
Houston, TX 77051

Contact:
Dr. Myron Kuhlman
Phone:
(713) 447-5544
Fax:
(713) 447-6669

Age of Company:	Number of Employees:	Annual Revenue:
3 years	10	$2.5 million

Facility Name and Address:

Mobile Treatment Facility

Age of Facility: N/A

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: None

Technology Description:

Counter current soil washing is used to remove hydrocarbons, metals and radionuclides. Combinations of water temperature, pH adjustment, surfactants, and specialized chemicals are used to extract a wide range of contaminants from soil and debris. Wash water is processed to remove contaminants and reused. The equipment is standard mining and materials processing equipment and is readily transported.

System Capacity: 30 thp 150,000 tons

Excess Capacity: 66% availability over year

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☑ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Enviroglass	Vitrification	

Company Name and Address:

Vectra
One Harbison Way
Suite 209
Columbia, SC 29212-3408

Contact:
Mr. Paul Denault
Phone:
(803) 781-0426
Fax:
(803) 781-9316

Age of Company:	Number of Employees:	Annual Revenue:
16	650	$130 Million

Facility Name and Address:

Mobile Treatment Facility

Age of Facility: N/A

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: None

Technology Description:
Full scale vitrification system with liquid and solid feed capabilities and full off-gas treatment.

System Capacity:	Excess Capacity:
200 to 250 lbs per hr	100%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☑ Non-metal debris
- ☑ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
High Shear Waste Immobilization	Stabilization	

Company Name and Address:	Contact:
Westinghouse Science and Technology Center 1310 Beulah Road Pittsbugh, PA 15235	Dr. Nancy Ulerich Phone: (412) 256-2198 Fax: (412) 256-1222

Age of Company:	Number of Employees:	Annual Revenue:
50 + years	800	$ 8 billion

Facility Name and Address:	Age of Facility: 6 years
Westinghouse STC Environmental Lab 1310 Beulah Road Pittsburgh, PA 15235	RCRA Treatment Permit Date: Exp: Rad Mat #: SNM-47 and PA-0198

Technology Description:

The Westinghouse STC high shear cement encapsulation/stabilization process effectively immobilizes a wide range of waste streams. The high shearing action, with the use of contaminant specific additivies, allows contaminants to be immobilized while achieving high waste loadings. The process has been successfully implemented on extremely difficult to stabilize wastes, including: resins, oils, highly concentrated salts, and acids. Waste loadings with packaging efficiencies as high as 80% have been achieved. The process meets both NRC and TCLP waste leachability requirements, as well as the NRC compressive strength guidelines as a function of demanding environmenal conditions.

System Capacity:	Excess Capacity:
The process can be effectively scaled to any throughput	Can be made available

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Plasma	Vitrification	

Company Name and Address:

Westinghouse Science and Technology Center

1310 Beulah Road

Pittsbugh, PA 15235

Contact:

Dr. Nancy Ulerich

Phone:

(412) 256-2198

Fax:

(412) 256-1222

Age of Company:	Number of Employees:	Annual Revenue:
50 + years	800	$ 8 billion

Facility Name and Address:

Westinghouse STC Environmental Lab

1310 Beulah Road

Pittsburgh, PA 15235

Age of Facility: 6 years

RCRA Treatment Permit

Date: **Exp:**

Rad Mat #: SNM-47 and PA-0198

Technology Description:

The Westinghouse Plasma Melter is the basis for a waste vitrification process used by the Westinghouse Science & Technolgy Center (STC). This system provides a high-throughput, readily scaleable technology for converting hazardous solid and liquid feeds into stable, low-leachability glass. Waste is screened to remove large particles with minimal contamination, partially dewatered to improve economics, and then vitrified with the Plasma Melter to destory the hazardous organics and convert the contaminated fines to a low-leachability glass product. The other streams leaving the system are non-hazardous discharge water, a small calcium sulfate stream from offgas sulfur removal, and a clean offgas stream.

System Capacity:	8 tons/day	Excess Capacity:	Availability can be acquired

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☑ Metal debris
- ☑ Non-metal debris
- ☑ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☑ Elemental lead
- ☑ Lead batteries
- ☑ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Soil Washing	Soil Washing	

Company Name and Address:

Westinghouse Science and Technology Center

1310 Beulah Road

Pittsbugh, PA 15235

Contact:

Dr. Nancy Ulerich

Phone:

(412) 256-2198

Fax:

(412) 256-1222

Age of Company:	Number of Employees:	Annual Revenue:
50 + years	800	$ 8 billion

Facility Name and Address:

Westinghouse STC Environmental Lab

1310 Beulah Road

Pittsburgh, PA 15235

Age of Facility: 6 years

RCRA Treatment Permit

Date: **Exp:**

Rad Mat #: SNM-47 and PA-0198

Technology Description:

Initially, the excavated soil is processed to remove large rocks and debris. The soil is then process in a rotating drum or vibrating screen device to sort and prewash the soil. The contaminated soil is then processed in mineral processing equipment where soils are contacted with the appropriate extractant, and the highly contaminated fractions are separated. The washed soils are rinsed, monitored, and returned to the site. The contaminated extractant is treated and reused. The concentrated contaminants are recycled when possible or packaged for disposal.

System Capacity:	Excess Capacity:
20 ton/hr 2 ton/hr	Avialability can be obtained

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☑ Elemental lead
- ☑ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
CHEM MATRIX	Stabilization	

Company Name and Address:	Contact:
WMX Technologies Inc. 100 Technology Drive Anderson, SC 29625	Mr. Edward Wannemacher Phone: (864) 646-2413 Fax: (864) 646-5311

Age of Company:	Number of Employees:	Annual Revenue:
25 years	74,000	$10.2 billion

Facility Name and Address:	Age of Facility: 3 years
Clemson Technical Center 100 Technology Drive Anderson, SC 29642	RCRA Treatment Permit Date: Exp: Rad Mat #: SC 482

Technology Description:

The treatment system employs conventional equipment and unit operations. The overall process consists of two basic modules. The pre-treatment module involves capability for size reduction, debris removal/destruction, and chemical pretreatment (the latter for wastes containing hazardous/radioactive constituents not immobilized by normal stabilization using hydraulic binders and additives). The mixing module consists of a high intensity, high shear continuous pugmill. The special applications of this process stem from its ability to "mix and match" various physical and chemical process operations to meet specific characteristics and associated requirements of incoming waste streams and desired characteristics of the treated product.

System Capacity:	Excess Capacity:
3 systems: 100 - 150 tons/hr	50%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☑ Currently available
- ☐ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Cold Crucible Vitrification

Technology Category: Vitrification

Company Name and Address:
WMX Technologies Inc.
100 Technology Drive
Anderson, SC 29625

Contact:
Mr. Edward Wannemacher
Phone: (864) 646-2413
Fax: (864) 646-5311

Age of Company: 25 years

Number of Employees: 74,000

Annual Revenue: $10.2 billion

Facility Name and Address:
Clemson Technical Center
100 Technology Drive
Anderson, SC 29642

Age of Facility: 3 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: SC 482

Technology Description:

The cold crucible process uses a rotary evaporator to reduce liquid waste to approximately 80% solids content and feed them directly into the crucible. A high-frequency generator and induction coil produce a joule heating effect to create molten glass. The cold crucible is formed within a matrix of water-cooled stainless-steel fingers. When the molten glass contacts these fingers, a cold zone is established and the glass creates its own refractory. The process has many advantages over traditional joule-heated melters, including elimination of high-maintenance refractories and elctrodes within the melt zone, greater capacity, and a more homogeneous glass product.

System Capacity: Pilot-scale unit being designed

Excess Capacity: 50%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☐ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☑ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
DECHLOR®	Organic Destruction	

Company Name and Address:	Contact:
WMX Technologies Inc. 100 Technology Drive Anderson, SC 29625	Mr. Edward Wannemacher Phone: (864) 646-2413 Fax: (864) 646-5311

Age of Company:	Number of Employees:	Annual Revenue:
25 years	74,000	$10.2 billion

Facility Name and Address:	Age of Facility: 3 years
Clemson Technical Center 100 Technology Drive Anderson, SC 29642	RCRA Treatment Permit Date: Exp: Rad Mat #: SC 482

Technology Description:

Chemical dehalogenation of PCB's, dioxins, furans, and other halogenated aromatic and aliphatic compounds. Batch reaction process occuring in heated, stirred tank reactor. Performance and costs dependent on concentration and degree of chlorination of contaminants. Most effective on higher chlorinated species.

System Capacity:	Pilot unit: 100 gal/day	Excess Capacity:	90%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Freeze Separation	Recovery of Metals	

Company Name and Address:	Contact:
WMX Technologies Inc. 100 Technology Drive Anderson, SC 29625	Mr. Edward Wannemacher Phone: (864) 646-2413 Fax: (864) 646-5311

Age of Company:	Number of Employees:	Annual Revenue:
25 years	74,000	$10.2 billion

Facility Name and Address:	Age of Facility: 3 years
Clemson Technical Center 100 Technology Drive Anderson, SC 29642	RCRA Treatment Permit Date: Exp: Rad Mat #: SC 482

Technology Description:

Freeze crystallization or separation reduces the volume of an aqueous solution by partial freezing of the water and subsequent separation of the resulting solids (ice cyrstals). It offers significant advantage over traditional vapor-liquid separation by providing much higher energy efficiencies. The technology is in commercial use for seawater desalinization and food preservation. Only bench-scale testing has been done for mixed waste, primarily for radioactive waste containing sodium and other nitrates.

System Capacity:	Excess Capacity:
Only bench-scale testing to date	

Technology Maturity:

- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☐ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: Joule-Heated Melters

Technology Category: Vitrification

Company Name and Address:
WMX Technologies Inc.
100 Technology Drive
Anderson, SC 29625

Contact: Mr. Edward Wannemacher
Phone: (864) 646-2413
Fax: (864) 646-5311

Age of Company: 25 years

Number of Employees: 74,000

Annual Revenue: $10.2 billion

Facility Name and Address:
Clemson Technical Center
100 Technology Drive
Anderson, SC 29642

Age of Facility: 3 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: SC 482

Technology Description:
As a member of the DOE Industrial Vitrification Center, Rust is performing bench-scale and pilot-scale demonstrations for vitrifying commercial low-level waste from the nuclear utility industry, and has extended these investigations to include mixed waste. Various vitrification processes are being tested. Two joule-heated vitrification systems are available for demonstration at CTC or the IVC: an EnVitCo cold-top melter and a stirred glass melter (Stir Melter).

System Capacity: Not provided

Excess Capacity: Not provided

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:
- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☑ High level waste

Select all that apply

Residuals:
- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Molten Salt Oxidation	Organic Destruction	

Company Name and Address:	Contact:
WMX Technologies Inc. 100 Technology Drive Anderson, SC 29625	Mr. Edward Wannemacher Phone: (864) 646-2413 Fax: (864) 646-5311

Age of Company:	Number of Employees:	Annual Revenue:
25 years	74,000	$10.2 billion

Facility Name and Address:	Age of Facility: 3 years
Clemson Technical Center 100 Technology Drive Anderson, SC 29642	RCRA Treatment Permit Date: Exp: Rad Mat #: SC 482

Technology Description:

MSO destroys the organic component of mixed waste by catalytic oxidation in a bed of molten sodium carbonate. The process serves as its own off-gas scrubber, and retains radioactive elements. It has destruction efficiencies of >99.9999% for most organics and virtually no gaseous emissions.

System Capacity:	Excess Capacity:
Depends on heating value of waste. Typical for CTC pilot plant, 0.5 lb/hr	Pilot plant available

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☑ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☑ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☑ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
Phoenix Ash Technology (TIDE Bricks)	Stabilization	

Company Name and Address:	Contact:
WMX Technologies Inc. 100 Technology Drive Anderson, SC 29625	Mr. Edward Wannemacher Phone: (864) 646-2413 Fax: (864) 646-5311

Age of Company:	Number of Employees:	Annual Revenue:
25 years	74,000	$10.2 billion

Facility Name and Address:	Age of Facility: 3 years
Clemson Technical Center 100 Technology Drive Anderson, SC 29642	RCRA Treatment Permit Date: Exp: Rad Mat #: SC 482

Technology Description:

Phoenix Ash Technolgy (PAT) is a process for encapsulating hazardous, radioactive, and mixed waste in flyash. The process is particularly applicable to waste material containing nitrates and other salts, and can be used with pre-treament methods required for hard-to-treat metals such as cadmium and chromium. In the PAT process, Type C flyash, waste, and other ingredients are compressed with a hydralic ram to form blocks of cylinders. CTC demonstrated that waste forms produced in this test met all RCRA disposal requirements for physical characteristics and leachability as determined by TCLP testing. Tests indicate volume reductions of at least 50%.

System Capacity: Bench-scale only to date	Excess Capacity:

Technology Maturity:

- ☐ R and D
- ☑ Bench Scale
- ☐ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☑ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☐ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:	Technology Category:	
PO*WW*ER®	Organic Destruction	

Company Name and Address:	Contact:
WMX Technologies Inc. 100 Technology Drive Anderson, SC 29625	Mr. Edward Wannemacher Phone: (864) 646-2413 Fax: (864) 646-5311

Age of Company:	Number of Employees:	Annual Revenue:
25 years	74,000	$10.2 billion

Facility Name and Address:	Age of Facility: 3 years
Clemson Technical Center 100 Technology Drive Anderson, SC 29642	RCRA Treatment Permit Date: Exp: Rad Mat #: SC 482

Technology Description:

PO*WW*ER is a proprietary evaporative oxidation waste treatment system. Hazardous volatile and some semi-volatile organics, and a portion of the water in the mixed waste stream are volatilized, leaving the inorganic, non-volatile material, such as radionuclides (except tritium), metals, and salts in the evaporator to form a high solids content brine. The volatilized organics are superheated and catalytically oxidized. Acid gases formed from the oxidation of halogenated hydrocarbons are scrubbed, and a condensed clean water product is produced.

System Capacity:	Excess Capacity:
CTC pilot unit: 1 GPH Mobile unit: 20 GPM	90%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☐ Pilot Scale
- ☑ Commercial

Pick the best one

☑ DOE/Gov experience

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☑ Aqueous liquids
- ☑ Aqueous slurries
- ☑ Organic liquids
- ☐ Inorganic sludges
- ☐ Organic sludges
- ☐ Soils
- ☐ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☐ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name: SOIL*EX™

Technology Category: Soil Washing

Company Name and Address:
WMX Technologies Inc.
100 Technology Drive
Anderson, SC 29625

Contact: Mr. Edward Wannemacher
Phone: (864) 646-2413
Fax: (864) 646-5311

Age of Company: 25 years

Number of Employees: 74,000

Annual Revenue: $10.2 billion

Facility Name and Address:
Clemson Technical Center
100 Technology Drive
Anderson, SC 29642

Age of Facility: 3 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: SC 482

Technology Description:
SOIL*EX selectively removes radionuclides, hazardous metals, and organic contaminants from soils, sludges, debris and other matrices by chemical extraction, catalytic oxidation, evaporation, and mechanical processes. A project-specific selective chemcial extraction solution, typically containing a chelant, carbonate, and other solution conditioning agents, is used to wash contaminants from the waste stream. Once in the aqueous phase, contaminants are concentrated (radioactive/hazardous metals) or destroyed (VOCs, semi-VOCs) by a combination of evaporation and catalytic oxidation, repectivley.

System Capacity: Pilot plant, 100 lb/hr

Excess Capacity: 90%

Technology Maturity:
- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:
- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:
- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☑ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☑ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:
- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:
- ☑ Residuals ready for disposal
- ☑ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply

MIXED WASTE TREATABILITY STUDY TECHNOLOGY QUESTIONAIRE

Technology Name:
VAC*TRAX™

Technology Category:
Recovery of Organics

Company Name and Address:
WMX Technologies Inc.
100 Technology Drive
Anderson, SC 29625

Contact:
Mr. Edward Wannemacher
Phone:
(864) 646-2413
Fax:
(864) 646-5311

Age of Company: 25 years

Number of Employees: 74,000

Annual Revenue: $10.2 billion

Facility Name and Address:
Clemson Technical Center
100 Technology Drive
Anderson, SC 29642

Age of Facility: 3 years

RCRA Treatment Permit
Date: **Exp:**

Rad Mat #: SC 482

Technology Description:
VAC*TRAX thermal desorption uses vacuum and low heat (260-315 C) to remove volatiles, semi-volatiles, PCBs, pesticides, and elemental mercury from solid matrices. Contaminants are recovered by condensation for separate disposal. Removal efficiencies have exceeded 99.9% for volatiles and PCBs. Development has been done under a PRDA from DOE-METC; VAC*TRAX is a Western Governer's Association pilot technology, with testing on actual Rocky Flats waste.

System Capacity: Pilot unit takes 15 gallons per charge, 4 - 20 hours processing time

Excess Capacity: 90%

Technology Maturity:

- ☐ R and D
- ☐ Bench Scale
- ☑ Pilot Scale
- ☐ Commercial

Pick the best one

☑ **DOE/Gov experience**

Technology Availability:

- ☐ Currently available
- ☑ Scheduled availability

Pick the best one

Scheduled Date:

Media Treated:

- ☐ Aqueous liquids
- ☐ Aqueous slurries
- ☐ Organic liquids
- ☐ Inorganic sludges
- ☑ Organic sludges
- ☑ Soils
- ☑ Soils and debris
- ☐ Metal debris
- ☐ Non-metal debris
- ☐ Lab packs
- ☐ Reactive metals
- ☑ Elemental mercury
- ☐ Elemental lead
- ☐ Lead batteries
- ☐ Cadmium batteries

Select all that apply

MW Categories Accepted:

- ☑ Low level waste
- ☑ Transuranic waste
- ☐ High level waste

Select all that apply

Residuals:

- ☐ Residuals ready for disposal
- ☐ Residuals need additional treatment
- ☑ Secondary wastes returned to generator

Select all that apply