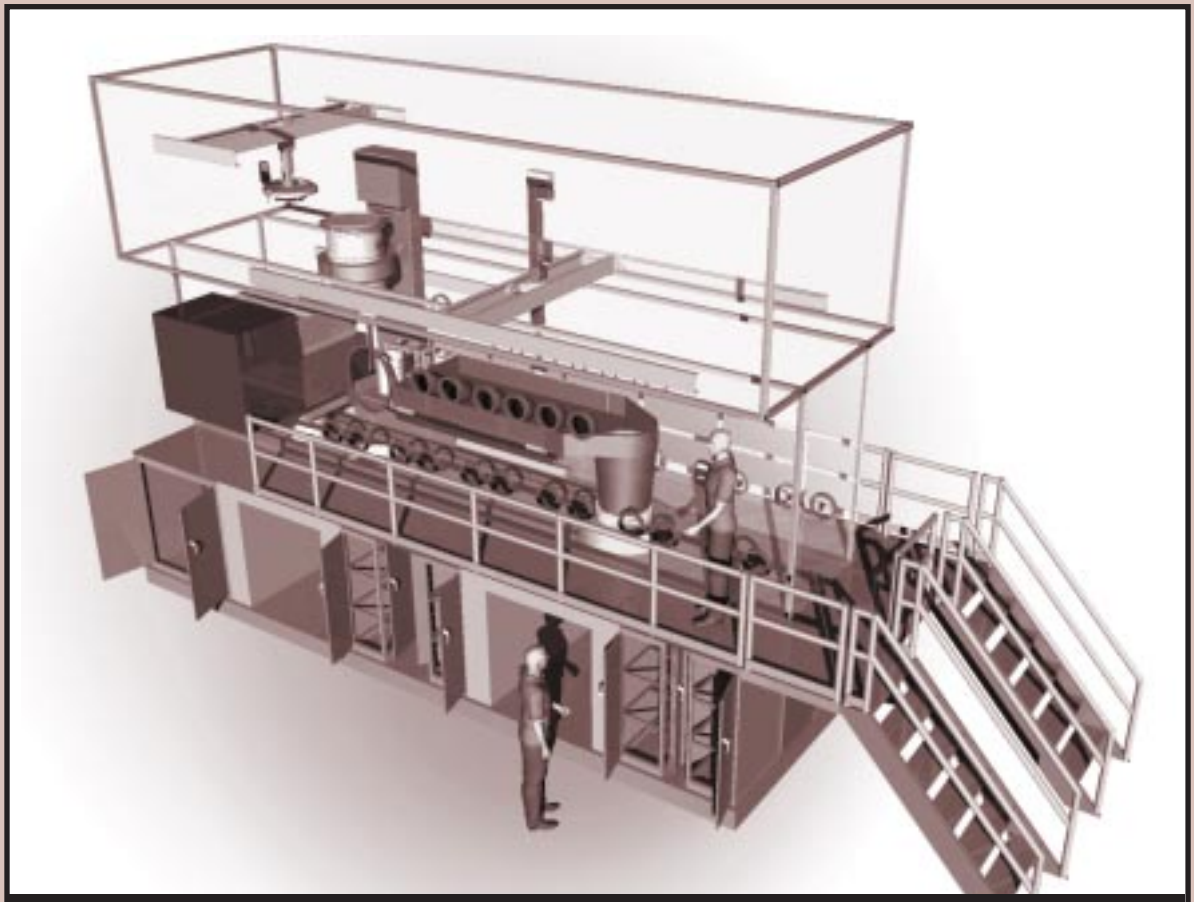
TRU & Mixed Waste

Focus Area

FY2000



From Research to Deployment …
Finding Solutions for Today and the Future

U.S. Department of Energy
Office of Environmental Management
Office of Science and Technology

A Message from the Program Director

Several new developments have taken place in the past year. You may have noticed our new name, the TRU & Mixed Waste Focus Area (TMFA). It reflects the importance the Department of Energy (DOE) places on ensuring uninterrupted, safe, and efficient shipments of transuranic (TRU) waste from storage to the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico. Meeting the DOE's technology needs for managing TRU wastes has always been a significant part of our program.

Another new, yet related development is that the DOE-Idaho Operations Office and Carlsbad Field Office are jointly accountable for the TMFA to the Office of Science and Technology. Each office has a Focus Area Co-Manager. The Carlsbad office brings new expertise to our technical management program, which improves our TRU waste management research and development capabilities.

Maintaining a steady flow of waste to WIPP requires automated or remote-controlled systems for many of the steps between storage and disposal. This year, we accomplished a major technical milestone by completing Phase I of HANDSS-55. Intended for deployment at the Savannah River Site, HANDSS-55 is an automated, remote, waste sorting and repackaging system. Phase I's completion allows us to move on to greater challenges: mounting an automated handling system on a mobile platform for sites with small TRU waste quantities, and remotely-handling large pieces of contaminated equipment. The project has been a model for cooperation between the sites and programs. These include the Savannah River Site, Idaho National Engineering and Environmental Laboratory, Western Environmental Technology Office, Pacific Northwest National Laboratory, and Office of Science and Technology.

Solutions were deployed for an array of mixed low-level and TRU waste problems. The DOE's waste operations managers now have a quick, inexpensive method for analyzing the chlorine content in waste destined for treatment. They also have a new method for treating mixed low-level waste debris that results in a 25% volume reduction over conventional techniques. We delivered a mixer system that allows some mixed low-level wastes to be stabilized while in their drum containers. We also deployed surrogates for standard waste boxes and crates, which were needed at several sites for evaluating, calibrating, and refining nondestructive crate/box assay systems.

An informal call was issued for technology deployment proposals for the treatment of unique (small-quantity and problematic) wastes. Four potential deployments with broader benefits to the DOE Complex were identified: Sandia National Laboratory, Hanford Reservation, Idaho National Engineering and Environmental Laboratory, and Oak Ridge Reservation. These will be funded in FY2001 under the auspices of the Broad Spectrum waste treatment contract.

An important aspect of the TMFA's work since its inception has been to improve the environmental performance of DOE's mixed low-level waste incinerators. We have also maintained a technology development effort for wastes that can't be incinerated. The TMFA remains committed to meeting the DOE's needs for their operating incinerators, and is prepared to support incineration as long as it remains a DOE waste treatment option. However, since the DOE began to shut down its incinerators, our focus has shifted towards accelerating and expanding development of alternative technologies. We need to learn both how these alternatives perform on various mixed waste streams, and the quantity and characteristics of their emissions and how to best monitor and control them.

The TMFA Regulatory Coordination Group played an instrumental role in developing a Memorandum of Understanding, signed by the DOE and Environmental Protection Agency (EPA). The agreement will help the agencies propose a collaborative research agenda that will ultimately benefit agencies, state regulators, and the regulated community.

We remain committed to addressing needs identified by the Site Technology Coordination Groups. However, we will attend to other interested and knowledgeable sources of technology needs, such as the Environmental Management Advisory Board, the Blue Ribbon Panel for technology alternatives to incineration, the Environmental Management Advisory Board, and the National Academy of Sciences. By expanding our view, we will be able to direct basic science and applied research activities toward problems that loom on the horizon, possibly unrecognized by our site end-users.

Bill Owca
TMFA DOE
Idaho Co-Manager

Roger Nelson
TMFA DOE
Carlsbad Co-Manager

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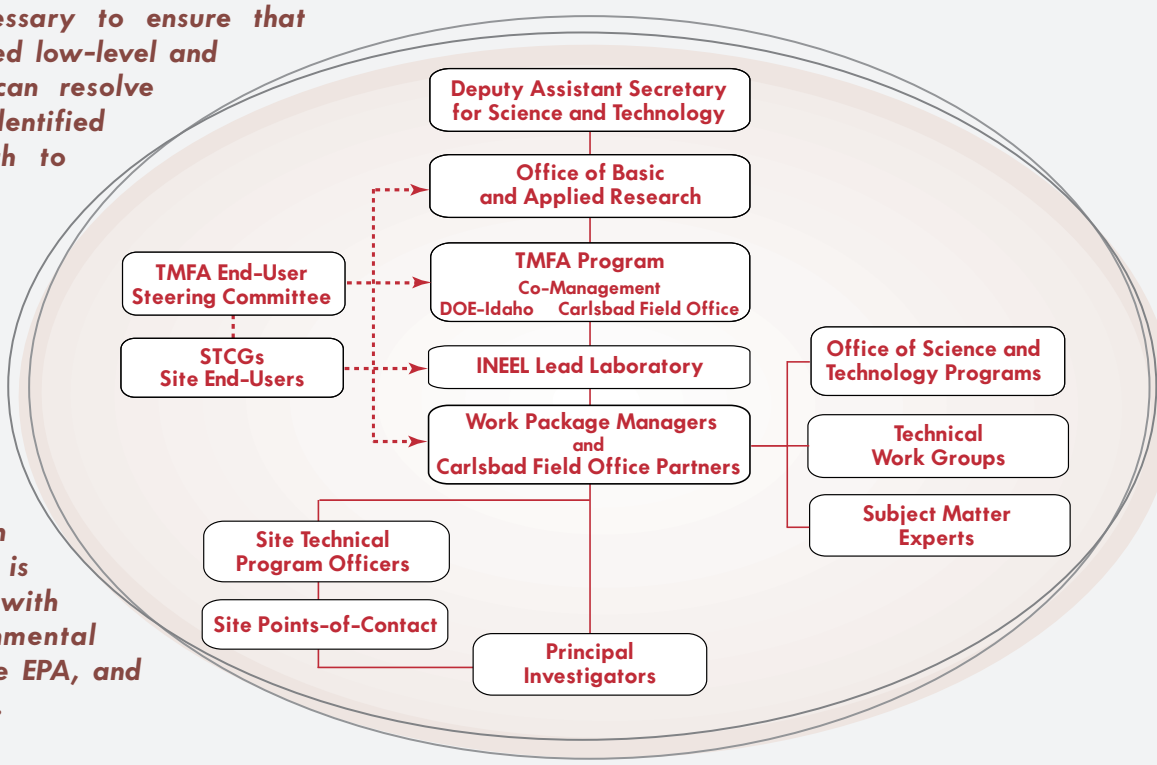
The TMFA Mission

The TRU & Mixed Waste Focus Area delivers technical and engineering solutions necessary to ensure that program managers of mixed low-level and transuranic (TRU) waste can resolve present and future needs identified in their "accelerated path to closure" planning.

The Focus Area invests in solutions that will be deployed and have a significant national impact. This is accomplished by an end-user driven process, which enables all steps from needs identification through solution deployment, and is completed in partnership with the DOE's Environmental Management programs, the EPA, and other government agencies.



Introduction

Approximately 154,000 cubic meters of mixed low-level and TRU wastes are currently in storage at 36 DOE and non-DOE sites. This inventory, heterogeneous both physically and chemically, is composed of more than 754 waste streams. About 70% of the total inventory is categorized as TRU and packaged in a variety of containers, ranging from 55-gallon drums to fairly large cargo containers. Most of the TRU waste is destined for disposal at WIPP. Treatments for the remaining stored inventory – mixed low-level wastes – are prescribed in Consent Orders established between the sites and their host states in compliance with the Federal Facilities Compliance Act of 1992.

Current DOE estimates project that an additional 217,000 cubic meters of TRU waste and 364,000 cubic meters of mixed low-level waste will be generated within the next seventy years. This waste will come primarily from environmental restoration and decontamination and decommissioning activities, as well as site operations.

The TMFA is presently addressing or planning to address approximately 140 technology needs identified by the DOE sites for managing these wastes. The needs extend through the entire waste management process – characterization, remote and automated handling, shipping, pretreatment, treatment, and disposal. The TMFA uses a strong systems approach: analyzing the need, developing a plan to address the need, and then engaging the best technical resources available to solve the need. These resources include the Office of Science and Technology (OST) Cross-Cutting Programs, industry, universities, national laboratories, and other Federal agencies.

The TMFA targeted two long-term stewardship challenges in FY2000: 1) developing mechanisms to promote the sustainability of long-term stewardship, and 2) incorporating long-term stewardship considerations into waste management decisions. The TMFA met these challenges by working closely with the DOE's sites to identify their needs and to ensure end-user involvement.

The TMFA is co-managed by the DOE Idaho Operations Office and the Carlsbad Field Office, with support from Bechtel BWXT Idaho, LLC and Los Alamos National Laboratory/Carlsbad Operations.

" The Environmental Management Science Program has a valuable role to play by improving the scientific basis for environmental management decision making, and by building a solid foundation to develop new technologies."

— Dr. Carolyn Huntoon, April 1999

Mission of the Environmental Management Science Program

1) *Develop a targeted long-term basic research agenda for environmental problems so that transformational or breakthrough approaches will lead to significantly long-term reduced cleanup costs and risks to workers and the public.*

2) *Bridge the gap between broad fundamental research that has wide-ranging applicability (such as that performed in the Office of Science) and the needs-driven applied technology development (such as conducted in the Office of Environmental Management's Office of Science and Technology).*

3) *Serve as a stimulus for focusing the nation's science infrastructure on critical national environmental management problems.*

Environmental Management Science Program

The Environmental Management Science Program is a collaborative partnership between the DOE's Office of Environmental Management, Office of Science, and Idaho Operations Office to sponsor basic environmental and waste management related research.

The Office of Science has sponsored leading-edge scientific research for many years, and is uniquely positioned to evaluate the scientific merit of the proposed research. The Office of Science and Technology provides the needed insight on the relevance of these projects. This synergy is a real strength of the Environmental Management Science Program. The Office of Environmental Management is responsible for site remediation and provides the long-term stewardship to insure that sites remain safe long after the cleanup is completed.

Leveraging the Present to Prepare for the Future

The Environmental Management Science Program funds projects that both improve our understanding and subsequently lead to new or improved processes and techniques. One such example is Dr. Benjamin Hay's project, *Computational Design of Metal Ion Sequestering Agents*. Metal ion recognition is critical to the development of improved sensors, separating agents, and analytical techniques. Dr. Hay's project has led to the discovery of new ligand (a molecule binding to another molecule) architectures, which can be used for the selective binding of radioactive metal ions.

The Environmental Management Science Program sponsored a national workshop titled *Science Advancing Solutions* in April 2000. The workshop highlighted research sponsored by the Environmental Management Science Program and areas of future research. In addition, interaction between the participants encouraged new partnerships and potential collaborations.

The Department of Energy estimates that 581,000 cubic meters of TRU and mixed low-level waste will be generated over the next seventy years from environmental restoration and deactivation and decommissioning projects. To support the management of these waste streams, the TMFA has identified the following basic research areas:

- Understanding the separation and/or destruction mechanisms involved in alternatives to incineration treatment processes
- Obtaining basic signature information for fissile isotopes
- Understanding the failure mechanisms for materials in alternative to incineration treatment processes
- Obtaining signature information for trace quantities of contaminants in operating and waste treatment effluent systems
- Understanding generation mechanisms for dioxins and furans in off-gas systems.

Accelerated Site Technology Deployment Initiative

The Accelerated Site Technology Deployment (ASTD) program is a national initiative that uses a multi-site competitive award program to accelerate the implementation of new, demonstrated cleanup technologies and innovative approaches. The initiative supports the Focus Areas by helping to remove the barriers that keep technologies and processes from being implemented, and trying to improve coordination across DOE's Environmental Management organizations through joint ownership and funding of projects.

In FY2000, the TMFA continued work on six previously awarded ASTD projects, including:

- Combined Thermal Epithermal Neutron (CTEN) Prototype (deployed at Las Alamos National Laboratory in FY2000) (Tech ID 1568)
- Mixed Waste Debris Macroencapsulation Technology (deployed at Oak Ridge National Laboratory in FY2000) (Tech ID 2927)
- Alternative Remote-Handled Transuranic Waste Transportation System (to be deployed at Battelle Columbus Laboratories in Ohio) (Tech ID 2975)
- Microchip Memory Button and Internal Pressure Sensing Technology (to be deployed at the Fernald Site in Ohio) (Tech ID 2976)
- Dissolvable Anti-Contamination Materials Processing System (to be deployed at Savannah River Site) (Tech ID 2929)
- Enhanced Stabilization and Volume Reduction of Solar Pond Sludge (now cancelled) (Tech ID 2928)

Mixed waste treatment problems are targeted by two of the projects, the third provides a solution for small quantities, the fourth helps accelerate cleanup, the fifth solves plutonium problems, and the sixth targets volume reduction of solid wastes. Deployment of these projects has begun and will extend to 15 DOE sites located in 13 states. These projects are scheduled for completion within the year.

Crosscutting Programs

Four programs support the Focus Areas with research, development, demonstration, testing, and evaluation of technologies that may help the environmental cleanup of the DOE weapons complex:

- Characterization, Monitoring and Sensor Technology (CMST),
- Efficient Separations and Processing (ESP),
- Robotics (RBX), and
- Industry.

Because these programs may address technologies spanning multiple focus areas, the TMFA actively interfaces with these programs to obtain the most appropriate Office of Science and Technology resources, and to avoid duplication of effort.

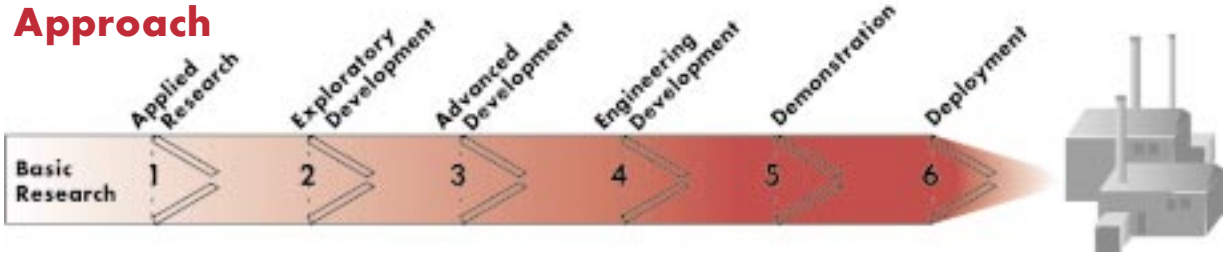
The ESP crosscut program sponsors projects with the most promising waste separation solutions. (The DOE separates its defense waste streams for many reasons of efficiency and economics. Separated waste streams are smaller and more concentrated. Concentrated waste streams can often be more easily disposed of and purified streams can be released to the environment.)

The CMST crosscut program provides expertise and solutions for environmental characterization and monitoring problems.

The Robotics crosscut program provides expertise and solutions for robotics, automation, and remote systems technologies.

The Industry Program fosters the development, demonstration, and deployment of cost-effective technologies by private sector businesses, so they can be used to solve problems at multiple DOE sites.

Gate Approach



Technology development is tracked using a gate model to ensure resources are applied appropriately to the projects showing progress. Six reviews are performed in a technology's life cycle – from basic research to deployment.

Technology Management System

The Technology Management System (TMS) is a comprehensive on-line inventory containing information about Office of Science and Technology technologies. Each technology is given a unique identification number. For example, Tech ID 2163 was assigned to the Crate Surrogates project. Developers and users can find and enter information about technologies online at ost.em.doe.gov/tms. The site includes technology descriptions, benefits, applications, commercial availability and points of contact.

Innovative Technology Summary Reports

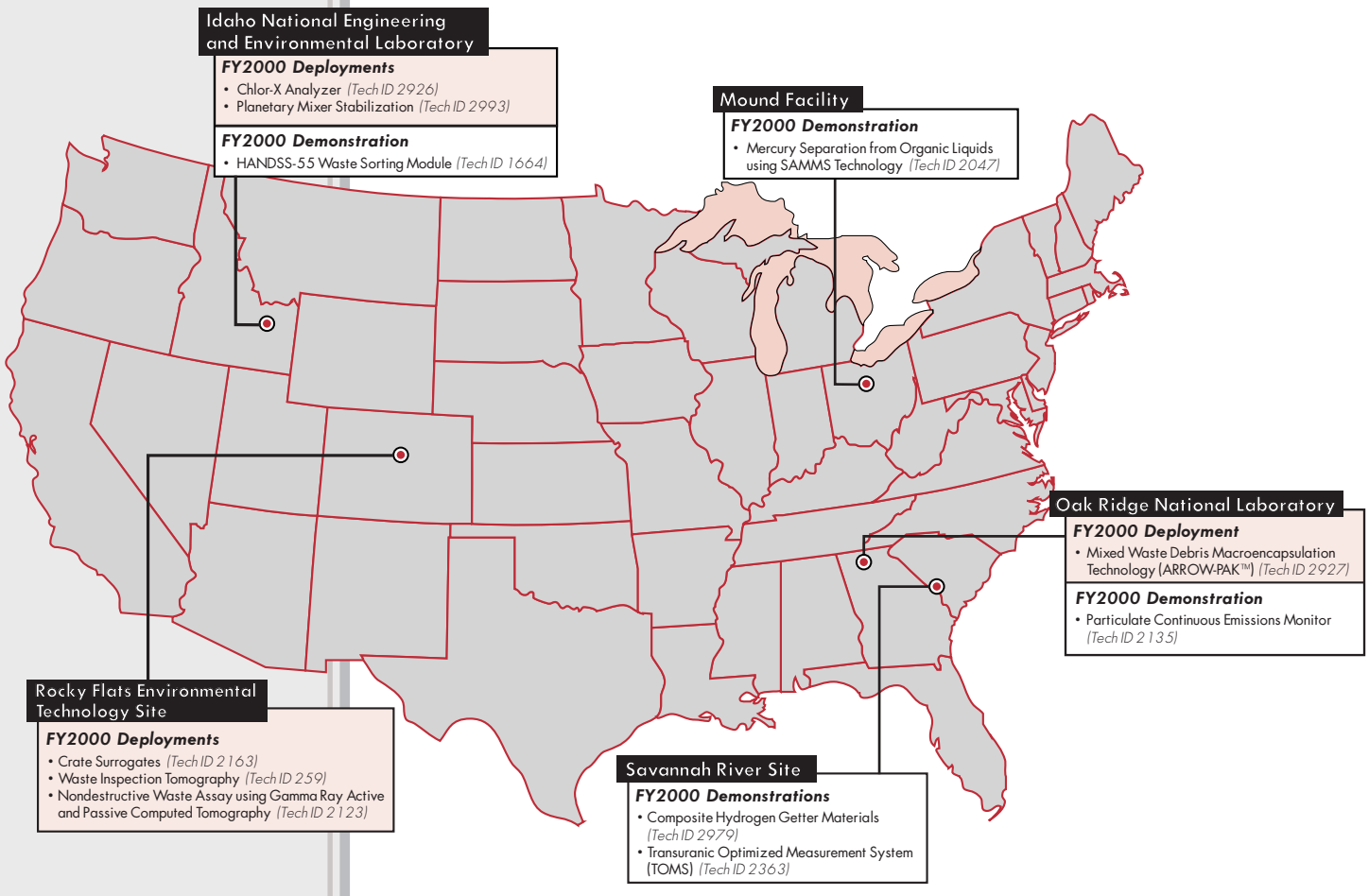
Innovative Technology Summary Reports (ITSRs) are written for potential users of a particular technology, system, or process. Each report presents the full range of environmental management problems that can be addressed as well as performance, cost, cleanup effectiveness, and regulatory acceptance advantages. Information about commercial availability, technology readiness, comparisons to baseline and competing technologies, is also included. Information not available at publication time is so noted.

By the end of FY2000, the TMFA had prepared two Ready for Implementations (RFIs). During FY2001, the TMFA will prepare ITSRs for the following technologies:

- Transuranic Optimized Measurement System (TOMS) (Tech ID 2363)
- Inner Layer Confinement Reduction Request for Proposals (Tech ID 2999)
- Multistage Combustion NO_x Treatment System (Tech ID 221)
- Mercury Separation from Organic Liquids using SAMMS Technology (Tech ID 2047)
- Mixed Waste Debris Macroencapsulation Technology (ARROW-PAK™) (Tech ID 2927)

ITSRs for the TMFA can be downloaded off the Internet at

em-50.em.doe.gov/itsrtmwfa.htm



TMFA Leads Team to Develop Alternatives to Incineration

The DOE's planned suspension of radioactive and mixed waste incineration at the Savannah River Site, the Idaho National Engineering and Environmental Laboratory, and Oak Ridge Reservation has made it necessary to develop and demonstrate alternatives to incineration as soon as possible. The DOE's change in strategy was prompted by a long history of public concern about off-gas emissions and the EPA's new and more stringent air emissions standards, which would require significant and costly upgrades to DOE's incinerators. As a result, the DOE's incineration capacity will be severely limited over the next five years.

Alternatives to incineration that can effectively treat a portion of the waste streams treatable by incineration need to be identified as quickly as possible to avoid disrupting scheduled cleanup goals. In addition to incineration alternatives, more pre- and post-treatment technologies are expected to be needed and new or adapted forms of effluent monitoring and control will be necessary. The Office of Science and Technology (OST) will request additional funding to meet these needs.

In leading the OST's alternatives to incineration development team, the TMFA's goal is to use the OST's financial and technical resources to provide fully-integrated non-flame treatment systems for organic destruction. This will be accomplished by:

- Testing and deploying relatively mature technologies to begin filling the anticipated gap as soon as possible,
- Putting promising next-generation treatment concepts into the technology development pipeline, and
- Focusing basic and applied research on long-term treatment needs.

Development team members include the TMFA; Western Environmental Technology Office (WETO); the Diagnostic Instrumentation and Analysis Laboratory at Mississippi State University (DIAL); Florida International University (FIU); and the Robotics, ESP, and CMST crosscut programs.

TMFA Supports Blue Ribbon Panel

The Blue Ribbon Panel on Emerging Technological Alternatives to Incineration began evaluating alternatives to incineration in May 2000 as part of DOE's settlement agreement with a citizen's group in Jackson, WY. The Panel is assessing emerging technologies, including chemical and biological processes, that could treat low-level, alpha low-level and TRU wastes contaminated with polychlorinated biphenyls (PCBs) and hazardous constituents. The panel members have a broad range of expertise and experience in environmental management, legal and technical aspects of hazardous waste management, and related treatment technologies. The Panel's recommendations are expected in December 2000.

The TMFA is providing technical support to the Panel on understanding the various categories of waste treatment and will provide support in testing and demonstrating the recommended technologies under the Alternatives to Incineration Work Package (see page 18 of this report).

TMFA Regulatory Program and EPA Build Strong Partnership

The TMFA's regulatory program ensures that DOE's research and development activities will meet both current and future environmental regulations. A close working relationship with the EPA has been vital to this effort. Though the EPA is experienced with hazardous wastes, the TMFA is working to assist the EPA in their understanding of the unique aspects of radioactive wastes.

In February 2000, the DOE's Office of Science and Technology and the EPA's Office of Solid Waste signed a Memorandum of Understanding to improve cooperation in the research and development of technical solutions for mixed waste treatment. Three projects have been initiated.

The first project will study the effectiveness of particulate matter continuous emissions monitors to determine how they can be used to monitor for potential HEPA filter failure. A second project will determine the kinds of data required to help regulators decide whether to issue a permit. The results of this study will help the EPA develop a standardized approach for gathering data. The third project focuses on helping the EPA identify the technical data gaps in their proposed mercury action plan. Filling those gaps will help the EPA implement their new rules for addressing DOE wastes with mercury pollution.

The TMFA regulatory program also conducts workshops and symposiums on regulations and upcoming changes with other DOE sites, often with beneficial results. For example, the DOE sites at Hanford and Fernald recently learned that new rules for handling PCB-contaminated waste actually gave them more options and opportunities than originally thought.

In the future, the TMFA regulatory program will face more complex and intricate decisions because of the complex nature of DOE's wastes.

Nondestructive Characterization for Treatment, Transportation, and Disposal of Mixed Low-Level and Mixed Transuranic (TRU) Waste

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The bulk of the nation's mixed waste is located at DOE-owned or -operated facilities. Significant time is spent at these sites in waste management activities – especially characterization and monitoring – to ensure safe storage, selection of appropriate and effective treatment, and adherence to disposal standards.

Characterization can be difficult and costly for some of these wastes. WIPP's waste acceptance criteria for transuranic wastes demand stringent and detailed characterization. Complications include the presence of radioactive and RCRA hazardous constituents, the heterogeneous nature of a substantial percentage of wastes, and the application of current characterization requirements to alpha-mixed "legacy" waste.

The TMFA is specifically charged by the DOE with supporting the development of crucial characterization technologies through basic science, applied research, demonstration, and deployment. The TMFA's objective is to improve the capability of end-users to nondestructively examine and assay containerized waste for radioactive and hazardous components.

Work to provide solutions for contact-handled drums is expected to continue through FY2001. A new solution for characterizing contact-handled boxes is planned to be demonstrated in FY2002 and solutions for containerized remote-handled wastes should be available by the end of FY2003. Finally, a measurement system to characterize the majority of remote-handled wastes is planned for FY2004.

Technology Highlights

- Nondestructive Support of the Carlsbad Field Office's Performance Demonstration Program
- Transuranic Optimized Measurement System (TOMS)
- Crate Surrogates
- Nondestructive Assay of Boxes Containing TRU Waste
- Nondestructive Waste Assay Using Combined Thermal Epithermal Neutron Interrogation
- Chlor-X Analyzer

Nondestructive Assay Waste Characterization Conferences

The 7th Nondestructive Assay Waste Characterization Conference was held May 23-25, 2000, in Salt Lake City, Utah. It provided a forum for discussing characterization issues, reviewing technologies, and meeting with counterparts from other sites and industry. Oral presentations were organized into the following areas of emphasis:

- Programmatic Issues: Direction, Needs, Strategies, and Schedules
- Compliance: Regulations, Demonstration, and Implementation Experience
- Technical Nondestructive Assay: Neutron- and Gamma-Based Techniques/Design/Applications
- Alternate Acceptable Characterization Methods: Sampling/Destructive Assay, Process Knowledge, and Statistical Techniques
- Waste Form Inventory/Characteristic Information
- End-User Implementation and Certification Experience.

The 8th Nondestructive Assay Waste Characterization Conference is scheduled for December 2001 in Denver, Colorado.

Nondestructive Support of the Carlsbad Field Office's Performance Demonstration Program

(Tech ID 2017)

Working Reference Materials, also known as radioactive standards, are being developed for the Carlsbad Field Office's Transuranic Waste Characterization Nondestructive Assay Performance Demonstration Program. These standards are used to evaluate nondestructive assay measurement systems' capability for determining the transuranic content of transuranic waste containers. The development of standards is necessary to meet the objectives of the Quality Assurance Program Plan, which was formulated to ensure compliance with the WIPP transuranic data quality objectives outlined in the Waste Characterization Program.

Standards are fabricated by obtaining, characterizing and blending plutonium, americium, and uranium materials with inert matrix materials. The blended material is placed in stainless steel cylinders, which are sealed, checked for leaks, and then packaged and shipped to eight DOE receiving sites.

In FY2000, Working Reference Materials (WRMs) were deployed at four sites:

1) Six Phase IID (depleted uranium) WRMs were sent to Rocky Flats Environmental Technology Site,

2) Ten Phase IIC (enriched) WRMs were sent to Rocky Flats Environmental Technology Site and Los Alamos National Laboratory,

3) Twelve Phase IIIA (plutonium) WRMs were sent to Rocky Flats Environmental Technology Site, Los Alamos National Laboratory, Savannah River Site, and Hanford Site,

4) Three Phase IIIA WRMs were prepared for the Idaho National Engineering and Environmental Laboratory.

Current plans are for high-activity, plutonium-238 standards to be deployed in FY2001 at Los Alamos National Laboratory and at the Savannah River Site.

Demonstrated

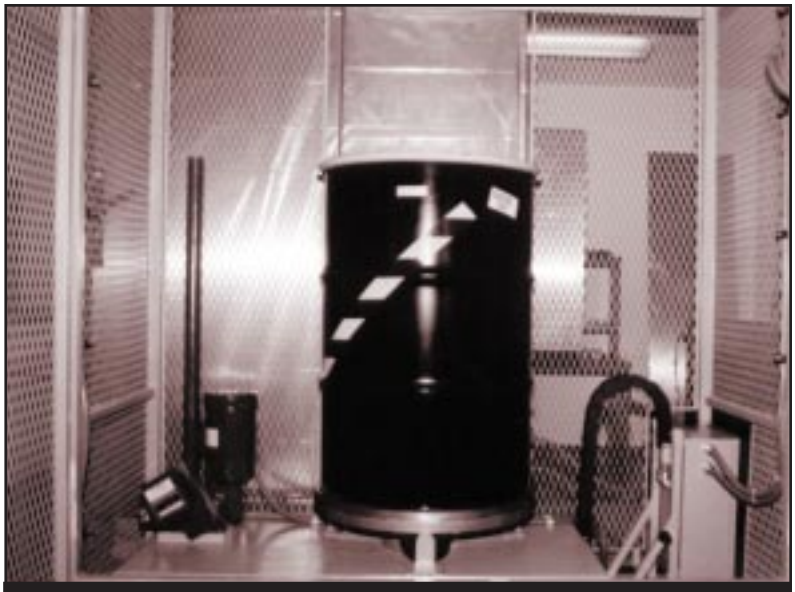
Transuranic Optimized Measurement System (TOMS)

(Tech ID 2363)

The Transuranic Optimized Measurement System (TOMS) is being developed specifically to characterize plutonium-238 contaminated wastes. Significant amounts of this waste are found at both the Savannah River Site and Los Alamos National Laboratory.

The TOMS system uses an innovative detector – a Duode detector – to segregate transuranic from non-transuranic waste, while performing analysis in less than 45 minutes. This technology could result in the reclassification of a significant portion of transuranic waste as low-level or mixed low-level waste. Reclassification of the waste results in cheaper disposal alternatives than if the waste had to be disposed of at the WIPP.

Designed for field use, the operational TOMS was successfully demonstrated in FY2000 on simulated wastes at Radiation Technologies International in Alachua, Florida. The system is scheduled to be moved to the Savannah River Site in early FY2001 for acceptance testing, with final demonstration and deployment of the system planned for later in FY2001. The TOMS system was developed in cooperation with Radiation Technologies International, and Princeton Gamma-Tech Inc. in Princeton, New Jersey.



Transuranic Optimized Measurement System (TOMS)

Many publications are available on the Internet in pdf format, including Innovative Technology Summary Reports and current annual reports for the five Focus Areas. These publications can be downloaded on the Internet at ost.em.doe.gov/

Deployed

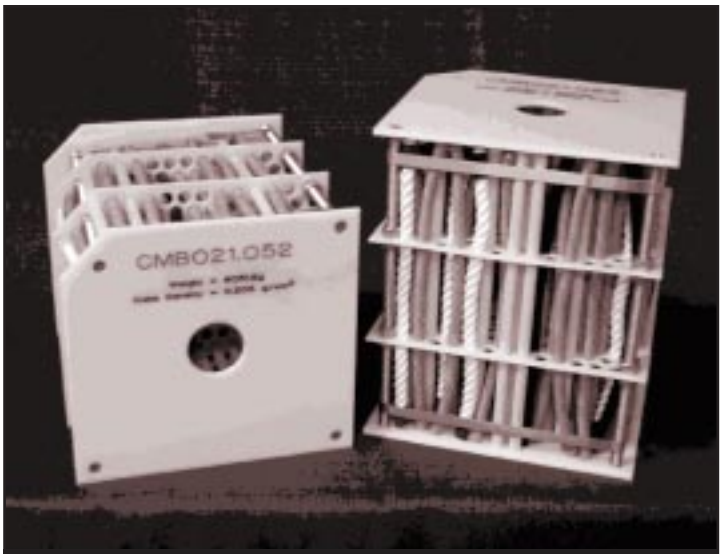
Crate Surrogates

(Tech ID 2163)

The Crate Surrogates project involves the design and fabrication of B-25 and standard waste box surrogates. The box surrogates are necessary for box assay system development, system response characterization, and compliance demonstration activities to meet characterization requirements.

The boxed surrogate matrices are representative of actual waste forms identified at Los Alamos National Laboratory, Lawrence Livermore National Laboratory, Oak Ridge Reservation, Rocky Flats Environmental Technology Site, and Hanford. Waste matrix attributes replicated in the surrogate materials include elemental composition, matrix density, spatial distribution of these parameters, and overall packaging configuration. The surrogate matrix sets are modular, allowing a large variety of waste form configurations to be simulated. The matrix housing is also fitted to allow the precise insertion and positioning of radioactive standards for assay system characterization.

Crate surrogates were deployed at Rocky Flats Environmental Technology Site in FY2000 to support the development and demonstration of the Multi-Purpose Crate Counter, and the Super-HENC (High-Efficiency Neutron Counter). The surrogates were also used to calibrate and evaluate the Crate Waste Assay Monitor developed for Oak Ridge.



Crate surrogate matrix modules

Nondestructive Assay of Boxes Containing Transuranic (TRU) Waste

(Tech ID 2146)

A nondestructive box assay technology called the Integrated Box Interrogation System (IBIS) is being developed to support characterization of standard waste boxes and crates (up to 4 ft. by 4 ft. by 7 ft.). These boxes and crates are used at many DOE sites to store transuranic waste.

The IBIS incorporates improved gamma and passive/active neutron interrogation components developed for 55-gallon drum assay techniques. This new technology is expected to reduce the need for opening the boxes to sample and analyze the contents and repackaging the contents into drums.

The Integrated Box Interrogation System is being developed by the TMFA in collaboration with Los Alamos National Laboratories and Canberra Industries. Design, fabrication, and demonstration are expected to be completed in FY2002.

Nondestructive Waste Assay Using Combined Thermal Epithermal Neutron Interrogation

(Tech ID 1568)

Combined Thermal Epithermal Neutron (CTEN) Interrogation technology extends the capabilities of the baseline DDT/PAN nondestructive waste assay technology. Existing passive active neutron (PAN) methods have difficulty meeting WIPP accuracy requirements for some waste forms. CTEN technology improves on the existing technology with its ability to identify and assay lumps of fissile material. In addition, CTEN's improved active-assay accuracy at low sum mass loadings allows certification of drums that could not be certified by any other technique.

CTEN interrogates the fissile content of 55- and 83-gallon drums with both thermal and epithermal neutrons. CTEN's system capabilities include:

- Active and epithermal neutron interrogation for detection of self-shielding fissile material

Combined Thermal Epithermal Neutron (CTEN) Interrogation

- New type of neutron multiplicity module for both active and passive measurements
- Detectors and methods to determine the distribution of fissile material in a waste drum
- Pulse-Arrival-Time Recording Modules
- Flux monitors to detect matrix inhomogeneities
- Methods to use the additional matrix information to improve assay accuracy.

During FY2000, the CTEN technology was evaluated in the Performance Demonstration Program at Los Alamos National Laboratory. The technology was also transferred to Canberra Industries. The CTEN project is one of six Accelerated Site Technology Deployment programs supported by the TMFA.

Deployed

Chlor-X Analyzer

(Tech ID 2926)

The Chlor-X-Analyzer is a table-top x-ray fluorescence instrument that analyzes the total chlorine content of solid waste samples collected from waste scheduled for treatment. Using the system, a five-minute analysis can provide results down to 50 parts per million with an error of ± 10%. This technology provides a significant time and cost savings over the off-site analysis that took place previously. In addition, the test is nondestructive and generates no secondary waste.

On March 20, 2000, the Chlor-X Analyzer was deployed at the Idaho National Engineering and Environmental Laboratory's Waste Experimental Reduction Facility on actual waste. The technology is commercially available through NuMaT, Inc.

Chlor-X Analyzer

Chlor-X Analyzer

Handling Mixed Waste Contaminated Materials during Characterization, Treatment, Packaging, and Disposal

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Because of the toxic and radioactive nature of mixed waste, efficient and safe handling techniques are a high priority. Some commercially available technologies can be adapted for handling wastes designated as contact-handled. But a significant portion of DOE's mixed waste inventory – about 35% of the transuranic waste volume in storage, according to the National TRU Waste Management Plan – requires new technology for its treatment and disposal.

Robotics and automation technologies are providing improved solutions for opening, inspecting, sorting, and repackaging mixed wastes prior to shipment. These technologies are increasing DOE's capacity to handle the waste while eliminating potential worker exposure.

Technology Highlights

- **Mechanical Systems – Handling Material in Contact-Handled Processes using HANDSS-55 Systems**

Mechanical Systems – Handling Material in Contact-Handled Processes using HANDSS-55 Systems

(Tech ID 1664)

HANDSS-55 is a remote, modular waste sorting and repackaging system for 55-gallon drums of contact-handled transuranic mixed waste. This system is designed to satisfy the unique and varying needs of each waste generator. Each module is designed to be operated individually or in integration with the others. Though HANDSS-55 is being developed for the Savannah River Site, which has approximately 10,000 drums of transuranic waste that must be processed for shipment to WIPP, its individual modules may also be used at other sites.

The HANDSS-55 system remotely opens 55-gallon drums and their 90-millimeter polyethylene liners, gains access to the waste, removes non-compliant items, and repackages the waste into polyethylene canisters. The canisters fit into standard 55-gallon drums, but have the potential to be used with other disposal containers, such as Standard Waste Boxes. The old drums and liners are shredded to reduce their volume before disposal.

The system is comprised of four modules:

- Sorting, which includes an automated drum and liner opener,
- Volume reduction of liner and drum,
- Repackaging of compliant waste, and
- Integration and control of three hardware modules.

Future plans include adapting the HANDSS-55 technology to a mobile platform to meet the needs of small generator sites, as well as fully automating the technology so it can be used in remote-handled waste environments.

In FY2000, final testing was completed for the HANDSS-55 Waste Sorting Module components and the Infrared Welder for the HANDSS-55 Transuranic Waste Repackaging Module. A bench-scale demonstration of the Waste Sorting Module was completed in July 2000. The modules will be transferred to the Western Environmental Technology Office in Butte, Montana, for integration and demonstration at the end of FY2002. Expected deployment is scheduled for FY2003 at the Savannah River Site.

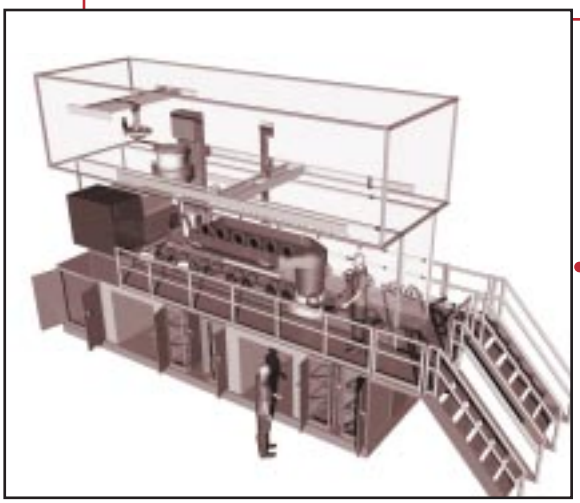
HANDSS-55 is a collaborative effort between the TMFA and Robotics crosscut program. The HANDSS-55 technology is being developed by a multi-site team from the Idaho National Engineering and Environmental Laboratory, Savannah River Technology Center, and the Pacific Northwest National Laboratory, in collaboration with private industry and academia. The TMFA, supported by the Robotics crosscut program, is co-funding the development of the HANDSS-55 technology. The Office of Waste Management at the Savannah River Site is funding HANDSS-55 support equipment and providing the secondary and tertiary containments.

1 Automated Drum and Liner Opener

Opens a 55-gallon metal drum and the rigid polyethylene liner.
Demonstration: Spring 1999

2 Waste Sorting Station

Enables identification and removal of items that do not comply with WIPP acceptance criteria. The remaining compliant waste is repackaged into polyethylene containers.
Demonstration: Spring 2001

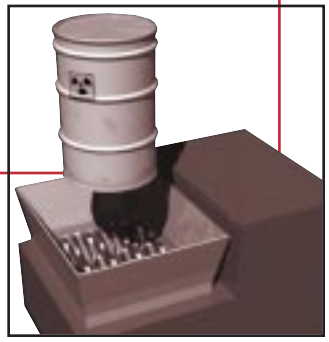


5 System Integration and Control Station

Integrates the HANDSS-55 modules to operate as one unified system. Its functions include collision avoidance, task prioritization, mobilization of the equipment, and overall system control.
Cold Demonstration: Summer 2002

3 Process Waste Reduction Module

Reduces the volume of the old drum and liners using a mechanical shredder. The small shards remaining are packaged with the waste into WIPP-compatible containers.
Fabrication: Spring 2001



4 Transuranic (TRU) Waste Repackaging Port

Repackages WIPP-compliant waste into a polyethylene canister using a split-plug bagless transfer system. A sphincter seal and hollow plug provide contamination control.
Demonstration: Spring 2001

Material Handling Evaluation

The TMFA, in cooperation with the Industry program (though the National Energy Technology Laboratory) and the Robotics crosscut program, will adapt commercially available technology to meet remote-sizing needs at the Hanford Site. During FY2000, research was conducted to evaluate the DOE complex's current sizing capabilities and determine where technology gaps exist. A report was issued identifying the remote-sizing needs having the greatest possibility of being solved by commercially available technology. The TMFA will issue a call in late FY2001 to the commercial sector for technologies that can address the volume reduction needs.

The TMFA, working through the National Energy Technology Laboratory, will issue a call to the commercial sector for remote sizing technologies in early FY2001. The proposal selection process will be completed in the 2nd Quarter of FY2001 with a demonstration on a surrogate waste stream scheduled for April 2001. This accelerated schedule is being strongly supported by the National Energy Technology Laboratory and the end-users at the DOE's Hanford site.

Payload Enhancement for Transporting Transuranic (TRU) Waste within Regulatory Limits

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Technology Highlights

- Hydrogen Gas Getters
- Alternative Remote-Handled TRU Waste Transportation System
- Headspace Gas Sampling of Remote-Handled TRU Waste Containers

Transuranic wastes currently in storage at 27 DOE and non-DOE sites are scheduled to be shipped to WIPP for disposal during the next several years. To ensure safety during shipment, the Nuclear Regulatory Commission has imposed strict limits for flammable, volatile, and semi-volatile gas concentrations in TRUPACT-II and 72-B transport packages. One of their concerns is hydrogen gas buildup – the result of radiolysis of hydrogenous materials – and the potential for fire or an explosion during transport. The TRUPACT-II limits are set at 5% by volume for hydrogen in air and must be complied with for the sixty-day shipping period. The same hydrogen gas concentration requirements have also been imposed on the transport of remote-handled transuranic waste in the 72B cask.

Currently, it is estimated that 35% of the transuranic waste stored at the Idaho National Engineering and Environmental Laboratory, Los Alamos National Laboratory, and Rocky Flats Environmental Technology Site cannot be certified to meet the hydrogen gas limitations. It is expected there will be a significantly greater percentage at the Savannah River Site. The current options available for addressing drum repackaging or treatment are costly and inefficient given the size of the problem. Simplifying drum repackaging or reducing the need for repackaging could potentially result in cost-savings exceeding $600 million.

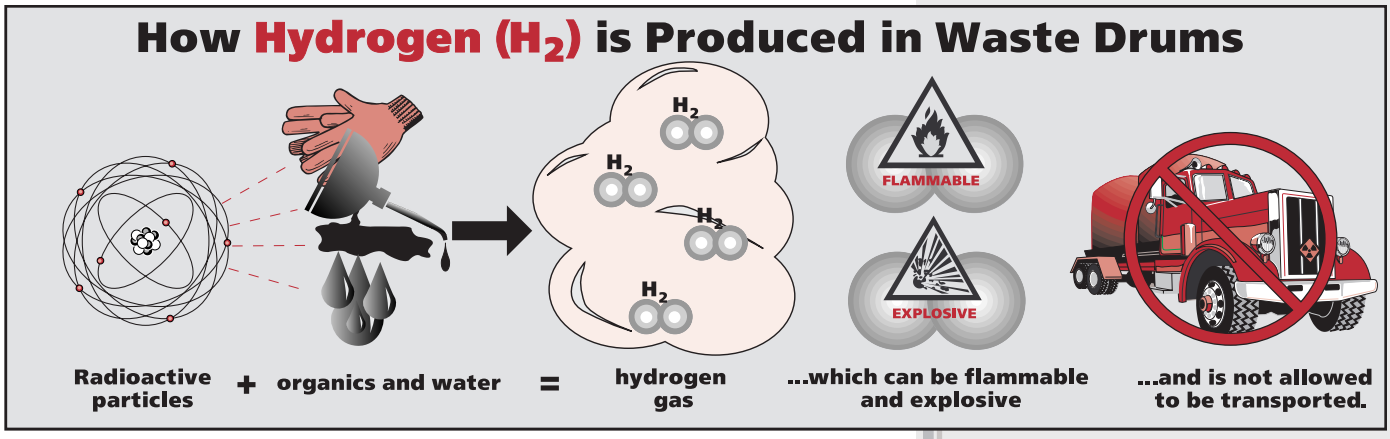
The TMFA, in cooperation with the DOE Carlsbad Field Office and the DOE's transuranic waste sites, is conducting several research and development efforts to reduce transuranic waste transport issues. These efforts include predicting hydrogen gas concentrations, and finding methods for removing problem gases from waste packages before or during shipment.

TRUPACT-II Matrix Depletion Program Final Report Completed

(Tech ID 2022)

The revised TRUPACT-II Matrix Depletion Program Final Report (INEEL/EXT-98-00987) was issued and submitted to the Carlsbad Field Office. The report documents the surrogate and real waste testing and modeling completed to support the revision of the TRUPACT-II Safety Analysis Report wattage limit tables. The wattage limits were identified to ensure each drum of waste does not exceed the flammable gas limits established by the Nuclear Regulatory Commission. The wattage limits are based on the waste type and packaging configurations.

The revised Safety Analysis Report has been submitted to the Nuclear Regulatory Commission for review. If the revised report is approved, a much greater percentage of the current contact-handled transuranic/mixed transuranic waste inventory can be certified for shipment to WIPP without requiring gas generation testing or repackaging/treatment.



Demonstrated

Composite Hydrogen Getter Materials

(Tech ID 2979)

A hydrogen gas getter package is being developed that will maintain the hydrogen concentration in transuranic waste drums at a safe level during shipment to WIPP and ensure that the flammable gas shipping limit is met. (Hydrogen gas getters are solid materials that chemically and irreversibly bind hydrogen.) Because of potential hydrogen buildup, high-curie drums require treatment or repackaging into multiple drums (from one to possibly hundreds) to meet the flammable-gas concentration limits. Using hydrogen getters in the shipping package will reduce the number of drums requiring repackaging, avoiding the associated costs for characterization, transportation and disposal of the additional drums.

In FY2000, the TMFA supported a call for proposals to identify potential getters for use in transporting transuranic wastes. The programs selected for funding involve the study of Polymer Encapsulated DEB (1,4-bis[phenylethynyl] benzene), Sol-Gel metal hydrides, and a polymer-based getter.

The initial development and testing of the Polymer Encapsulated DEB compound is being conducted jointly by the Idaho National Engineering and Environmental Laboratory and the Los Alamos National Laboratory. Current research focuses on developing an appropriate encapsulation material that will protect the compound from the gaseous poisons found in transuranic waste containers while selectively allowing the passage of hydrogen. Plans for FY2001 include identifying an appropriate encapsulation material and optimizing the encapsulation method.

The Sol-Gel metal hydride compound and the polymer-based getter also are being evaluated for application to transuranic waste transportation. The Sol-Gel metal hydride was originally developed to support tritium operations at Savannah River, but initial review showed applicability for the waste transport issue. The polymer-based getter is a commercially-available getter material currently used in applications such as vacuum insulation panels, heat transfer pipes, and batteries. FY2001 plans include optimizing one of these getter formulas and developing a deployment concept for the TRUPACT-II transport package.

Inner Layer Confinement Reduction Request for Proposals

(Tech ID 2999)

A request for proposals was issued in late 1999 for research, development, and demonstration of technologies that will minimize hydrogen gas buildup within contact-handled transuranic waste containers. Multiple layers of packaging within the containers restrict the release of hydrogen, resulting in potentially flammable or explosive mixtures within the drum.

The primary objectives of the Inner Layer Confinement Reduction (ICR) project are to deliver mechanisms or technologies that breach the inner confinement layers in 55-gallon drums and validate the breach.

The proposed techniques must accommodate the majority of waste packaging configurations within the DOE's stored transuranic waste inventory and must not impact the criteria for waste shipment or disposal at WIPP. Identification of waste surrogates and development of test procedures began in FY2000. Demonstrations of ICR concepts are planned for FY2001. It is expected that a successful demonstration could result in deployment within the year.

CNS 10-160B cask

Alternative Remote-Handled Transuranic (TRU) Waste Transportation System

(Tech ID 2975)

The CNS 10-160B cask provides an alternative, cost-effective methodology for transporting remote-handled transuranic and high-activity low-level wastes from small quantity sites to WIPP or to characterization/packaging facilities at larger sites. The 10-160B cask – a commercial Type B transportation cask – has the capacity to ship up to ten drums of remote-handled transuranic waste, a payload more than three times that of the 72B cask. The alternative cask does not require the construction of specialized facilities, and because more drums can be moved per shipment, overall costs are expected to be 60% less than with the use of the 72B cask.

The 10-160B cask can potentially support numerous small-quantity sites in meeting their cleanup milestones. It also provides new options for disposing of shielded overpacks as contact-handled transuranic waste at WIPP.

The 10-160B cask is scheduled for deployment in late FY2001 at Battelle Columbus Laboratories Decommissioning Project in Ohio. Deployment at the Energy Technology Engineering Center in California will follow. The development of the CNS 10-160B cask is an Accelerated Site Technology Deployment program supported by the TMFA.

Headspace Gas Sampling of Remote-Handled Transuranic (TRU) Waste Containers

(Tech ID 2031)

Research was completed to measure the hydrogen gas generation rate and the concentration of volatile organic compounds (VOCs) in the headspace of ten canisters loaded with remote-handled transuranic waste. The canisters are among a total of 17 canisters at Los Alamos National Laboratory packaged for shipment to WIPP. The canisters do not meet the decay heat limits identified in the *72B Safety Analysis Report*. If the gas generation testing results can verify the canisters meet shipping limits, the waste will not need to be repackaged to be certified for shipment to WIPP.

A shielded sampling apparatus was developed to obtain in-situ evolved gas samples from the ten canisters of concern to determine hydrogen gas generation and headspace VOC concentrations. Headspace hydrogen gas analysis was then performed at prescribed intervals to gather new data. Both this data and existing characterization documentation from these canisters were used to determine hydrogen gas generation rates. A determination was made that the rates were less than those listed in the *72B Safety Analysis Report*, and the canisters potentially can be shipped under this revision. The results of the research were sent to Carlsbad for review. The new gas generation methodology must be approved prior to obtaining approval for shipment. (WIPP is scheduled to begin accepting remote-handled transuranic wastes in FY2002.)

Initial hydrogen gas generation data for the Idaho National Engineering and Environmental Laboratory's newly packaged remote-handled transuranic waste is also being quantified. Two drums of characteristic, measured remote-handled transuranic hot cell debris, one combustible and one noncombustible, were prepared in the Argonne National Laboratory–East's Alpha-Gamma Hot Cell Facility. Four sampling and analysis campaigns were completed in an eight-month period to determine the characteristic gas generation information for this waste type. This data is currently being analyzed and a final report is expected in the first quarter of FY2001.

Monitoring and Removing Hazardous and Radioactive Contaminants from Off-gas Streams

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Off-gases created during mixed waste treatment and handling processes at DOE's thermal treatment facilities require careful monitoring. However, increasingly stringent regulatory permits, the public's concerns about off-gas emissions (which can include mercury, dioxins and furans, particulate matter, and multiple metals) and the EPA's Maximum Achievable Control Technology for Hazardous Waste Combustors (MACT) Rule have created a need for cost-effective emissions control and monitoring solutions. Because the diagnostic tools that can verify whether emissions can meet the MACT Rule often do not exist, facility operators must resort to periodic and costly sampling and analysis.

The compliance date for the MACT Rule is three years from the date of promulgation, September 30, 1999. This rule will directly impact DOE's high temperature waste treatment processes, including incinerators, melters, and calciners. Any equipment needed to comply with the emissions requirements set by the MACT Rule must be installed by September 2002. This means that solutions should be identified within the next 12 to 18 months.

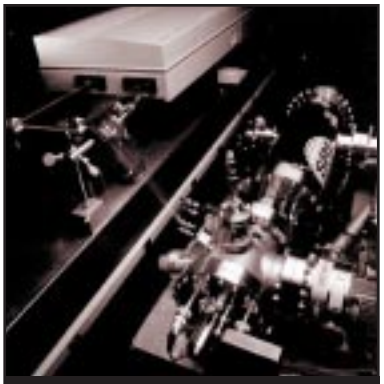
Technology Highlights

An interagency team – composed of the DOE, EPA, many universities, the Diagnostic Instrumentation and Analysis Laboratory at Mississippi State University, and private industry – is working to improve monitoring systems that sample, analyze, and report emissions in as near to "real time" as possible. The team is working closely with the EPA to develop more achievable performance specifications and to help refine proposed regulations as they are drafted. Additional efforts are also in progress, including improved off-gas filtration and modifications to facility operating procedures. To expedite these goals, current plans are to conduct demonstrations of new and available technologies at DOE's incinerators.

SRI REMPI Continuous Emission Monitor for Dioxins

(Tech ID 2305)

The SRI REMPI Continuous Emission Monitor for Dioxins project is developing an instrument to continuously monitor dioxins and furans, which form in the off-gas of thermal treatment systems, such as incinerators. The ultra-sensitive analytical technique, known as jet-cooled resonance enhanced multi-photon ionization (jet REMPI), will rapidly analyze incinerator emissions for the 17 identified toxic dioxin/furan compounds and directly measure them at parts-per-trillion levels without preconcentration. This technology will improve on the current EPA method, which requires four or more weeks for laboratory analysis. Originally in development for use in mixed waste treatment units, it is now destined for research to "fine tune" the treatment process.



REMPI Continuous Emission Monitor

SRI International is currently assembling a second mass spectrometer for use with the jet REMPI instrument. The new spectrometer will allow new designs for jet nozzles and ion extraction optics to be tested. A field test of this technology is expected within two to three years. The jet REMPI technology is being developed in collaboration with the DOE, EPA, Industry crosscut program (through the National Energy Technology Laboratory), and SRI International Corporation.

SAW Mercury Vapor Sensor

(Tech ID 2170)

The SAW (surface acoustic wave) mercury sensor may be a more reliable and less costly continuous emissions monitor for the DOE's treatment facilities. Its use is expected to help the off-gas control systems at the DOE's thermal treatment facilities comply with new emissions limits.

SAW Mercury Vapor Sensor

The SAW sensor's minimum detection limit has been established in laboratory conditions at less than 10 parts per billion for elemental and ionic mercury. Tests will be conducted in FY2001 using simulated off-gas to determine the sensor's performance when typical interferents are present. This technology is being developed by Sensor Research and Development through the National Energy Technology Laboratory's Industry Program.

Multistage Combustion NO_x Treatment System

(Tech ID 221)

The Multistage Combustion NO_x Treatment System – the NO_xidizer™ – is designed to remove or reduce the high levels of oxides of nitrogen (NO_x) found in off-gas from calcined or incinerated high-nitrate wastes before subsequent treatment of the off-gas for mercury. The treatment system is also designed to remove unburned hydrocarbons, dioxins and furans. These other contaminants are regulated, but are difficult to monitor and remove when NO_x levels are high.

The NO_xidizer™ is a two-stage, natural gas-fired high-temperature combustion system that uses two furnaces. In the first furnace, high temperatures (2000-2600° F) reduce the NO_x to nitrogen. Other byproducts from the first stage include carbon monoxide, water vapor, and unburned hydrocarbons. In the second furnace, air is introduced to produce virtually complete oxidation of the carbon monoxide and hydrocarbons, but the temperature is regulated to prevent formation of thermal NO_x. Both processes take less than three seconds.

Final assembly and systems operational testing of the NO_xidizer™ is underway in Butte, Montana at the DOE's Western Environmental Technology Office. A report of the first year's test results has been completed. Future studies will address the volume of off-gas and the fate of mercury and target organics in the NO_xidizer™. If multi-stage combustion is chosen as part of the high-level waste management process, completed testing will provide critical data for a new facility to process sodium-bearing waste at the Idaho National Engineering and Environmental Laboratory. The TMFA, DOE's Office of Waste Management, and MSE Technology Applications, Inc., of Butte, Montana, are participating in the development of this technology.

DIAL Research

Particulate matter continuous emissions monitors, required by the new MACT rule, will need to be calibrated to meet EPA protocols at facilities with HEPA filters. Research is underway to learn how particulate matter continuous emissions monitors perform when they follow a HEPA filter. The research also focuses on mechanisms of HEPA filter failure and whether particulate matter continuous emissions monitors can be used as failure or breakthrough monitors. The resulting information will be used to develop calibration techniques and compliance methodologies.

This research is taking place at the Diagnostic Instrumentation and Analysis Laboratory (DIAL) at the Mississippi State University, which provides support for basic and applied science projects in off-gas monitoring of multiple metals.

Demonstrated

Particulate Matter Continuous Emissions Monitors

(Tech ID 2135)

Continuous emissions monitors capable of accurately monitoring particulate matter will be required to help sites obtain and maintain operating permits, allowing the DOE's waste treatment facilities to continue to operate and meet various state compliance agreements. Though commercially available, particulate matter continuous emissions monitors have not been used in this country.

In FY2000, a comparative demonstration of available particulate matter continuous emissions monitors was completed at the TSCA incinerator at Oak Ridge. The TSCA incinerator is scheduled to burn sludge waste in the future and tests have shown that MACT emission limits cannot currently be met. Results of the demonstration will be used to determine which type of monitor is most suitable and to understand how to perform site-specific calibration. The EPA will use the results in their development of protocols for site-specific calibration and performance guidelines.

Alternatives to Incineration to Reduce Emission Hazards

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A New Strategy

The DOE announced plans to suspend radioactive and mixed waste incineration at Savannah River for at least five years, and to stop incineration of these wastes at the Idaho National Engineering and Environmental Laboratory and Oak Ridge in 2001 and 2003, respectively. Therefore, DOE's incineration capacity will be severely limited over the next five years and may be permanently eliminated.

The TMFA is leading an Alternatives to Incineration development team that will fully utilize the Office of Science and Technology's financial and technical resources to provide the DOE with fully integrated treatment systems for replacing incineration. The strategy is to:

1) Test and deploy relatively mature organic destruction/removal technologies to begin filling the gap as soon as possible

2) Put promising "next generation" treatment concepts into the technology development pipeline

3) Focus basic science research on long-term treatment needs.

The Alternatives to Incineration development team also includes the Western Environmental Technology Office, the Diagnostic Instrumentation and Analysis Laboratory at Mississippi State University, Florida International University, and the Robotics and the Characterization, Monitoring and Sensor Technology (CMST) crosscut organizations.

Incineration has been the baseline treatment technology for destroying organic materials in mixed wastes prior to waste stabilization and disposal. However, it is not an option when organically-contaminated wastes contain a contaminant such as mercury or for some classes of transuranic mixed wastes because of difficulties in controlling materials in the off-gas. Stakeholders and regulators have concerns about the incineration of actinide, PCB, and tritium-containing wastes and incineration's potential to produce dioxins and furans and to release volatile metals and radionuclides. Alternatives to incineration – generally involving oxidizing or destroying the hazardous organic materials under conditions that generate less off-gas – are being developed.

The TMFA has provided technical support to the DOE at several sites. At the request of DOE's National Low-Level Waste Center of Excellence, the TMFA inspected and toured the former Bureau of Mines Test Facility near Albany, Oregon.

Technology Highlights

- Alternative Oxidation Technology Savannah River Site Demonstration

Now managed by the DOE, the facility must reach compliance with RCRA. Waste at the site resulted from processing and storing ore samples containing naturally-occurring radioactive elements and metals considered hazardous under RCRA. To support this effort, the TMFA provided a recommendation for sampling, packaging, treating, and shipping the facility's accumulated mixed waste, and a strategy for working with regulators.

The DOE's Ohio field office also requested technical assistance. The Ashtabula, Ohio site, now closed, needed help in selecting a treatment path for low-level waste soil contaminated with PCBs. The TMFA helped organize a workshop, which included representatives from DOE's Ohio sites as well as local, regional and national regulators, and presented information for evaluation on several commercial sector treatment options. As a result, a path forward was identified: direct soil disposal as allowed by the recently promulgated PCB MEGA rule.

The TMFA also participated in a complex-wide analysis of waste stream data to determine the future need for the DOE's existing incinerators. Working in cooperation with the Environmental Management Office of Integration and Disposition, current incineration demands were identified and documented using mixed low-level radioactive waste information contained in the Integrated Planning Analysis and Budgeting System (IPABS) database. The amount of mixed waste having no treatment alternatives other than incineration was quantified, and a "path forward" was identified for wastes requiring either incineration or an alternative organic destruction method. Representatives and contractors from nine DOE field offices and sites analyzed the results at a workshop sponsored by the Office of Integration and Disposition in Golden, Colorado. The TMFA presented information on commercial and non-commercial alternative technologies that are nearly or currently operational, allowing the participants to match their waste streams with applicable alternative technologies and with the existing operating TSCA incinerator.

Alternative Oxidation Technology (AOT) Savannah River Site Demonstration

(Tech ID 2167)

The Savannah River Site has approximately 5,000 drums of combustible transuranic mixed waste contaminated with sub-micron plutonium-238, known as "job control" wastes. The waste includes clothing, tools, debris, soils, munitions, propellants, and plastics. For the waste to meet shipping requirements, the organic components must be destroyed so that hydrogen generation due to radiolysis can be reduced or eliminated. Because incineration is not an option due to concerns about off-gas emissions, the preferred treatment for this waste is an alternative oxidation technology.

The Savannah River Site, in partnership with the TMFA and National Energy Technology Laboratory, issued a Request for Information to the private sector for technologies that could potentially destroy the organics in this waste. A team of independent experts evaluated numerous responses and determined that both high- and low-temperature technologies have the potential to be successful.

In early FY2001, the National Energy Technology Laboratory will issue *Decontamination/Destruction Technology Demonstration for Organics in Transuranic Waste,* a solicitation for a competitive procurement based on the responses to the Request for Information. The goal is to demonstrate an integrated production-scale process that will support end-user implementation. The selected technology(s) must allow the shipment of treated waste to WIPP. Awards are scheduled to be made during April and May 2001.

The targeted waste stream for the demonstration consists of 5,200 cubic meters of mixed transuranic waste. The project will use a four-phase approach, with phases three and four dependent upon successful completion of phases one and two. In addition to a potential for cost reduction, a successful demonstration may be useful at other sites for problematic wastes requiring oxidation without incineration. Current plans are for the system to be designed in FY2001, with actual treatment scheduled for 2003. The project is estimated to take four years from the date of award.

Incineration Workshop

An incineration alternatives workshop, sponsored by DOE, was held in Denver, Colorado in May 2000. Its purpose was to evaluate the consequences of terminating DOE's three existing mixed waste incinerators by 2003. Workshop attendees – including representatives from the DOE-Ohio sites, Rocky Flats Environmental Technology Site, Savannah River Site, Oak Ridge, the Hanford Site, DOE-Albuquerque Nevada Test Site, the U.S. Navy, and the Idaho National Engineering and Environmental Laboratory – were requested to identify probable alternatives for inventoried waste streams.

A preliminary assessment of the workshop results indicated that most non-closure sites should not be affected by the termination of incineration. However, there may be insufficient commercial alternative capacity to meet the identified waste treatment demand.

Several promising alternatives to incineration have been developed, including the technologies shown here.

40-liter glass Acid Digestion pilot-scale reactor

Pilot-scale Direct Chemical Oxidation laboratory unit used in destruction of trichloroethane solvents

Unique Waste

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Approximately 10-15% of the DOE's mixed waste inventory cannot be prepared for disposal using existing capabilities. Regulatory requirements, stakeholder concerns, and resource limitations also result in disposal issues. Because there is a low volume of these problematic wastes, their disposition priority has been relatively low at most sites. Collectively, however, they represent a significant proportion of the DOE's mixed waste inventory.

There are three main areas of concern:

- Small quantities of problematic waste streams at many of the DOE's sites,
- Improved capabilities for treating and stabilizing mercury-bearing wastes, and
- Improved methods for treating salt- and ash-bearing mixed wastes.

In FY2000, the TMFA consolidated its work to provide end-users with specialized solutions for small-quantity problematic waste streams. The TMFA's strategy involves leveraging available commercial treatment capabilities, evaluating and applying technologies from previous DOE development efforts, and transferring available technologies between the DOE sites. In partnership with the Low-Level and Mixed Low-Level Waste Center of Excellence and other technical experts from across the DOE complex, the TMFA will issue directed Request for Proposals to both the private sector and DOE complex. The proposals will be used to perform treatability studies and deploy technologies that can address unique waste needs.

In FY2000, the TMFA began assisting the Idaho National Engineering and Environmental Laboratory's High-Level Waste Program in the early stages of their planning for the future vitrification of sodium-bearing waste. The TMFA provided the secondary waste team with advice on the treatment and disposal of generated wastes and steps were outlined to determine their suitability.

Technology Highlights

- ❑ **Mercury Removal With Polymer Filtration**
- ❑ **Mercury Separation from Organic Liquids using SAMMS Technology**
- ❑ **Mercury Stabilization Demonstrations (at concentration levels >260 ppm)**
- ❑ **Mixed Waste Debris Macroencapsulation Technology (ARROW-PAK™)**
- ❑ **Gas Recontainerization Skid**
- ❑ **Stabilizing Ash Using Clemson's Sintering Process**
- ❑ **Sepradyne – Thermal Desorption Process for Treatment of Dioxin**
- ❑ **Dissolvable Anti-Contamination Materials System**
- ❑ **Envirobond Stabilization of Wastewater Residues**
- ❑ **CIF Stabilization Technology**

Problematic waste streams include:

- Highly-energetic wastes (including water reactive, pyrophoric, high explosive, and miscellaneous wastes, such as those containing shock-sensitive materials)
- Radioactively restricted wastes (i.e., wastes with specific radioisotopes and concentrations in their matrices that restrict them from being accepted for disposition at WIPP or other available disposal facilities)
- Logistically prohibitive wastes (for example, wastes with ambiguous regulatory status or cost- or schedule-prohibitive treatment options)
- Miscellaneous unique wastes (for example, oversized articles, radioactively contaminated batteries, unsuccessfully stabilized wastes, and wastes that cannot be categorized, such as contaminated earth materials and compressed gas cylinders)

Treating and Stabilizing Mercury-bearing Wastes

Mercury is a complicating presence in many of the DOE's mixed waste streams. Because mercury is highly mobile and easily vaporized, its presence makes the design of waste treatment systems much more difficult. Removing the mercury would simplify treatment of these mixed waste streams and reduce cost and risk. The separated mercury would then need to be amalgamated or stabilized for disposal as a separate waste stream. Previously demonstrated technologies are being deployed in three areas: mercury amalgamation, stabilization, and separation/removal.

Mercury Amalgamation

The TMFA is continuing with a national elemental mercury treatment program, aimed at reducing costs by combining wastes from across the complex into a single treatment campaign. This effort has resulted in elemental mercury being added to the Broad Spectrum Phase II procurement at Oak Ridge. In addition, some vendors will team with permitted treatment facilities to deploy their demonstrated amalgamation processes. The TMFA will coordinate the shipments of waste from the sites.

Mercury Stabilization

The TMFA coordinated demonstrations of four stabilization processes for mercury-containing wastes with mercury concentrations of less than 260 parts per million. These demonstrations meet the EPA's Universal Treatment Standards for mercury waste. The TMFA will pursue the deployment of these processes through national contracts.

At the present time, stabilization is not allowed for mercury-containing wastes having concentrations of greater than 260 parts per million. Debris wastes can be macroencapsulated, but before soils and sludges can be stabilized, the mercury must be recovered through roasting or retorting. The cost of the double treatment is prohibitive and thermal processes are a concern because of possible gaseous mercury emissions.

Because the single most desirable treatment process appears to be stabilization, it must be demonstrated to be an environmentally sound alternative for wastes with mercury concentrations of greater than 260 parts per million. Through commercial contracts and in partnership with the EPA, the TMFA is coordinating the demonstration of mercury stabilization systems.

Mercury Separation and Removal

Most of the DOE's mixed waste contains other contaminants along with mercury. Because mercury's presence creates treatment complications and the EPA's new MACT rules may require mercury to be removed before incineration, a non-thermal mercury removal technology is crucial. The DOE's laboratories and commercial vendors are developing nonthermal methods for extracting mercury, focusing on those wastes destined for incineration. These include soft debris, organic liquids, and mercury-containing wastewater. The TMFA is supporting both this development effort and subsequent technology demonstration and deployment.

Mercury Removal with Polymer Filtration

(Tech ID 2041)

The Polymer Filtration process uses hydrogen peroxide or other mercury-mobilizing agents and a polymer complexing agent to remove mercury from mixed waste materials. The resulting solid wastes meet universal treatment standards for mercury, and the liquid wastes meet drinking water standards. The process can be applied to a variety of mercury-containing mixed waste streams, including soils, solid surfaces, sludges, pump oils, and solutions. After applying this process, subsequent waste treatment is much simpler and associated costs and risks are reduced.

The process dissolves mercury out of the waste matrices in an agitated water bath by complexing it with a polymer. The complexed mercury is removed from the wash solution using a filtration process and then chemically treated so the mercury is separated from the polymer. The mercury is then stabilized and the polymer recycled.

Bench-scale testing of the polymer filtration process was completed in FY1998 at Los Alamos National Laboratory. Several of the DOE's sites are interested in the application of this process. This technology has received support from the Industry crosscut program and is scheduled for deployment in FY2001.

Demonstrated

Mercury Separation from Organic Liquids using SAMMS Technology

(Tech ID 2047)

Self-Assembled Monolayers on Mesoporous Supports (SAMMS) material – a powdered mercury sorbent – was developed to remove mercury from organic liquid mixed waste streams. Five grams of SAMMS powder (about a teaspoon) has the total surface area of a football field. The use of this material prepares the organic portion of the waste for incineration and minimizes the volume of secondary waste, which can then be disposed of as a stable waste form.

The TMFA and the Decontamination and Decommissioning Focus Area combined efforts in FY2000 to demonstrate the use of SAMMS material on mercury-containing organic liquids at the DOE's Mound Facility in Ohio. The demonstration was conducted by the Large-Scale Demonstration Project, with technical support from the Oak Ridge National Laboratory. In FY2001, the TMFA will coordinate the deployment of SAMMS material for the treatment of 1000 gallons of mercury-contaminated, tritiated oil, and smaller quantities from other sites.

The SAMMS technology was developed by the TMFA in collaboration with the Efficient Separations crosscut program, Mercury Working Group, Pacific Northwest National Laboratory, and Oak Ridge National Laboratory. An Innovative Technology Summary Report is scheduled for publication in FY2001.

SAMMS technology

Mercury Stabilization Demonstrations (at concentration levels >260 ppm)

(Tech ID 2177)

The Mercury Working Group, in cooperation with the EPA, has completed three treatment demonstrations for "high-activity" mercury wastes. These demonstrations – three commercially available, the other developed by DOE – began in FY1999.

The demonstrations, using actual wastes from Brookhaven National Laboratory's Chemical Hole, are being compared against a retort process currently required by the EPA. They include:

- Low-temperature vacuum extraction (Raduce, Inc.) (Tech ID 2380)
- Aqueous-based stabilization (Nuclear Fuel Services, Inc.) (Tech ID 2229)
- Grout-based stabilization (Allied Technology Group) (Tech ID 2407)
- Sulfur polymer stabilization/solidification (Brookhaven National Laboratory) (Tech ID1678)

Results from the demonstrations will be used by the TMFA and EPA to support changes to mercury treatment regulations, which do not currently allow stabilization of mercury-containing wastes at concentration levels exceeding 260 parts per million.

Sepradyne completed its demonstration of low-temperature vacuum extraction in FY2000, processing fifteen 55-gallon drums of soil. The process reduced the total weight of the soils from 7,700 lbs. to 4,700 lbs., an approximately 3000-lb. reduction. Brookhaven National Laboratory has submitted the preliminary results for analysis.

The EPA is contributing additional funding to determine how the final waste forms from the demonstrated technologies will behave in various disposal scenarios. Innovative Technology Summary Reports for Raduce, Inc.'s low-temperature vacuum extraction process and Brookhaven's sulfur polymer stabilization/solidification technologies are planned for completion in FY2001.

Salt, Ash, and Small-Quantity Problematic Wastes

Portland cement is the baseline low-temperature stabilization technology used for much of the sludge, soils, and homogeneous solids that make up the DOE's mixed low-level waste inventory. Many of these waste streams, particularly waste streams produced as fly ash or scrubber blowdown from the DOE's incinerators, contain materials such as salts, excessive heavy metals, and unburned organics. A sufficient quantity of any one of these materials can cause premature degradation of the waste form or result in cement waste forms not setting at all. This problem is currently unsatisfactorily resolved by mixing a very small proportion of the waste material with the cement, which increases the final waste volume and the related handling and transportation costs, and consumes disposal capacity. New stabilization technologies that are capable of maintaining waste form integrity at higher waste loadings are needed.

New micro- and macroencapsulation and immobilization technologies are also needed for various other mixed waste streams, such as debris. These waste streams may or may not contain the same troublesome components existing in the salt and ash mixed waste streams.

The TMFA, in partnership with other Environmental Management organizations, has responded to these needs by coordinating the development and demonstration of several new stabilization materials. Included in these are ceramics and polymers, which increase waste loading and improve final waste form performance for both salt and ash waste streams. Other stabilization methods have also been developed, including polyester, phosphate bonded ceramics, enhanced cements, polysiloxane, sintered ceramics, polyethylene, sulfur polymer cement, iron phosphate ceramics, and Sol-Gels.

Information on these and other existing, newly developed, and commercial technologies, is being consolidated by the TMFA so potential end-users will be able to select technologies that can be further developed and adapted for their particular sites.

Several Innovative Technology Summary Reports have been written on these technologies and more are planned to be issued in FY2001.

Two Arrow-Paks are loaded for shipment

Deployed

Mixed Waste Debris Macroencapsulation Technology (ARROW-PAK™)

(Tech ID 2927)

The Mixed Waste Debris Macroencapsulation process is a recently-developed option for treating and storing mixed low-level waste debris. The method uses a high-density polyethylene tube, approximately 21 feet in length and 30 inches in diameter, called an ARROW-PAK™. The ARROW-PAK™ technology is capable of achieving a 25% volume reduction as compared to the conventional macroencapsulation approach. The process also allows on-site treatment of the waste, reduces storage costs, and protects the environment.

The mixed waste debris is loaded into 55-gallon drums, compacted, and then encapsulated with a low-volume, high-density polyethylene. This material provides a long storage life, comparable to or better than concrete. Once filled, the drums are crushed by a "supercompactor" into 12-inch thick "pucks". Three pucks can be loaded into a standard 85-gallon metal drum known as an "overpack", and seven overpacks will fit into each ARROW-PAK™. When it is packed, the ARROW-PAK™ can hold the equivalent of twenty-one 55-gallon drums of mixed waste debris.

In FY2000, the ARROW-PAK™ technology was deployed at the Oak Ridge Site to treat 1,392 drums of mixed waste debris and may be deployed in FY2001 on legacy mixed low-level waste debris. The ARROW-PAK™ system, another of the six Accelerated Site Technology Deployment programs supported by the TMFA, was deployed by Boh Environmental, LLC, in collaboration with the TMFA, Oak Ridge and Florida International University.

Gas Recontainerization Skid

(Tech ID 2016)

The Gas Recontainerization Skid is a skid-mounted (transportable) mechanical unit that characterizes the content of radioactively-contaminated compressed gas cylinders destined for disposal, and either vents or incinerates the gas, or transfers the contents to a new container. The unit is capable of treating cylinders of various sizes. Depending on the type of cylinder, the unit can treat from one to eight cylinders per day.

Gas Recontainerization Skid

The Gas Recontainerization Skid is in operation at Oak Ridge National Laboratory, treating an estimated 200 compressed gas cylinders. This site is the first of possibly several sites to deploy the technology as part of the TMFA's national treatment campaign for gas cylinders. This technology was developed at Los Alamos National Laboratory in partnership with the TMFA.

Stabilizing Ash Using Clemson's Sintering Process

(Tech ID 2037)

The Clemson's Sintering process is capable of sintering and stabilizing fly ash or other radioactively contaminated hazardous mixed waste solids and sludges. The waste is mixed with sized fractions of naturally-occurring Red Roan Formation material and proprietary plasticizers. The mixed material is then shaped and fired to produce the sintered ceramic final waste form. In some applications, this process accomplishes vitrification at temperatures lower than those typically required for melting, achieves higher waste loadings, and can be used on both wet and dry waste streams.

In FY2000, Phase II of the ash stabilization demonstration using the Clemson's Sintering process was completed on one 55-gallon barrel of actual mixed waste fly ash from the Idaho National Engineering and Environmental Laboratory's Waste Experimental Reduction Facility (WERF) Incinerator. The results of the demonstration were mixed. One-third of the fired batches had Toxicity Characteristic Leaching Procedure (TCLP) leach test results indicating a failure for lead. However, these brick waste forms bloated during firing and were already suspect. The Clemson team expects the remaining waste forms will pass both TCLP and dioxin/furan analysis.

The Clemson's Sintering process was developed by the TMFA in collaboration with Clemson University. Demonstrations were conducted with assistance from Idaho National Engineering and Environmental Laboratory personnel.

Sepradyne – Thermal Desorption Process for Treatment of Dioxin

(Tech ID 2380)

Sepradyne is a vacuum-assisted thermal desorption process, which stabilizes mixed wastes by separating volatile metals and organics from the waste matrices for further treatment. In some cases, the organics can be directly destroyed.

The TMFA is working with Raduce, Inc., the developer of Sepradyne, to demonstrate its effectiveness on reducing dioxins in mixed waste fly ash generated by the Idaho National Engineering and Environmental Laboratory's Waste Experimental Reduction Facility. The dioxins must be destroyed to concentrations below the regulatory limit of 1 part per billion.

The effectiveness of the Sepradyne process is based on Raduce, Inc.'s proprietary rotary shaft seal. This seal allows precise control of the vacuum and temperature levels through all phases of the process. (The Sepradyne process is also being investigated as an appropriate technology for mercury-contaminated soils and other waste matrices.)

The Sepradyne Thermal Desorption Process

Dissolvable Anti-Contamination Materials Processing System

(Tech ID 2929)

The Dissolvable Anti-Contamination ("anti-c") Materials Processing System uses a commercially available process to dissolve discarded anti-c clothing and other materials used in radioactively-contaminated applications. The anti-c material used for this process is a solid polyvinyl alcohol material. The liquid processing system will significantly decrease the current disposal volume of contaminated cloth materials and reduce the solid waste disposal costs associated with their incineration or macroencapsulation.

The new system easily dissolves the polyvinyl alcohol anti-c materials in hot water. Metal contaminants are then easily recovered from the wash solution to be processed with other methods.

The Dissolvable Anti-C Materials Processing System is an Accelerated Site Technology Deployment program supported by the TMFA. Contingent on funding, the system will be deployed at the Savannah River Site in FY2001.

Stabilization/Volume Reduction of Wastewater Residues

(Tech ID 2928)

Envirobond's phosphate-based technology was developed to stabilize more than 17,000 cubic feet of mixed wastewater treatment sludges at Rocky Flats Environmental Technology Site. The commercially-developed process uses a low-temperature process to convert RCRA hazardous materials present in the waste to insoluble phosphate complexes. The equipment necessary to retrieve and treat the waste is readily available, and consists of items such as pumps, de-watering systems, mixing units, and absorbent, stabilizer binding hoppers.

The Envirobond process may improve on the baseline cement-based stabilization methods, and does not produce a monolithic waste form. However, a demonstration of the Envirobond stabilization technology in FY2000 raised some concerns, and higher waste treatment priorities were identified. As a result, deployment was delayed until plutonium stabilizing efforts at Rocky Flats are completed satisfactorily and the TMFA's resources were reallocated. This technology was also an Accelerated Site Technology Deployment program supported by the TMFA in FY2000.

Development of CIF Stabilization Technologies

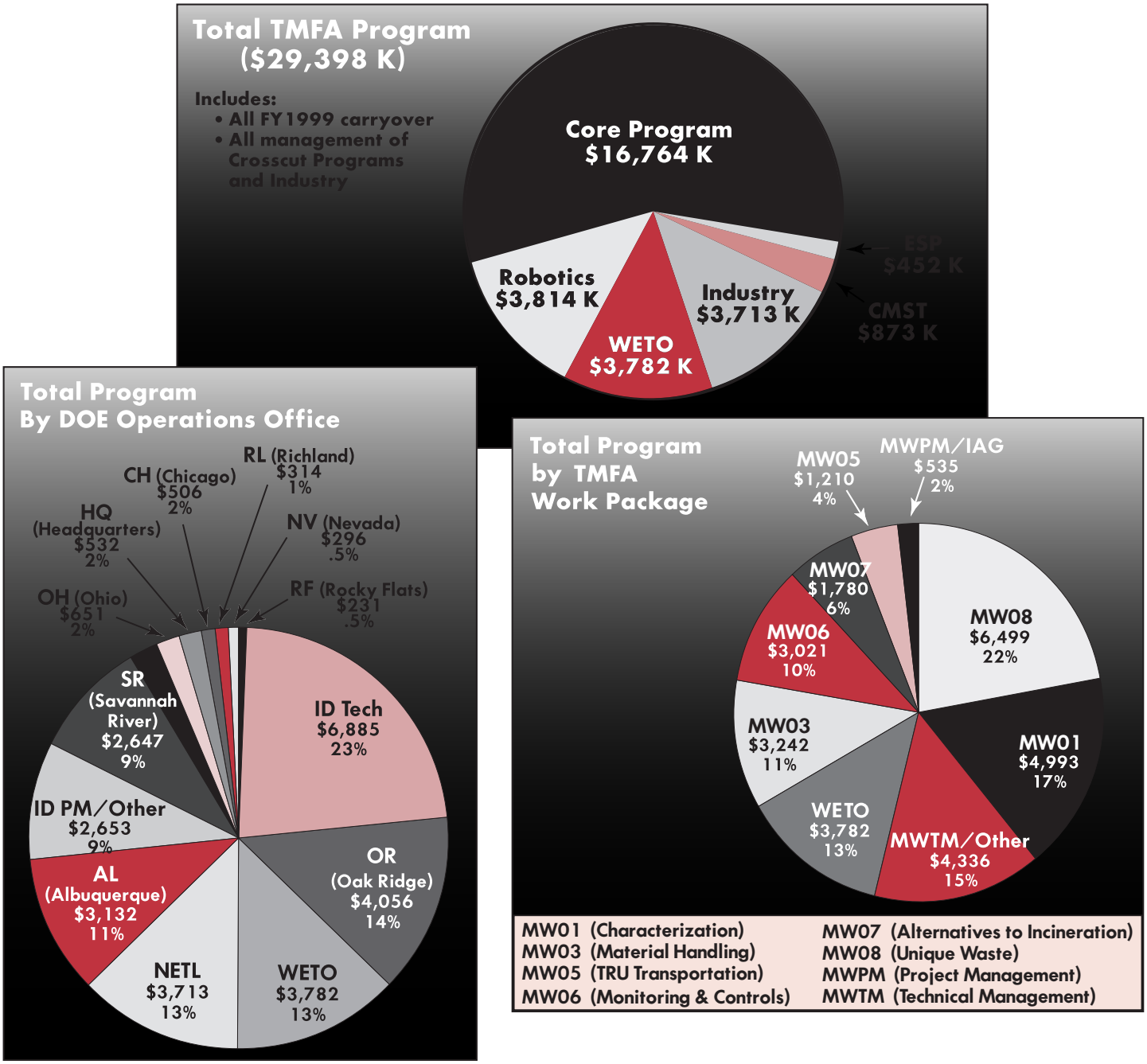
(Tech ID 2309)

A low-temperature stabilization technology is needed at Savannah River Site's Consolidated Incineration Facility (CIF). At the present time, the facility generates excessive amounts of mixed waste fly ash and off-gas scrubber blowdown, which cannot be effectively stabilized by the currently used cement grouting method. As a result, the facility's operations have been limited.

In FY2000, the TMFA supported the identification of technology options and equipment modifications, and the development of a process necessary to meet Savannah River specific waste acceptance criteria for fly ash and blowdown. However, efforts were terminated due to the DOE's suspension of operations at the Savannah River Site's Consolidated Incineration Facility later in FY2000.

CIF Stabilization

FY2000 Funding Distribution



FY2000 Environmental Management Science Projects

Project Name	Tech ID	Need Number	PBS Number	FY2000 Funding ($1,000)
Architectural Design Criteria for F-Block Metal Ion Sequestering Agents	54679	AL-07-01-10-MW	AL012, AL013	160
Basic Engineering Research for Dismantlement and Decommissioning of Reactor Storage Pond Sludge – Electrokinetics, Carbon Dioxide Extraction and Supercritical Waste Oxidation	64979	SR00-1007	SR-SW02	

PL01: Material Handling and Characterization Solutions

MW01: Nondestructive Characterization for Treatment, Transportation, and Disposal of MLL and MTRU Waste

Project Name	Tech ID	Need Number	PBS Number	FY2000 Funding ($1,000)
NDA of Boxes Containing TRU Waste	2146	AL-07-01-14-MW AL-07-02-06-MW AL-09-01-25-MW-S AL-09-01-06-MW OH-WV-901 OK99-06 RL-MW025 SR00-1003	AL012; AL013 AL017 AL012; AL013 AL012; AL013 OH-WB-02 OK-021 RL-WM04 SR-SW03	1,410
NDA Support of the Carlsbad Field Office's Demo Program	2017	AL-07-01-14-MW AL-07-02-06-MW ID-3.1.06 OH-WV-901 RL-MW025 SR00-1003	AL012; AL013 AL012; AL013 ID-WM-103 OH-WV-02 RL-WM04 SR-SW03	270
ASTD-Deployment of Combined Thermal/Epithermal Neutron (CTEN) LANL	1568	AL-07-01-14-MW AL-07-02-06-MW ID-3.1.06 OH-WV-901 OK99-06 SR00-1003	AL012; AL013 AL012; AL013 ID-WM-103 OH-WV-02 OK-021 SR-SW03	101
Multi-Detector Assay System (MDAS)	2052	AL-07-02-06-MW AL-09-01-24-MW-S CAO-99-04 ID-3.1.32 OH-WV-901 RL-MW013 RL-MW03 SR00-1003	AL017 AL013 CAO-4 ID-WM-103 OH-WV-02 RL-WM04 RF002 SR-SW03	293
NDA Conference	N/A			100
Nondestructive Assay Evaluation Support	N/A	AL-07-01-14-MW AL-07-02-06-MW AL-09-01-05-MW ID-3.1.06 ID-3.1.42 ID-S.2.02 OH-WV-901 RL-MW07-S SR00-1003	AL012; AL013 AL012; AL013 AL012; AL013 ID-WM-103 ID-WM-101 ID-WM-101 OH-WV-02 RL-WM04 SR-SW03	151
Characterization – RH-TRU (MDAS)	2052	AL-07-02-06-MW AL-09-01-24-MW-S CAO-99-04 ID-3.1.32 ID-S.1.05 OH-WV-901 RL-MW013 SR00-1003	AL017 AL013 CAO-4 ID-WM-103 ID-WM-103 OH-WV-02 RL-WM04 SR-SW03	358
Crate Surrogates	2163	AL-07-01-14-MW AL-09-01-06-MW AL-09-01-25-MW-S OH-WV-901 OK99-06 RL-MW025	AL012; AL013 AL012; AL013 AL013 OH-WV-02 OK-021 RL-WM04	467

(MW01, continued)

Project Name	Tech ID	Need Number	PBS Number	FY2000 Funding ($1,000)
Box Waste Assay System Characterization	2146	SR00-1003 AL-07-01-14-MW AL-09-01-06-MW AL-09-01-25-MW-S OH-WV-901 OK99-06 RL-MW025	SR-SW03 AL012; AL013 AL012; AL013 AL013 OH-WV-02 OK-021 RL-WM04	6
Transuranic Optimized Measurement System	2363	SR00-1003 SR00-1003	SR-SW03 SR-SW03	325
Ind/Univ. Projects: Westinghouse PGNAA Proposal	2226	AL-09-01-05MW ID-3.1.32 ID-S.202 ID-3.2.47	AL012; AL013 ID-WM-103 ID-WM-101 ID-WM-101	1215
1999 Carryover				**297**
TOTAL MW01				**$ 4,993**

MW03: Handling MW Contaminated Materials during Characterization, Treatment, Packaging and Disposal

Project Name	Tech ID	Need Number	PBS Number	FY2000 Funding ($1,000)
HANDSS-55	2083/ 1872/ 1664	AL-09-01-19-MW-S CAO-99-02 NV07-0001-03 RL-MW02 RL-MW04 SR00-1010 SR00-1012 SR00-1013	AL012; AL013 CAO-4 NV350 RL-WM04 RL-WM04 SR-SW02 SR-SW02 SR-SW03, SR-SW04	3,160
1999 Carryover				**82**
TOTAL MW03				**$ 3,242**

MW05: Payload Enhancement for Transporting TRU Waste within Restrictive Regulatory Limits

Project Name	Tech ID	Need Number	PBS Number	FY2000 Funding ($1,000)
Headspace Gas Sampling of RH-TRU Waste Containers LANL	2031	AL-09-01-16-MW	AL012, AL013	250
Demonstration of Potential Getters and Recombiners	2021	AL-09-01-17-MW AL-09-01-19-MW-S ID-3.1.33 ID-S.1.03 RF-SNM01 RF-WM03 SR00-1001	AL012; AL013 AL013 ID-WM-103 ID-WM-103 RF002; RF009 RF002 SR-SW02	165
Reduce Confinement Layers within Drums	TBD	AL-09-01-14-MW CAO-99-06 SR00-1001	AL012, AL013 CAO-4 SR-SW02	209
Effects of Beta/Gamma Radiation	2031	AL-09-01-16-MW	AL012, AL013	30
ASTD Deploying an Alternative Remote-Handled TRU Waste	2975	TBD		150
1999 Carryover				**406**
TOTAL MW05				**$ 1,210**
TOTAL PL01				**$ 9,445**

PL02: Non-Thermal Treatment Solutions

MW07: Alternatives to Incineration to Reduce Emissions Hazards

Project Name	Tech ID	Need Number	PBS Number	FY2000 Funding ($1,000)
Small Scale Delphi Detox Unit	106	AL-09-09-01-MW	AL012, AL013	1,412
Alternative Oxidation Technology (AOT) SRS Demo	2167	AL-08-01-17-MW AL-09-01-09-MW AL-09-01-10-MW RL-MW06 SR00-1007	AL012, AL013 AL012, AL013 AL012, AL013 RL-WM04 SR-SW02	60
Ind/Univ. Projects:				
Delphi Detox (MC29107)	106	AL-09-09-01-MW	AL012; AL013	274
1999 Carryover				**34**
TOTAL MW07				**$ 1,780**

MW08: Facilitating Deployment for Unique Waste

Project Name	Tech ID	Need Number	PBS Number	FY2000 Funding ($1,000)
ASTD Deployment of the Microchip Memory Button and Internal Pressure Sensing Technology	2976	ID-3.1.47	ID-WM-101	400
Treatment Demonstrations for High Mercury Wastes	2177	AL-07-01-07-MW CH-MW01-99 OH-F043 ORHG-05 RL-MW018 RF-WM14 SR00-1002	AL012, AL013 CH-BRNLRA OH-FN-10 OR-221 RL-WM04 Unknown SR-SW03	254
ASTD Deployment of Mixed Waste Debris Macroencapsulation Technology	2927	ORWM-23	OR-38111, 45301, 45302	2821
ASTD Enhanced Stabilization/Vol. Reduction Solar Pond	2928	TBD		1702
ASTD Dissolvable Anti-Contamination Materials Processing System	2929	SR00-1014	SR-SW07	222
Phase 2 WERF Ash Demonstration – Clemson Sintered Ceramic	2037	ID-3.1.41	ID-WM-101	75
Development of CIF Stabilization Technologies	2309	SR00-1019 SR00-1022	SR-SW01 SR-SW01	234
Crosscut Projects				
Mercury Removal from Mixed Waste Using Polymer Filtration	2041	AL-07-01-07-MW ORHG-05 RL-MW018	AL012, AL013 OR-221 RL-WM04	250
Mercury Removal from DOE Waste Organics	2047	AL-07-01-07-MW OH-M905 RL-MW018	AL012, AL013 OH-MB-02 RL-WM04	126
PNNL Support for Removal of Mercury from Organic Liquids	2047	AL-07-01-07-MW OH-M905 RL-MW018	AL012, AL013 OH-MB-02 RL-WM04	75
Ind/Univ. Projects				
UNDEERC Tech. Assessment (MC31388)	N/A	N/A	N/A	150
1999 Carryover				**190**
TOTAL MW08				**$ 6,499**
TOTAL PL02				**$ 8,279**

PL03: Thermal Treatment Enabling Solutions

MW06: Monitoring and Removing Hazardous and Radioactive Contaminants from Off-gas Streams

Project Name	Tech ID	Need Number	PBS Number	FY2000 Funding ($1,000)
Consolidated Incineration Facility (CIF)	22135	SR00-1018 SR00-1021	SR-SW01 SR-SW01	335
Microwave Plasma Continuous Emissions Monitor	1619	ID-2.1.18 ID.3.2.32 ORWM-13 SR00-1004	ID-HLW-101 ID-WM-101 OR38111 SR-SW01	707
Diagnostic Testing at the Toxic Substances Control Act Incinerator	2135	ORWM-13 ID.2.1.18 ID.3.2.32 SR00-1004 SR00-1023	OR38111 ID-HLW-101 ID-WM-101 SR-SW01 SR-SW01	255
Crosscut Projects Development of AOTF Multi-Element Metal CEM	1564	ID-2.1.18 ID-3.2.32 ORWM-13 SR00-1004	ID-HLW-101 ID-WM-101 OR-411 SR-SW01	284
Ind/Univ. Projects SRI REMPI Dioxin Monitor (FT40370)	2305	ID-2.1.18 ID-3.2.32 SR00-1004	ID-HLW-101 ID-WM-101 SR-SW01	513
SRDCC: SAW HG Vapor Sensor (FT34316)	2170	ID-2.1.18 ID-3.2.32 ORWM-13 SR00-1004	ID-HLW-101 ID-WM-101 OR-411 SR-SW01	940
1999 Carryover				**(13)**
TOTAL MW06				**$ 3,021**
TOTAL PL03				**$ 3,021**

PL04: Program Management/Other

Project Name	Tech ID	Need Number	PBS Number	FY2000 Funding ($1,000)
IAG-EPA/DOE	N/A			200
MWFA Program Integration	N/A			1013
MWFA Technical Program Support	N/A			1257
Regulatory National Technical Program	N/A			379
Crosscut Management Funds	N/A			1,684
1999 Carryover				**338**
TOTAL PL04				**$ 4,871**

Controlled Emissions Demonstration Project	221			$3,782

Total Technical Program	**$ 24,527**
Total TMFA Program Management	**$ 4,871**
Total	**$ 29,398**

TRU & Mixed Waste Focus Area

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