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Office of Environmental Management
Office of Science and Technology

DOE/EM-0512

Tanks Focus Area FY1999 ANNUAL REPORT

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Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

November 10, 1999

Subject: Tanks Focus Area (TFA) Program Message

Fiscal Year (FY) 1999 was another year of accomplishment and growth for the TFA. The TFA provided extensive technical and scientific assistance to its users and effected the deployment of 27 TFA technical solutions and 5 crosscutting technical solutions for tank waste cleanup. In addition to these technical accomplishments, the TFA focused on strengthening several core programmatic values by emphasizing the focus area–centered approach. This approach, which makes the focus area the central point of contact for science and technology resources, has produced the following improvements:

- emphasis on an integrated portfolio, from basic science through deployment;
- improved integration of crosscutting programs into the focus area systems;
- strengthening of performance measures; and
- continuing emphasis on providing a full suite of technical solutions, including technologies, as well as scientific data needed for defining baselines, reducing risks, and improving cleanup processes.

It has been a pleasure to work with the TFA team and users across the complex, integrating the corporate knowledge of the site program managers, technology developers, and the users in the field. Partnering among these groups has fostered continued improvement and additional technical solutions that meet high-priority needs while delivering the best technical solutions for tank cleanup.

In FY 2000, it remains the goal of the TFA to continue a needs-driven process, which will ensure the users' science and technology needs are being met. In addition, the TFA will focus on maintaining a balanced program that is poised to meet future needs, while continuing to focus on providing the most efficient and comprehensive program possible.

Thank you for your continued support of the TFA!

Ted Pietrok

Theodore (Ted) P. Pietrok, Team Lead
Tanks Focus Area

The Tanks Focus Area works to implement solutions to users' needs

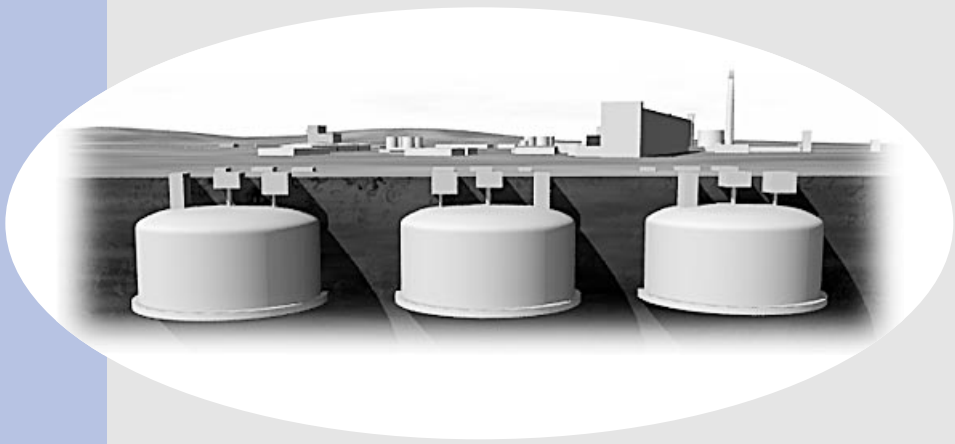
Technical solutions working to effect tank cleanup

The U.S. Department of Energy (DOE) continues to face a major radioactive waste tank remediation effort with tanks containing hazardous and radioactive waste resulting from the production of nuclear materials. Some 346 million liters containing nearly 700 million curies of waste is stored in 289 tanks across the DOE complex in the form of solid, sludge, liquid, and gas. Radioactive waste storage tank remediation is the nation's highest cleanup priority.

Differing waste types and unique technical issues require specialized science and technology to achieve tank cleanup in an environmentally acceptable manner. Some of the tank contents have reacted to form flammable gases that pose additional safety risks. The challenge is to characterize and maintain these contents in a safe condition and continue to remediate and close each tank to minimize the risks of waste migration and exposure to workers, the public, and the environment.

In 1994, the DOE's Office of Environmental Management (EM) created a group of integrated multiorganizational teams focusing on specific areas of the EM cleanup mission. These teams have evolved into five focus areas managed within EM's Office of Science and Technology (OST):

- **Tanks Focus Area (TFA)**
- Mixed Waste Focus Area
- Deactivation and Decommissioning Focus Area
- Nuclear Materials Focus Area
- Subsurface Contaminants Focus Area

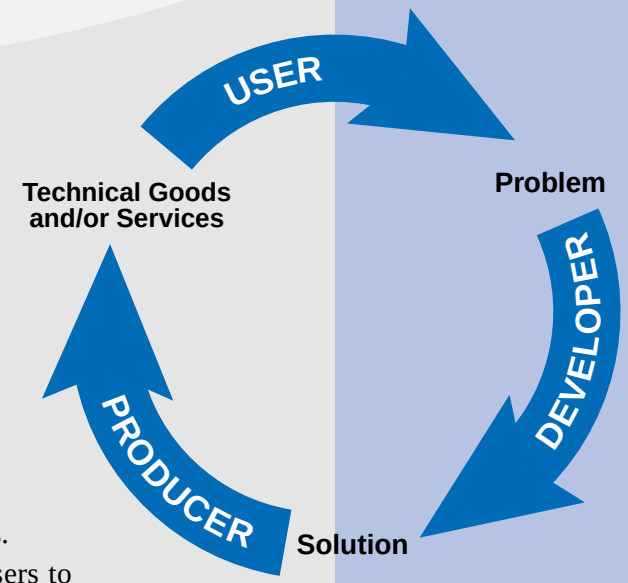


The Tanks Focus Area Vision—Enable tank cleanup at DOE sites

The **TFA Mission** is to deliver integrated technical solutions that enable tank waste remediation to be successful across the DOE complex.

The Tanks Focus Area

- brings together the sites' users, technical experts, and efficient management concepts to execute the mission;
- integrates efforts across the sites and utilizes multiple funding organizations; and
- builds teams of users and providers to deliver and deploy technical solutions.



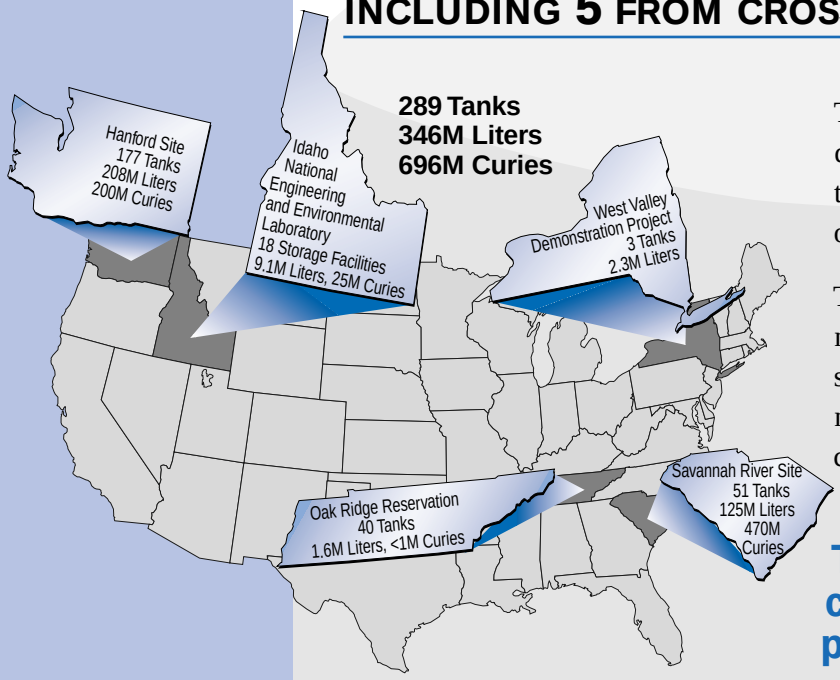
To accomplish this mission, **TFA Goals** include working to increase OST's funded results, reduce programmatic and technical risk, and pursue contingency or alternative technology approaches. The TFA team executes the focus area mission by working with users to deliver technical solutions using an integrated approach to safely and efficiently accomplish tank waste remediation across the DOE complex. TFA seeks to

- provide technical solutions to enable and enhance tank waste remediation,
- respond to the unique technical challenges inherent to the radioactive tank waste mission, and
- work with users and program partners throughout the tank waste remediation process from problem identification to implementation of technical solutions.

The Tanks Focus Area is committed to providing critical technical solutions, ranging from scientific data to deployed technologies, to support cleanup projects at all stages of development and execution.

—Ted Pietrok, Tanks Focus Area Team Lead

TFA achieved 32 deployments in FY 1999, including 5 from crosscutting programs



TFA manages a solutions-oriented program to develop and implement technical solutions to tank waste remediation as defined by the needs of site users.

The TFA program is effective because it maximizes the synergy among OST technical solutions developed for the needs of EM's five major waste tank sites within the DOE complex.

Technical solutions are categorized in five specific process steps

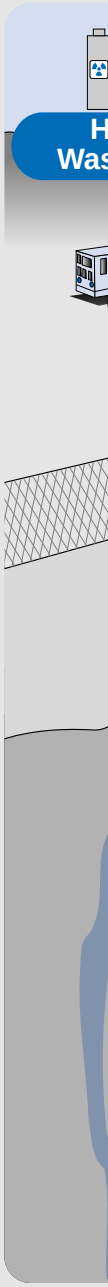
Safe Waste Storage—TFA is supporting sites' efforts to resolve technical issues associated with safe waste storage. Each site requires improvements in monitoring tank integrity, preventing tank corrosion, ventilating tanks, and characterizing tank waste. Waste minimization technologies are also being implemented to reduce the volume of waste being added to the tanks. TFA is investing in characterization tools that will enable a more proactive approach to monitoring the conditions of the tanks.

Collaboration with the Tank Focus Area has been instrumental in our Gunite and Associated Tank waste retrieval activities.

—Gary Riner, DOE Oak Ridge Reservation

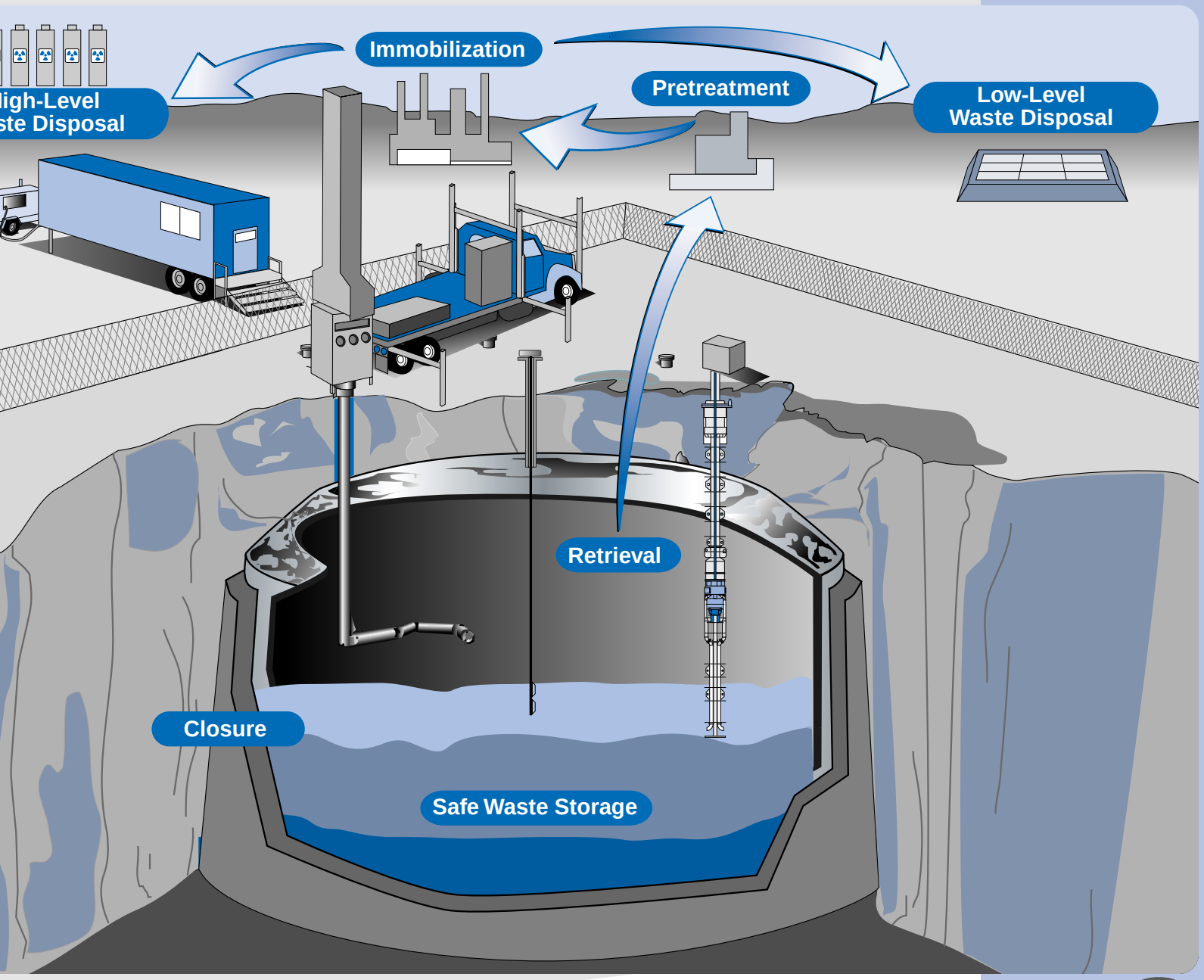
Retrieval—Most remaining tanks require waste retrieval before closure. This must be accomplished with minimal impact on other tanks' cleanup activities and downstream waste processing. Waste types include solid, sludge, liquid, gas, and miscellaneous debris, each type and combination presenting unique challenges. Retrieval requires remotely controlled equipment operations with tools able to enter underground tanks through small openings. Retrieval processes must also avoid causing waste to congeal or solidify and then plug transfer pipes. TFA is developing methods that retrieve hard, solid waste at tank bottoms ("heels") without adding water, while still enabling optimal transfer and treatment properties.

Closure—Closure of tanks has become important to sites' baseline plans for reducing costs and accelerating cleanup while reducing the potential for release of wastes to the environment. The current baseline practice for closing tanks is to fill them with a grout formulation to immobilize tank waste residues. Technical solutions are being used to stabilize residual waste and provide structural integrity and isolation for emptied tanks. TFA is developing characterization solutions to support the negotiation of closure criteria within regulatory constraints and cleaning methods that do not introduce excess water or chemicals with undesirable effects on downstream processes.



Pretreatment—Once retrieved, waste must be immobilized into a stable waste form. However, directly immobilizing all retrieved waste without pretreatment steps would be unnecessarily expensive and exceed planned storage space. Therefore, TFA is developing waste minimization solutions to separate waste types and reduce high-level waste volumes.

Immobilization—Sites must immobilize their waste into solid and stable forms that prevent release of radioactivity or hazardous chemicals. The highly radioactive waste is melted into a durable, vitrified (glasslike) form to isolate it from the environment. The less hazardous radioactive waste is immobilized through grouting. TFA continues to provide information to DOE to enhance glass formulations, melter performance, and waste product performance.



TFA USES THREE KEY MANAGEMENT CONCEPTS

• *User driven* • *Lead laboratory* • *Leveraged partnerships*

These management concepts support EM's operating philosophy and organizational structure.

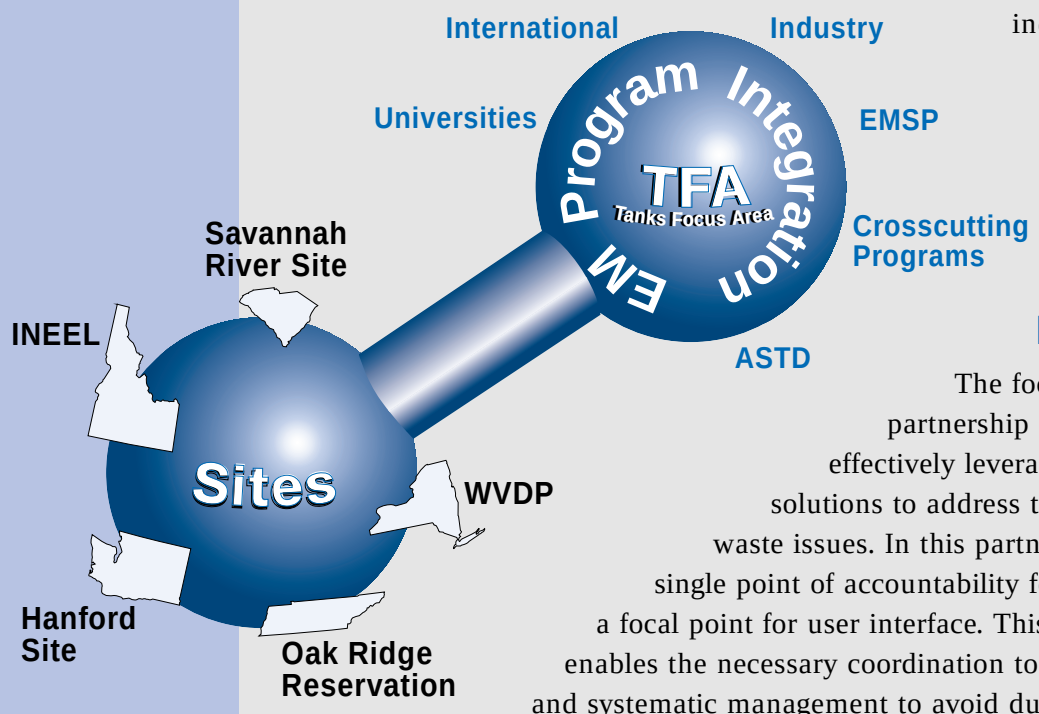
Management Team Driven by Users' Needs

The TFA Management Team consists of DOE site representatives from each of the five TFA sites; the program lead, which is a part of DOE Richland Operations Office; and DOE Headquarters representatives from OST. The TFA Management Team has several operational philosophies:

- Accountability of the TFA program to the site users
- Acceptability of technical solutions by the user for deployment
- Integration of users with the environmental remediation industry

Lead Laboratory

TFA uses a lead laboratory concept wherein the Technical Team, led by Pacific Northwest National Laboratory and six partner laboratories, is teamed with DOE in implementing the program. The Technical Team engages subject matter experts from several DOE laboratories, private industry, and universities as appropriate. The lead laboratory supports TFA by providing technical management guidance.

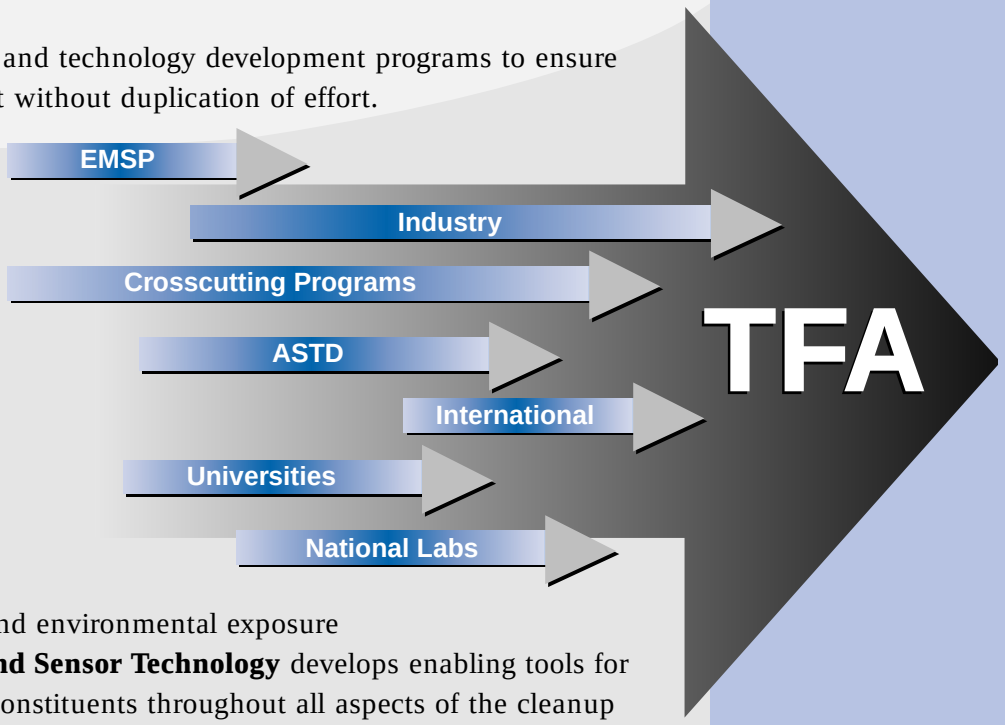


Focus Area–Centered Partnership

The focus area–centered partnership allows TFA to more effectively leverage resources for technical solutions to address the nation's radioactive tank waste issues. In this partnership approach, TFA is the single point of accountability for tank cleanup and acts as a focal point for user interface. This partnership concept enables the necessary coordination to deliver effective solutions and systematic management to avoid duplication of resource investment. Each partner of TFA facilitates the transition of science and technology from basic research to implementation.

PARTNERSHIP PROGRAMS SUPPORT THE FOCUS AREA–CENTERED APPROACH

TFA actively participates in science and technology development programs to ensure that users' needs are effectively met without duplication of effort.



Crosscutting Programs—The OST focus areas share three common science and technology disciplinary needs:

- **Efficient Separations and Processing** enable segregation of waste by distinct chemical and physical properties
- **Robotics** utilizes remotely operated machines to characterize and handle wastes, preventing unnecessary human and environmental exposure
- **Characterization, Monitoring, and Sensor Technology** develops enabling tools for identifying and analyzing waste constituents throughout all aspects of the cleanup processes

Industry Programs—Through DOE's National Energy Technology Laboratory (formerly the Federal Energy Technology Center), private-sector companies partner with TFA to work cooperatively in developing technical solutions for deployment at DOE sites

University Programs—Coordinates research and developmental technology programs that foster relations between universities and industry for advancement of science and engineering capabilities

International Programs—Augments DOE's investments in technology, performance data, and resources that provide solutions based on lessons learned in waste remediation from other nations

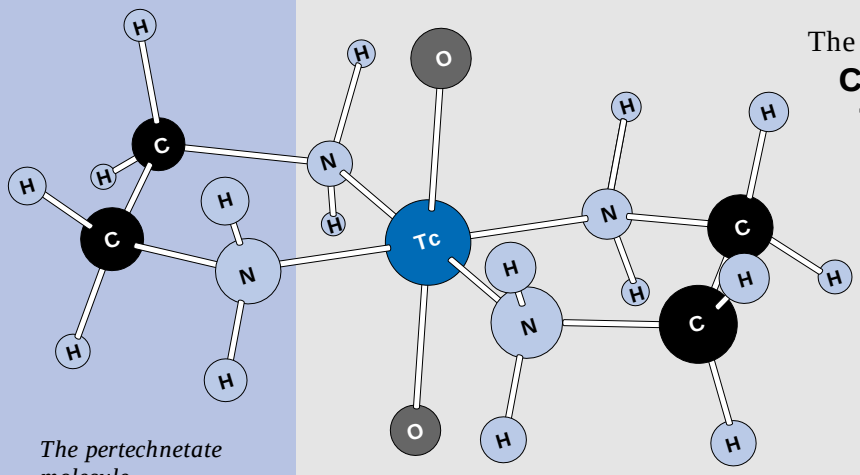
Environmental Management Science Program (EMSP)—Focuses on integration of scientific research that develops into innovative technologies through organizational and interdisciplinary methods

Accelerated Site Technology Deployment (ASTD)—Facilitates the implementation of technical solutions to high-priority issues across the DOE complex

The following pages provide further detail on EMSP and ASTD.

Environmental Management Science Program

Since 1996, EMSP has conducted approximately 70 projects with the focus areas addressing DOE's radioactive materials as a primary problem area. With EMSP, TFA strives to support strong programmatic and technical links to provide mechanisms through which science information can be communicated to the users and employed to impact cleanup actions. Turning science research into deployable technical solutions is critical to the success of TFA and EMSP. Projects include a focus on short-term environmental problems, as well as solutions for longer-term, strategic user needs.



The pertechnetate molecule.

The EMSP project **Fundamental Chemistry, Characterization, and Separation of Technetium Complexes in Hanford Waste** seeks to characterize the major classes of technetium formed under tank waste conditions and study their reaction chemistry. These complexes will then be used as standards to characterize chemical species using a specialized characterization technique. This project is intended to provide basic information on chemical processes, which should help facilitate the development of innovative nonthermal processing technologies related to radioactive tank waste.

Other examples of ongoing EMSP projects:

- ***Detection and Characterization of Chemicals Present in Tank Waste***, developing innovative microsensors that can be used for in situ chemical characterization and measurement of physical parameters based on a combination of gravimetric, photoinduced, and photothermal detection
- ***Stability of High-Level Waste Forms***, developing a basic understanding of the phase equilibria and solid solution behavior of the constituents of radioactive waste forms and modeling that behavior
- ***Interfacial Radiolysis Effects in Tank Waste Speciation***, providing basic information on nonthermal interfacial processes, which will facilitate the development of nonthermal processing technologies related to radioactive waste

We have the entire periodic chart in here—radioactive tank waste is the most complex chemical form you'll ever deal with.

—Dr. William Holtzscheiter, Westinghouse Savannah River Company

Accelerated Site Technology Deployment

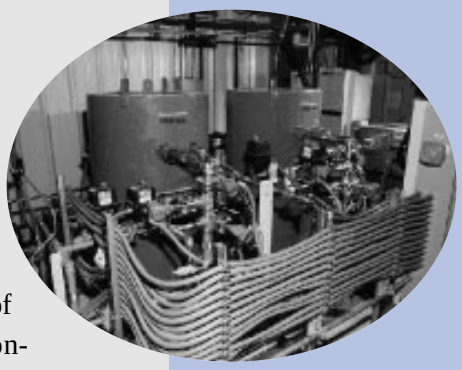
ASTD was established in 1997 to expedite the use of innovative technical solutions to achieve cleanup goals identified by users. In FY 1999, ASTD was more fully incorporated into the focus areas, which acted to facilitate and integrate ASTD projects.

Under an ASTD project at the Oak Ridge Reservation, a pretreatment system that consists of three TFA-developed technical solutions is processing stored and newly generated tank waste for more effective immobilization results.

- **Crossflow Filtration (OST/TMS ID 350)** is a separation process that segregates undissolved solids from supernatant, supporting downstream processing operations for both liquids and solids and preventing carryover of radionuclides. Crossflow filtration has demonstrated higher throughput and greater reliability than other separation methods.

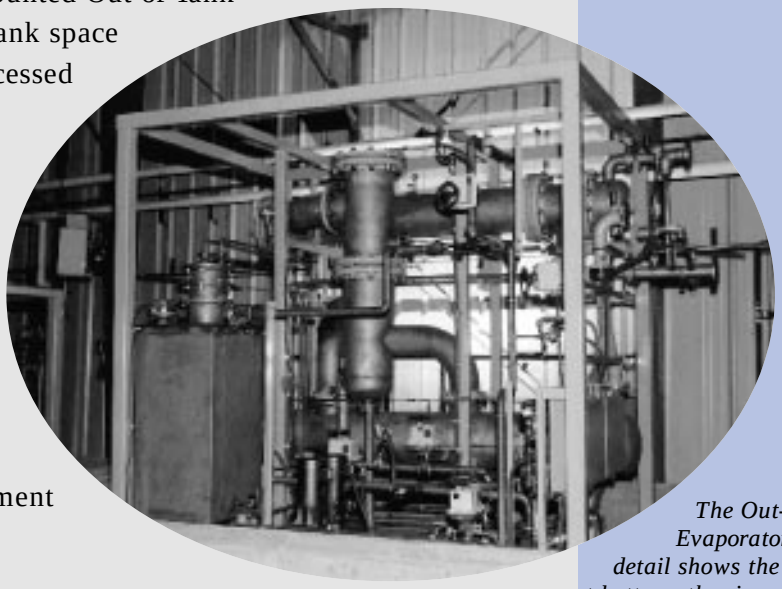
- **Cesium Removal Using Crystalline Silicotitanate (OST/TMS ID 21)** The crystalline silicotitanate (CST) process is an efficient method for removal of cesium from tank waste supernatant. The compact, modular unit consists of ion-exchange columns packed with CST, a highly selective inorganic sorbent. Cesium is trapped in the sorbent as waste flows through successive columns.

- **Out-of-Tank Evaporator (OST/TMS ID 20)** reduces radioactive tank waste inventory that occupies valuable storage space needed for liquid removed from leaking storage tanks and for newly generated waste. A significant amount of this dilute liquid can be evaporated. The skid-mounted Out-of-Tank Evaporator concentrates waste, conserving tank space and reducing the volume of waste to be processed during supernatant immobilization.



Ion-exchange columns for cesium removal.

Following successful filtration of waste using Crossflow Filtration, waste processing began in the adjacent Cesium Removal System and Out-of-Tank Evaporator. By mid-June, the integrated system had processed 33,540 gallons of liquid low-level waste. These technologies will be operated in series at the Oak Ridge Reservation through 2001 or until waste consolidation is complete. The pretreatment system is applicable at three other TFA sites.



The Out-of-Tank Evaporator in this detail shows the reboiler at bottom, the riser with the mist eliminator, and the condenser module on top. The system can produce 90 gallons per hour of clean distillate, which can be treated and released, freeing up tank space.

Fiscal Year 1999 Accomplishments

- 32 Deployments in actual radioactive tank waste remediation environments (including 5 from crosscutting programs)
- 5 Demonstrations in mock-up or simulated deployments (including 1 from a crosscutting program)
- 12 Ready for Implementation, proven technical solutions that are validated for use at DOE sites

The following highlights describe some exemplary technical solutions for each of TFA's five process steps. Technologies are accompanied by their reference numbers in OST's Technology Management System (OST/TMS ID), which provides access to data and information relevant to EM programs, technical solutions, cleanup problems, and sites. TFA has nearly 100 listings in the TMS database, viewable on the OST Web site at http://tms.em.doe.gov.

The Savannah River Site is using the Raman Probe's chemical analysis capability to monitor corrosion of waste tanks. The probe has two channels, one for laser excitation and one for signal collection.

Safe Waste Storage

Raman Probe (OST/TMS ID 2015) is tested in the Savannah River Site hot cell

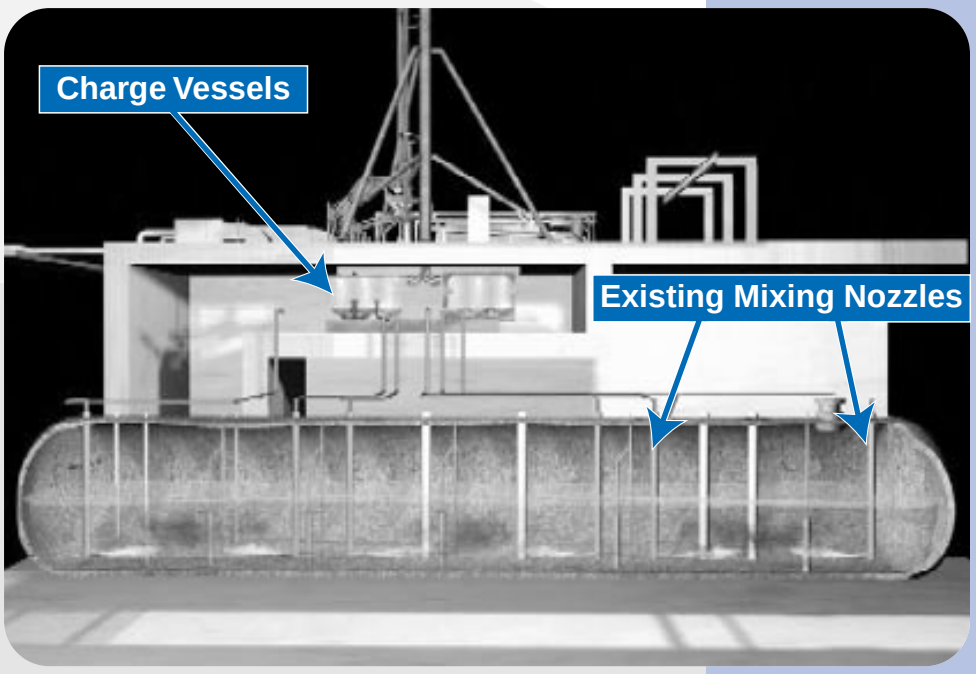
Radioactive and hazardous wastes are stored in hundreds of tanks that are susceptible to corrosion cracking induced by chemical ions. Maintaining safe ion levels can prevent this degradation. Current methods for corrosion control are costly and can introduce excess liquids (corrosion inhibitors) into the tanks, resulting in an increased waste volume requiring treatment and disposal. TFA is partnering with the Characterization, Monitoring, and Sensor Technology Crosscutting Program to develop a hybrid probe that will aid in controlling corrosion with the addition of less corrosion inhibitor to the tank contents.

Alternative Filtration Technologies (OST/TMS ID 2091)

Conventional high-efficiency particulate air (HEPA) filters, made of paper filter media, are used throughout the DOE complex to reduce air emissions with radioactive particulates. Alternative Filtration Technologies such as HEPA filters constructed of sintered stainless steel or ceramic filtering media will provide durable filtration systems that are less susceptible to moisture damage, can be cleaned for reuse, and minimize spent filter waste. These alternative HEPA filters can be installed with built-in water jets for self-regeneration. Replacing traditional HEPA filters with the Alternative Filtration Technologies will also reduce radiation exposure to workers, minimize waste filter handling and processing, and provide an overall cost reduction.

Retrieval

AEA Fluidic Pulse Jet Mixer (OST/TMS ID 1511) mobilizes tank waste at Oak Ridge



AEA Fluidic Pulse Jet Mixer.

The Fluidic Pulse Jet Mixer (developed by AEA Technology, an international company based in the United Kingdom) performs a number of tasks for TFA site users, including bulk mixing to maintain the suspension of solids and the blending of process liquids. The mixer can combine a tank's available liquid waste with the sludge to form homogenized slurries suitable for pumping during tank waste retrieval activities. The technology has no moving parts exposed to tank contents, minimizes the need to add liquid, and can also utilize in-tank piping where available.

February 1999 demonstrations at the Oak Ridge Reservation successfully transferred waste to a more secure storage area and demonstrated the successful application of the Fluidic Pulse Jet Mixer for DOE's underground storage tank remediation work. This TFA technology demonstration shows International Programs' ability to successfully introduce effective technical solutions for DOE sites.

Pulsed-Air Mixer (OST/TMS ID 1510)

The Pulsed-Air Mixer introduces pulses of air near the tank floor using large horizontal, circular plates positioned just above the tank floor. Pipes deliver gas to each plate's center from adaptations of commercially available pulsing valves. This technology suspends solids that have settled to the tank floor and maintains a unified suspension for slurry mixing applications. Demonstrated at the Oak Ridge Reservation in FY 1999, the system was successfully operated to mix tank contents to obtain more representative samples in tanks with separated waste layers.

The AEA Technology system has been a great success. The partnership between AEA Technology, the Energy Department, and the Tanks Focus Area in cleaning out three of the Bethel Valley Evaporator Service Tanks enabled the work to be accomplished at a fraction of the original estimate.

—Cavanaugh Mims, DOE Oak Ridge Reservation

Closure

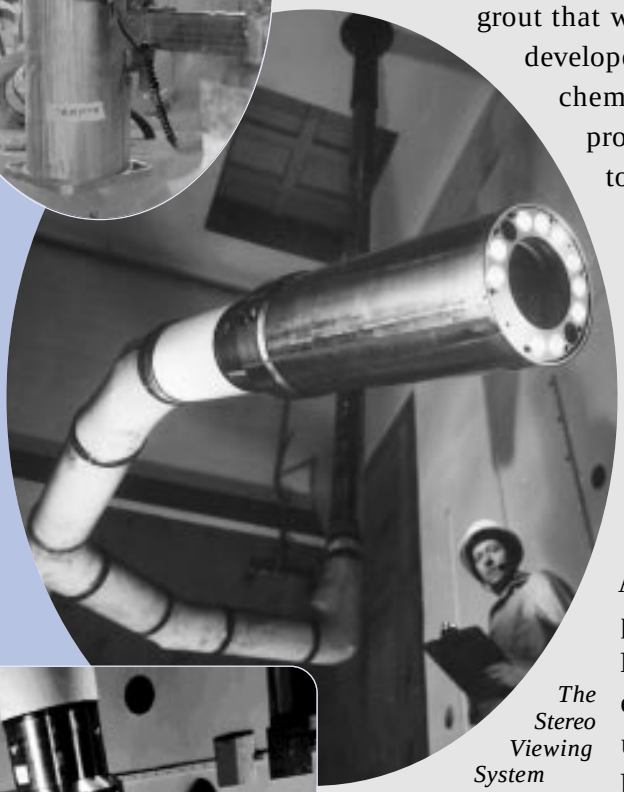
Light Duty Utility Arm System (OST/TMS ID 85) and End Effectors (OST/TMS ID 890, 278, 2386, 2394, 2393) facilitate tank surveillance and closure

Idaho National Engineering and Environmental Laboratory (INEEL) plans to close at least two tanks by grouting the heel in place. The liquids in the INEEL tanks are known to be acidic. Potential problem constituents are borates, phosphates, permanganates, and sulfates, which can be challenging to treat. To develop a grout that will mix with the heel, solidify, and remain stable, developers need heel samples to characterize the quantity and chemistry of the waste. Waste samples from tanks will also provide information about waste constituents that is required to prepare a closure plan for the INEEL tanks.

For other tanks to remain in service throughout their planned life span, their integrity and degree of corrosion need to be surveyed. Operations would involve retrieving corrosion samples, conducting weld inspections, and using end effectors (robotic tools) to examine the tank floor under the waste.

In FY 1999, a Light Duty Utility Arm (LDUA) was deployed through a 12-inch riser into a tank at INEEL. A Stereo Viewing System (OST/TMS ID 890) enabled preliminary visual inspection of the tank's interior. The Robotic Tank Inspection End Effector (OST/TMS ID 278) evaluated welds for corrosion defects. The LDUA was also utilized to obtain heel samples using the Heel Sampling End Effector (OST/TMS ID 2386). End effectors were exchanged using a Remote End Effector Tool Plate (OST/TMS ID 2394) and Remote End Effector Exchange System (OST/TMS ID 2393).

The Heel Sampling End Effector.



The Stereo Viewing System mounted on the Light Duty Utility Arm.

The Robotic Tank Inspection End Effector.

The Tanks Focus Area's data is a critical component in increasing the waste loading. The data provided this year would increase the size of the database on liquidus predictions by as much as 200%.

—Dr. Jerome Morin, Westinghouse Savannah River Company

Pipe Cutting and Isolation System (OST/TMS ID 2093) stops leakage into tanks

Retrieval of residual waste from tanks in preparation for closure is facilitated by the Pipe Isolation System. Many small-diameter pipes run horizontally underground and into and through tanks at the Oak Ridge Reservation and other similar sites. Some of these pipes, which are over 50 years old, have degraded: rainwater is percolating through the ground, seeping into the pipes, and entering the tanks. To prevent further in-leakage after completing retrieval operations, these pipes must be plugged. TFA worked successfully with the site to develop an efficient system for sealing the pipes.

The Gunite Tank Cleaning System is a huge success story.... It could help clean up much more complex and much larger-scope projects at other parts of the DOE complex nationwide."

—Congressman Zack Wamp

The Pipe Cutting and Isolation System consists of three individual tools: the Pipe-Cutting Tool, the Pipe-Cleaning Tool, and the Pipe-Capping Tool. The first is a standard industrial band saw attached to a modified Light Duty Utility Arm via the Gripper End Effector. The robotic arm moves the blade through the pipe. The Pipe-Cleaning Tool can then remove residual waste from within open-ended pipe. Also adapted for application using the modified LDUA, the Pipe-Capping Tool is an epoxy-filled cap that seals off open-ended pipes or pipes that have been cut by the Pipe-Cutting Tool. An added benefit of the system is that it removes obstructions within the tank that may inhibit retrieval and closure activities. The Pipe-Cutting and Pipe-Capping tools were successfully deployed at the Oak Ridge Reservation.

The Pipe Cutting and Isolation System's end effectors are deployed by a modified Light Duty Utility Arm.

The Pipe-Cutting Tool.

The Pipe-Capping Tool.

The Pipe-Cleaning Tool.

Pretreatment

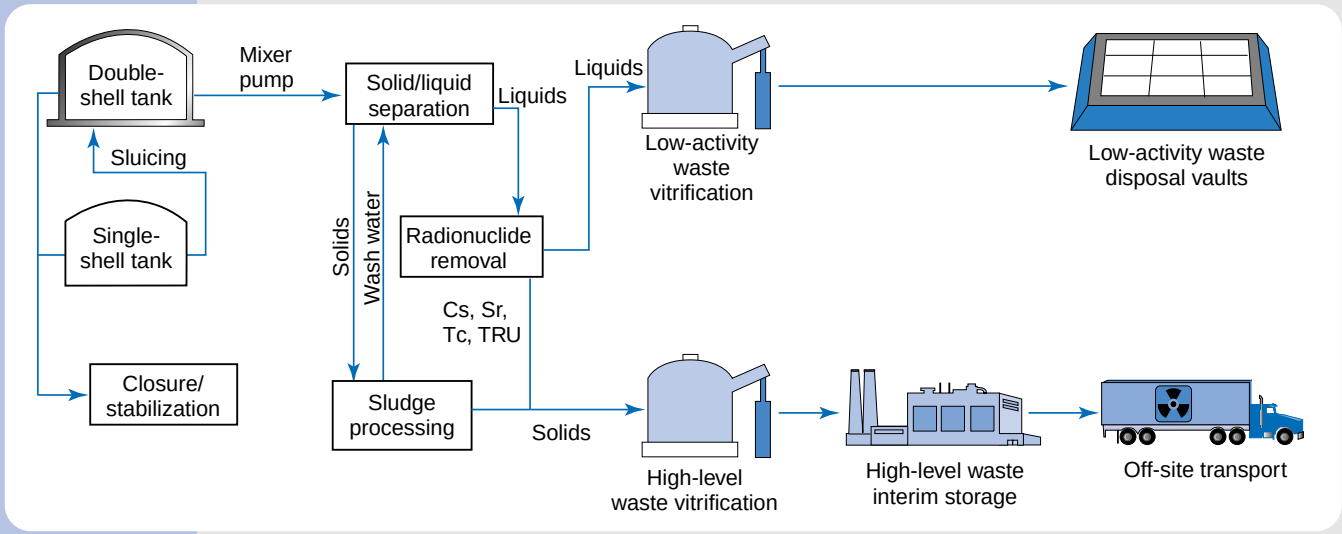
Enhanced Sludge Washing (OST/TMS ID 233) reduces the volume of highly radioactive waste

Enhanced Sludge Washing (ESW) is the process of extracting components from sludges with both water and caustic solutions, as opposed to simple sludge washing using only water. ESW uses a series of steps ("washes") in which sludge is mixed with a concentrated solution of sodium hydroxide. This solution is heated and cooled. The liquid is then pumped away, leaving behind a much reduced volume of radioactive sludge. The remaining sludge is then washed several times with a more dilute solution to remove additional chemicals. The result of these steps is a much smaller volume of radioactive sludge.

The ESW process serves several purposes:

- Removes more of the nonradioactive components (such as aluminum, chromium, and phosphate) from sludge than conventional washing practices.
- Reduces the resulting volume of waste that is more expensive to treat. At Hanford this practice avoids significant pretreatment costs.

The Hanford Site has approximately 30 different sludge types. Studies have been conducted to test 49 different samples representing 90% of the sludge in the tanks.



The tank closure process at Hanford, including enhanced sludge washing.

Immobilization

Melter Knife Edge (OST/TMS ID 2092) is demonstrated

In vitrification, molten glass must be transferred from the melter to stainless steel canisters for storage and disposal. Currently, the Savannah River Site (SRS) Defense Waste Processing Facility's melter pour spout accumulates glass and crystalline deposits over time. These deposits eventually deflect the melt pour stream and ultimately plug part or all of the melter discharge area. Melter downtime impacts facility operating efficiency and overall canister production. Improved designs for the pour spout were laboratory tested to identify the operational parameters and design features that lead to glass wicking, accumulation, and plugging. Data obtained in the FY 1999 demonstration enabled design of a new melter pour spout, and the results will be incorporated into SRS's melter pour spout enhancement recommendations.

The Savannah River Technology Center installed a full-sized stirred melter for testing. Demonstration of the replacement Melter Knife Edge was successfully completed in June 1999. Design recommendations will be completed in FY 2000.

Redesigning the pour spout.

In a nonradioactive test, glass pours from a full-scale pour spout knife edge. The high surface tension of glass and its tendency to adhere to the surface of the spout cause the glass to flow through the spout as a thin ribbon, which gathers at the knife edge to create a free-falling stream.

Multipoint Grout Injection (OST/TMS ID 2368) facilitates tank closure by immobilizing residual tank waste

Radioactive tank waste contained in 16 tanks at the Oak Ridge Reservation must be retrieved so the tanks can be closed. In many cases, removing the small amounts of sludge that remain in the tank after the bulk of the waste is retrieved is extremely costly and provides little benefit from site health and environmental standpoints. Grouting immobilizes the residual waste in place and fills void spaces in emptied tanks to prevent collapse. TFA worked with the Oak Ridge Reservation to demonstrate the application of Multipoint Grout Injection technology for immobilizing the residual waste in tanks. Demonstrations were performed on two horizontal tanks at a test facility in Odessa, Texas. Less than four hours was required to complete the grout injection mixing effort for both tanks. Examination of the grout inside the tank showed that the tank contents were sufficiently incorporated throughout the injected grout. In the future, grout technology will help fulfill tank closure needs at SRS and the West Valley Demonstration Project.

Vitrification of high-level waste is a primary mission of the Savannah River Site. Improvements to glass production operations . . . can have a dramatic impact on plant throughput, resulting in substantial cost savings.

—Tom Gutmann, DOE Savannah River Site

Innovative Technology Summary Reports present the full range of problems that a technology, system, or process will address and its advantages to the DOE cleanup in terms of system performance, cost, and cleanup effectiveness.

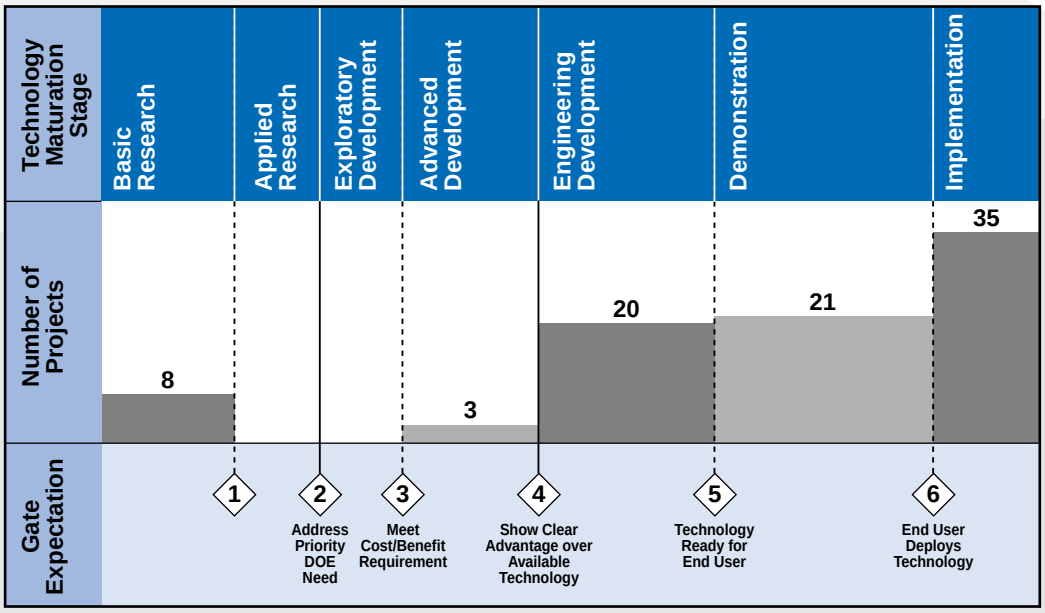
—Jef Walker, DOE Office of Science and Technology

Innovative Technology Summary Reports

The Tanks Focus Area has published 20 Innovative Technology Summary Reports (ITSRs) that describe how risks and costs are being reduced through TFA technologies. Additionally, they are a testament to a technology's "Ready-for-Implementation" status to alert DOE users and others working in the environmental industry. Published ITSRs are available on the OST Web site at http://ost.em.doe.gov under "Publications."

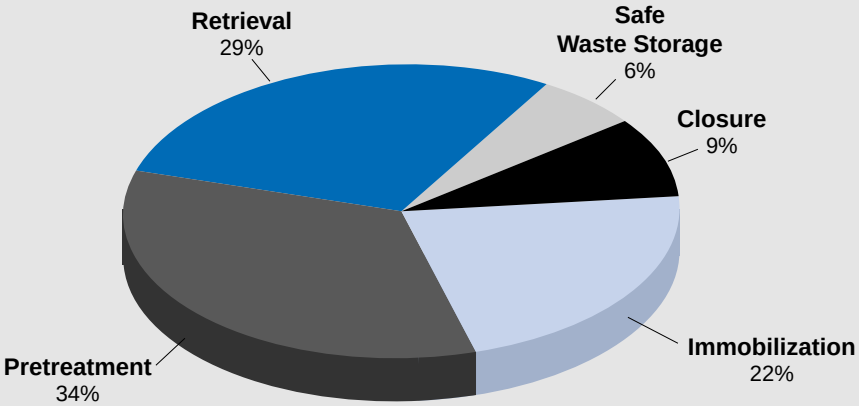
Download (OST/TMS ID)	To learn about
Safe Waste Storage	
Corrosion Probe (1985)	Controlling corrosion, maintaining tank integrity
Laser Ablation/Mass Spectroscopy (127)	Chemical analysis method for tank waste
Near-Infrared Spectroscopy (86)	Measuring moisture in waste samples
Topographical Mapping System (130)	Charting the inside of waste storage tanks
Retrieval	
AEA Fluidic Pulse Jet Mixer (1511)	Low-maintenance equipment for mobilizing settled solids
Borehole Miner (1499)	High-pressure sluicing nozzle to mobilize tank waste
Comparative Testing of Slurry Monitors (1547)	Real-time measurement of slurry density
Confined Sluicing End Effector (812)	Dislodging waste using high-pressure, rotating water jets
Fluidic Sampler (2007)	Pressurized, stationary sampler for process tanks
Light Duty Utility Arm (85)	Mobile, multiaxis robotic arm for in tank applications
Pulsed-Air Mixer (1510)	Using air bubbles to mix tank contents
Pretreatment	
Cesium Removal Using Crystalline Silicotitanate (21)	Cesium removal using high-capacity sorbent to reduce waste volume
Crossflow Filtration(350)	Solid/liquid separation process using membranes
Out-of-Tank Evaporator (20)	Modular evaporator to reduce waste volume and free tank space
TRUEX/SREX (347)	Radionuclide removal from high-level waste
Caustic Recycle (885)	Membranes for removing sodium from waste
Immobilization	
Vitrification of Ion Exchange Materials (81)	Glass formulations for ion-exchange sorbents
Closure	
Raman Probe (1544)	Analysis of organic and inorganic chemical species
Pipe Cutting and Isolation System (2093)	In-tank cutting, cleaning, and capping of pipes
SRS Tank Closure (22)	Technologies for closing tanks

Distribution of 87 Technical Solutions by Stage of Maturity*

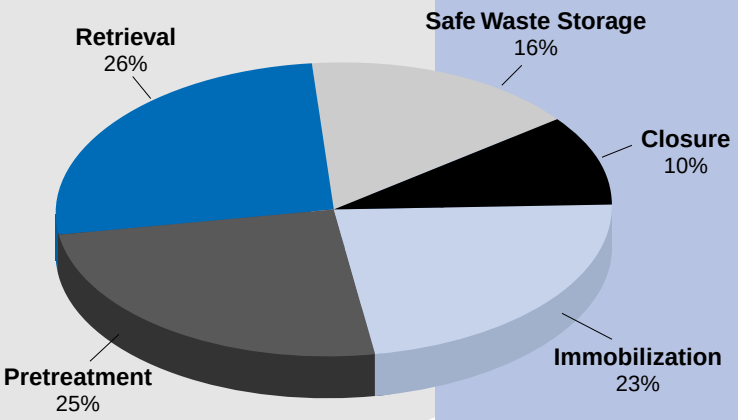


* Per TMS entries for TFA since program inception.

Distribution of Project Budgets by Process Steps ($29,150K total budget)



Distribution of Projects by Process Steps (31 total projects)



TFA's 31 FY 1999 Projects

Process Step	Priority	Tech Response ID	FY 1999 TFA Funding ($K)	Project Title	OST/ TMS ID	TMS Title	Site/ Site Need ID
Safe Waste Storage 5 Projects $1,762K Total FY 1999 TFA Funding	2	98004	670	DST Corrosion Monitoring	198	Corrosion Probe	RL-WT04/ Hanford
	4	98067A	0	Tank Inspection Techniques for Hanford, SRS, ORR	278	Robotic End Effector for Inspection and Sampling of Storage Tanks	INEEL
	10	98061	495	Demonstrating Alternative Filtration Technologies to Replace HEPA Filters	2091	Regenerable, In Situ, HEPA Filter System	SR-2027/ SRS
	20	98039	400	LDUA Deployment of Sampling and Inspection End Effectors at INEEL	890	Stereo Viewing System	ID-2.1.10/ INEEL
	46	98055	197	In Situ Methods for Characterization of Tank Wastes			SR-2918/ SRS
Retrieval 8 Projects $8,486K Total FY 1999 TFA Funding	5	98050B	157	Small, Horizontal, Limited-Access Tank Retrieval	1499	Borehole Miner	TK-09/ ORR
	6	98045	3,467	GAAT Retrieval	85	Light Duty Utility Arm	TK-02/ ORR
	14	98053	1,330	Tank Heel Retrieval at SRS	2097	Heel Retrieval for SRS	SR-2037/ SRS
	15	98028	1,421	Hanford/SRS Waste Mixing-Mobilization	2097	Heel Retrieval for SRS	SR-2911/ SRS
	17	98054	100	Alternate Salt Removal Methods	1989	Salt Dissolution/Density Gradient	SR-2028/ SRS
	21	98056	225	Methods to Unplug Waste Transfer Lines	2367	Pipe Unplugging	SR-2039/ SRS
	22	98009	986	Representative Sampling and Associated Analysis to Support Operations and Disposal	127	Laser Ablation/Mass Spectroscopy (LA/MS)	RL-WT09/ Hanford
		98046	800	ORR Sludge Mixing and Mobilization		TK-03/ORR	
Pretreatment 8 Projects $10,122K Total FY 1999 TFA Funding	3	98048	1,060	Solid-Liquid Separation Demonstration	350	Crossflow Filtration	TK-05/ ORR
	8	98057	2,290	Alternatives to In-Tank Precipitation	21	Cesium Removal Using Crystalline Silicotitanate	SR-2034/ SRS
	9	98058	695	DWPF Recycle Treatment	21	Cesium Removal Using Crystalline Silicotitanate	SR-2033/ SRS
	11	98024B	0	Hanford and SRS Sludge Scale-Up Studies	350	Crossflow Filtration	RL-WT024/ Hanford
	16	98073	1,740	CIF Evaporator	20	Mobile Evaporator	SR-2047/ SRS

Process Step	Priority	Tech Response ID	FY 1999 TFA Funding ($K)	Project Title	OST/ TMS ID	TMS Title	Site/ Site Need ID
	18	98023	1,218	Leachate Chemistry Behavior (Gel, Precipitation, Dissolution)	233	Sludge Washing	RL-WT023
	24	98035	430	Solvent Extraction and Ion-Exchange to Remove TRU, SR, TC and Cs from ICPP Tank Farm	347	TRUEX/SREX	ID-2.1006/ INEEL
	38	98052	2,689	Mobile Evaporator	20	Out-of-Tank Evaporator	TK-11/ ORR
Immobilization 7 Projects $6,290K Total FY 1999 TFA Funding	7	98059	1,550	High-Activity Waste Glass Formulation to Optimize Loading and Manage Problem Constituents for SRS, Hanford, and INEEL	2009	High-Activity Waste Forms and Processes	SR-2032/ SRS
	12	98010	550	Low-Activity Form Product Acceptance Testing	82	Low-Activity Waste Form	ID-2107/ INEEL
	19	98062	1,440	Develop Second-Generation DWPF Melter	2092	DWPF Melter Pouring Enhancements	SR-2036/ SRS
	28	98036	225	Develop Technology to Stabilize/ Solidify ICPP Low-Activity Waste	82	Low-Activity Waste Form	ID-2.1.07/ INEEL
			1,425	Advanced Vitrification System			Hanford Strategic
			1,000	M-Area Melter at SRS for LAW Glass Formulations			Hanford Strategic
			100	Spent Ion-Exchange Resins and Mo-99 for Argentina			International
Closure 3 Projects $2,490K Total FY 1999 TFA Funding	1	98050A	940	ORR/SRS Tank Closure	22	In-Tank Grouting/Tank Closure	SR3022/ SRS
	13	98051	200	GAAT Tank Isolation	2093	GAAT Tank Isolation	TK-10/ORR
	23	98013	1,350	Hanford Tanks Initiative	2010	(HTI) In-Tank Characterization	RL-WT013/ Hanford

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TFA Home Pages
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