

4.1 Overview of Development and Demonstration of Environmental Technologies at Florida International University's Hemispheric Center for Environmental Technology

M.A Ebadian, PhD, ebadian@eng.fiu.edu, (305) 348-3585

R. W. Rose, rrose@eng.fiu.edu, (305) 348-6623

Florida International University
Hemispheric Center for Environmental Technology
10555 West Flagler Street
EAS-2100
Miami, FL 33174

Abstract

Florida International University's Hemispheric Center for Environmental Technology (FIU-HCET) was established in 1995 by the University and the United States Department of Energy-Office of Science and Technology (DOE-OST) to research, develop, and demonstrate innovative environmental technologies and to establish alliances that support the implementation of these technologies. FIU-HCET's research and development (R&D) activities support U.S. Department of Energy Environmental Management (DOE-EM) Program in the areas of deactivation and decommissioning; mixed waste; characterization, monitoring, and sensor technology; subsurface contamination monitoring; radioactive tank waste remediation; and international technology integration. FIU-HCET has established a reputation for cost-effective, non-biased, independent testing of innovative environmental technologies. Since many environmental problems in the Western Hemisphere cannot currently be resolved using existing technologies, progress in technology innovation is a logical extension of the problem-resolution process.

FIU-HCET forms partnerships with small businesses and inventors, assisting them in the evaluation of the market potential and, if warranted the development of their new technology concepts. These partnerships result in a greater opportunity for technology demonstrations, provide access to potential funds for demonstrations and commercialization, and increase the commercial sector's access to federally developed technologies.

FY02 Projects

The projects proposed by FIU-HCET for FY02 aim to make technical advances, achieve cost savings, and facilitate technical implementation to benefit the DOE-EM Program. In FY02 FIU-HCET is executing projects to support work got the Deactivation and Decommissioning Focus Area, the Tanks Focus Area, the Transuranic and Mixed Waste Focus Area and the Department's International Programs. The specific projects to be discussed in this presentation include:

- D&D Focus Area
 - D&D Technology Assessment Program
 - D&D Technology Information Management and Dissemination
 - D&D Tool and Sensor Applied Research and Development
 - D&D Tool and Sensor Delivery Platform Applied Research and Development
 - Deployment of D&D Technologies
 - Long Term Monitoring and Stewardship of Nuclear Facilities
 - Aerosol Research and Modeling to Support D&D Operations
- Tanks Focus Area
 - Plugging Prevention and Unplugging of Waste Slurry Transfer Pipelines
 - Solids Formation and Feed Stability During Waste Slurry Transfer and Saltcake Dissolution Study
 - Simulant Characterization for Tank Waste Slurry Transfer
 - Demonstration and Evaluation of Potential Glass-Fracturing Technologies for SRS
 - Center of Expertise for the Development and Deployment of Tank slurry Monitoring (Dual Coriolis)
 - Sludge Mapping and Volume Estimates
 - Tank Integrity Inspection Techniques
- Transuranic & Mixed Waste Focus Area
 - Unique Waste Treatment Technology Development and Alternatives to Incineration Support
 - Waste Treatment Effluent Monitoring Technology Assessment



F Y 2002 F I U - H C E T E M - 50

Research and Development Program

M.A. Ebadian, Director
Robert Rose, Program Manager
Hemispheric Center for Environmental Technology
Florida International University



Selected Research Activities

D&D Focus Area

- D&D Technology Assessment Program
- Technology Assessment & Evaluation Facilities and Methodology
- D&D Technology Information Management and Dissemination
- Tool & Sensor Applied Research & Development
- Tool & Sensor Delivery Platform Research & Development
- Technology Deployment
- Aerosol Research, Development & Modeling to Support D&D Operations
- Long-term Monitoring & Stewardship for DDFA

Transuranic & Mixed Waste Focus Area

- Unique Waste Treatment development and Alternatives to Incineration Support
- Waste Treatment Effluent Monitoring Technology Assessment

Tanks Focus Area

- Plugging and Unplugging of Waste Slurry Transfer Pipelines
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- Sludge Mapping and Volume Estimates
- Tank Integrity Inspection Techniques

International Technology Integration Program

- Opportunities to Market U.S. Technologies Throughout the Western Hemisphere





D & D Focus Area



Technology Assessment Program

Needs Statement

DOE Need ID No.	DOE Need Title	HCET TAP Project Area
OH-M901 ORDD-12	Improved facility survey techniques Improved characterization of buildings and facilities	Facility characterization
AL-07-01-12-DD	New technologies to decontaminate and decommission radioactively contaminated facilities	Metal and masonry decontamination
OH-F027	Improved equipment dismantlement	Equipment dismantlement
RF-DD11 RL-DD02 RF-DD21	Size reduction of contaminated equipment and demolition waste Glove box size reduction system for PFP Removal of glove box lead shielding	Glove box and tank size reduction
ID-7.2.2.8 ORDD-07	Remote demolition of concrete structures Remote dismantlement methods	Facility dismantlement
ID-3.2.3.2 ID-81	Develop thermal treatment unit offgas PM-CEMs Need for continuous emission monitors	Waste management



Technology Assessment Program

Expected Outcome

- Evaluation of technologies in a standardized manner
- Generation of comparable data on both baseline and innovative technologies
- Dissemination of data to technology need holders/end users through written reports and the Internet
- Nearly 100 technologies have been demonstrated to date
- FY 02 demonstrations planned in:
 - Facility characterization/decontamination/dismantlement
 - Equipment dismantlement
 - Integrated "multi-purpose" D&D technologies
 - Waste management
 - Russian Developed Strippable Coatings
 - Others, to address special needs



Technology Assessment & Evaluation Facilities and Methodology Development

Needs Statement

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AL-07-01-12-DD	New technologies to decontaminate and decommission radioactively contaminated facilities	Metal and masonry decontamination
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Technology Assessment & Evaluation Facilities and Methodology Development

Expected Outcome

- Improved technology assessment capabilities
 - Better simulated field conditions
 - Closer tie to DOE technology end users
 - Upgrade of multimedia capabilities
- Upgraded information acquired about innovative technologies
- Training syllabus for student assessment evaluators
- Initial focus
 - Gamma radiation imaging technologies



Technology Information Management and Dissemination

Needs Statement

- To develop information systems that provide project managers across the DOE Complex with ready access to up-to-date, accurate technology information that can assist them in identifying solutions to cleanup problems
- Accomplishments to date

The DDFA technology information management and decision support repository -

Gateway to Environmental Technology (GET) –

is accessible at <<http://www.DandD.org>>



Technology Information Management and Dissemination

Expected Outcome

- Maintenance and enhancement of DDFA's technology information repository
 - Provide easy access to up-to-date information
- Facilitating of collaboration on technology development, improvement, and deployment
 - Information and experience exchange between developers, manufacturers, vendors and users
- Continued maintenance and updating of TIS, MIS and LSDDP databases, and Electronic Reference Library of technology assessment reports and ITSRs



Tool and Sensor Applied Research and Development

Needs Statement

DOE Need ID No.	DOE Need Title	HCET Associated TSARDP Project
ID-7.2.19	Remote/robotic technologies for access and deployment of characterization and sampling tool.	Remote harsh-environment surveyor (RHES)/ <i>In situ</i> pipe decontamination and monitoring system
ID-7.2.08	Robotics for D&D.	Remote harsh-environment surveyor (RHES)/ <i>In situ</i> pipe decontamination and monitoring system
CH-DD11-99	Remote characterization of in-ground concrete structure	Remote harsh-environment surveyor.
OH-C901	Robotic device to improve characterization of underground pipe lines	<i>In situ</i> pipe decontamination and monitoring system
ID-7.2.06	Remote characterization for building release, large area surface soil characterization, and characterization of sumps, debris, underwater area, and buried pipes and utilities	Remote harsh-environment surveyor (RHES)/ <i>In situ</i> pipe decontamination and monitoring system



Tool and Sensor Applied Research and Development

Expected Outcome

- Development and/or integration of innovative D&D and long-term monitoring and surveillance tools and sensors

For remote hazardous environment surveyor (RHES) robotic platform

- Sonar-imaging scanner
- High-resolution color CCD camera
- Various combinations of sensors

Radiation, temperature, and humidity

For in-situ pipe tool

- Wireless video camera for interior pipe inspection



Tool and Sensor Delivery Platform Research and Development

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ID-7.2.08	Robotics for D&D.	Remote harsh-environment surveyor (RHES)/ <i>In situ</i> pipe decontamination and monitoring system
CH-DD11-99	Remote characterization of in-ground concrete structure	Remote harsh-environment surveyor.
OH-C901	Robotic device to improve characterization of underground pipe lines	<i>In situ</i> pipe decontamination and monitoring system
ID-7.2.06	Remote characterization for building release, large area surface soil characterization, and characterization of sumps, debris, underwater area, and buried pipes and utilities	Remote harsh-environment surveyor (RHES)/ <i>In situ</i> pipe decontamination and monitoring system



Tool and Sensor Delivery Platform Research and Development

Expected Outcome

- Development of delivery platforms to move tools and sensors

For D&D and long-term monitoring and surveillance needs

- FY02 initiatives

Crate size reduction tool delivery platform

- Developed for LANL DVRS facility
- Cutting fiberglass-reinforced plywood crates by guiding and carrying one or multiple cutting tools

In-situ pipe robotic tool/sensor delivery crawler

- Robotic autonomous or remotely controlled crawler/delivery platform
- Work in variety of pipe sizes



Technology Deployment

Needs Statement

DOE Need ID No.	DOE Need Title	HCET's Technology Development Projects
AL-00-01-06-DD	Effective decontamination of concrete	Online decontamination and characterization system
AL-01-01-01-DD	Internal pipe characterization for alpha particles	MIP-DC system
ID-7.2.03	Decontamination of concrete walls, floors, ceilings, and corners	Online decontamination and characterization system
ID-7.2.25	Decontamination of metal pipes	MIP-DC system
ID-7.2.26	Decontamination of metal walls, floors, ceilings, and corners	Online decontamination and characterization system
SR00-4005	Characterization of inaccessible areas	Remote hazardous-environment surveyor
RL-DD055	Remote monitoring system upgrades for S&M program	Remote hazardous-environment surveyor



Technology Deployment

Expected Outcome

- Deployment of innovative technologies for D&D and long-term monitoring and surveillance at DOE complex
- Review of technologies and potential DOE use
 - Gamma imaging technology
 - Electric arc saw

Technologies for Demonstration and Deployments	Potential Deployment Site	Application
MIP-DC	DRS and Rancho Seco, Fernald site, INEEL	Characterization and decontamination of large-bore pipes (6 inch <diameater>24 inch).
IVOD	Mound, Rancho Seco (SMUD), INEEL, Rocky Flats	Characterization and decontamination of concrete walls and floor surfaces.
Online	Mound, Rancho Seco (SMUD), INEEL	Characterization and decontamination of concrete floor surfaces.
PCB pilot plant	Rancho Seco (SMUD), INEEL	Destruction of PCB.



Aerosol Research, Development, and Modeling to Support D&D Operations

Needs Statement

Needs Identification No.	Title
AL-00-01-02-DD-S	Remote-handled size reduction technology
AL-00-01-06-DD	Effective decontamination of concrete
AL-00-01-07-DD	Ex situ glove box size reduction system
AL-07-01-12-DD	Decontaminate and decommission radioactively contaminated facilities
AL-09-01-12-DD	Decontamination and volume reduction of TRU and LLW metals
AL-09-01-02-DD-S	Radiological air monitoring needs for current D&D/ ER operations
AL-09-01-04-DD-S	Methodologies for effective D&D of large environmental sites
CH-DD06-99	Size reduction of massive metal structures
OH-C003	Diamond wire saw demolition and size reduction of reactor bioshield
RF-DD03	Improved interior airborne particulate control
RF-DD18	Real-time radiation air monitoring during building demolition
RL-DD02	Glove box size reduction for PFP



Aerosol Research, Development, and Modeling to Support D&D Operations

Expected Outcome

- Generation of data on characteristics of airborne particulates generated during metal cutting. Useful for:
 - Assessment of inhalation exposures and control. Planning respiratory equipment & exposure times will result in efficient utilization of skilled work force
 - Designing and use of suitable prefilters will extend the life of expensive HEPA filters
- Modification of existing airborne concentration prediction models based on data collected by this project



Long-term Monitoring and Stewardship

Needs Statement

- To provide identification of:
 - Long-term monitoring requirements in DOE facilities (e.g., contaminants movement, structural integrity, water and air infiltration, climate, flora, fauna)
 - Stabilization technologies and decision analysis tool for facility reuse
- STCG Needs: AL000102DD; AL000103DD; AL090102DD-S; ID7.2.06; SR004012; SR004013; RLDD07; RLDD011,32,45,50,52,55,56



Long-term Monitoring and Stewardship

Expected Outcome

- Development of innovative long-term monitoring and surveillance tools and sensors
- Additional tools and sensors for remote harsh-environment surveyor (RHES)
 - Navigational system to guide robotic platform into hazardous environment
 - Radiological air monitoring system
- Assessment of promising LTS technologies
- Deployment of developed technologies at DOE sites





Transuranic & Mixed Waste Focus Area



Unique Waste Treatment Technology Development & Alternatives to Incineration Support

Needs Statement

- The presence of odd combinations of contaminants and matrices that do not fall within the “normal” categories of waste that can be treated by more conventional treatment systems.
- An increase in public resistance to incineration emissions (e.g., dioxin/furans) and the promulgation of more stringent and potentially expensive offgas treatment and monitoring requirements.



Unique Waste Treatment Technology Development & Alternatives to Incineration Support

Expected Outcome

- Working with TMFA, determine available technologies (pilot and full-scale) demonstrated on MLLW and mercury contaminated waste streams
 - Identification of technology gaps for potential R&D
- Participation on TMFA DOE waste elimination team
 - Multi-matrix variable waste
 - Mercury-contaminated waste matrices
- Final testing of PCB treatment technology



Waste Treatment Effluent Monitoring Technology Assessment

Needs Statement

DOE Need ID No.	DOE Need Title	Associated HCET Project Area
OR-WM13	Metals monitoring of gaseous emissions	Waste characterization Waste management
SR00-1004	Need for continuous emission monitors for measurement of hazardous compound concentrations in incinerator stack gas	Waste characterization Waste management
ID-3.2.3.2	Develop thermal treatment unit offgas CEM monitors	Waste characterization Waste management
ID-S.1.02 ID-2.1.18	Continuous emissions monitors for offgas analysis	Waste characterization Waste management



Waste Treatment Effluent Monitoring Technology Assessment

Expected Outcome

- Detailed defensible performance data for mixed waste characterization, treatment, storage, and/or disposal.

Hg-CEMS at the TSCAI

Effluent monitoring systems that may be co-evaluated during alternatives to incineration demonstrations





Tanks Focus Area



Plugging and Unplugging of Waste Transfer Pipelines

Needs Statement

- Technical response B376 in the TFA FY02-FY03 Integrated Priority Listing

Need Description: As the tank clean-out and decommissioning program becomes active, there is an increasing potential that the transfer lines which are in place will become plugged (unable to facilitate waste transfer from one tank to another or from tankage to the waste processing facilities). Sites already experiencing problem include:

Savannah River

Hanford

Oak Ridge



Plugging and Unplugging of Waste Transfer Pipelines

Expected Outcome

- A full-scale pipeline unplugging and plug locating test bed has been set up at FIU for the purpose of bringing in industrial unplugging and blockage locating equipment for test and evaluation. Suitable technologies will be recommended to DOE sites to locate, reach and unplug the plugged pipelines.
- An instrumented flow loop at FIU will be used to obtain pressure drop at different flow rates. Visualization of the particle setting in the pipelines will be attempted. Simulants include the newly designed Hanford and INEEL slurries.



Solids Formation and Feed Stability During Waste Slurry Transfer

Needs Statement

- Technical response B554 in the TFA FY02-FY03 Integrated Priority Listing
- Primary reason for pipeline plugging is solids formation in the pipeline under certain feed and operating conditions. Detailed information is needed for prevention:
 - Waste slurry flow behavior
 - Chemical and physical property effects on solids formation
 - Additional data related to waste feed stability



Solids Formation and Feed Stability During Waste Slurry Transfer

Expected Outcome

- Identification of operating parameters and feed conditions that cause solids formation and pipeline plugging
- Obtaining correlation of the observed data that will enable prediction of slurry transport characteristics
- Providing engineering data and technical recommendations to support Hanford tank waste remediation system (TWRS) operation



Waste Conditioning for Tank Slurry Transfer

Needs Statement

- Technical response B376 in the TFA FY02-FY03 Integrated Priority Listing
- Waste stored in underground storage tanks need to be removed and the tanks cleaned and closed. To date, evaluations and demonstrations of waste retrieval technologies have experienced difficulties during the waste transfer, including pipeline blockage and transfer rate limitation. Information is needed on the effects of physical and chemical properties of waste in order to specify and design transfer equipment and pipelines.



Waste Conditioning for Tank Slurry Transfer

Expected Outcome

- Generation of waste simulant slurries that have nearly identical physical and mechanical characteristics to that of real waste from the following sites:
 - Hanford
 - Savannah River
 - Idaho
- Characterization of physical and chemical properties of simulant slurries



Demonstration and Evaluation of Potential Glass-Fracturing Technologies for Savannah River Site

Needs Statement

- Several techniques are available that could potentially be of use to fracture the glass matrix, perform refractory cleaning, and fracture the refractory of the melter at SRS. These techniques have not been specifically applied to a radioactive waste melter, so the effectiveness of each technology is unknown. Testing on a non-radioactive surrogate glass is required to determine the most cost-effective and efficient technology. Furthermore, these tests will determine which technologies, if any, are suitable for cleaning the glass melter for HLW at SRS.



Demonstration and Evaluation of Potential Glass-Fracturing Technologies for Savannah River Site

Expected Outcome

- Results from the demonstration of various glass fracturing technologies. Tests will be divided into three areas with the following potential technologies:

Glass breakup

- Jack hammer/chisel and needle gun

Removal of glass from K-3 refractory surface

- Diamond wheel shaver, needle scaler, and needle gun

K-3 breakup

- Jack hammer/chisel and a rotary tool with a face-grinding wheel



Center of Expertise for the Development and Deployment of Tank Slurry Monitoring (Dual Coriolis)

Needs Statement

This project is a collaborative effort with ongoing tasks at HCET, DOE-TFA, and SRS.

STCG Need Number	Need Title	Technical Task
SR99-2037	Tank heel removal/ closure technology	Instruments to measure wt% solids and real-time rheological data
ID-2.1.31	Characterization of entrainable solids in tank waste	Instruments to measure wt% solids and real-time rheological data
ID-2.1.67	High-level waste slurry handling	Instruments to measure wt% solids and real-time rheological data
ORTK-01	Tank waste characterization	Measure solids wt% in tank.
ORTK-04	Sludge mixing and slurry transport	Monitoring of the retrieved sludge
SR01-2044	<i>In situ</i> technology for waste characterization and level monitoring	<i>In situ</i> real-time waste slurry wt% monitoring.
ID-2.1.67	High-level waste slurry handling	Real-time waste slurry wt% monitoring.



Center of Expertise for the Development and Deployment of Tank Slurry Monitoring (Dual Coriolis)

Expected Outcome

- Testing of the first prototype Dual Coriolis Slurry Monitoring System (DCMS), an in-tank weight percent solids monitoring system, under mock-up conditions
- Enhancement of the prototype based on results of testing
- Testing of second prototype for all scenarios of field installation and operation
- A continuing workshop environment provided for site users, DOE field decision makers, and select experts in the field of slurry transport integrity



Sludge Mapping and Volume Estimates

Needs Statement

Technical response B376 in the TFA FY02-FY03 Integrated Priority Listing

DOE Need ID No.	DOE Need Title	Origination Date	End Date
SR00-2044	<i>In situ</i> technology for waste characterization and level monitoring	FY2000	FY 2022
ID-2.1.72	Simplified tank solids and vault sampling and sludge volume determination system	FY2000	FY2003
ORTK-01	Tank waste characterization	FY1998	FY2002



Sludge Mapping and Volume Estimates

Expected Outcome

- Development of a bench-scale test platform that will address the issues currently found throughout the DOE complex
- Identification, integration and bench-scale testing of commercially available system for sludge mapping and volume estimation inside HLW tanks
- Development of conceptual design drawings for modifications of promising commercial technologies (if required)



Tank Integrity Inspection Techniques

Needs Statement

Technical response B376 in the TFA FY02-FY03 Integrated Priority Listing

DOE Need ID No.	DOE Need Title
RL-WT05	Remote inspection of high-level waste single-shell tanks (SSTs)
RL-WT022	Adapting tandem synthetic aperture focusing technique (TSAFT) for flaw characterization in the inaccessible portion of the knuckle region of the double-shell tanks (DSTs)
RL-WT067	Improved double-shell tank (DST) integrity NDE measurement tools
ID-2.1.20	Tank annulus/vault inspection
SR01-2035	Develop advanced techniques for life extension of high-level waste tanks and piping
SR01-2037	Tank heel removal/closure technology
OH-WV-907	High-level waste tank interim maintenance



Tank Integrity Inspection Techniques

Expected Outcome

- Identification, modification, and/or design of an NDE/sensor delivery platform that can operate within the constraints of HLW tanks
- Development of a prototype crawler technology
- Construction of a mock-up testing facility for the demonstration of the new prototype





International Technology Integration Program



Opportunities to Market U.S. Technologies Throughout the Western Hemisphere

Expected Outcome

- Support for focus areas in overcoming cultural and logistical barriers when working with international counterparts
- Training for interested CNEA members in establishment of ISO 9001
- Population of an international expert database of the Latin American and Caribbean DOE-OST focus area counterparts and their current research interests
- Facilitation of communication and other activities between DOE and CNEA



Contact Information

M.A. Ebadian, Ph.D., Director

Robert Rose, Program Manager

Hemispheric Center for Environmental Technology

Florida International University

10555 West Flagler Street, CEAS 2100

Miami, Florida 33174

Phone: (305) 348-6623

Fax: (305) 348-1852

Email: ebadian@hcet.fiu.edu or rrose@hcet.fiu.edu

Visit HCET on the Internet: <http://www.hcet.fiu.edu>

