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FINAL REPORT

VALIDATION AND VERIFICATION OF CMST-CP REMOTE SURVEILLANCE SENSORS

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Prepared for:

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

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LIST OF ACRONYMS

ASTM	American Society for Testing and Materials
DOE	Department of Energy
CDI	Hanford Canyon Disposition Initiative
CMST-CP	Characterization, Monitoring, and Sensor Technology – Crosscutting Program
HCET	Hemispheric Center for Environmental Technology
EM	Environmental Management
EML	Environmental Measurement Laboratory
EPA	Environmental Protection Agency
ETV	Environmental Technology Verification Program
ITSR	Innovative Technology Summary Reports Program
OSHA	Occupational Safety and Health Association
PCAMP	Post-Closure Assurance and Monitoring Program
PPPL	Princeton Plasma Physics Laboratory
STCG	Site Technology Coordination Group
PCE	tetrachloroethene
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TMS	Technology Management System
VOC	volatile organic compounds

EXECUTIVE SUMMARY

In its original form, this project was intended to utilize the capabilities of the Analytical Laboratory at Florida International University's Hemispheric Center for Environmental Technology (FIU-HCET) to carry out validation and verification of data obtained in the field for purposes of characterization, monitoring, and sensing in relation to closure and post-closure of various sites throughout the DOE complex. To do this, technologies were to be identified that had already been deployed and had produced field data. The role of the FIU-HCET Analytical Laboratory was considered first as part of a round robin team with other laboratories or, alternatively, to act as an objective third-party laboratory in evaluating validation data by others.

Shortly after the onset of the project, FIU-HCET determined that specific deployed technologies were not readily identifiable. Thus, the direction of the project was changed to one in which the FIU-HCET Analytical Laboratory would investigate DOE needs that require validation. These needs were examined primarily on the Internet, as listed by each specific site. In addition, needs having validation implications for regulatory agencies, such as the EPA, were also investigated. Furthermore, contact was made with laboratories with which the FIU-HCET Analytical Laboratory could act in a round robin or third-party capacity.

Included in this report are potentially deployable technologies that would lend themselves to validation and verification of field data. FIU-HCET intends to monitor the deployment of these technologies with a view toward carrying out the validation activities originally proposed.

1.0 INTRODUCTION

This project was initiated as a subtask to supplement the deployment of sensor technologies into monitoring and surveillance systems throughout the Department of Energy (DOE) complex. These technologies are important for the successful closure and post-closure operations of DOE sites throughout the country. To ensure users, regulators, and stakeholders that the applied technology was accurate and produced data that was representative of the true state of the system to which it was applied, it was recognized that a verification and validation process was needed. This need was underscored in June 1997 in the PCAMP (CMST) FY99 Technical Planning Program under Technology System Need #13 dealing with Technology Validation, Standards, and Deployment.

Originally, laboratory data were used for the development of field technologies to be deployed on-site. Once these technologies were deployed, the FIU-HCET Analytical Laboratory intended to verify and validate the data obtained, whether done remotely or non-remotely. This validation was then to be offered to regulatory agencies, such as EPA, ASTM, OSHA, and others, to provide a basis for monitoring other sites.

The FIU-HCET Analytical Laboratory is particularly well equipped to carry out this responsibility, by virtue of possessing the instrumentation, equipment, facilities, and expertise to conduct this activity. The original direction of this project was one in which deployed technologies would be identified to the Laboratory, data would be provided, and appropriate validation experiments would be carried out to prove the accuracy of the data obtained. Thus, the Laboratory was to respond reactively to the deployed technologies.

As originally planned, the FIU-HCET Analytical Laboratory was considered to best contribute to the validation effort as part of a round-robin data evaluation effort with other certified laboratories involved in validation activities.

Shortly after the onset of this project, it was found that specific identification of already deployed characterization technologies was not readily available. Under its original scope, the necessity of waiting until an appropriate technology and sensor system could be selected, approved, and deployed would indefinitely delay the initiation of work, and it was decided that the Laboratory would undertake the investigation of potential technologies for deployment and validation based upon specific site needs.

In this regard, the Laboratory undertook to evaluate site needs on a proactive basis to define where validation and verification activities were likely to be needed. This new direction thus precluded carrying out the actual physical verification of data from deployed technologies but rather examined those potentially deployable technologies that would require validation and verification in the future. To accomplish this, closure and post-closure characterization needs from Site Technology Coordination Groups (STCGs) and from individual sites were examined and listed. In addition, other laboratories that might be likely to engage in validation activities were contacted with a view to collaboration in their efforts toward validation.

2.0 PROJECT OUTLINE

To identify potential deployable technologies the following approaches were initiated: 1) examination of individual DOE site needs utilizing the Internet; 2) investigation of U.S. Environmental Protection Agency (EPA) requirements through sources, such as their Environmental Technology Verification Program (ETV); 3) state EPA technology requirements; 4) calls to industry for potential commercial technologies appropriate for closure based on DOE needs; 5) use of the Innovative Technology Summary Reports (ITSRs or Greenbooks).

The roles of the laboratory in validation activities were best thought of as 1) acting as a third-party objective entity to verify data obtained by laboratories that may have conflicting interests, 2) acting as a secondary validation laboratory to supplement data produced by a primary one, 3) evaluating field-deployable technologies prior to their deployment followed by recommendations as to their applicability, 4) using personal contacts of key individuals to initiate sources to identify site needs.

2.1 RESEARCH RESOURCES

Direction for the course of the program was obtained through several discussions with Glenn Bastiaan (Ames Laboratory), the CMST Facilitator, and Paul Szerszen, FIU-HCET CMST Program Manager. Primary sources of information were obtained by examination of various specific site home pages on the Internet, overall DOE needs statements, and needs statements of regulatory bodies, such as the EPA. Additional sources were derived from personal contact with individuals involved in specific programs, such as the Hanford Canyon Disposition Initiative (CDI) and the Environmental Measurement Laboratory (EML)

2.2 SITE-SPECIFIC VALIDATION NEEDS

In order to identify possible areas where verification of field data is essential, the published needs of various sites were examined. The sites involved encompassed Hanford, Washington; Savannah River; Oak Ridge, Tennessee; Albuquerque, New Mexico; Kansas City, Missouri; Grand Junction, Colorado; the Chicago DOE Office; and Fernald in Cincinnati, Ohio. The findings are summarized in Tables 1, 2, and 3. The information reflects those needs for either characterization, monitoring, or sensing where obvious validation would be required for the accuracy of the measurements. The required technologies to satisfy these needs have not yet been deployed, and validation of them will await their application.

2.3 OTHER VALIDATION NEEDS

In addition to the needs derived from publications from specific sites, other sources of technologies that require validation are available. Among these are the Environmental Technology Verification Program (ETV), the Fernald Site Technology Coordination Group (STCG), and the Hanford Canyon Disposition Initiative (CDI). These sources have all been examined for areas where validation and verification opportunities present themselves.

2.3.1 ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM (ETV)

The ETV is particularly important since its exclusive emphasis is on validation. The ETV program consists of six pilot programs designed to promote partnerships with stakeholders, private industry, academia, and regulators. Currently, the pilots are comprised of 1) Drinking Water Systems, 2) Pollution Prevention and Waste Treatment Systems, 3) Site Characterization and Monitoring Technologies, 4) Indoor Air Products, 5) Pollution Prevention Through Improved Coatings, and 6) the Independent Entity option. The latter involves a totally independent, private approach to verification.

Of great interest are the Drinking Water Systems and Site Characterization and Monitoring Technologies. Part of the Drinking Water Program is intended to develop standard verification protocols and carry out independent testing. In a university setting, method development is particularly attractive and highly consistent with the capabilities of FIU-HCET. Although some analytical services will be contracted with certified laboratories, there may be opportunities for FIU-HCET acting as an objective third-party entity, a strategy proposed for developing FIU-HCET opportunities to contribute. FIU-HCET could also play a role in method development where initial certification may not be an immediate requirement.

The Site Characterization and Monitoring Technology pilot program has demonstrated nine innovative technologies within three major technology classes. These include 1) cone penetrometers, 2) field-portable GC/MS for volatile organics in water, and 3) soil and emerging technologies for detection of toxic metals in soil. The capabilities of the FIU-HCET Analytical Laboratory, with its GC/MS, HPLC, X-Ray Dispersive Analysis, and Atomic Absorption equipment, are particularly related to these interests. Reports and verification statements for seven of these technologies have already been issued, and additional ones for in-situ, real-time devices for sampling soil, soil gas, and groundwater are planned for verification. Once these technologies are deployed, FIU-HCET could act as an objective third party.

The Pollution Prevention and Waste Treatment Systems Pilot Program involves partnerships with the state of California. Solicitations for these technologies were made in 1996, with 10 selected. They may now be ready for verification activities.

The improved coating program may provide opportunities for FIU-HCET, given their materials evaluation capabilities. Tests were scheduled to be conducted in March 1997, and questions of verification may be timely now.

2.3.2 SITE TECHNOLOGY COORDINATION GROUP (STCG)

The STCG proactively represents Fernald interests to the many DOE research, development, demonstration, and deployment efforts throughout the country. They are active in acquiring and implementing technologies at Fernald to expedite schedule, enhance safety, and reduce remediation costs. The STCG has a broader responsibility than validation alone; however, the technologies with which they are involved lend themselves to verification once they are applied. STCG acts as a vital link between various DOE offices, other DOE sites, technology providers, Fernald projects, and stakeholders. The information in Table 3 for Fernald in Cincinnati was obtained through issuance of their technology needs.

2.3.3 HANFORD CANYON DISPOSITION INITIATIVE (CDI)

FIU-HCET was highly involved with the disposition of the 221-U-plant building on the Hanford, Washington, site as part of the planning team. This project is intended to utilize the 221-U-plant building as a waste storage facility for materials generated during the production of plutonium at two other canyon buildings. The U-plant building at present contains large quantities of material placed there over the last 50 years. Key to the successful utilization of this facility is the characterization of the materials in the production cells, deck, and galleries. In many respects, new remote technologies will be required, and their accuracy in producing results will have to be verified. One area that FIU-HCET has pursued is the monitoring of alpha radiation in the railway tunnel associated with the building. It was felt that the electret technology with which FIU-HCET is currently involved may prove to be a deployable technology. Likewise, this would have validation implications to prove the technique out. FIU-HCET has proposed this as a technique if alpha radiation is a characterization concern. As yet, no decision has been made to monitor the tunnel for alpha radiation; however, if decided upon, validation and verification issues will be discussed.

2.3.4 TECHNICAL MANAGEMENT SYSTEM (TMS)

An additional source for identifying potentially deployable technologies that would require validation was obtained through the Technology Management System (TMS) website of the DOE.

3.0 CONCLUSION

Closure and post-closure of DOE sites will require validation of monitoring and sensing technologies to ensure that their findings truly represent the state of the system to which they are applied. Examinations of site needs have indicated that many technologies will require validation; however, no clear listing of technologies that have been deployed to date appears to be available. The descriptions of the needs listed in this report represent potential areas where validation of data will be required and their implementation of these technologies can be monitored.

4.0 REFERENCES

PCAM(CMST) FY99 Technical Planning, <http://www/em/doe.gov/acc2006/>.

Table 1.
Hanford, Savannah River, and Oak Ridge Validation Needs

Hanford		Savannah River Site		Oak Ridge	
ID #	Description	ID #	Description	ID #	Description
D&D RLD01	Requirement for determining leaching of cesium chloride and strontium chloride from capsules in the Waste Encapsulation Storage Facility.	SR-1W10	<u>Regulatory Monitoring and Bioassay Laboratory.</u> This project involves the construction of an 80,000 sq. ft. laboratory housing sample prep areas, analytical instrumentation rooms, mechanical and electrical support services, and offices. It is possible that overflow work undertaken by this facility could be done at FIU-HCET	DD-01	(<u>Very high priority</u>) <u>Radiological characterization of contaminated equipment and facilities.</u> Confirmation of field deployable equipment
D&D RLD03	Surface decontamination of Plutonium Finishing Tank utilizing strippable coatings and other techniques.	SR-SW03	<u>Mixed Low-Level Waste Project.</u> Among the activities listed is verification (after treatment) that the waste meets the facility waste acceptance criteria.	WM-13	<u>Continuous Measurement Of Total, Elemental, and Speciated Gaseous, Toxic Metals Effluents.</u> Validation of real-time monitoring system.
D&D RLD04, -07, --014,-018	Long-life fixatives to contain radioactive materials on various surfaces.	SR-1W04	<u>Low-Level Waste Project.</u> Among the activities listed is verification (after treatment) that the wastes meet the facility waste acceptance criteria.	BW-03	In-Situ Assay Systems. Evaluation of LLW waste, mixed waste, corrosives, oxidizers, reducing agents, organics, TRU, PCB's picric acid, in burial grounds, seepage pits, soils, burn areas. High opportunity to evaluate many technologies that may be applied for remediation.

Table 1.
Hanford, Savannah River, and Oak Ridge Validation Needs (Continued)

Hanford		Savannah River Site		Oak Ridge	
ID #	Description	ID #	Description	ID #	Description
D&D RLD012	Mapping of radioactive contaminants on vertical and horizontal surfaces.	SR-1W05	<u>Hazardous Waste Project.</u> Methodology is needed to characterize waste that has been previously difficult to sample and/or analyze.	HY-13	<u>Treatment of groundwater plumes with reactive materials.</u> This project may have relevance to a proposal that has been submitted to Fernald regarding interaction of water with liner material.
Mixed Waste RLMW05	Remote treatment of organic contaminated soil.	SR-1W06	<u>Sanitary Waste Project.</u> Scope requires verification that waste meets commercial disposal facility waste acceptance criteria.	WM-27	<u>Non-Destructive Assay Performance Demonstration of TRU wastes.</u> Verification of assay performance by possible round robin involvement.
Mixed Waste RLMW06	Treatment of TRU liquid waste contaminated with PCBs and ignitables.			HG-15	<u>In-situ methods for reducing mercury in influent streams.</u> Verification of meeting requirements for extremely low concentration delectability at ng/L level.

Table 1.
Hanford, Savannah River, and Oak Ridge Validation Needs (Continued)

Hanford		Savannah River Site		Oak Ridge	
ID #	Description	ID #	Description	ID #	Description
Subsurface RLSSXXX	<p>In-situ remediation of carbon tetrachloride in groundwater.</p> <p>In-line monitoring of carbon tetrachloride in process water.</p> <p>Remediation of hexavalent chromium in groundwater.</p> <p>In-line detection of chromium in process water.</p> <p>In-situ detection of chromium in groundwater.</p> <p>In-situ remediation of chromium, mercury, and lead.</p> <p>In-situ remediation of uranium, plutonium, cesium, and cobalt.</p> <p>Field screening of uranium, plutonium, cesium, cobalt, and strontium.</p> <p>Long-life waste isolation barriers.</p> <p>Detection of pyrophoric materials.</p>			HG-16	<p><u>Nondestructive device to detect mercury in water or aqueous solutions.</u></p> <p>Confirmation of technology performance will be required.</p>

Table 1.
Hanford, Savannah River, and Oak Ridge Validation Needs (Continued)

Hanford		Savannah River Site		Oak Ridge	
ID #	Description	ID #	Description	ID #	Description
Tank Waste RLWT019 , -020	ILAW product acceptance inspection and test methods.			WM-06	<u>Removal of nitrates from Aqueous Waste in the Presence of Radionuclides.</u> FIU-HCET may be able to play a key role based upon its Nitrate to Ammonia Conversion (NAC) experience.
Tank Waste RLWT021	Secondary Products Acceptance Inspection and test methods.			WM-12	<u>Decontamination of scrap metal.</u> Use of FIU-HCET X-Ray Dispersive Analysis System can provide confirmation of contaminant removal.
Tank Waste RLWT02	Round-robin laboratory method for technetium 99 verification.			HY-15	<u>Vapor phase treatment alternatives.</u> Verification of destruction of chlorinated solvent vapors using systems other than carbon absorption type.
Tank Waste RLWT06	In-tank corrosion monitoring.			BW-19	<u>Remediation of secondary soil contamination.</u> Involves confirmation of characterization of soil contaminated with radionuclides, heavy metals, and/or volatile organic compounds.

Table 1.
Hanford, Savannah River, and Oak Ridge Validation Needs (Continued)

Hanford		Savannah River Site		Oak Ridge	
ID #	Description	ID #	Description	ID #	Description
Tank <u>Waste</u> RLWT07	Inspection of high-level waste single-shell tanks, metallurgical examination.			WM-23	<u>Treatment of heterogeneous waste.</u> Confirmation of effectiveness of removal of organic contaminants from waste.
Tank <u>Waste</u> RLWT030	Study of glasses with insoluble phases.			WM-15	<u>Removal of lithium from aqueous waste.</u> Validation using Atomic Absorption Spectrophotometer.
Tank <u>Waste</u> RLWT030	Crack patterns within glasses (utilize SEM and thermal analysis).			HY-04	<u>VOC monitoring and detection.</u> Verification of performance of field measurements. Use of FIU-HCET Analytical Lab GC/MS.
	Solubility of components in solid and liquid matrices of tank wastes. Compilation of previous information to predict precipitation or gel formation.			WM-14	<u>Long-term performance of final waste forms.</u> Modeling of mechanisms for release of radioactive and toxic constituents.

Table 2.
Albuquerque, Idaho, and Chicago Validation Needs

Albuquerque/Kansas City/Grand Jct.		Idaho National Laboratories		Chicago Office	
ID #	Description	ID #	Description	ID #	Description
AL-07-01-02-MW	<p><u>high priority</u></p> <p>In-Situ Remediation of 25 Material Disposal Areas.</p> <p>Long-term surveillance and maintenance will be implemented, requiring validation and verification of post-closure monitoring performance.</p>	6.1.01	<p><u>In-Situ Debris Characterization for Partial Retrieval, Removal, and Treatment of massive quantities of buried waste at the INEEL OU 7-13 (SDA Pits and Trenches) may be required.</u></p> <p>In-situ or real-time debris characterization data are needed to reduce the volume of debris to be processed.</p>	CH-0010	<p><u>New techniques for monitoring of groundwater beneath parts of the Princeton Plasma Physics Laboratory (PPPL) containing volatile organic compounds (VOCs) needed. Primary contaminants are tetrachloroethene (PCE), trichloroethene (TCE), 1,1,1-trichloroethane (TCA), and their breakdown products.</u></p> <p>Any proposed technologies would require validation and verification activities to ensure the accuracy of the data obtained.</p>
AL-08-01-16-SC	<p><u>high priority</u></p> <p><u>Cost-Effective Technologies for Addressing TRU in Soils and Sediments.</u></p> <p>Effectiveness of remediation techniques will need to be demonstrated.</p>	3.2.32	<p><u>Develop Thermal Treatment Unit Offgas CEM Monitors.</u></p> <p>Opportunity to develop continuous emission monitor (CEM) systems for offgases, toxic metals including Hg, dioxins, radionuclides, and thermal treatment processes. CEM</p> <p>Performance must exceed anticipated EPA contaminant emission standards.</p>	CH-0005	<p><u>New techniques are required for radiological decay and long-term monitoring for plumes of groundwater contaminated with tetrachloroethene (PCE) and carbon tetrachloride (CCl₄).</u></p> <p>Proposed technologies will require validation and verification of the obtained data.</p>

Table 2.
Albuquerque, Idaho, and Chicago Validation Needs (Continued)

Albuquerque/Kansas City/Grand Jct.		Idaho National Laboratories		Chicago Office	
ID #	Description	ID #	Description	ID #	Description
	<u>medium priority</u> Non-Intrusive Removal of Polychlorinated Biphenols (PCBs) from Soil Both Above and Below the Water Table Underneath Buildings. Confirmation of the removal will be required.	6.1.02	<u>Real-time Field Instrumentation for Characterization and Monitoring Soils and Groundwater.</u> Rapid and accurate monitoring instrumentation is needed that can identify groundwater and soil contamination and determine the extent of contamination, verify soils contaminant concentrations above and below risk-based levels, and ensure retrieved soils meet the regulatory limits for repository disposal.	CH-0008	<u>An in-situ remedial technology is needed to remove a mixture of organic solvents from shallow, high clay content soil, which is the source of a groundwater plume that is migrating toward an off-site nature preserve.</u> Any remedial action for this site would require confirmation of its effectiveness.

Table 2.
Albuquerque, Idaho, and Chicago Validation Needs (Continued)

Albuquerque/Kansas City/Grand Jct.		Idaho National Laboratories		Chicago Office	
ID #	Description	ID #	Description	ID #	Description
AL-07-09-02-SC	<p><u>medium priority</u></p> <p>Hydrogeologic Performance Monitoring of Engineered Covers.</p> <p>Long-term surveillance and maintenance will be implemented requiring validation and verification of post-closure monitoring performance.</p>	6.1.04	<p><u>In-situ Treatment of VOC Contaminated Groundwater in Deep Fractured Rock.</u></p> <p>An alternative in-situ technology is needed to a) reduce overall remediation cost and schedule and b) ensure compliance with meeting the maximum contaminant levels for contaminants of concern, including the volatile organic compounds trichloroethene (TCE), dichloroethene (DCE), and perchloroethene (PCE). Inorganic and radionuclide contaminated water in a 300 ft well bottom.</p>	NV02-9801-01S	<p><u>A cost-effective sampling technology for groundwater in deep wells that does not adversely affect solution chemistry and cause dissolution of colloids is needed.</u></p> <p>It must be demonstrated that the sample is representative of the actual conditions by validation of its effects on the chemistry.</p>

Table 2.
Albuquerque, Idaho, and Chicago Validation Needs (Continued)

Albuquerque/Kansas City/Grand Jct.		Idaho National Laboratories		Chicago Office	
ID #	Description	ID #	Description	ID #	Description
AL-07-01-02-MW	<u>medium priority</u> Contamination Plumes in Soil and Turf. Plumes of tritium, volatile organic compounds, and chlorinated hydrocarbons need technology for treatment. Verification of the technology will be required.				
AL-07-01-14-MW	<u>medium priority</u> <u>Appropriate Characterization of TRU Waste Now Stored in Fiberglass Reinforced Plywood Boxes for Waste Isolation Pilot Project.</u> Verification of decontamination procedures will be required.				
AL-07-01-10-MW	<u>medium priority</u> <u>Proper Treatment of Certain Low-Level Mixed Waste Streams.</u> Confirmation of technology performance will be required.				

Table 2.
Albuquerque, Idaho, and Chicago Validation Needs (Continued)

Albuquerque/Kansas City/Grand Jct.		Idaho National Laboratories		Chicago Office	
ID #	Description	ID #	Description	ID #	Description
AL-07-01-11-MW	<u>medium priority</u> <u>Waste Sorting and Characterization.</u> Characterization techniques of drum wastes will need validation.				
AL-07-01-11-MW:	<u>medium priority</u> <u>High Explosive (HE) and Barium (Ba) Remediation of Soils, Surface Water, and Groundwater</u> Verification of barium removal is within capabilities of FIU-HCET laboratory.				
AL-08-06-02-DD	<u>medium priority</u> <u>Decontamination of Concrete Surfaces Contaminated with Radionuclides and High Explosive Materials Using Microbially Influenced Degradation.</u> Confirmation of the effectiveness of the technology must be demonstrated.				

Table 2.
Albuquerque, Idaho, and Chicago Validation Needs (Continued)

Albuquerque/Kansas City/Grand Jct.		Idaho National Laboratories		Chicago Office	
ID #	Description	ID #	Description	ID #	Description
AL-07-06-01-DD	<p><u>medium priority</u></p> <p><u>Decontamination and Decommissioning (D&D) Technology Development.</u></p> <p>Pantex plant facilities are scheduled for D&D over a 20-year period. Characterization is specifically called out as necessary, implying the need for a full validation program.</p>				
AL-07-06-04-SC	<p><u>medium priority</u></p> <p><u>In-Situ Remediation of HE, Solvents, VOCs, SVOCs, Heavy Metals, and Landfill Materials.</u> Technologies to remove contaminants will require verification.</p>				
AL-07-01-06-MW	<p><u>low priority</u></p> <p><u>Development of Technology to Treat Waste at Point of Generation.</u></p> <p>Verification of applied technologies will be needed.</p>				

Table 3.
Fernald and Technology Management Systems Validation Needs

Fernald (STCG)		Technology Management Systems	
ID #	Description	ID #	Description
F008	Extraction of Rad, RCRA, TSCA Organic Waste.	Tech ID:72	<u>Characterization – Expert System Development for NDA Data Validation.</u> Promotion of the development and commercialization of chemical analysis and sample preparation technologies necessary for the automation of DOE and private contract environmental laboratories.
F002	Real-Time Monitor for Alpha Contamination.	Tech ID:260	Characterization – Expert System Development for NDA Data Validation. Validation is required for 100% of the drums being characterized.
F0029	Collection of Large Quantities of Super-Fine Powders from Silo-3 Wastes.	Tech ID:260	Characterization – Expert System Development for NDA Data Validation. Validation is required for 100% of the drums being characterized.
F030	Radon Diffusion Through Water.	Tech ID: 523	Barriers and Post-Closing Monitoring. Evaluation of automated state-of-the art soil moisture monitoring systems for measuring hydrogeologic performance.
F001	Groundwater Reinjection Technology.	Tech ID: 120	Closure of High-Level Waste Tanks Using Stabilized Contaminated Soils and Debris. Requires demonstration of soil and debris stabilization, stabilization of sodium salts, and performance monitoring activities.
F004	Technetium-99 Detector/Analyzer in Soil and Groundwater.	Tech ID: 1535	Assessment of Subsurface VOCs Using a Chemical Microsensor Array. (No technical description available)

Table 3.
Fernald and Technology Management Systems Validation Needs (Continued)

Fernald (STCG)		Technology Management Systems	
ID #	Description	ID #	Description
F009	Real-Time Soil Waste Stream Analyzer.	Oak need: 4	DNAPL Plume Characterization. Method is needed to locate high concentrations of PCE; TCE; 1,1-DCE; cis-1,2-DCE; 1,1-DCA; 1,2-DCA; 1,1,1-TCA; 1,1,2-TCA; CCl ₄ CHCl ₃ , and vinyl chloride.
F015	Real-Time Automated Liquid Waste Stream Uranium Analyzer.		
F019	Real-time In-situ Systems, Groundwater.		