



U.S. DEPARTMENT OF
ENERGY

OFFICE OF
**ENVIRONMENTAL
MANAGEMENT**

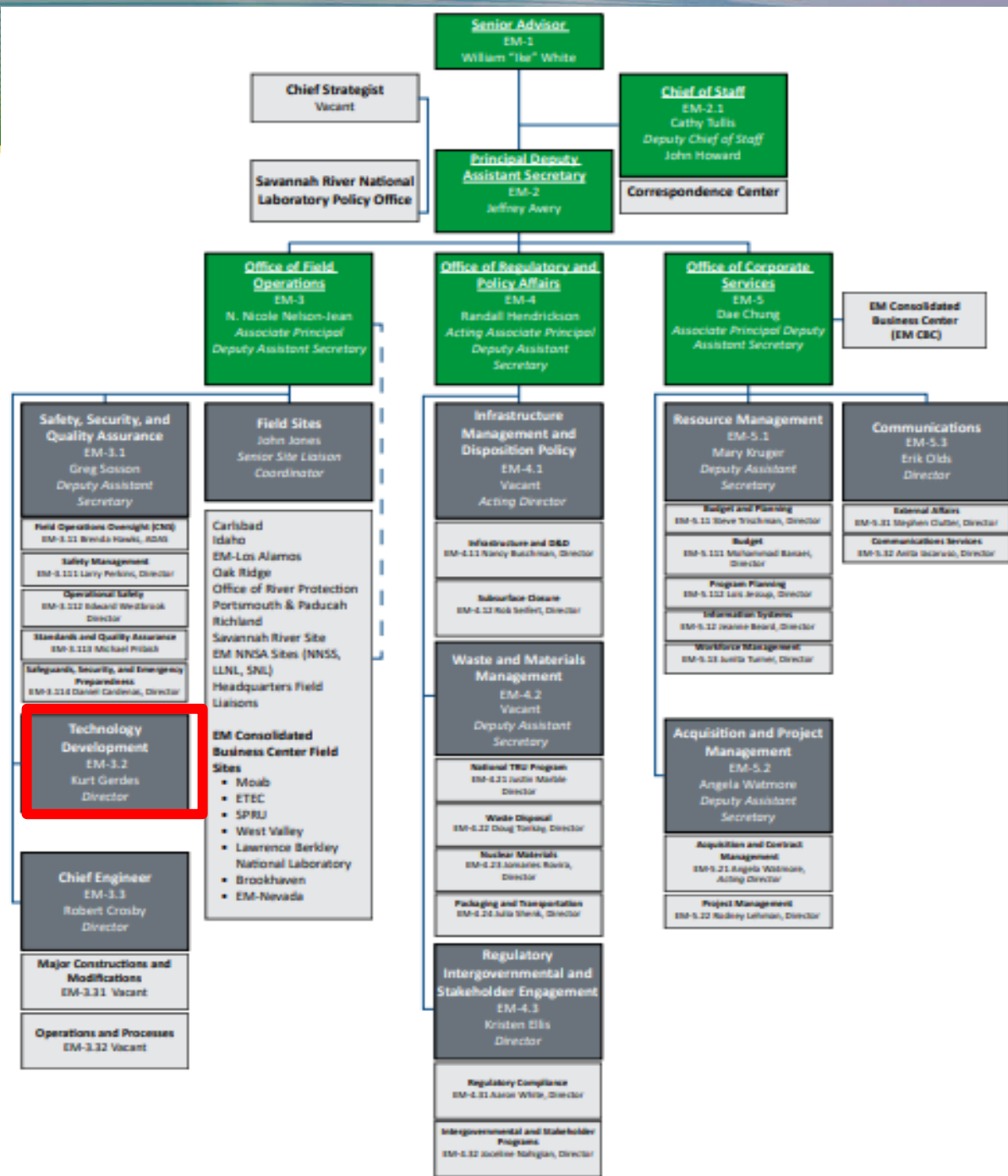
Overview of the Environmental Management Technology Development Program

DOE Office of Environmental Management
Office of Technology Development

March 2023

Presentation for Environmental Management Site Specific Advisory Board

- ❖ **TDO (EM 3.2) Organization**
- ❖ **TD Office Mission & Functions**
- ❖ **Ongoing Mission Challenges/Opportunities**
- ❖ **TD Program Framework**
- ❖ **History & Brief Summary**
- ❖ **TD HQ Program Funding**
- ❖ **Management Initiatives and Non-Labor Program Support funding Request**
- ❖ **Backup charts**
 - **Dashboard for Technology Development**
 - **Congressional Directed TD – SNF, CRESP, Robotics, HEPA**
 - **TD Discretionary Effort Details**
 - **International Collaboration**
 - **Site Funded TD**



Technology Development – EM-3.2

- Under Office of Field Operations EM-3
- Other EM-3 Field support:
 - Safety, Security, Quality Assurance
 - Engineering
 - Field/HQ Interface – Liaisons
- Other EM-HQ organizations:
 - EM-4: Office of Regulatory and Policy Affairs
 - EM-5: Office of Corporate Services

Technology Development
EM-3.2
Kurt Gerdes
Director

Technology Development - Mission

TDO provides **leadership and develops mission strategies, policy, and guidance for technology development** to support EM's cleanup mission. TDO supports the **use of state-of-the-art technology to reduce costs, accelerate schedules, and mitigate vulnerabilities**; and has the **overriding responsibility to support field offices** by enabling the effective execution of the mission. In addition to integrating best practices across the DOE complex, the office **manages EM's technology-based international, interagency, and academic interfaces** to identify advancing technologies, solutions, materials and processes. The office **fosters the transfer of commercially available technology and newly developed entrepreneurial technology** to support cleanup.

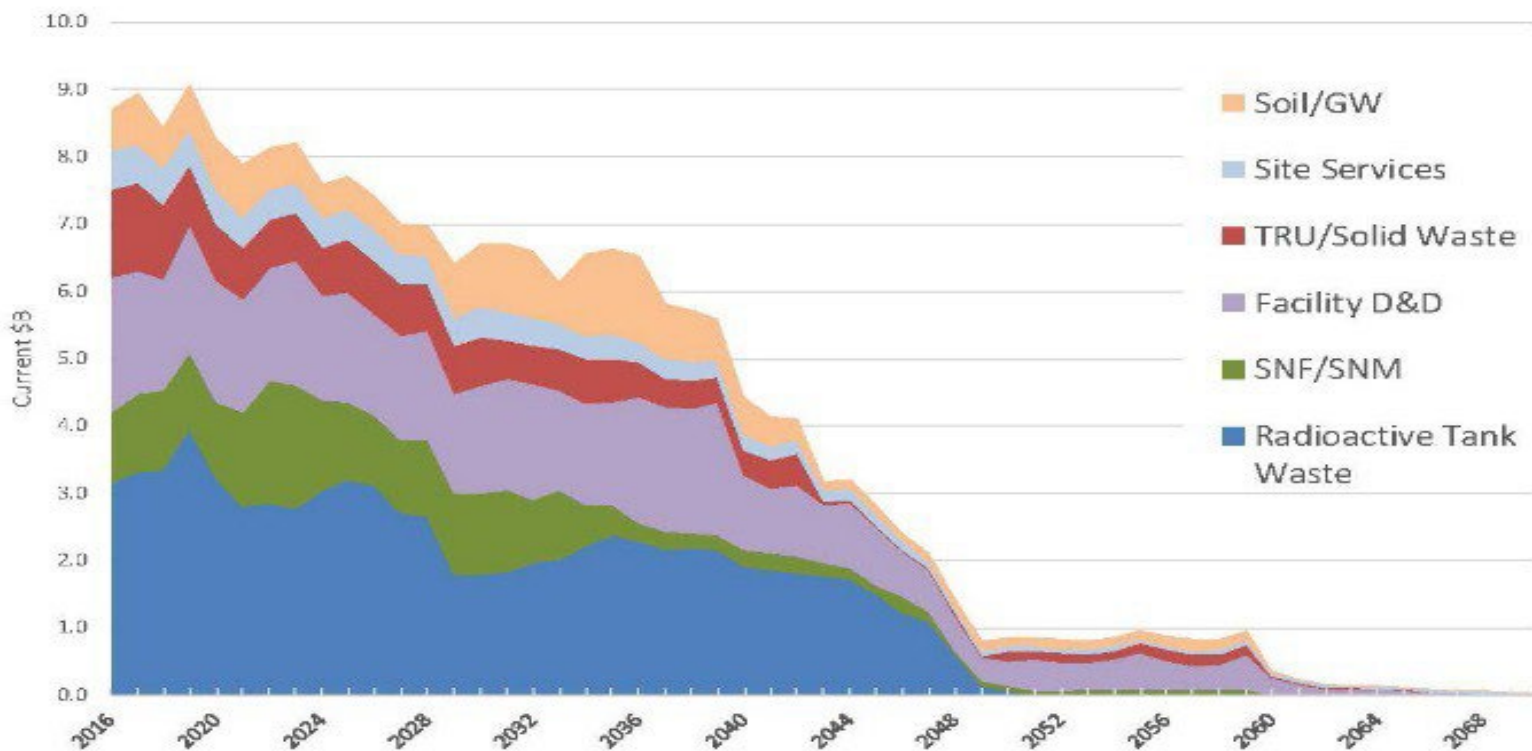
Technology Development - Functions

1. **Complex-Wide TD Activities:** Recommends complex-wide technology strategies and supports implementation of specialized technology programs and projects.
2. **TRA Support:** Supports technology readiness assessments and assists field offices with implementing technology development concepts.
3. **STEM:** Manages EM's participation in Science, Technology, Engineering, and Mathematics Emphasis Programs and provides guidance for EM internship programs, traineeships, minority serving institution partnership programs, and other initiatives.
4. **Best Practices & S&T Initiatives:** Identifies technological best practices (e.g., Laboratory Directed Research and Development portfolios, Work-For-Others, doctoral research); and represents EM in interagency science and technology initiatives and establishes formal agreements.
5. **Innovation:** Facilitates mission innovations and life-cycle technological advancements and advises EM senior leadership on technical issues with potential impact to programmatic deliverables.
6. **National Laboratory Activities:** Coordinates technology development activities performed by DOE's national laboratories and technology centers, including the use of EM resources by technology researchers and developers for promising technologies related to the EM mission (i.e., radioactive test beds) and serves as a TD interface with SRNL.

National Academies of Sciences, Engineering and Medicine - 2019

Independent Review Assessment of Science and Technology for the Department of Energy's Defense Environmental Cleanup Program:

“The long estimated remaining life of the cleanup program provides ample time for new cleanup approaches and technologies to be developed and deployed to reduce cleanup costs and schedules and to mitigate cleanup risks and uncertainties.”



❖ Focus Areas and Enablers

- **Tank Waste Treatment: Retrieval, Separation & Immobilization**
- **Soil & Groundwater Remediation: Cleanup & Monitoring**
- **Facility Decontamination & Decommissioning: Closure & Characterization**
- **Spent Fuel & Nuclear Material Disposition: Storage, Characterization & Disposition**
- **Enablers: Robotics, Artificial Intelligence, Sample Analysis**

❖ Portfolio Elements

- **Technical Assistance – response to field requests, typically National Lab teams**
- **Test Bed Program – in-field testing of relatively mature technology new to nuclear environment**
- **Research and Development Projects – advancement of lab & engineering scale work**
- **Program Leveraging – with other venues, e.g., SC, LM, CRESP, MSU, SBIR, etc.**

❖ TD Office Mission

- Strategies, policy, and guidance for technology development to support EM's mission.
- Support deployment of technology to reduce costs, accelerate schedules, and mitigate vulnerabilities in support of field offices.
- Funding for management initiatives and discretionary TD taskings.

❖ TD Origins

- 1990s – Focus Area Program
 - Waste Tanks, Soil & Groundwater, Mixed Waste, D&D, Nuclear Materials

❖ Budget Evolution for TD

- \$200M - \$400M per year from 1990 – 2002
- Reduced by Congress over next few years (2003 – 2006)
- Since 2007 ~ \$25-\$35M per fiscal year

Technology Development Funding

| Program Element | FY21 | FY22 | FY23 | Description | Examples |
|--|---------------|---------------|-------------|--|--|
| Directed Funding- Spent Nuclear Fuel Program through Idaho | \$ 5 M | \$ 5 M | \$ 5 M | Address issues related to storing, transporting, processing, and disposing of DOE-owned and managed spent nuclear fuel | Measurement of gas generation by radiolysis, modelling corrosion of storage canister |
| Directed Funding- Consortium for Risk Evaluation and Stakeholder Participation (CRESP) | \$ 5 M | \$ 0 M | \$ 0 M | Coordinated university consortium with capability to carry out a variety of R&D activities related to EM mission | Independent expert reviews, modelling of radionuclide movement from waste forms and through environment |
| Directed Funding- HEPA through MSU/ICET | \$ 5 M | \$ 7 M | \$ 7 M | Creation and use of test platforms for air filtration systems critical to ES&H at nuclear facilities | Qualification testing of High Efficiency Particulate Air Filters (HEPA) under fire suppression scenarios (high heat, humidity) – at Mississippi State University – Institute for Clean Energy Technology (MSU/ICET) |
| Directed Funding- Wearable Robotic Devices | \$ 6.5 M | \$6.5M | \$ 0 M | Testing of mechanical aids to increase muscular ability, improve worker safety & increase productivity | Assessment and testing of commercially available and custom wearable devices for EM suitability, including PPE compatibility and decontaminability. |
| Discretionary to EM TD Program | \$ 7.3 M | \$10.4M | \$ 26.5 M | Address Tank Waste, D&D, GW/S and other areas through R&D projects, technical assistance and test beds | Improved SWPF Solvent Extraction to reduce risk of process upset; Development & testing of fixatives for D&D; Dissolution of tank waste solids (Al & phosphates); Glass waste form database; Cementitious material studies |
| SC Tax to EM | \$1.2 M | \$1.1M | \$1.5 M | SBIR Program | Support Small Business R&D administered by Office of Science (SC) |
| Total | \$30 M | \$30 M | \$40 | HQ Technology Development Program | |

FY23 HQ Technology Development Program Cycle

| Activity | Schedule * |
|---|----------------------------------|
| <u>Technology Needs Request:</u> HQ (TD director) request field input (needs and opportunities) | Jan 30, 2023 |
| Consolidate input from field | Feb 17, 2023 |
| <u>Proposal request:</u> HQ (TD director) notifies National Labs and other performers to submit technology development proposals. The field “needs” information is also distributed to inform proposals | March 2023 Due April/May 2023 |
| <u>Prepare for prioritization:</u> Assemble review team (may include field, liaisons, other HQ offices). Review criteria approved. Proposals and technology need information distributed. | April/May 2023 |
| <u>Presentations:</u> Lab leads invited to briefly discuss proposals with the review team. | May/June 2023 |
| <u>Prioritization:</u> Proposals scored and ranked. Discussed by the team and adjusted for portfolio balance and scoring inconsistencies. | June/July 2023 |
| Funding sent out: Principal Investigators develop TCRs with scope, milestones and other information | July 2023 |

- Move schedule earlier for FY2024 & future
- Ideally complete the prioritization of needs prior to the new fiscal year funding

❖ Management Initiatives Funding

Florida International University (FIU)

Budget: FY22/FY23 \$4M

FIU supports EM in environmental remediation and workforce development in several major areas of research:

- High-Level Waste (SRS, ORP, Hanford; e.g., robotics for tank inspection; transfer line flushing)
- Soil & Groundwater (SRS, Hanford, WIPP; e.g., uranium sequestration in soil)
- Deactivation & Decommissioning (SRS 235-F Risk Reduction Project)
- Knowledge Management & Information Technology applications (multiple sites)
- Workforce Development with DOE Fellows working with several EM and LM field sites

❖ Non-Labor Funding

Minority Serving Institution Partnership Pgm (MSIPP) Budget: FY21 \$5.5M/FY22 \$56M/FY23 \$56M

- Develops skills and talent for DOE's technical workforce at DOE EM.
- Supports science, technology, engineering, and mathematics (STEM) activities at Minority Serving Institutions engaged in research and related STEM efforts based on EM's mission essential areas and critical research topics.
- Creates opportunities for minority students through research and field study internships at DOE EM, EM field sites and National Laboratories.

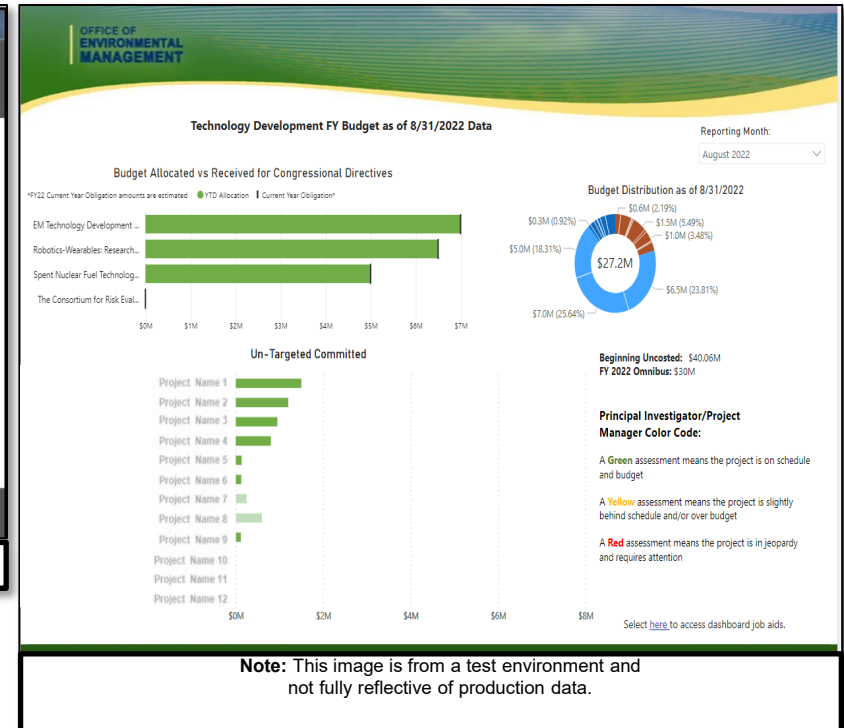
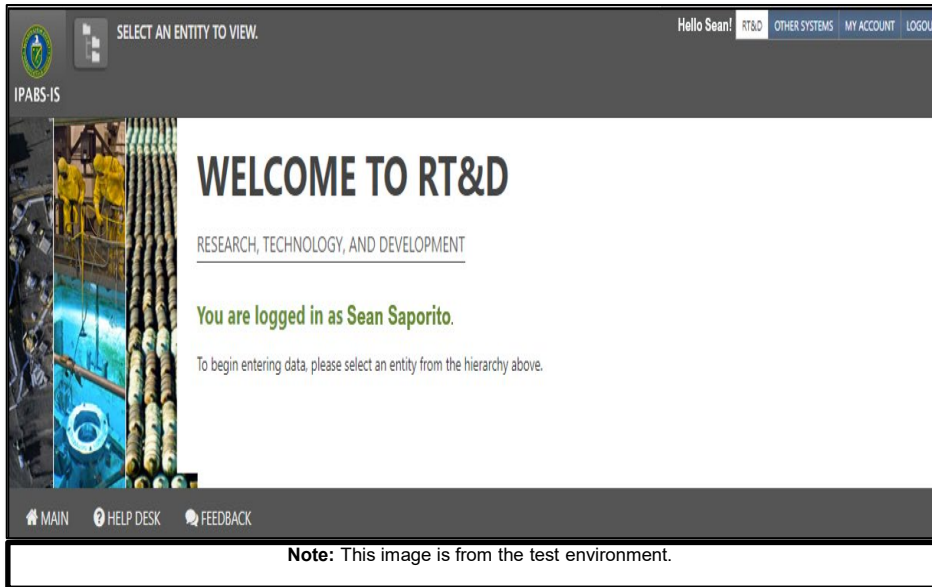
Back Up Slides

Dashboard for Research, Technology Development and Deployment

DOE EM Research, Technology and Development (RT&D) Dashboard - Complex wide

Description: The DOE EM RT&D dashboard is an interactive visual interface that gathers performance and financial data. This dashboard will enable one to monitor and evaluate science and technology efforts across the DOE EM cleanup complex.

- Includes both HQ-funded and Field-funded efforts

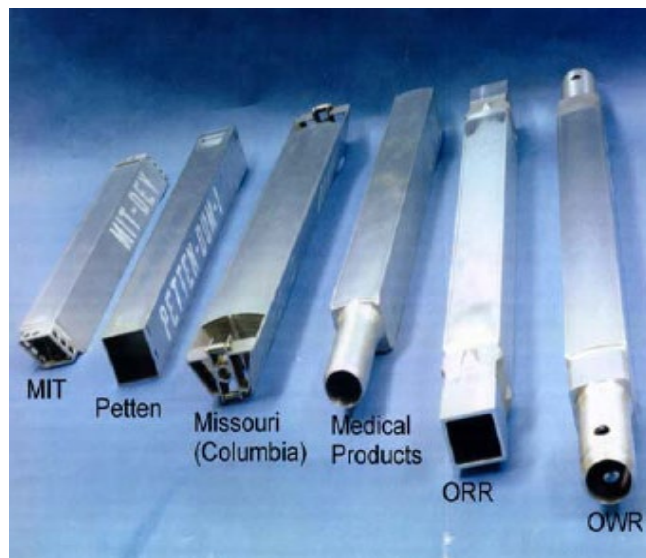


- Data entry via PI or designee
- In IPABS/RT&D module

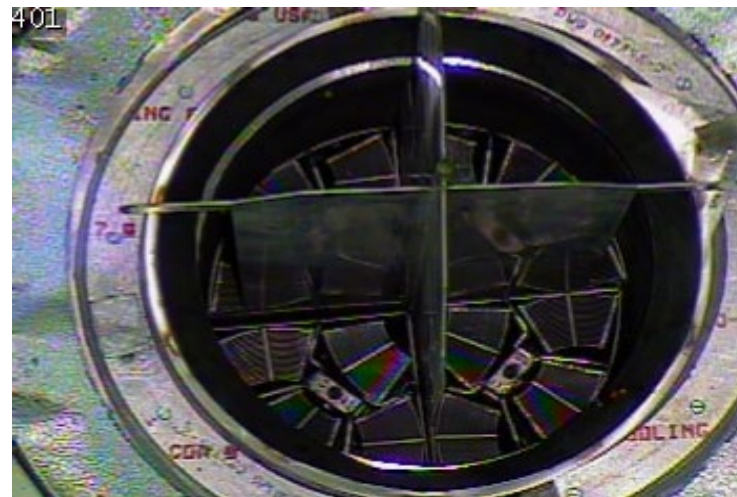
- HQ/TD dashboard display

Spent Nuclear Fuel R&D - Directed Funding to address:

- issues related to storing, transporting, processing, and disposing of SNF
- the need for additional assessments into material degradation from decades of storage
- nuclear material measuring and monitoring and other activities



Research reactor fuel elements



ATR elements stored in a CPP-603 storage configuration

CRESP is a multi-university Consortium for Risk Evaluation and Stakeholder Participation (CRESP) that has served DOE and its stakeholders since 1995, through a cooperative agreement awarded to Vanderbilt University.

Representation includes Vanderbilt, Rutgers, Oregon State, University of Virginia, Howard University, Georgia Institute of Technology, and New York University.

Project areas include:

- Waste Processing and Special Nuclear Materials
- Remediation, Near-Surface Disposal, and Long-Term Stewardship
- Nuclear Waste Management Policy and Strategy
- Stakeholder Engagement & Communications
- Reviews (as requested; e.g., ORP System Plan, Contractor Assurance System)
- Education (Support to Grad Students and Post Docs)

Mississippi State University – Institute for Clean Energy Technology (MSU-ICET)

For several years, MSU has supported WTP specialized off-gas filters and, more recently, Idaho Waste Treatment Unit (IWTU) Technical issue resolution

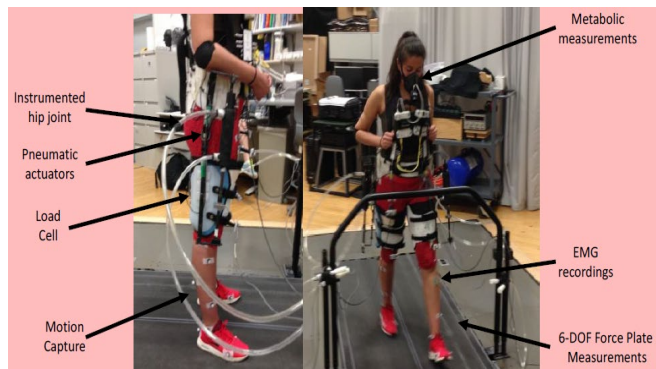
Work Scope:

- Basic and Early-stage applied research in new clean air technologies
- Perform design-specification and QC/QA inspection & testing of HEPA filters and clean air technology
- Testing and evaluation of HEPA filter performance in design-basis and off-normal operating conditions
- Computer modeling and numerical simulation of airflow dynamics (multiphase flow, particle tracking, evaporation, combustion, convection, conduction & heat transfer)
- In-depth engineering analysis of complex fluid flows (velocity, pressure, turbulence, temperature & species concentration)
- Support R&D of new and plant-specific designs of related air filtration technologies such as in-line sensors
- Support complementary and alternative technologies, such as robotics and remote systems, to support the inspection and maintenance of ventilation systems as critical infrastructure
- Troubleshooting and problem-solving technical support to DOE in support of operational air cleaning challenges throughout the DOE complex

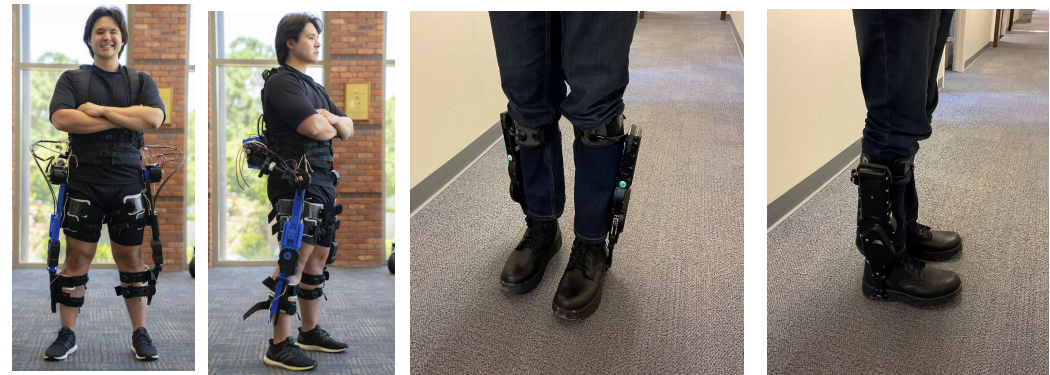


Robotic-Wearables: Research, Development and Deployment to Enhance Worker Safety

- The wearable project is congressionally mandated.
- This work will address short- and mid-term ergonomic challenges facing DOE-EM workers. To address short-term needs at active sites, an exoskeleton testbed has been established at Sandia National Laboratories (SNL).
- Development of this testbed has been started and is being used.
- The testbed will allow rapidly emerging commercial systems to be tested in EM-relevant environments (e.g., with appropriate tasks and PPE) to determine if they are applicable to existing EM site needs. This will offload this testing and evaluation from the sites themselves and accelerate the selection of appropriate devices.
- Some wearable devices and biomechanical sensors have been procured. In this work, additional hardware will be acquired, including PPE, and EM tasks will be replicated at SNL. Some evaluation and device examples are shown below.



Biomechanical evaluation of generalized EM tasks



Develop lower-body device tailored to Hanford tank farm workers

Wearable Robotic Device Team:



Coordinate team's effort with EM, work with sites, Exoskeleton Testbed



Biomechanical research on EM-relevant tasks and devices



Advance wearable technologies to address EM-specific gaps



Work with additional sites, study radiation effects on devices



Work with additional sites, study PPE compatibility and integration



Study unique EM applications, evaluate and develop novel technology

Discretionary Funding:

- \$5 - \$7M per fiscal year budget not directed by Congress
- EM TD Office funded multiple projects across the portfolio to address Tank Waste, Deactivation & Decommissioning, and Soil & Groundwater

| Project | Performing Entity |
|---|-------------------|
| Artificial Intelligence: Long Term Monitoring, Big Data | LBNL, SRNL |
| International UDASS Collaborative Project | NuVision/ANTECH |
| Cesium Removal – Next Generation Solvent | ORNL |
| In Situ Decommissioning | SRNL |
| ALTEMIS – S/GW Targets | SRNL/PNNL |
| Per & Poly Fluoro Alkyl (PFA) remediation issues | SRNL |
| Cold Crucible Induction Melter evaluation | INL/SRNL |
| WIPP Data & Measurement Modernization | SNL |
| Hg Remediation Technical Support at Oak Ridge | ORNL |
| Low Activity Waste Glass processing constraints | PNNL |

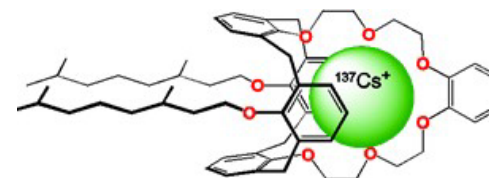
Discretionary Funding - Example

ORNL: Next Generation Solvent for SWPF

- First Generation solvent system employed BOBCalixC6 as extractant; deployed in the Modular Caustic Side Solvent Extraction Unit (MCU) in 2008. It operated successfully with a decontamination factor (DF) > 100.
- A Next Generation solvent system used MaxCalix as the active extractant, deployed in the MCU in 2013 and achieved DF > 50,000.
- Research completed on the NGS system in FY22, optimizing solvent components for operation in SWPF for increased throughput and solvent stability.



Contactors at MCU for mixing waste and solvent



MaxCalix is a key constituent of the NGS system

International Collaboration on Technology Development

- ❖ International cleanup programs have similar challenges as EM
- ❖ Various countries are developing technologies to address the challenges
- ❖ Countries may leverage their investment in technology development by:
 - Sharing cost wherever possible
 - Sharing expertise and state-of-the-art equipment
 - Taking advantage of different testing environments to prove out technology in the location where:
 - The cost may be lower
 - Regulator and stakeholder barriers may be lower
 - Impact of success is higher, or impact of failure is lower

EM INTERNATIONAL PROGRAM



US and UK Collaborative Projects

❖ Improved Characterization/Sentencing (Disposition) of wastes

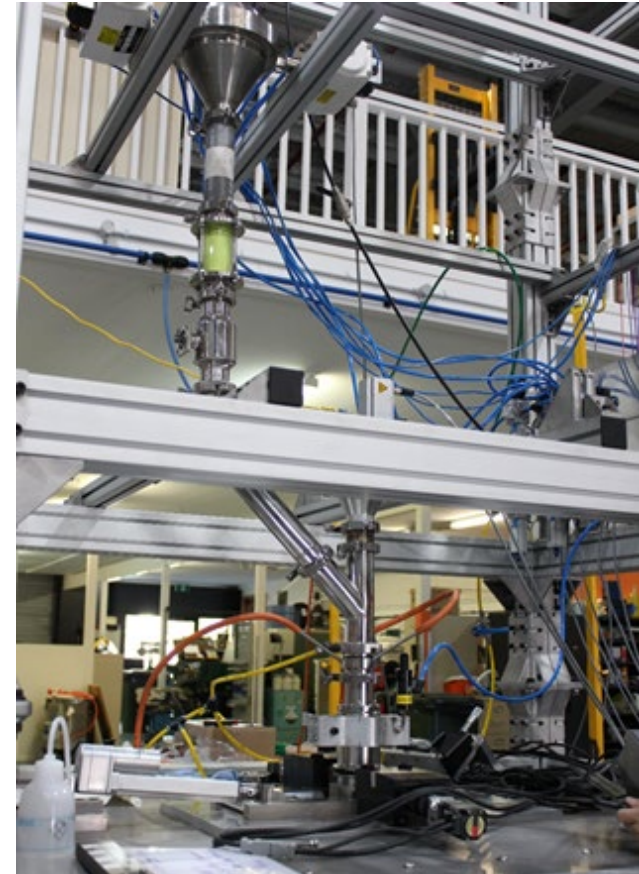
- Conservatism may disposition waste as TRU instead of low-level waste
- The Universal Drum Assay and Sentencing System (UDASS) combines 3 proven characterization technologies into a single system and offers more accurate sentencing (disposition) of 55-100 gallon drums
- NuVision Engineering

❖ Safe, effective filling of cannisters for Hot Isostatic Pressing (HIP) without appreciable contamination or loss of material

- UK NDA issue: Pu/Pu residues
- US DOE issue: Calcine wastes at Idaho
- Involves UK NNL, GeoRoc (Australia), NuVision Engineering (US) to develop and demonstrate a can filling system using surrogate
- DOE-Idaho supporting the US work
- DOE-Idaho providing funds



UDASS Prototype System



**HIP Cannister Filling Rig:
Hopper at the top**

Site-Funded Technology Development Program (Reviews)

- **National Academies 2019 Review: Estimate for FY18 - \$85M**
- **DOE Evaluation (HQ & Field) 2019:**
 - Estimate for FY19 - \$151M
 - Projection for FY20 – \$155M
 - Funding totals include \$85M for Integrated Waste Treatment Unit (IWTU) at Idaho for both FY19 and FY20
- **EM National Laboratory Network Evaluation (2020-2021) for FY20**
- **Many activities were evaluated for technical scope only.**