U.S. DEPARTMENT OF ENERGY | OFFICE OF ENVIRONMENTAL MANAGEMENT

Enabling Innovation in Our Mission

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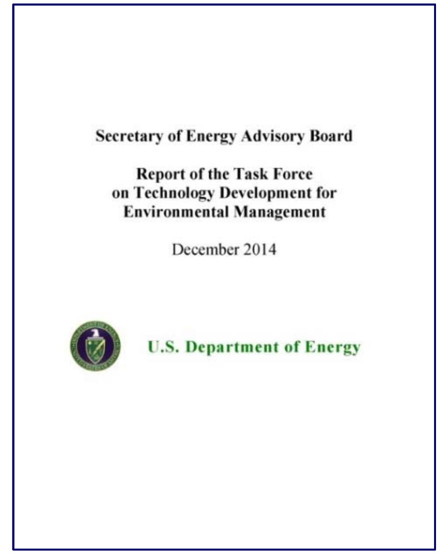
Technology Development Program
Our current initiatives

- ❖ **New strategy → focus on cost reduction, increasing operational efficiency, and enhancing safety**
  1) **Secretarial Initiative**
     - **Secretary of Energy Advisory Board (SEAB) Task Force on EM TD**
  2) **Re-structure the EM Technology Development Program**
  3) **Alignment of**
     a) **International Program**
     b) **Traineeship program**
     c) **Cooperative Agreements**
  4) **Partner with Office of Science and Office of Nuclear Energy**

SEAB Task Force Recommendations

- **SEAB Task Force issued report in December 2014**
  - **Recommendations**
    1) **Incremental technologies – improve the efficiency and effectiveness of existing cleanup processes**
    2) **High impact technologies – target big challenges, and hold the promise of breakthrough improvements**
    3) **Fundamental research – provides knowledge and capabilities that bear on the EM challenges**
    4) **EM university collaboration – next generation**


Secretary of Energy Advisory Board

Report of the Task Force
on Technology Development for
Environmental Management

December 2014

U.S. Department of Energy

- **EM TD technology portfolio and management framework adopts many SEAB recommendations**

2) Re-structure the EM TD Program

- **We will target critical, near-term technology challenges**

  A. **Disposition of cesium and strontium**

  B. **Remediation of mercury contamination**

  C. **Smarter solutions for technetium management**

  D. **Develop capability for Radioactive Test Beds**

  E. **Leverage federally funded initiatives and advancements in robotics**

A. EM TD – Cesium/Strontium

- Deep Bore Hole Demonstration
  - Target waste are Cs (74 million curies) and Sr (32 million curies) packaged in 1,936 stainless steel capsules in underwater storage at Hanford's Waste Encapsulation and Storage Facility
  - Prototypical family of designs for universal canisters
  - Universal Can Challenge is led by Steve Gomberg (EM-32)
- Use of non-elutable ion exchange resins
  - Strive to handle contaminants once → direct disposal once captured
  - "IX Challenge" is led by David Hobbs (SRNL on detail to EM)
- Disposition Alternatives for Calcine Waste
  - 4,400 m^3 (155,000 ft^3) or 5.5 million kg (12.2 million lbs) stored in 43 stainless steel bins at Idaho
  - "Calcine Challenge" is led by Joel Case (ID) and Steve Schneider (EM-21)

B. EM TD – Mercury

- **About 11 million kg (24.2 million lbs) of elemental mercury were used at the Oak Ridge Y-12 National Security Complex for lithium isotope separation from 1950-1963**
- **About 3% of the mercury was lost to the air, to soil and rock under facilities, and to East Fork Poplar Creek, which originates onsite**
  - **Elemental mercury in surface water can convert to methylmercury, which is a neurotoxin and accumulates in fish**
  - **While discharges ended in 1963, mercury continues to be released into the creek from contaminated soil and water**

Mercury droplets in contaminated Y-12 soil

- **“Mercury Challenge” is led by Karen Skubal (EM-12)**

C. EM TD – Technetium

- Tc-99 is an environmental risk driver
  - Accounts for 90% of risk in the Hanford site performance assessment
  - Tc-99 is a contaminant of interest in at least 18 waste units
- Significant uncertainty
  - Movement of Tc-99 in the deep vadose zone
  - Predicting future impacts to groundwater
  - Long-term remediation and monitoring
- Treatment issues
  - Volatilizes during plant processing (e.g., in melters)
  - Separation, capture and immobilization must address multiple technetium species
- "Technetium Challenge" is led by Nick Machara (EM-21)

D. EM TD – Rad Test Beds

- Physical platforms to demonstrate innovative tooling, treatment technologies, and other solutions at our existing facilities
- Provide technologists the unique opportunity to
  - Use radioactive and chemically reactive wastes and materials (no costly surrogates or simulants)
  - Conduct technology demonstrations in spaces and areas that
    - Have radiation fields
    - Are contaminated with surface and/or fixed radioactivity
    - Are inaccessible, inhabitable, or not safe for worker entry
    - Are difficult to replicate or mock-up
- "Rad Test Beds Initiative" is led by Rod Rimando (EM-23)

E. EM TD – Robotics

- Robotics are needed to access areas/spaces within our facilities that are
  - Inaccessible, hard to reach, or limited by size and configuration
  - Un-inhabitable, contaminated, unsafe
  - Otherwise preclude the safe and direct entry by workers
- Robotics are needed to perform remote tasks
  - Monitoring, measuring, sampling, surveying, imaging, and other characterization and investigative tasks
  - Cutting, dismantlement, decon, repair, housekeeping, and surveillance
  - Initial response to off-normal events, performing emergency actions, and conducting search and rescue operations
  - Post-accident actions such as damage and habitability assessments, troubleshooting, forensic investigations, and initial recovery actions
- Leverage other Federal agencies and capabilities
- “Robotics Initiative” is led by Rod Rimando (EM-23)

3) Alignment of TD Enablers

a) International Program
- Expanding technology, knowledge and personnel exchanges with the UK, Canada, and Japan

b) Traineeship Program
- Engage faculty, postdocs, and graduate students for fresh ideas
- Access advances in engineering and science
- Provide a cadre of educated personnel over the next few decades

c) Cooperative Agreements
- Scientific and engineering research to solve EM challenges
  - Consortium for Risk Evaluation with Stakeholder Participation
  - Mississippi State University Institute for Clean Energy Technology
  - Florida International University
  - NuVision Engineering (international liaison with the UK)

4) Office of Science Basic Research Needs for Environmental Management – July 2015

- **Priority Research Directions**
  1) High dimensional interrogation of inaccessible environments with diverse data
  2) Predicting and controlling chemical and physical processes far from equilibrium
  3) Understanding critical physicochemical interfacial reactions across scales
  4) Long term evolution of non-equilibrium structures
  5) Harnessing physical and chemical mechanisms to revolutionize separations
  6) Mechanisms of Materials Degradation in Harsh Environments
  7) Mastering Hierarchical Structures to Tailor Waste Forms
  8) Scale-aware prediction of terrestrial system behavior and response to perturbations

Closing Thoughts

- **Future investments to revive EM innovation**
- **Our continued mission success relies on creativity and enthusiasm**
- **We will exploit and leverage opportunities with other technologists**
  - **Especially with other federal agencies where taxpayer funds have already been invested**
- **We will cultivate a mind-set and discipline that enables innovation**