Rocky Flats: **Nuclear Weapons Component Manufacturing** **Cleanup** **National Wildlife Refuge**

Fernald: **Uranium Processing** **Cleanup** **Wetlands**

EM Cleanup

"Reducing risk to our country, citizens, and environment through nuclear waste cleanup"

Mark A. Gilbertson
Deputy Assistant Secretary for Engineering & Technology
Office of Environmental Management

March 3, 2008

EM manages the largest environmental cleanup program in the world . . . .

Two million acres, the size of Rhode Island and Delaware combined

34,000 Workers

Enough nuclear waste to fill the Superdome

4,500 facilities to cleanup/demolish

Our program requires us to . . .

Work with some of the most dangerous substances known to humanity

Perform first-of-a-kind tasks in highly hazardous work environments

Design, construct and operate first-of-a-kind technology and facilities to solve problems that once seemed unsolvable

We have demonstrated successes . . .

Remediation of 89 of 105 total sites

Retrieval of tank waste

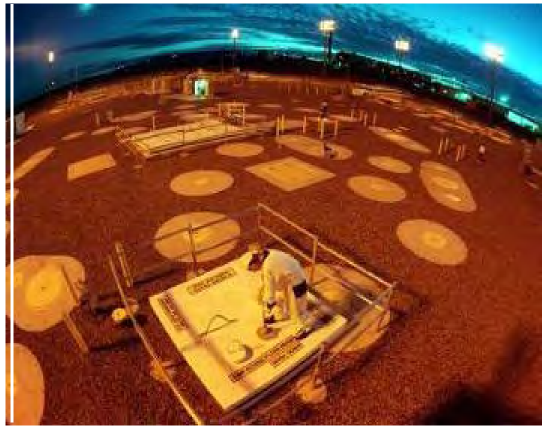
Disposal of transuranic (TRU) waste

Stabilization and storage of plutonium

Groundwater pump-and-treat

Decontamination and decommissioning (D&D) of hundreds of facilities

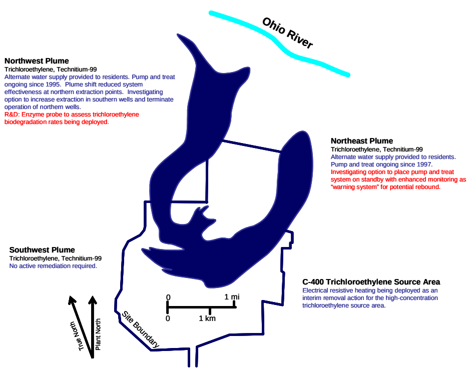
But significant cleanup challenges lie ahead . . .

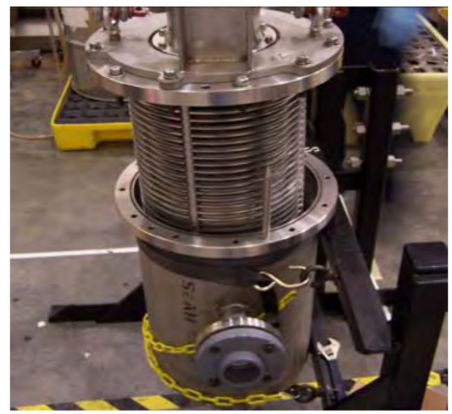


Remediating 88 million gallons of liquid radioactive waste . . .

. . . stored in more than 200 aging underground tanks. . .

. . . equivalent to 22,000 containers of high-level waste.





Remediating 100 sq. miles of contaminated groundwater.

Maintaining a stable and skilled workforce.

Identifying new technologies.

We have created the world's greatest nuclear cleanup organization . . .

Managers, Scientists, Engineers, Technicians, and Support Personnel

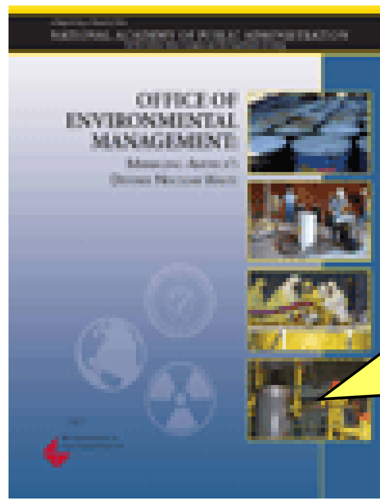
Equipment and Facilities **Safety Processes and Procedures**

And are creating a corporate culture of excellence . . .

Corporate Best Practices Adopted

- High-performing organization principles
- Independent validation lifecycle costs and schedules
- Integration of procurement functions
- Project management processes
- Business management processes
- Senior management focus on project execution

Performance Recognized by National Organizations



"EM is on a solid path to becoming a high-performing organization."

--National Academy of Public Administration

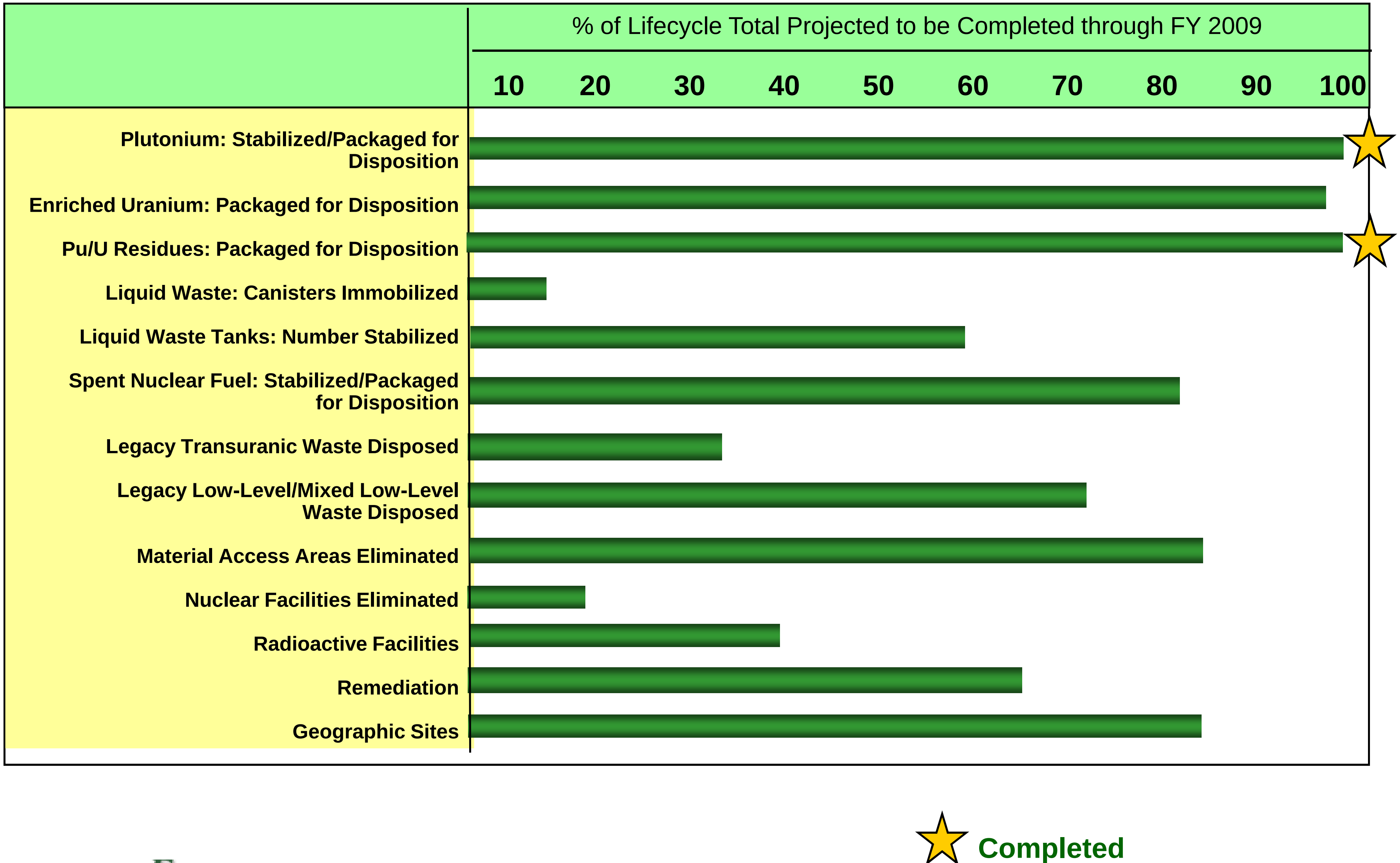
- **2006 Project of the Year (Rocky Flats)**
- **2007 Project of the Year (Fernald)**

-- Project Management Institute

We are making significant cleanup progress . . .

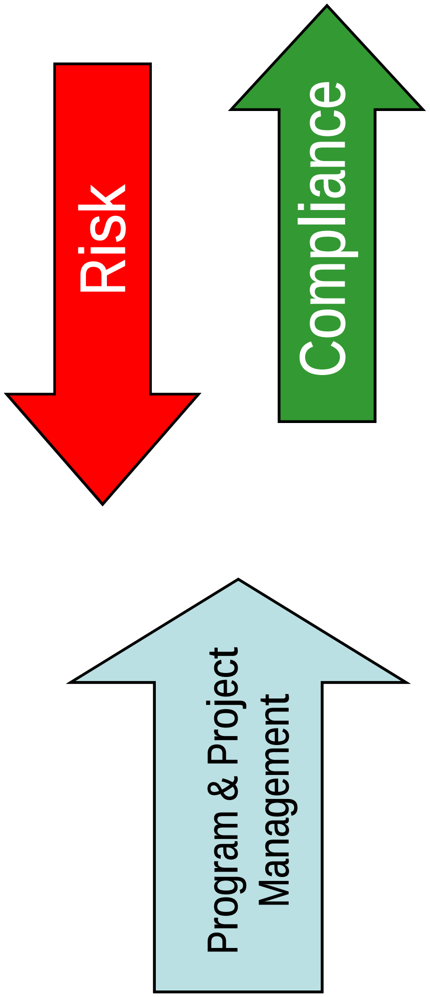
Cleanup Area	Projected FY08-09 Achievements
Tank Waste Processing	• Hanford Waste Treatment and Immobilization facility construction will be 56% complete by end FY09 • Continue construction of the Sodium Bearing Waste facility at Idaho and the Salt Waste Processing facility at Savannah River through FY09 • Grout and close 7 underground tanks at Idaho in FY08
Consolidation and Disposition of Surplus Plutonium, Spent Nuclear Fuel, and Uranium	• Begin disposition of surplus non-pit plutonium at Savannah River in FY08 • Complete consolidation of Hanford plutonium at Savannah River in FY09 • Complete K West sludge containerization at Hanford in FY08 • Complete all wet to dry spent fuel transfers at Idaho by end of FY09 • Complete construction and start operations of Depleted Uranium Hexafluoride (DUF6) Conversion Facilities at Portsmouth and Paducah by end of FY09 • Finalize the design for uranium-233 blend down equipment and initiate Building 3019 modifications at Oak Ridge by the end of FY09
Disposition of Legacy Waste	• Begin shipping remote/contact handled transuranic waste from Oak Ridge to WIPP in FY08 • Complete shipment of transuranic legacy drums at Savannah River to WIPP for disposal in FY09 • Complete shipment of all EM remote handled transuranic waste at Idaho to WIPP in FY08 • Complete disposition of legacy low-level, mixed low-level and PCB waste at Paducah in FY09
Soil and Groundwater Remediation and D&D	• Begin operations of enhanced groundwater remediation for hexavalent chromium at Hanford in FY09 • Complete decontamination and decommissioning of Test Area North at Idaho in FY08 • Demolish east wing of the K-25 processing facility in Oak Ridge in FY09 • Complete demolition of K-East basin at Hanford in FY09
Site Cleanup Completions	• Complete cleanup of 4 sites in FY08 and 2 more in FY09

Bringing us closer to our destination . . .



Our priorities . . .

#1 Priority: Safety



Reduce risk while maximizing regulatory compliance

- Construct **waste treatment facilities** to clean up tank wastes
- Consolidate and prepare for disposal of **surplus plutonium** and **spent nuclear fuel**
- Continue disposal of **transuranic and low-level waste**
- Continue **soil and groundwater remediation**
- Continue decontamination and decommissioning of **unneeded facilities**

Strengthen program and project management

- Implement **National Academy of Public Administration** recommendations
- Independently verify **project baselines** – scope, cost, schedules
- Strive for **"Best in Class"** capability
- Assure effective identification and **management of risk**
- Implement more effective **acquisition process**
- Develop and deploy needed **technologies**
- Focus on **project execution** through enhanced use of
  - Earned Value Management Systems and
  - Ongoing performance reviews by project and senior EM managers

Environmental Management Program
Life-Cycle Cost (LCC) Range

Large Sites	LCC Total Range
Fernald Environmental Management Project	3,203,481
Oak Ridge Reservation	9,408,916 - 9,644,852
Los Alamos National Laboratory	2,626,399 - 3,598,399
Savannah River Site	51,021,088 - 65,902,088
Idaho National Laboratory	18,723,551 - 19,724,651
Waste Isolation Pilot Plant	9,248,503 - 10,312,803
Paducah Gaseous Diffusion Plant	13,703,463 - 13,901,763
Portsmouth Gaseous Diffusion Plant	9,918,412 - 16,127,312
Hanford Site	53,973,542 - 57,190,942
Office of River Protection	57,019,683 - 74,956,683
Rocky Flats	6,519,882
Total Program Life-Cycle Cost Range*	**265,098,683 - 305,004,110**

* Total includes additional site work (i.e. Mound, West Valley, Nevada Test Site, Moab, etc.)

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Site Closure Dates

Consistent with the Office of Environmental Management's (EM) baseline review and approval process for those sites with cleanup work scope beyond the near-term that have approved baselines, EM's life-cycle cost estimates will reflect a range of site completion dates. This range is shown on the following table.

Site	Completion Date
Los Alamos National Laboratory	**2015**
Oak Ridge Reservation	**2021 - 2022**
Savannah River Site	**2038 - 2040**
Idaho National Laboratory	**2035 - 2044**
Waste Isolation Pilot Plant	**2035 - 2039**
Paducah Gaseous Diffusion Plant*	**2040**
Portsmouth Gaseous Diffusion Plant	**2044 - 2052**
Hanford Site	**2050 - 2062**

*Project baselines for these sites have not been approved by DOE

* Total includes additional site work (i.e. Mound, West Valley, Nevada Test Site, Moab, etc.)

Issues to be resolved . . .

Regulatory Compliance

The Administration recognizes EM's FY 2009 budget request would not enable the Department to meet some of the milestones contained in agreements that have been negotiated with regulators over many years.

Milestones

Incomplete knowledge of complexity, inconsistent performance, overly optimistic assumptions, and emerging technical barriers have been impediments.

Tools for Resolution

Independently audited cost and schedule baselines, life-cycle planning estimates, and "analytical building blocks" will provide a basis for conducting credible and defensible analyses.

Path to Resolution

Using these tools, we will engage in meaningful dialogue with regulators, stakeholders, and Tribal Nations to assess existing priorities and mutually identify opportunities to complete cleanup.

Waste Processing Risks & Strategic Initiatives

Technical Risk and Uncertainty

Waste Storage

- Existing tanks provide limited storage and processing capacity, have exceeded their original design life, and will likely be in service for extended periods of time.
- Conservative assumptions regarding behavior of waste during storage, such as flammable gas generation, restrict operations and increase costs.

Waste Retrieval

- Current waste removal and retrieval operations and monitoring technologies are costly, sometimes inefficient, and are limited by complicated internal tank design (e.g., obstructions) and conditions (e.g., past leak sites).

Tank Closure

- Achieving lower levels of residual radioactivity and improving immobilization of residual materials might be possible if there were more cost-effective and efficient closure methods for some tanks.
- Final closure of some waste management areas, including closure of ancillary equipment such as underground transfer lines and valve boxes, would be facilitated by improved closure methods that would make the process more cost-effective and efficient.

Waste Pretreatment

- Achieving effective separation of low- and high-level wastes (HLW) prior to stabilization requires improved, engineered waste processes and a more thorough understanding of chemical behavior.

Stabilization

- Waste loading (i.e., the amount of waste concentrated in waste containers) constraints limit the rate that HLW can be vitrified and the tanks can be closed.
- Current vitrification techniques may require supplemental pretreatment to meet facility constraints.

Strategic Initiatives

Improved Waste Storage Technology

- Develop cost-effective, real-time monitoring of tank integrity and waste volumes to ensure safe storage and maximum storage capacity.
- Improve understanding of corrosion and changing waste chemistry, including flammable gas generation, retention, release, and behavior to establish appropriate assumptions in safety analyses.

Reliable & Efficient Waste Retrieval Technologies

- Develop optimization strategies and technologies for waste retrieval that lead to successful processing and tank closure.
- Develop a suite of demonstrated cleaning technologies that can be readily deployed throughout the complex to achieve required levels of removal.

Enhanced Tank Closure Processes

- Improve methods for characterization and stabilization of residual materials.
- Develop cost-effective and improved materials (i.e., grouts) and technologies to efficiently close complicated ancillary systems.
- Perform integrated cleaning, closure, and capping demonstrations.

Next-Generation Pretreatment Solutions

- Develop in- or at-tank separations solutions for varying tank compositions and configurations.
- Improve methods for separation to minimize the amount of waste processed as HLW.

Enhanced Stabilization Technologies

- Develop next-generation stabilization technologies to facilitate improved operations and cost.
- Develop advanced glass formulations that simultaneously maximize loading and throughput.
- Develop supplemental treatment technologies.

Groundwater & Soil Remediation Risks & Strategic Initiatives

Technical Risk and Uncertainty

Sampling and Characterization

- Current sampling techniques and characterization technologies result in costly, time-consuming characterization programs, may leave large gaps in plume delineation, and may lead to uncertainty in the selection of cleanup strategies.
- Incomplete understanding of contaminant subsurface behavior results in long-term uncertainty regarding risks to human health and the environment.

Modeling to Guide Cleanup

- Existing models provided limited capability to represent complex hydrogeology, biogeochemistry, chemical reactions, and transport. Improved models are needed to reduce risk and uncertainty in predicting contaminant fate and transport and to provide an improved technical basis for optimizing the selection, design and implementation of remedies.

Treatment and Remediation

- In-situ treatment and stabilization technologies provide cost, human health and ecological benefits, but require additional development and demonstration to realize their full potential and to be accepted by the regulatory community.
- Ex-situ technologies may be necessary to remove, treat, isolate and dispose of contaminants in certain situations, but current ex-situ treatment technologies may result in high cleanup costs and unacceptable risks to workers.

Strategic Initiatives

Improved Sampling and Characterization Strategies

- Develop advanced sampling and characterization technologies and strategies for multiple contaminants (organics, metals and radionuclides) in challenging environments (e.g., around subsurface interferences, at intermediate and great depths, and in low and high permeability zones.
- Use basic and applied research to gain a better understanding of contaminant behavior in the subsurface and to provide defensible prediction of risk.

Advanced Predictive Capabilities

- Develop advanced models that incorporate chemical reactions, complex geologic features, and/or multiphase transport for multiple contaminants (organics, metals and radionuclides) in challenging environments to provide an improved technical basis for selecting and implementing remedies.
- Determine mechanisms and rates of release of contaminants from low porosity/permeability zones.
- Develop models that integrate data from various monitoring forms to design long-term effective monitoring systems.

Enhanced Remediation Methods

- Develop, demonstrate and implement advanced in-situ and ex-situ methods which reduce costs, increase effectiveness and reduce risks to human health and the environment.
- Improve understanding of in-situ degradation of chlorinated organics and immobilization of radionuclides and metals to facilitate development and use of advanced, cost-effective in-situ technologies and use of natural processes.
- Provide the technical basis for use of monitored natural attenuation (MNA) of organics, radionuclides, and metals in the subsurface, including use of MNA in conjunction with other methods (e.g., barrier technology).
- Develop safe, cost-effective strategies to treat and remediate legacy materials in historical waste sites, as appropriate.

D&D/Facility Engineering Risks and Strategic Initiatives

Technical Risk and Uncertainty

Characterization

- Limited techniques for detection, quantification and localization of penetrating radiation, radioactive contamination (e.g., Pu, U, tritium), chemicals (asbestos, beryllium, metals, organics, caustic and acidic solutions, lead paint), and biological contaminants (mold, dead birds and rodents, and animal feces) increase the risk of personnel exposure to hazardous conditions.

Deactivation, Decontamination, and Demolition

- Hazardous conditions involving radionuclides, heavy metals, and organic contaminants result in worker safety issues and lead to use of cumbersome personal protective equipment and D&D approaches.
- Inadequate historical knowledge of past operations and contamination (and other hazards) drive conservative and costly D&D approaches.

Closure

- End-state requirements for D&D of process facilities are not adequately defined.

Strategic Initiatives

Adapted Technologies for Site-Specific and Complex-Wide D&D Applications

- Develop and deploy improved characterization and monitoring technologies for detecting and quantifying penetrating radiation, radioactive, and biological contaminants.
- Develop and deploy improved deactivation, retrieval, size-reduction, and stabilization technologies that provide adequate personal protection and effectively achieve end-state requirements.
- Develop and deploy advanced remote and robotic methods to rapidly access and assay facilities to determine optimal D&D approach.
- Establish the scientific and technical basis for end-state conditions to satisfy federal, state, and local stakeholders.

Integration & Cross-Cutting Risks and Strategic Initiatives

Technical Risk and Uncertainty

Assessing Long-Term Performance

- Inadequate fundamental understanding of wasteform performance and contaminant release, transport, and transformation processes result in inadequate conceptual models potentially leading to selection and design of non-optimal remedial actions.
- Inadequate long-term monitoring and maintenance strategies and technologies to verify cleanup performance could potentially invalidate the selected remedy and escalate cleanup costs.

Transportation and Disposal Packaging

- Disposal and transportation restrictions include flammable gas limitations, material characteristics and configuration. Existing data is insufficient to quantify the effects of potential sources of hydrogen, deflagration events, degraded fuel, impurities, and other conditions for challenging materials.

Strategic Initiatives

Enhanced Long-Term Performance Evaluation and Monitoring

- Develop increased understanding of long-term wasteform performance integrated with transport of contaminants to support broad remedial action decisions and cost-effective design and operation strategies.
- Develop and deploy cost-effective long-term strategies and technologies to monitor closure sites (including soil, groundwater, and surface water) with multiple contaminants (organics, metals and radionuclides) to verify integrated long-term cleanup performance.

DOE Spent Nuclear Fuel (SNF) Risks and Strategic Initiatives

Technical Risk and Uncertainty

Spent Fuel Storage

- Storage of vulnerable SNF types (e.g., aluminum-clad) and conditions (SNF and basins) are subject to continued deterioration, and may impact repository acceptance.

Spent Fuel Stabilization

- Present facilities and methods are not designed for processing all SNF types.

Disposal Packaging Preparation

- Geologic disposal of SNF requires use of neutron absorbers over geologic timescales or extremely restrictive controls. Current plans identify the need for a canister closure weld in a high radiation environment for which commercial systems do not exist.

Improved SNF Storage, Stabilization and Disposal Preparation

- Improve monitoring of fuel condition, cladding integrity, and basin integrity.
- Develop efficient, cost-effective stabilization technologies and process flow sheets based on spent fuel types.

Strategic Initiatives

Develop disposal packaging that can meet geologic timescales and can be produced in field conditions.

- Improve monitoring of fuel condition, cladding integrity, and basin integrity.
- Develop efficient, cost-effective stabilization technologies and process flow sheets based on spent fuel types.

Challenging Materials Risks and Strategic Initiatives

Technical Risk and Uncertainty

Storage

- Improved inventory analyses, monitoring and storage systems are needed for unique TRU wastes and special nuclear materials.

Stabilization and Disposition

- Some materials have no defined path for disposal in their current condition.

Strategic Initiatives

Enhanced Storage, Monitoring and Stabilization Systems

- Develop advanced characterization, monitoring, and inventory analysis methods; and improved storage systems for multiple material forms including contaminants.
- Develop advanced flow sheets and processes for stabilization and waste form qualification.