EM U.S. Department of Energy
Office Of Environmental Management

Environmental Remediation Sciences Planning Meeting

Environmental Management Goals

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EM-20

Introduction

- Progress made in EM cleanup mission with completion at Fernald and Rocky Flats; more expected over next few years.
- Nevertheless, challenges for continuing completions across DOE complex need to address major uncertainties and risks; some large and unique efforts needing untested technologies.
- Life-cycle cost increases and schedule delays might arise from performance issues, technical and regulatory issues, emerging scope from programmatic risks, litigation, and other factors.

Objectives

- Establishing a disposition capability for radioactive liquid tank waste and spent nuclear fuel;
- Securing and storing nuclear material in a stable, safe configuration in secure locations to protect national security;
- Transporting and disposing of transuranic and low-level waste in a safe and cost-effective manner to reduce risk;
- Remediation of soil and groundwater in a manner that will assure long-term environmental and public protection; and
- Decontaminating and decommissioning facilities that provide no further value to reduce long-term liabilities while remediating the surrounding environment.

New Scope

EM has been identified as the organization to take on additional cleanup work scope from other programs including:

- D&D of additional excess and unwanted science and nuclear security facilities at the Oak Ridge National Laboratory and Y-12.
- D&D of facilities at Argonne, Brookhaven, and other Office of Science national laboratories.
- D&D of facilities at the Los Alamos National laboratory consistent with the 2005 consent Order.
- D&D of excess facilities at the Idaho National Laboratory from the Office of Nuclear Energy.

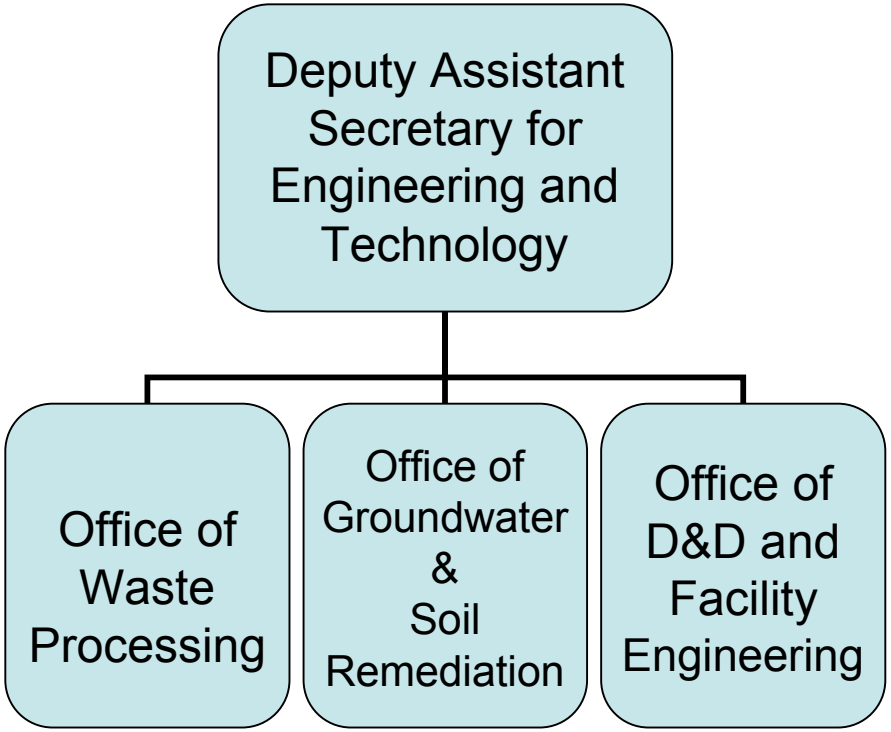
EM now estimates that the life-cycle cost for the program could increase by $50 billion. Of this increase, approximately $10 billion is attributable to new scope not in EM's previous baseline and $40 billion is associated with existing scope.

Site Closure Schedule

Site	Completion Date (Fiscal Year)
Oak Ridge Reservation	2015
Los Alamos National Laboratory	2015
Portsmouth Gaseous Diffusion Plant	2025
Nevada Test Site	2027
Moab (Note 1)	2028
Paducah Gaseous Diffusion Plant	2030
Savannah River Site (Note 2)	2031
Idaho National Laboratory	2035
Waste Isolation Pilot Plant	2035
Hanford Site; excluding ORP	2035
Office of River Protection (Note 3)	2042

Note 1: The revised end date from 2011 is an estimate, pending validation of the baseline.
Note 2: Revised end date based on current tank waste processing estimates.
Note 3: The new Waste Treatment Plant baseline results in a seven-year delay to site completion

EM Office of Engineering and Technology



Established to Reduce Technical Risk and Uncertainty in the EM Program

Functions

- Develop policy and guidance
- Assess projects and programs through technical reviews and oversight
- Provide technical assistance and support to the field and other Headquarters offices
- Manage the EM Technology, Development and Deployment Program

Strategic Planning for Engineering and Technology Activities

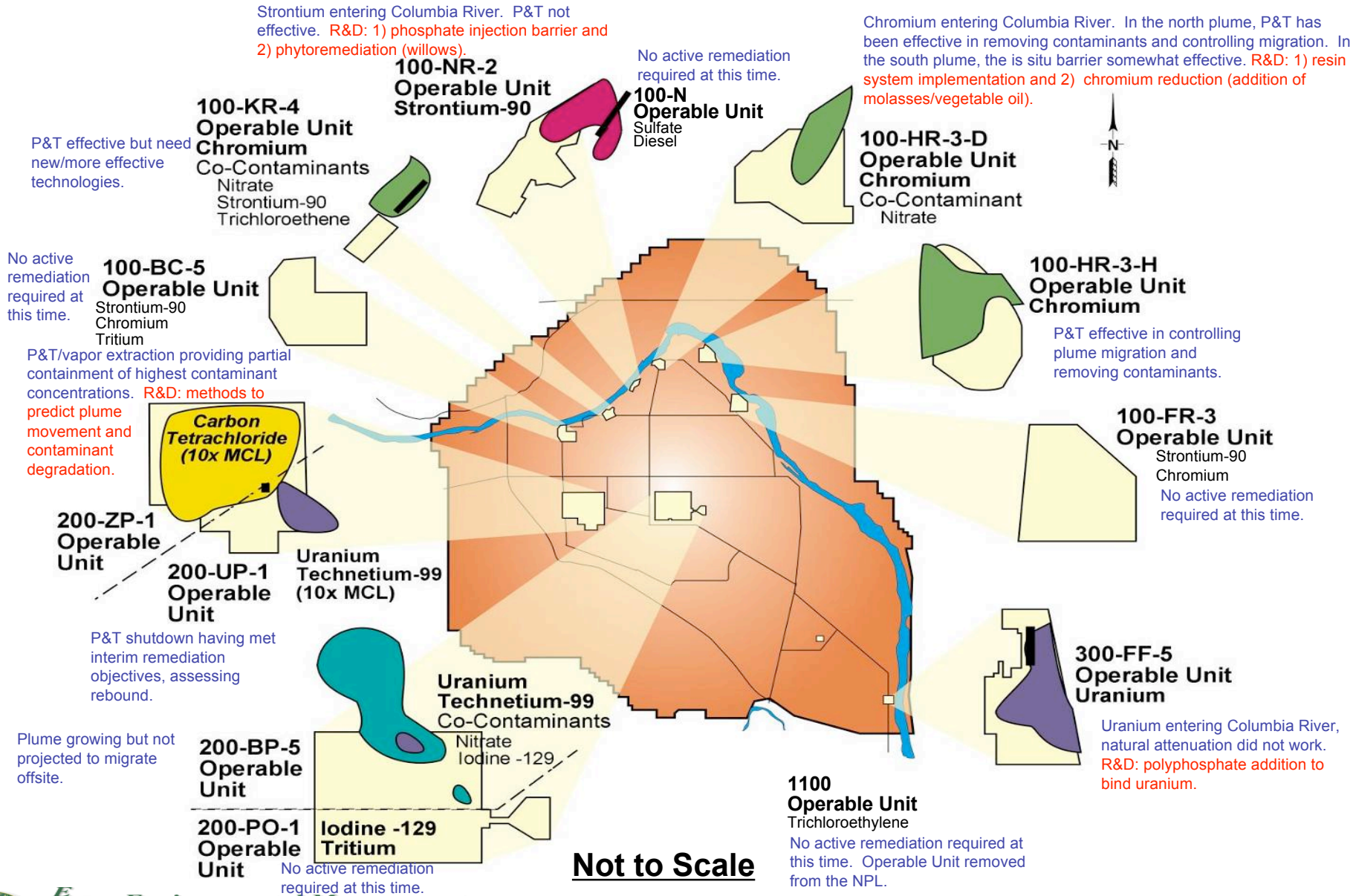
- Office of Engineering and Technology has a lead role in supporting EM projects by reducing technical barriers and uncertainties.
- Strategic planning and approach
  - Selected critical, high-risk, high-payoff projects
  - Technical workshops and exchanges
  - External Technical Reviews
- Continue close collaboration with national laboratories and universities for innovative technologies and technical exchanges.

Columbia River Initiative

- Inject Micron-size Iron into Deteriorating Portions of the In Situ Redox Manipulation (ISRM) Barrier
- Field Test Electrocoagulation for Accelerated Cleanup of the Northeastern Plume in the 100-D Area
- Accelerated Bioremediation through Polylactate Injection
- Chromium Vadose Zone Characterization and Geochemistry
- Refine Location of the Chromium Source at the 100-D Area and Support a Geochemical/Mineralogical Study of Chromium in the Vadose Zone
- 100-N Area Strontium-90 Treatability Demonstration Project: Phytoremediation along the 100-N Columbia River Riparian Zone
- Sequestration of Sr-90 Subsurface Contamination in the Hanford 100-N Area by Surface Infiltration of an Apatite Solution
- 300 Area Uranium Plume Treatability Demonstration Project: Uranium Stabilization through Polyphosphate Injection
- Carbon Tetrachloride and Chloroform Attenuation Parameter Studies: Heterogeneous Hydrolytic Reactions

Groundwater Plume Remediation

CERCLA Operable Units



Groundwater and Soil Remediation

Technical Risk and Uncertainty

--**Sampling & Characterization**

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

--Modeling to Guide Cleanup

- Current models do not adequately represent complex hydrogeology, biogeochemistry and reactive transport. Thus, under complex subsurface conditions, the models may not adequately predict contaminant fate and reactive transport and provide a sound technical basis for optimizing selection, design and implementation of remedies.

--Treatment & 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 be accepted by the regulatory community.
- Ex-situ technologies may be necessary to remove, treat, and dispose of contaminants in certain situations, but current ex-situ treatment technologies can 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 great depth, in low permeability/porosity zones, etc).
- Leverage 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 reactive transport, 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 mass transfer-limited release of contaminants from low porosity/permeability zones.
- Develop models that integrate data from various monitoring forms to design long-term 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 handle legacy materials in historical waste sites and methods to treat and remediate these materials.

Integration and Cross-Cutting 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.

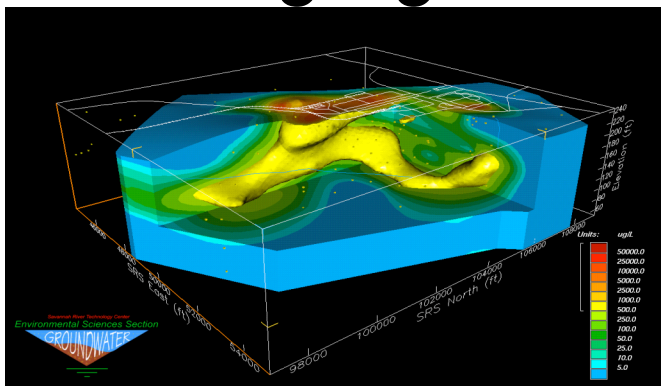
Strategic Initiatives

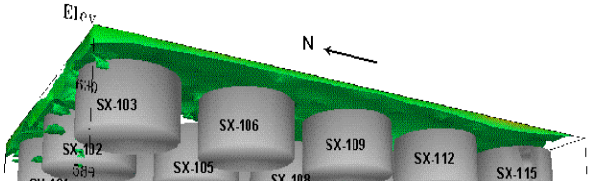
--Enhanced Long-Term Performance Evaluation and Monitoring

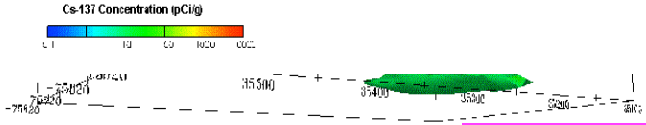
- Develop increased understanding of long-term wasteform performance integrated with transport of contaminants to support broad remedial action decisions and cost-effective design and operation strategies.
- Develop and deploy cost-effective long-term strategies and technologies to monitor closure sites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

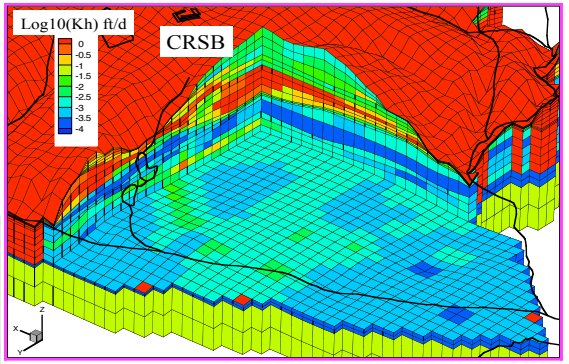
EM modeling: diverse and challenging

- Target EM applications include: vadose zone and groundwater contaminant plumes from past waste disposal; tank wastes; D&D impacts; treated, stabilized and/or capped wastes; distribute sources such as process sewer lines and contaminants transported and deposited over large areas.
- Target sites span regions and conditions: hydrology, meteorology, geology, chemistry, biology.







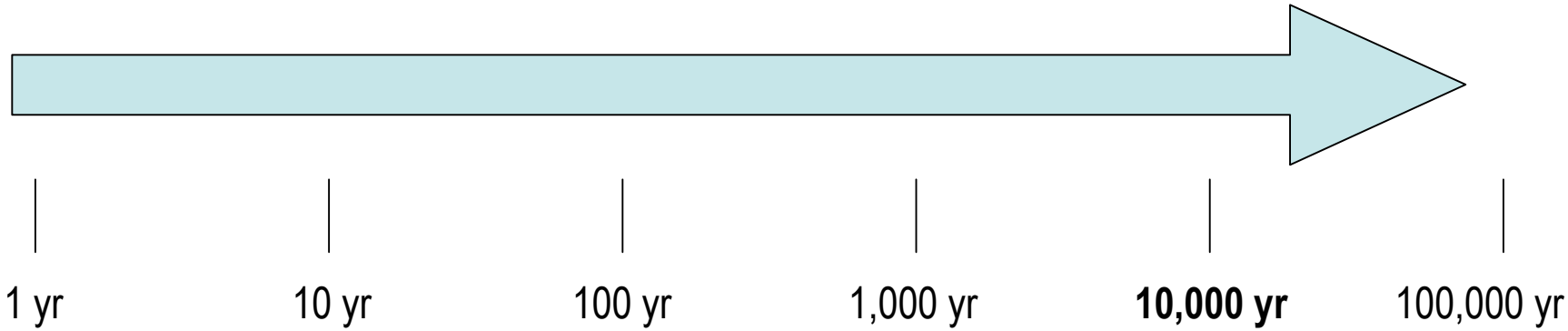


Summary of Identified Science Needs

- Geology and Heterogeneity Issues:
  - Fractured rock, karsts, and other strongly heterogeneous systems
  - Matrix diffusion and slow releases from “tight zones”
  - Linking models to data
    - upscaling and models that are robust across scales,
    - models that incorporate diverse data types such as point measurements, geophysics, climate and climate change, ecology and succession, etc.
  - Emerging applications and emerging contaminants
    - Nonpoint source and diffuse contamination modeling
    - modeling releases during D&D activities
- Coupled Biogeochemical Processes
  - Models that focus on natural or enhanced attenuation and stabilization mechanisms
  - Incorporation of the latest research → converting the state of the art to the state of practice
  - Improved algorithms and efficiency
  - Improved computing infrastructure.
- The time challenge (e.g., 10,000 years)

Models and the Time Challenge

Validity, Defensibility, Usability and Uncertainty of Performance Assessment Models over…



given climate change, geomorphology change, ecological change, politico-socioeconomic change, etc.

Viability of constitutive deterministic models over long time frames?
Alternative formulations? {or} Alternative ways to document environmental management decisions and acceptable risk?

Current High Priorities

- Hanford
  - Areas adjacent to the Columbia River and the central plateau
  - Sr, U, Tc, Cr, organic co-contaminants, extreme chemistry (pH, ionic strength, etc.)
- Paducah
  - large scale plume from operations and waste disposal; Tc and solvents
- Oak Ridge
  - mercury, uranium, solvents etc. in complex geology
- Savannah River Site
  - vadose and groundwater plumes including burial grounds, D&D and tanks; solvents, Sr, U, and Tc
- Idaho
  - vadose and groundwater plumes; solvents, Sr, Tc, U, etc.
- Miscellaneous issues at Los Alamos, Sandia, Lawrence Livermore, Brookhaven, and many small sites.

EM Perspective

- The list of science needs has not changed much in the past decade.
- EM looks forward to partnering with the Office of Science in developing a strategy to resolve these needs.
- Creativity and new approaches will be necessary.

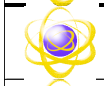
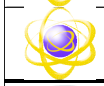
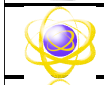
Back Up

Solving Cleanup Challenges Through Risk Reduction

EM LEGACY CLEANUP SCOPE		
Material	**Primary Locations**	**Current Disposition Plans**
Nuclear Materials		
Enriched Uranium	Idaho, Hanford, Savannah River Site	Blended down to low enrichment material, then used in fabricating fuel for commercial nuclear reactors
Plutonium	Hanford, Savannah River Site, Los Alamos National Laboratory and Lawrence Livermore National Laboratory	Proposed: Immobilization for disposal at a geologic repository
Depleted Uranium	Portsmouth and Paducah	Conversion of uranium hexaflouride into uranium oxide Disposal of uranium oxide offsite as low level waste
Radioactive Liquid Tank Waste		
Liquid Tank Waste	Idaho, Hanford, Savannah River Site, West Valley	Separation into low activity and high activity waste streams Immobilization (vitrification) of high activity waste for disposal at a geologic repository Immobilization of low activity waste for onsite disposal
Liquid Waste Tanks	Idaho, Hanford, Savannah River Site, West Valley	Disposed in place
Spent Nuclear Fuel and Solid Radioactive Waste in Storage		
Spent Nuclear Fuel	Hanford and Savannah River Site	Package in standardized canisters or Multi-Canister Overpacks, or process into High-Level Waste for disposal at a geologic repository
Transuranic Waste	Multiple Sites	Disposal at Waste Isolation Pilot Plant
Low-Level Waste	Multiple Sites	Disposal on site, Hanford, Nevada Test Site and commercial disposal sites
Contaminated Facilities, Soil and Groundwater		
Nuclear Facilities	Multiple Sites	Decommissioned to the appropriate end state: demolished; entombed; long term surveillance and maintenance; and deactivated/decontaminated for re-use
Radioactive Facilities	Multiple Sites	
Industrial Facilities	Multiple Sites	
Geographic Sites	Multiple Sites	Cleanup to regulatory standards for other uses

Solving Cleanup Challenges Through Risk Reduction

Corporate Performance Measures

	Performance Measure	Projected to be Completed Through FY 2007	Projected to be Completed Through FY 2008	Percent Projected to be Completed Through FY 2008	Lifecycle Total	Units
	Plutonium packaged for long-term disposition	Measure Complete		100%	6,314	Number of Containers
	Enriched Uranium packaged for disposition	6,972	7,192	97%	7,413	Number of Containers
	Plutonium and Uranium Residues packaged for disposition	Measure Complete		100%	107,828	kg Bulk
	Depleted Uranium and Uranium packaged for disposition	11,855	17,116	2%	698,243	Metric Tons
	Liquid Waste eliminated	.7 million	1.4 million	2%	88 million	gallons
	Liquid Waste Tanks closed	5	9	4%	239	Number of tanks
	High Level Waste Packaged for final disposition	2,675	2,861	14%	20,004	Number of Containers
	SNF Packaged for final disposition	2,127	2,127	88%	2,417	MT Heavy Metal
	Transuranic Waste disposed	43,701	54,466	40%	135,353	cubic meters
	Low Level /Mixed Low Level Waste disposed	987,249	1,004,386	76%	1,316,619	cubic meters
	Material Access Areas (MAAs) eliminated	11	11	85%	13	Number of MAAs
	Nuclear Facility D&D Completions	81	82	20%	407	Number of Facilities
	Radioactive Facility D&D Completions	322	337	40%	848	Number of Facilities
	Industrial Facility D&D Completions	1,417	1,560	47%	3,298	Number of Facilities
	Remediation Complete	6,532	6,781	65%	10,470	Number of Release Sites
	Geographic Sites Eliminated	86	89	82%	108	Number of Sites