



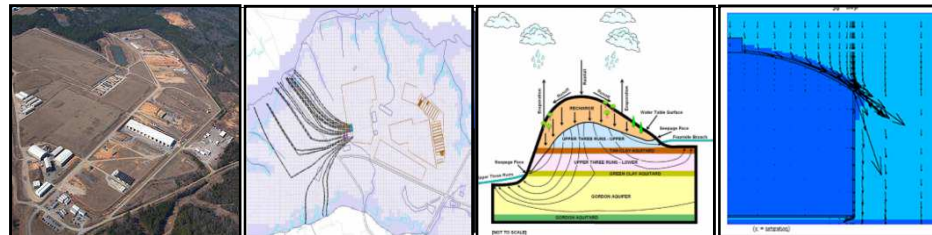
We Put Science To Work

Management of Radioactive Waste Resulting from Remediation Efforts in the United States of America

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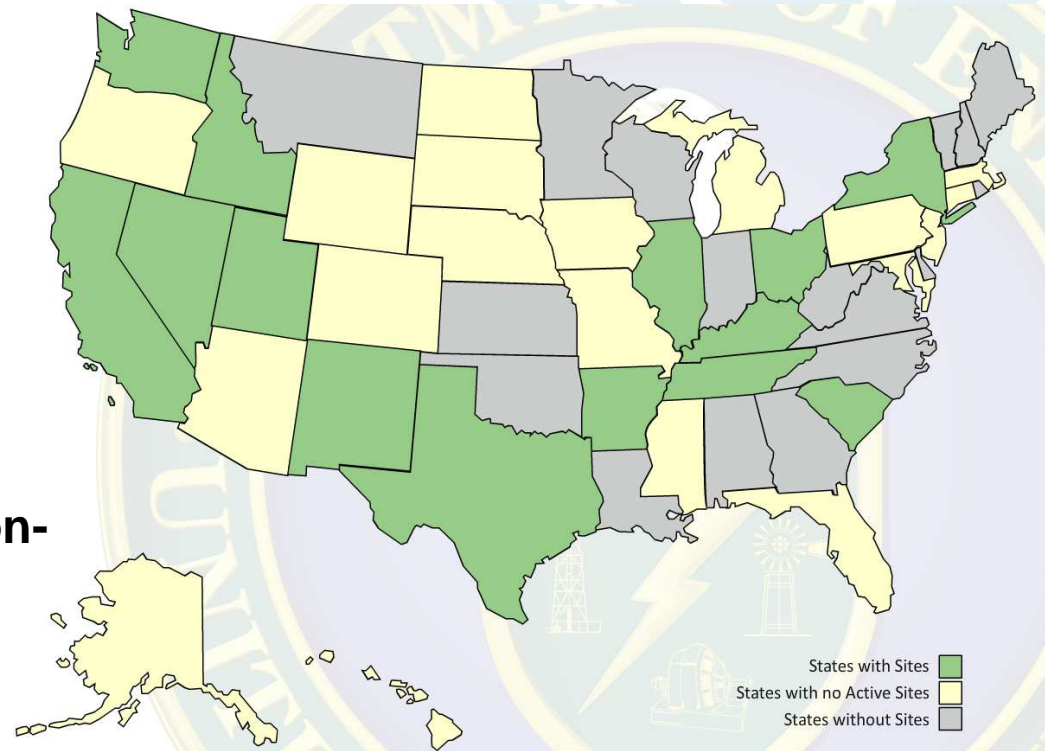
IAEA International Experts' Meeting on Decommissioning and Remediation After a Nuclear Accident, 28 January - 1 February 2013
Vienna, Austria



EM Office of Environmental Management
safety ♦ performance ♦ cleanup ♦ closure

Introduction

- The United States Department of Energy – Office of Environmental Management (USDOE-EM) is responsible for the largest cleanup program in the world
- Cleanup activities involve generation of large quantities of waste containing radionuclides and contaminants posing non-radiological hazards
- Disposal decisions are based on a robust decision-making process involving external regulation and input from stakeholders



107 USDOE-EM sites - As of September 2012, cleanup has been completed at 90 of those sites

Contents

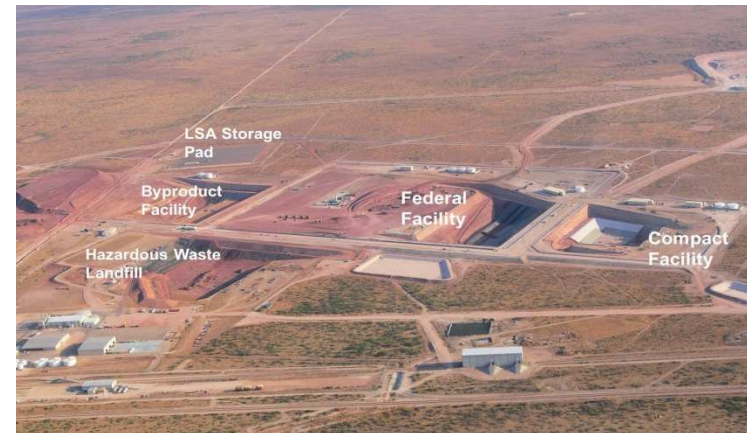
- **Examples of USDOE and commercial disposal facilities for wastes resulting from cleanup activities**
- **US Environmental Protection Agency Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) decision-making process**
- **Role of the safety case and the performance assessment “maintenance” process for USDOE disposal facilities**

Potential Disposal Options for Remediation Wastes

- **USDOE-EM has the option of developing on-site disposal cells, disposal at the Nevada National Security Site (NNSS) or using commercial disposal facilities**
- **On-site disposal is commonly selected as the preferred alternative, but may be combined with off-site disposal of some waste**
- **Potential new disposal facilities are being considered at three sites**
- **Emphasis of this presentation is on USDOE-EM operated disposal facilities**

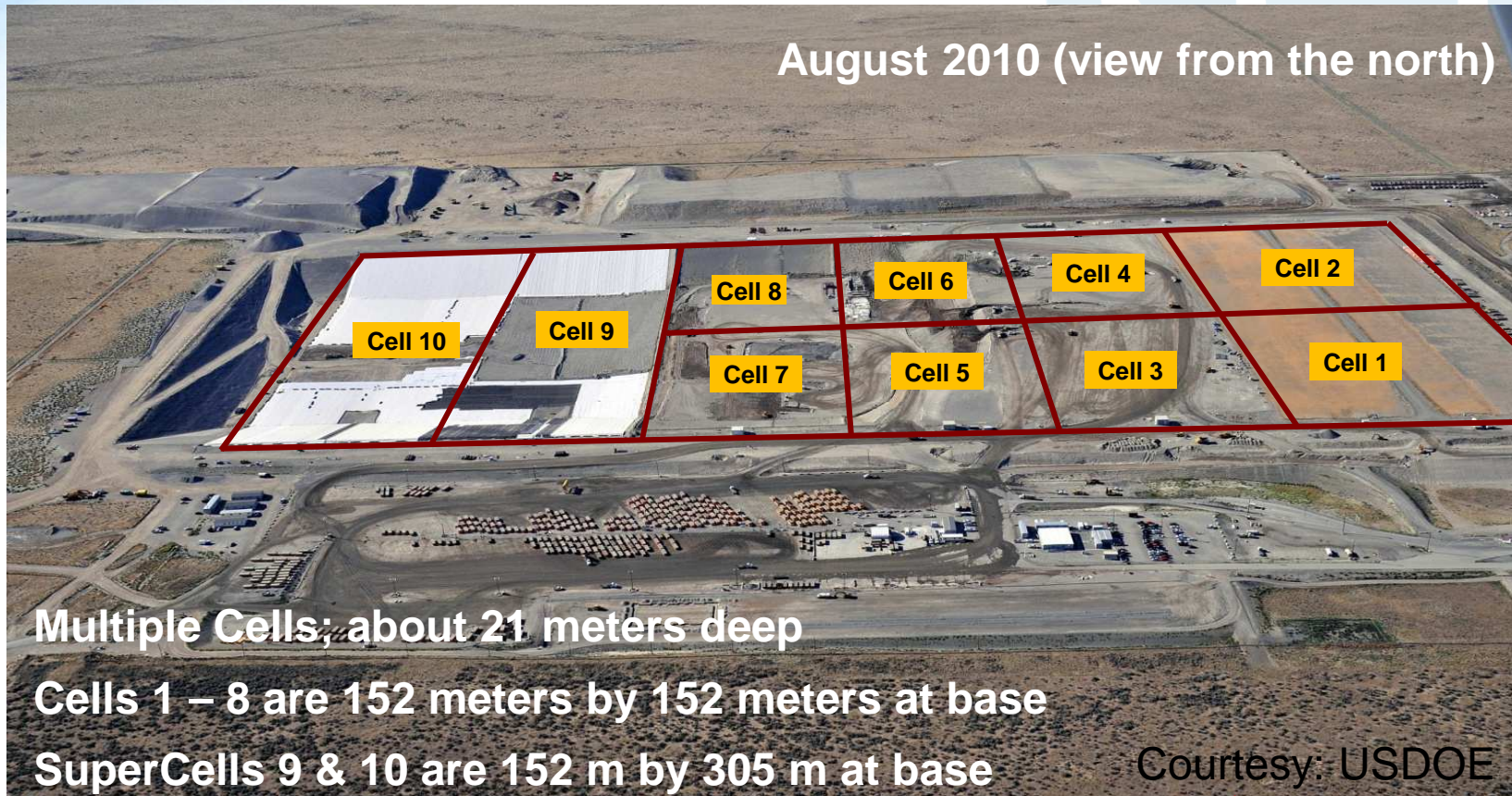


EnergySolutions' Clive disposal facility
(Courtesy: EnergySolutions)



Waste Control Specialists Texas disposal facility
(Courtesy: Waste Control Specialists)

USDOE On-Site Disposal (Hanford Site)



- Environmental Restoration Disposal Facility
- Largest DOE Disposal Cell (~16 million tons)



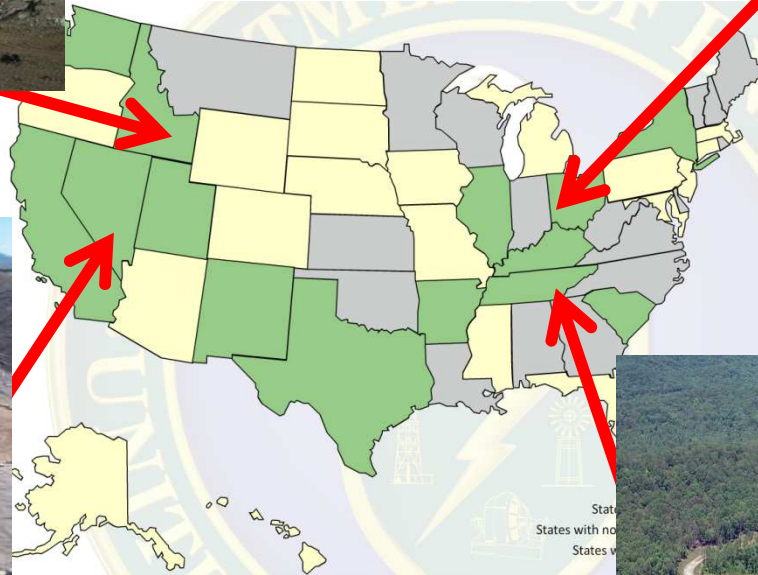
Other Examples of On-Site Disposal of Cleanup Waste



Idaho Site



Fernald Site



Photos Courtesy USDOE



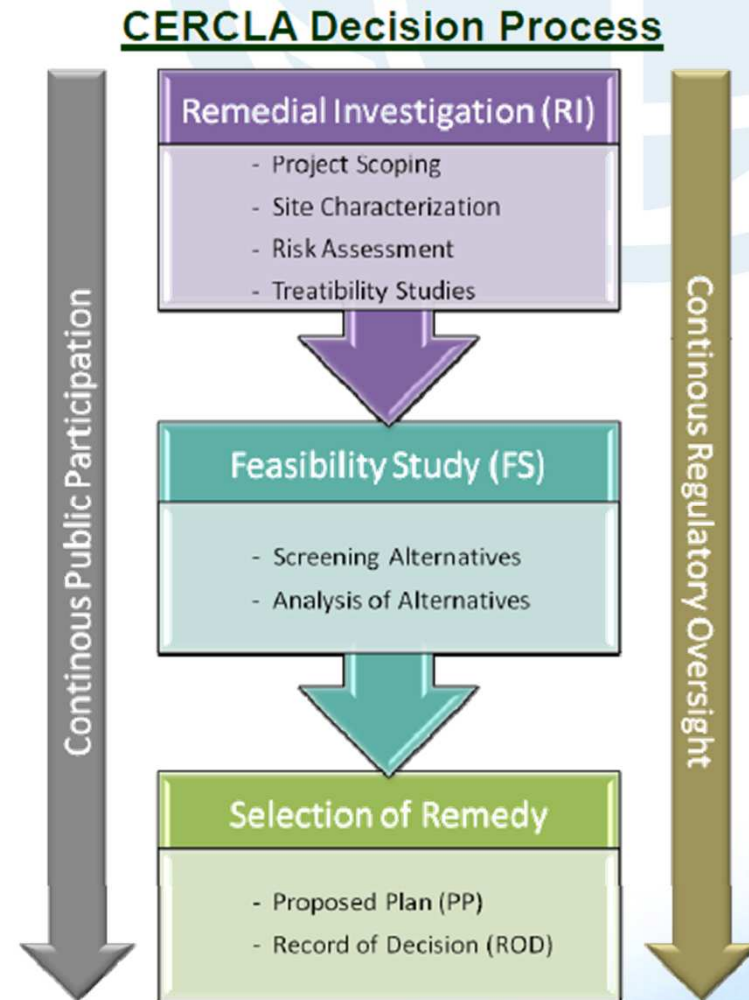
Nevada Site (accepts off-site waste)



Oak Ridge Site

Decision-Making Approach

- Most on-site disposal facilities for cleanup waste are being developed under the US Environmental Protection Agency CERCLA Process
- CERCLA is a 1980 Federal Law enacted in response to legacy environmental problems
- Provides Federal Authority to address threats to human health and the environment
- Decision-making via a remedial investigation and feasibility study (RI/FS)



Key Elements of CERCLA Process Applied to Disposal

- **Robust and structured approach for decision-making involving external regulators and input from the public**
- **Risk goals rather than constraints**
- **Must meet external regulatory requirements and DOE disposal requirements (USDOE and external regulator review processes are often conducted independently)**
- **Considers broad set of alternatives for cleanup**
- **Involves quantitative and qualitative assessment of potential impacts of different alternatives**
- **Following action, regular reviews are conducted to assess effectiveness of solution**

Nine Criteria to Compare Alternatives

- **Threshold Criteria**

- Protection of human health and the environment
- Compliance with Federal and State regulations

- **Balancing Criteria**

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Short-term effectiveness
- Implementability at the site
- Cost-effectiveness

- **Modifying Criteria**

- Regulatory acceptance (State and/or US EPA)
- Community acceptance

Example Alternatives

No Action

Demolition or
Decontamination

In-situ treatment/
conditioning

In-situ closure of large
facilities

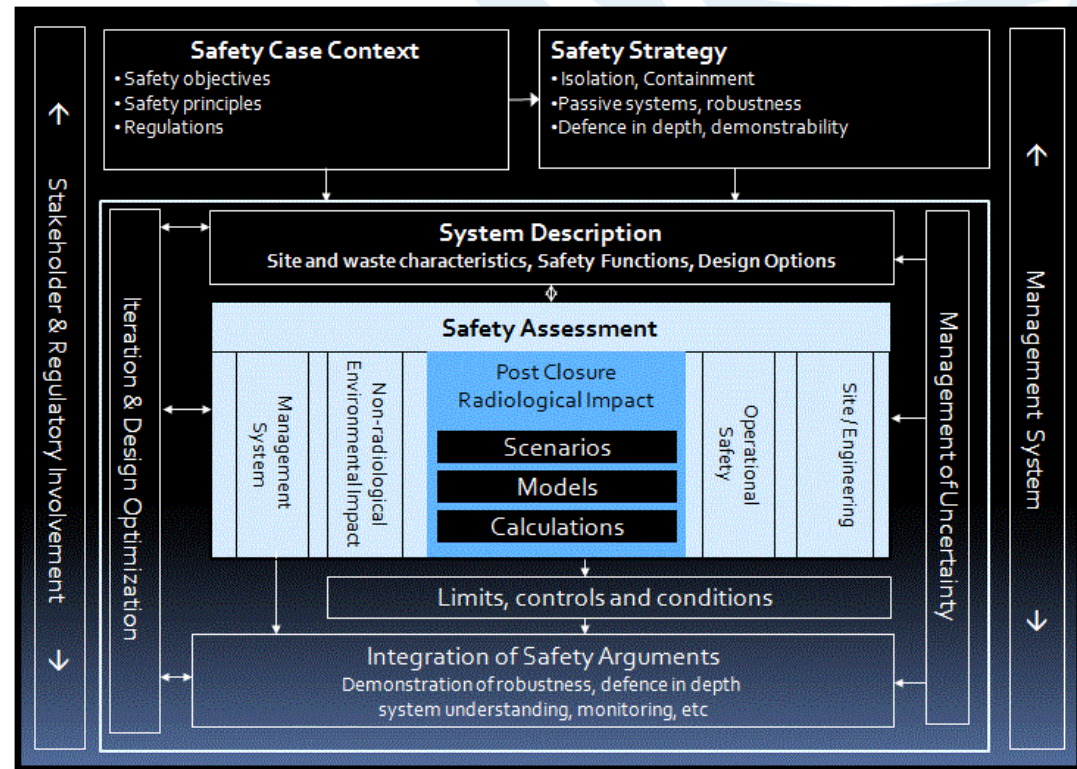
On-site disposal of debris
or soils

Off-site disposal of debris
or soils

Combinations of options

Safety Case Perspective

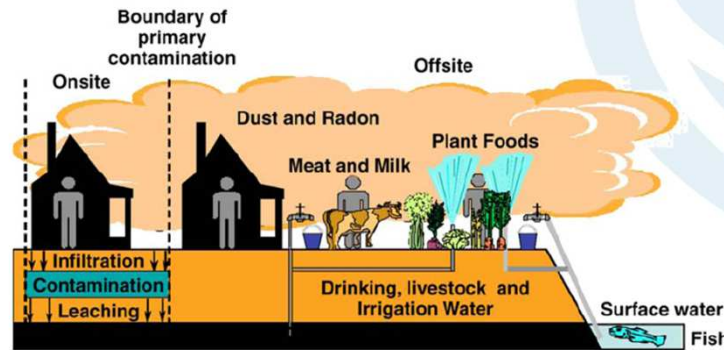
- CERCLA process has similarities with a safety case
- Structured view of all components supporting demonstration of safety for a disposal facility
- Highlights links among modeling, design and waste acceptance criteria
- Addresses management of uncertainties throughout process (e.g., engagement of stakeholders, testing, R&D, monitoring)



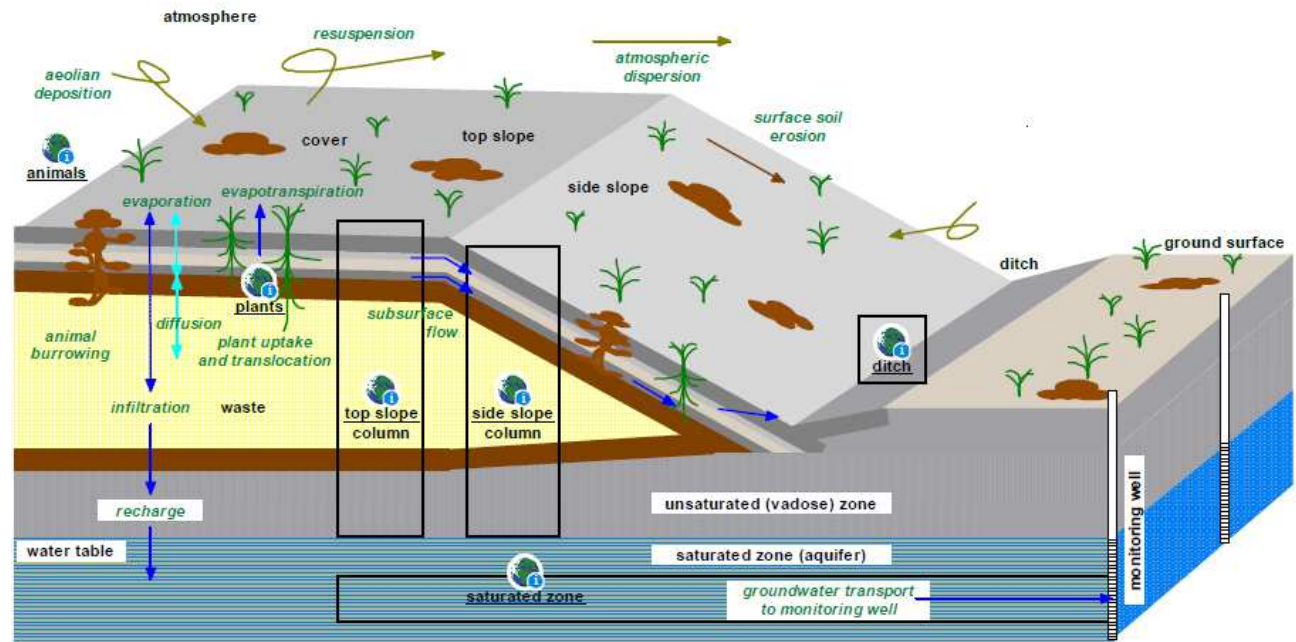
Courtesy: IAEA

Long-Term Modeling of Impacts (typical)

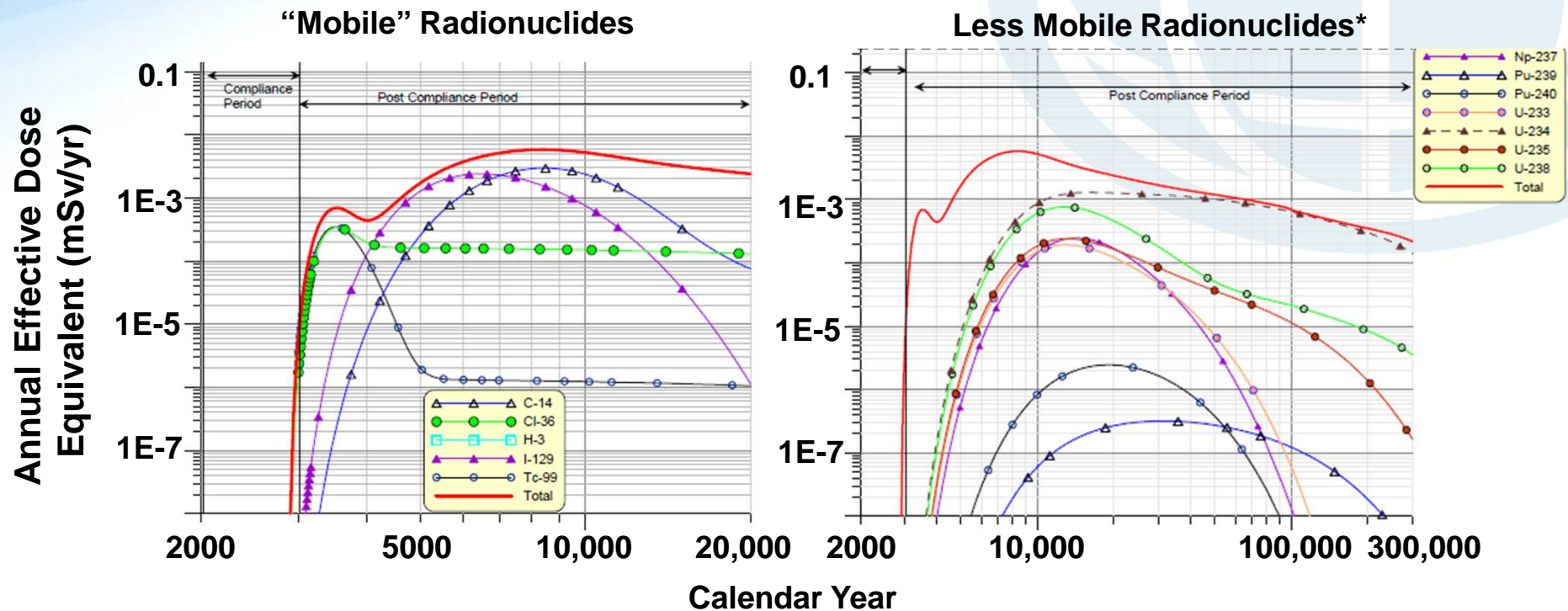
- Identify exposure pathways with input from stakeholders
- Develop and update conceptual models and identify processes to be considered with input from stakeholders



From NUREG/CR-6937, Fig. 1.1



Example Results from Idaho Disposal Facility



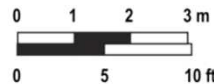
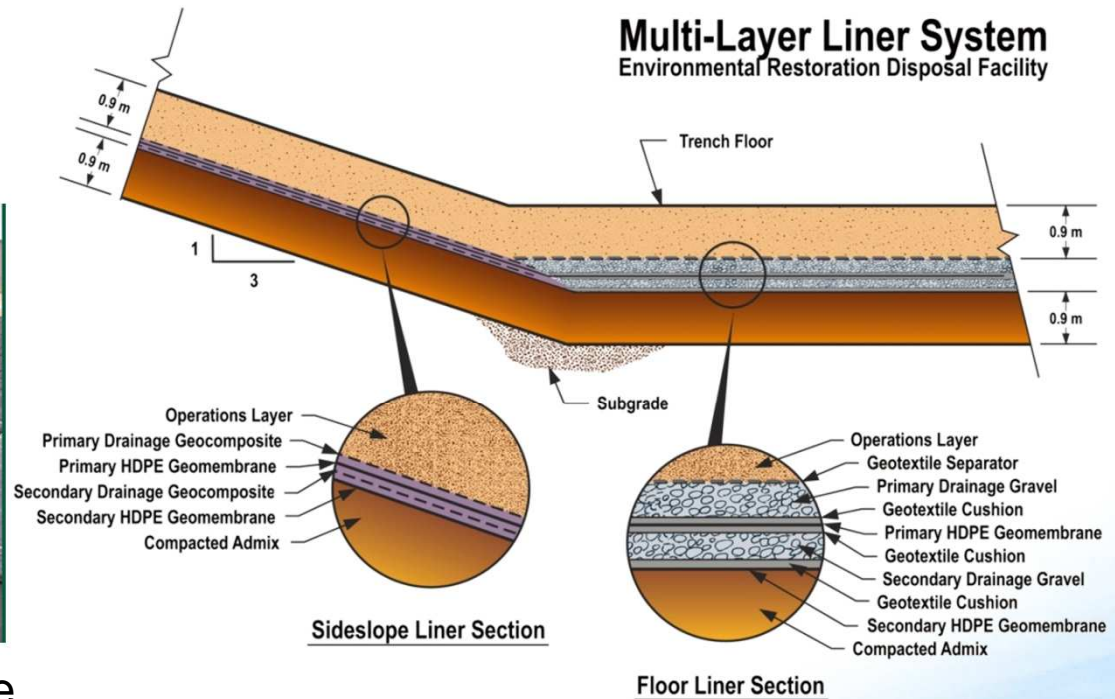
- Per USDOE requirements, compliance is addressed for the first 1,000 years after closure, potential peaks occurring farther out in time are considered as part of risk-informed decision-making.

Standardized Design

- Cleanup disposal facilities are designed to meet US EPA standards for hazardous waste disposal to address the non-radioactive hazards
- Use of standardized design helps to build public confidence

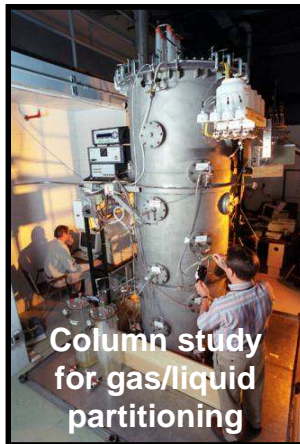
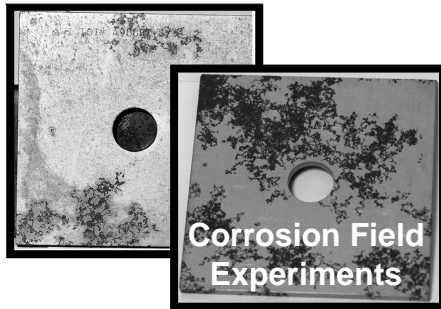
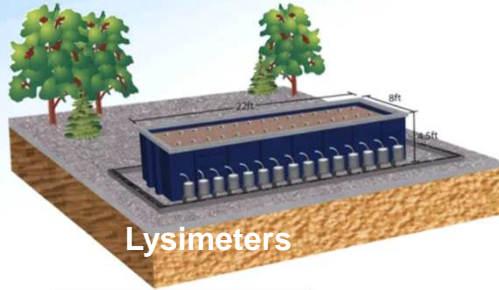


Installation of liner at Nevada Site



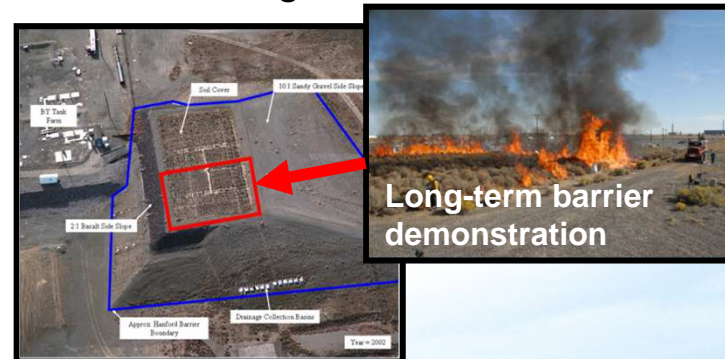
Liner design at Hanford Site

USDOE “Maintenance” Requirement



- Activities to confirm assumptions in modeling and to routinely report performance are required by USDOE and can include:

- Large scale demonstrations
- Laboratory and field studies
- Monitoring to confirm modeling results
- Routine reviews to consider new information relative to assumptions in modeling

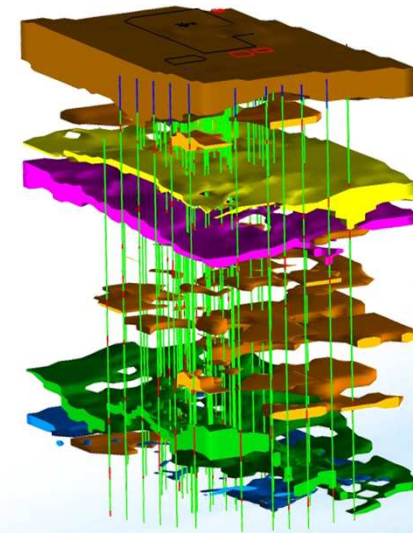


Stakeholder Confidence

- Physical models
- Graphical visualization of the subsurface
- External reviews
- Meeting requirements of DOE regulations and external regulators
- Routine public briefings (e.g., Citizens Advisory Board)
- Waste acceptance criteria
- Formal process to address unexpected conditions (e.g., new waste forms, monitoring results, data)



Physical model of proposed disposal facility with removable layers (liner, waste, cover)



Subsurface in one region of the Idaho Site



SRNL



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safety ✦ performance ✦ cleanup ✦ closure

Conclusions

- **On-site disposal has been selected as the preferred alternative for most USDOE-EM sites with large cleanup efforts involving waste posing radioactive and non-radioactive hazards**
- **Effective approaches to support these decisions have included several common elements:**
 - Robust and meaningful engagement with regulators and stakeholders
 - Formal regulatory decision-making process using quantitative and qualitative information (Nine Criteria)
 - Standardized designs based on US EPA specifications for hazardous waste disposal
 - Multiple independent reviews of modeling and supporting activities through the USDOE and State/US EPA processes, respectively
 - Commitment to regular reporting, monitoring and long-term oversight

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