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

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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.
Multiple Cells; about 21 meters deep

Cells 1 – 8 are 152 meters by 152 meters at base
SuperCells 9 & 10 are 152 m by 305 m at base

- Environmental Restoration Disposal Facility
- Largest DOE Disposal Cell (~16 million tons)
Other Examples of On-Site Disposal of Cleanup Waste

Photos Courtesy USDOE

Idaho Site

Fernald Site

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

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<thead>
<tr>
<th>Example Alternatives</th>
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<tbody>
<tr>
<td>No Action</td>
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<tr>
<td>Demolition or Decontamination</td>
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<tr>
<td>In-situ treatment/conditioning</td>
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<td>In-situ closure of large facilities</td>
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<td>On-site disposal of debris or soils</td>
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<tr>
<td>Off-site disposal of debris or soils</td>
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<td>Combinations of options</td>
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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
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.

*Note: the “total” line for the less mobile radionuclides includes contributions from all radionuclides. The graphs are provided separately to better illustrate the different radionuclides.
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)
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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