Holistic Approaches to Remediation: The Rocky Flats Example

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October 30, 2013
Outline

I. Rocky Flats
II. From CERCLA to Risk-Based End States
III. The Meanings of Sustainability
IV. Three Approaches to Alternative End States
Rocky Flats

- Function and facilities
- History
- Clean-up issues
- Refuge Act
- Risk-Based End State
- Current Status
The Weapons Production Process

- Uranium mining and milling
- Uranium refining
- Uranium enrichment
- Uranium foundry
- Fuel target fabrication
- Plutonium production reactors
- Reprocessing to separate plutonium
  - Nuclear components fabrication
- Nonnuclear components
- Weapons design and testing
- Weapons assembly
Appendix A, Map 1, Remedial Investigation Locations As Of 2002
From CERCLA to Risk-Based End States

1. The once-and-for-all assumption
2. The risk critique
3. Future use
4. The physical realities of clean-up
5. DOE’s risk-based end states directive
6. Long-term stewardship
Long-Term Stewardship

• Waste configurations for long-term stewardship

• Qualities of a long-term stewardship program

• Institutional controls
  – Active institutional controls
  – Passive institutional controls

• Procedures and institutions
The Meanings of Sustainability

• Temporal Concern
• Environmental Consideration
• Inclusive Process
Sustainability as Temporal Concern

• Literally and originally
• Accept some degree of usage
• Intergenerational equity
  – Conservation of options
  – Conservation of quality
  – Conservation of access
• Balancing across generations
# The Remediation Time Line

<table>
<thead>
<tr>
<th>Pre-Industrial Use</th>
<th>Uncontrolled Past</th>
<th>Polluted Present</th>
<th>Remediation</th>
<th>Foreseeable Future(s) (&quot;End State&quot;)</th>
<th>Long-Term Stewardship</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background Risk</strong> <em>(Pristine)</em></td>
<td><strong>Increasing Risk</strong></td>
<td><strong>Baseline Risks</strong></td>
<td><strong>Transition Risks</strong></td>
<td><strong>Target or Residual Risks</strong></td>
<td><strong>Long-Term Risks</strong></td>
</tr>
</tbody>
</table>
Sustainability as Environmental Considerations

- Equality of the environment
- Acceptance of limits
- Capacity of natural systems as a key constraint on scale
- Precautionary approach
Sustainability as Process

• Integration of sustainability into development decisionmaking
• Environmental assessment
• Inclusive participation
  – Stakeholders
  – Education and deliberation
• More governance than formula
• Role of law
Risk-Informed Decisionmaking

1. Identify viable options and potential decisions
2. Scope information and analysis
3. Collect data and refine models
4. Prepare a refined risk assessment
5. Conduct additional analyses and data collection to support decisions
6. Finalize the decision

Sources: NRC, Tank Waste Retrieval 2006; NRC, Risk and Decisions, 2005
Three Approaches to Alternative End States

• Rocky Flats
• Idaho National Laboratory
• Oak Ridge Reservation
Rocky Flats (reprise)

- Function and facilities
- History
- Clean-up issues
- Refuge Act
- Risk-Based End State
- Current Status
Idaho National Laboratory
Oak Ridge Reservation
# Oak Ridge Reservation

<table>
<thead>
<tr>
<th>End Use Category</th>
<th>Surface Use</th>
<th>Depth of Clean Soil</th>
<th>Groundwater Use</th>
<th>Surface Water Use</th>
<th>Ownership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrestricted</td>
<td>Unrestricted</td>
<td>Unlimited</td>
<td>Unrestricted</td>
<td>Unrestricted</td>
<td>Government or Private</td>
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<tr>
<td>Uncontrolled Industrial</td>
<td>Industrial</td>
<td>10 feet</td>
<td>Not Allowed</td>
<td>Unrestricted</td>
<td>Government or Private</td>
</tr>
<tr>
<td>Recreational</td>
<td>Recreational</td>
<td>2 feet</td>
<td>Not Allowed</td>
<td>Recreational Uses</td>
<td>Government or Private</td>
</tr>
<tr>
<td>Controlled Industrial</td>
<td>Industrial with Restrictions</td>
<td>2 feet, additional excavation by permit</td>
<td>Not Allowed</td>
<td>Not Allowed</td>
<td>Government or Private</td>
</tr>
<tr>
<td>Restricted Waste Disposal</td>
<td>Limited to monitoring and maintenance</td>
<td>No soil disturbance allowed</td>
<td>Not Allowed</td>
<td>Not Allowed</td>
<td>Government</td>
</tr>
</tbody>
</table>

Source: Oak Ridge Reservation End Use Working Group, July 1998
Figure 9. Map of the Bethel Valley Watershed and the Melton Valley Watershed

KEY
CFRF - consolidated fuel recycling facility; HFIR - high flux isotope reactor; HPRR - health physics research reactor; TSF - tower shielding facility

Source: Lockheed Martin Energy Systems, Inc. 1998