Decommissioning Legacy Uranium Mills in the United States

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for

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How NRC defines “Legacy sites”:

- Legacy sites at the NRC are characterized by:
  - Technical complexity,
  - Lack of funding, or
  - Other circumstance (for example: lack of remediation standards or technology)
  - Such that, decommissioning is substantially delayed

- Civilian nuclear power plants not considered “legacy sites” because none of the above factors apply

- Uranium recovery mills from the 1950’s through the 1980’s are largely considered legacy sites because the above conditions apply
NRC’s Responsibility:

- Regulatory oversight for milling activities; no authority over mining of uranium
  - URANIUM MILLING - “Any activity that results in the production of byproduct material…”
  - BYPRODUCT MATERIAL - “The tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content…”
U.S. Law Governing Mill Decommissioning:

  - TITLE I: Remedial action at inactive, abandoned, unlicensed sites
  - TITLE II: Licensing/Oversight/Remediation of uranium recovery facilities licensed by the NRC or an Agreement State in or after 1978
Roles and Responsibilities at Title I Sites:

- U.S. Environmental Protection Agency (EPA) establishes standards for cleanup and disposal
- U.S. Department of Energy (DOE) identifies and remediates all Title I sites to EPA standards
- NRC evaluates and concurs in DOE’s site remediation plans and that site remediation has been adequately completed
- DOE becomes the long-term site custodian under NRC General License
Roles and Responsibilities at Title II Sites:

• EPA establishes standards for cleanup and disposal of byproduct material
• Commercial Licensee remediates site
• NRC or Agreement State oversees decommissioning to EPA standards
• DOE’s develops Long Term Surveillance Plans for conventional mills
• NRC or the Agreement State terminates specific license
• DOE becomes the long-term site custodian under NRC General License
Decommissioning Standards - EPA:

- **40 CFR 192:**
  - Soil and Buildings:
    - 5 pCi/g averaged over the first 15 cm
    - 15 pCi/g averaged over 15 cm more than 15 cm below surface
  - Radon:
    - 20 pCi/m²sec
  - Ground water:
    - Background or maximum contaminant level whichever is higher, or
    - Alternate concentration limit
Historical Perspective on Regulatory Oversight:

• Milling activities in the U.S. peaked in the 1950’s to 1970’s
• Uranium Mill Tailings Radiation Control Act - 1978
• EPA standards at 40 CFR 192 promulgated in 1983, amended 1987
• Final NRC regulations at 10 CFR Part 40, Appendix A promulgated in 1985 (no ground water), amended 1987
• Regulatory framework finalized after the peak of milling
NRC Uranium Recovery Sites in Decommissioning

- 42 Uranium Recovery sites
  - 21 Title I (Inactive, pre-1978 sites)
  - 17 Title II (Active, post 1978 sites)
    - 12 Conventional mills (1 in standby, 11 undergoing reclamation)
    - 5 Completed decommissioning (DOE License for long term stewardship)
Title I Uranium Recovery Sites

- Tuba City
- Falls City
- Spook
- Riverton
- Lakeview
- Mexican Hat
- Durango
- Gunnison
- Shiprock
- LaVernia
- Lowman
- Salt Lake City
- Green River
- Atlas
- Naturita
- Tuba City
- Monument Valley
- Ambrosia Lake
- Canonsburg and Burrell sites located in Pennsylvania
Title II Uranium Recovery Sites

- Pathfinder Lucky Mc
- ANC Gas Hills
- Umetco Gas Hills
- Sweetwater (conventional mill standby)
- UNC Church Rock
- Rio Algom
- Arco-Bluewater
- Homestake
- L-Bar
- Western Nuclear Split Rock
- Union Pacific Bear Creek
- Exxon Highland
- PRI SR-HUP and Reynolds Ranch (active ISL)
- Edgemount
- Irigaray/Christiansen Ranch (active ISL)
- Crow Butte (active ISL)
- Pathfinder Shirley Basin
- Shirley Basin South
- Sequoyah Fuels

Note: Colorado, Texas, and Utah are agreement states
Case Studies of Decommissioning Mills in New Mexico

– ARCO-Bluewater – DOE General License
  • Decommissioning began 1989
  • Surface reclamation completed in 1995
  • License terminated in 1997
  • Site under DOE long-term care/custody

– Homestake-Grants – Decommissioning
  • Decommissioning began 1990
  • Surface reclamation complete 1995
  • Groundwater restoration ongoing
  • License termination expected in 2017

– Rio Algom-Ambrosia Lake – Decommissioning
  • Decommissioning began 2003
  • Surface reclamation nearly complete
  • Groundwater reclamation completed in 2001
  • License termination expected in 2011
Case Studies of Decommissioning Mills in New Mexico (cont.):

• **UNC Church Rock – Decommissioning**
  – Decommissioning began: 1982
  – Surface reclamation nearly complete
  – Groundwater restoration ongoing
  – Potential site for disposal of Northeast Church Rock mine tailings
  – License termination – TBD

• **L-Bar – DOE General License**
  – Decommissioning began 1986
  – Surface reclamation completed in 2000
  – License terminated in 2004
  – Site under DOE long-term care/custody
Title I – Salt Lake Mill - before
Salt Lake City Mill - after
Rifle Site - before
Rifle Site - after
Reclaimed Tailings Impoundment – East (Canonsburg)
Reclaimed Tailings Impoundment – West (Tuba City)
Legacy Sites: Lessons Learned

- Established regulatory framework essential to avoiding contamination
- Adequate financial assurance necessary to prevent orphaned sites
- Groundwater contamination = Time + $
- Groundwater flow and transport modeling key to identifying remediation strategies
- Long-term stewardship, including post closure groundwater monitoring confirms long-term performance
# Title I Decommissioning Summary
(Source: U.S. Energy Information Agency)

<table>
<thead>
<tr>
<th>Decommissioning Project (Mill Site Name, State)</th>
<th>Uranium Ore Processed</th>
<th>Disposal Cell</th>
<th>Remediation Project Cost</th>
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<tbody>
<tr>
<td></td>
<td>Ore (Million Short Tons)</td>
<td>Uranium Production (Million Pounds $U_3O_8$)</td>
<td>Remediated Material Volume (Million Cubic Yards)</td>
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Challenges:

• Addressing long-standing contamination
• Public confidence
• Licensing new facilities
  – Outdated regulatory framework