Uranium Mining
TENORM Waste Studies

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2006 NMA/NRC Uranium
Recovery Workshop
Overview

• EPA TENORM Program
• Uranium Report Volume I
• EPA Uranium Location Database
• Uranium Report Volume II
• Summary and discussion
Goal of TENORM Program

- Minimize exposures where natural sources of radioactivity are concentrated in the environment, or made more accessible due to human activities.
EPA TENORM Program Elements

• Identify and characterize abandoned uranium mine risks
• Reduce risks from contaminated buildings
• Participate in activities that reduce risks from uranium mines on federal lands
• Get feedback
Stakeholder Involvement

• A part of EPA’s TENORM program strategy
  – Is designed to determine interest and need for EPA technical, education, other assistance
  – Intended to find ways to partner to reduce radiation exposures
Overview

- EPA TENORM Program
- *Uranium Report Volume I*
- EPA Database
- Uranium Report Volume II
- Summary and discussion
Uranium Mining TENORM Report I

- Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining, Volume I: Mining and Reclamation Background
  - Available as bound copy, CD-ROM version and on the Internet at:
    - http://www.epa.gov/radiation/pubs.htm/tenorm

- Requests for copies can also be made to:
  - radiation.questions@epa.gov
Uranium Mining TENORM Report II

• Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining, Volume II: Investigation of Potential Health, Geographic and Environmental Issues From Abandoned Uranium Mines is undergoing revision after peer review.

• Available for public comment on the Internet: http://www.epa.gov/radiation/pubs.htm/tenorm
Volume I Provides Overview of U.S. Uranium Mining

- History
- Mining methods
- Wastes generated
  - Physical and chemical characteristics,
  - Waste volumes,
- Reclamation methods
- Statutory and regulatory responsibilities as an appendix.
Volume I

• Covers wastes generated by open-pit & underground mines, as well as mills, ISL and heap leach operations, per EPA’s Science Advisory Board recommendation.
  – Wastes considered byproduct materials under NRC or Agreement State authority identified in the text.
Volume I—Findings (Waste)

• TENORM at conventional mine sites includes overburden, unreclaimed protore, waste rock, evaporites, mine and pit lake water, drill core and cuttings, and contaminated refuse.

• Waste rock from ~4000 identified producing mines estimated to range from 1 to 9 billion MT, likely estimate of 3 billion MT. Ultimate numbers may be higher given EPA database study.
Volume I – Findings (Radiation)

• Radium-226 measurements higher than 20 pCi/g in overburden are unusual, but some previous surveys have found levels averaging 25 pCi/g.

• Protore --most material 30–600 pCi/g.

• Radon measurements in some abandoned underground mines can be elevated. A health/safety consideration for public recreation, government or contract workers.
Volume I— Findings (Hazards)

• Radionuclides, heavy metals, and radon are all potential hazards associated with U mining TENORM wastes.

• Regulatory requirements affect selected reclamation techniques.
  – Remoteness and aridity of a site and reduced risk for human exposure may affect decisions on whether a site is in need of reclamation, or the extent that it is reclaimed.
Volume I—Findings (Reclamation)

- DOE study of 21 mines—reclamation costs ranged from $0.18/kg uranium produced to $23.74/kg uranium produced.
  - Average cost of ~$14 million per mine.
  - Differences based on mine size, accounting methods.
- EPA found smaller mines <25 acres may cost <$45,000 to reclaim, but some CERCLA cleanups may be much more.
- When uranium facilities close, some may require long-term monitoring; others can be released for other uses.
Overview

• EPA TENORM Program
• Uranium Report Volume I
• *EPA Uranium Location Database*
• Uranium Report Volume II
• Summary and discussion
Uranium Location Database

• A digital GIS database product to be released shortly.
• A sign up sheet is available at this meeting to receive a copy by mail. It can also be requested at:
  – radiation.questions@epa.gov
  – peake.tom@epa.gov
Uranium Location Database

• Compilation of State and Federal databases
• USGS MAS/MILS and MRDS
• BLM State databases
• Individual States, some with multiple datasets
  – WY
  – NM
  – UT
  – TX
  – MT
  – AZ
  – CA
  – NV
  – CO
  – SD
Uranium Location Database Is Most Comprehensive

- Compilation of federal and state sources
- Production records document ~4,000 mines vs Uranium Location Database ~15,000 records
- Subset of mines compared to USGS topographic maps
Uranium Location Database Issues

• Completeness
  – Database contains more records than any other known database

• Redundancy
  – Use of multiple databases introduces redundant records
  – May not have caught all duplicates

• Reliability
  – Are the data good?

• Accuracy
  – How accurate are the data?
Uranium Location Database Issues

• Definition of a “mine”
  – Production?
  – Mine opening?
• Which mines are reclaimed?
  – We don’t have that information included yet
  – Some mines are reclaimed or in the process
• Accuracy of USGS topographic maps
Uranium Location Database

- Most mines producing uranium as a primary commodity are, or were located, in Colorado, Utah, Wyoming, New Mexico and Arizona, and are typically on federal and Tribal lands.

- Many mines in remote areas so recreational scenario may be most important.
Comparison of USGS MAS/MILS data & all ULD Data indicates ULD data more comprehensive

MAS/MILS data focused in 4 Corners area and Wyoming
Data Comparisons

- State & Federal datasets add additional locations
- BLM Data in the Tucson, AZ area appear to be separate from MAS/MILS
New Mexico Uranium Locations From Three Databases

Legend

- NM_subsetDB18_NM Geology
- NM_subsetDB11_Navajo
- NM_subsetDB5_MAS/MILS
Operational or Standby Operations (End of 2005)

- Information determined from State and Federal sources
- Have included one new mine in Nebraska
Overview

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- Uranium Report Volume I
- EPA Database
- *Uranium Report Volume II*
- Summary and discussion
Volume II—Approach Used

- Geographic Information System (GIS) analyses using Uranium Location Database:
  - Provides spatial distribution and co-location of uranium mine sites with human-environmental resources, land ownership patterns, etc.

- Risk analyses using analytical and computer models provides a measure of cancer risk from variety of human radiation exposure situations, and information obtained from GIS analyses.
Modeling Scenarios – Building Materials
Primary Scenario is Recreational

- Time & Concentration $\rightarrow$ Risk

![Graph showing risk versus radium concentration for different exposure times.](image)
Volume II--Findings

• Focus is abandoned uranium mines; previous EPA studies have been done on active uranium mine sites.

• Abandoned, unreclaimed U mines have the potential to become health hazards from radioactivity and metals.
  – Radium is probably the most important concern.
  – Uranium can pose a problem for groundwater.
  – Other metals associated with uranium, such as arsenic, can also pose health risks.
Volume II—Findings

• Many mines found on hard to reach federal lands, as well as Tribal lands.

• Most likely affected groups:
  – Native American families that live close to the mines
  – Recreational users
  – Federal land managers for policy implications

• Watersheds with high uranium mine density may have the potential to pose ecological risks.
Volume II—Findings

• Misuse of mine waste for buildings, mines in communities, homes on/adjacent to mines
  – Risks up to $10^{-2}$ or $10^{-3}$ for most exposed individuals
  – However, most common exposure scenario is likely to be recreational

• Uranium mine disturbed lands widespread throughout western U.S. in many locations
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Summary

• U Volume I Provides Background on Uranium Mining, Waste Characteristics, & Reclamation
• U Volume II is a Scoping Study of Abandoned Uranium Distribution and Risks
• Uranium Location Database is Available
• We Would Like Input on Priorities
Program Elements (1)

• Identify and characterize abandoned uranium mine risks
  • Database
    – Add new data set on closed mines
  • Human Risk assessment
    – Provide assistance to EPA regions, federal, state, Tribal agencies as requested
  • Ecological assessment
    – Collect additional data, provide assistance to EPA regions, others
Program Elements (2)

• Reduce risks from contaminated buildings
  • Navajo
  • Other Tribes/areas with contaminated buildings
  • Develop educational materials
Program Elements (3)

• Participate in activities that reduce risks from uranium mines on federal lands
  • Guidance (non-CERCLA) on when, and to what level to reclaim sites
  • Site assessments as requested
  • Ecological assessments as requested
Discussion

• Do our findings agree with your experience?
• Do you see your priorities reflected in our program?
• What do you think needs to be done?