



# ***EPA's REGULATORY RESPONSIBILITIES for URANIUM MINING and MILLING***

**NAS/NRC Committee on Uranium Mining in Virginia  
Washington, DC  
October 26, 2010**

**Loren Setlow, CPG  
U.S Environmental Protection Agency  
Office of Radiation and Indoor Air  
Radiation Protection Division (6608J)  
Washington, DC 20460**

[Setlow.loren@epa.gov](mailto:Setlow.loren@epa.gov)  
202-343-9445

# Overview

- Uranium mining and milling background
- EPA's regulatory authorities for uranium facilities
  - Clean Air Act
  - Clean Water Act
  - Uranium Mill Tailings Radiation Control Act
  - Safe Drinking Water Act
  - National Environmental Policy Act
  - Resource Conservation and Recovery Act
  - Comprehensive Environmental Response, Compensation and Liability Act
- Ongoing EPA Regulatory Reviews



# Uranium Mining and Milling Background

## Principal uranium ore minerals



Carnotite

[Theodoregray.com](http://Theodoregray.com)



Coffinite

[webmineral.com](http://webmineral.com)



Uraninite/Pitchblende

[cna.ca](http://cna.ca)



Brannerite

[mindat.org](http://mindat.org)

## Geological occurrence—Major types of deposits

Sedimentary: Sandstones, phosphates and coal,  
breccia pipes

Igneous: Veins (pegmatites), disseminated

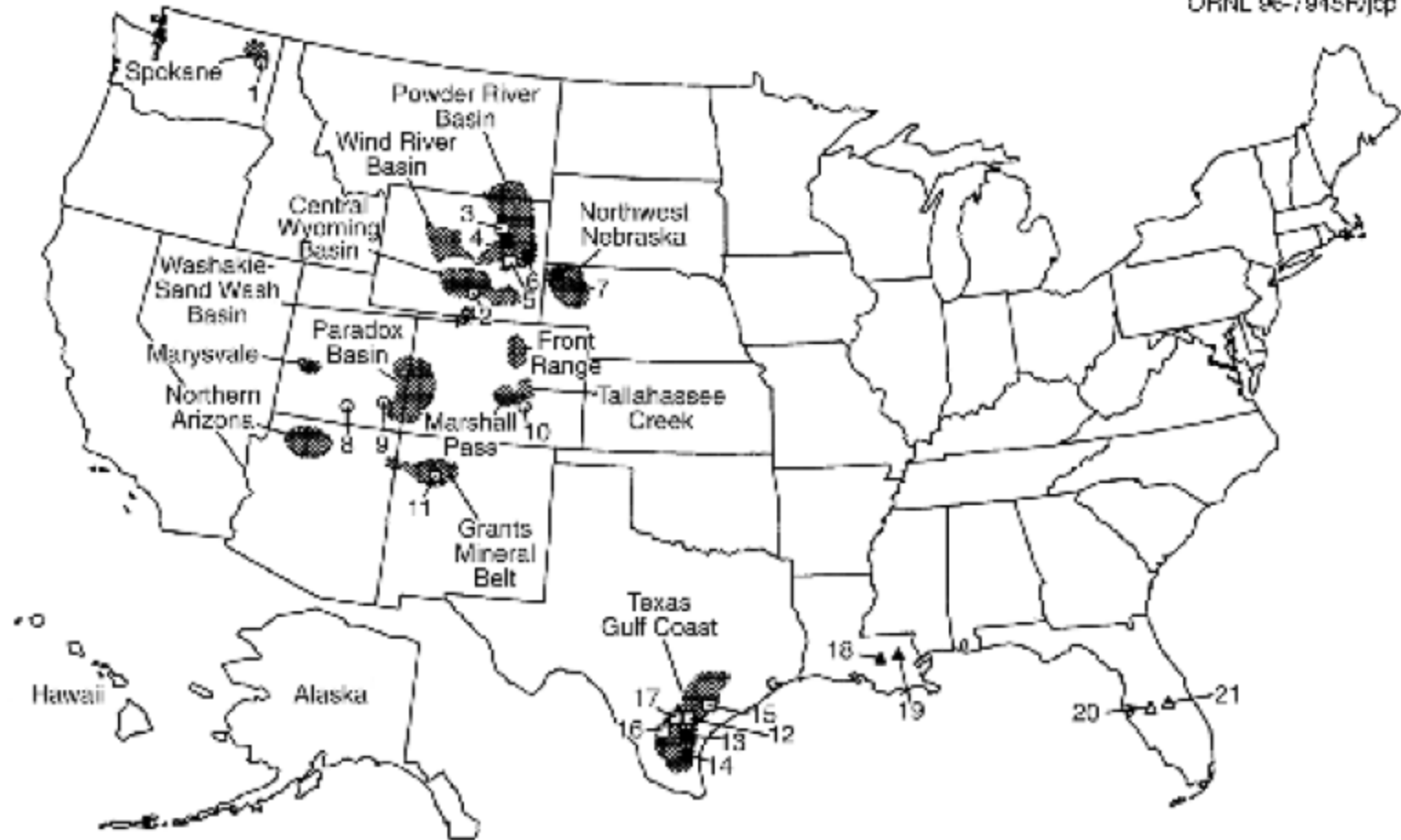
Other: Unconformity



# Uranium Mining and Milling Background

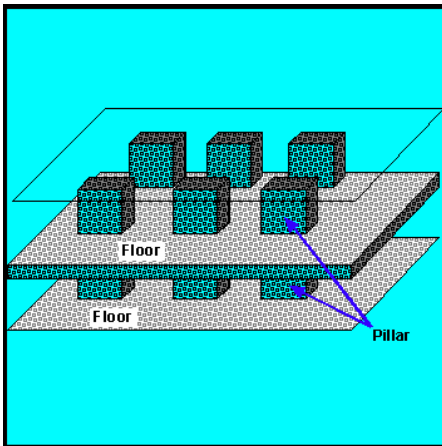
U.S. Uranium production areas—1996 (U.S. DOE-EIA)

ORNL 96-7945F/jcp



# Uranium Mining and Milling Background

**Conventional  
Open Pit or  
Surface Mining**

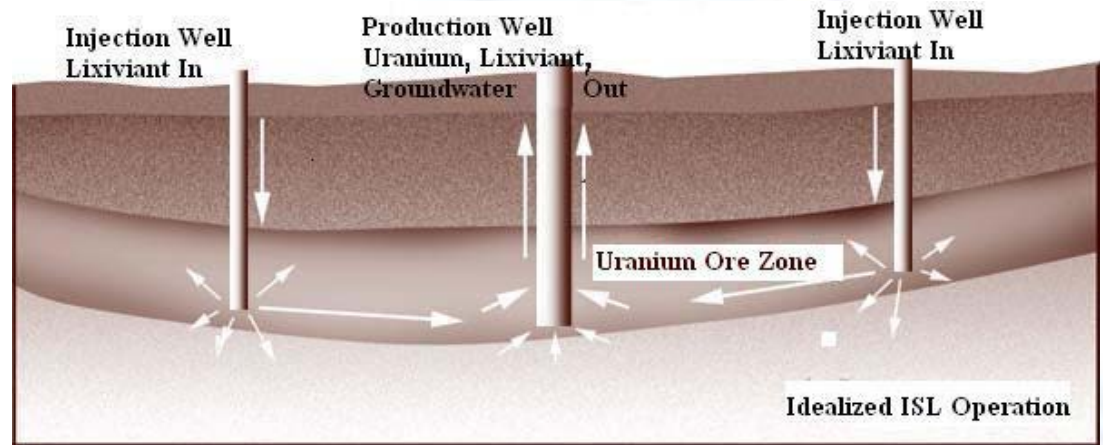
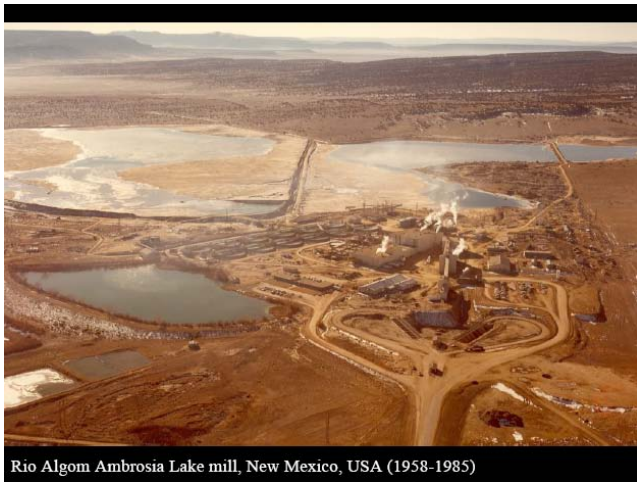


**Conventional  
Underground Mining**

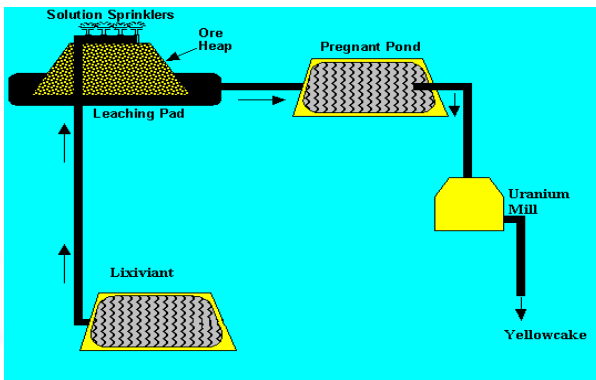
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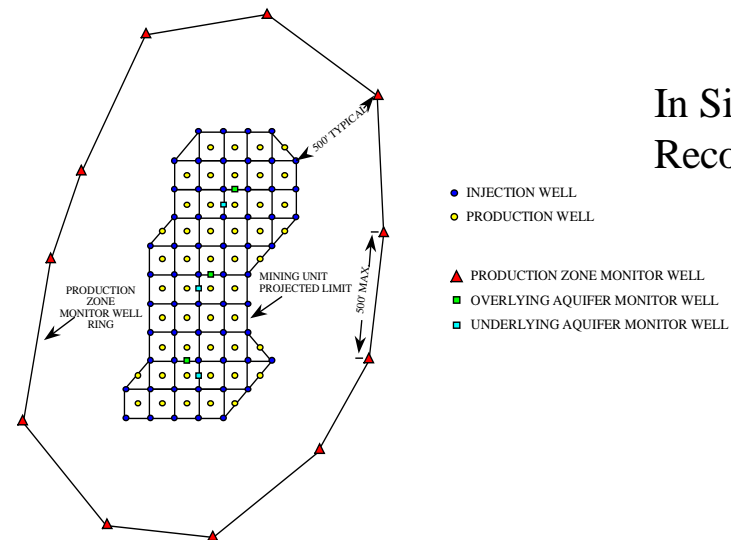
# Uranium Mining and Milling Background



## Conventional Surface Mill



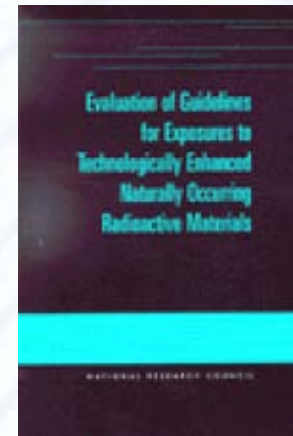
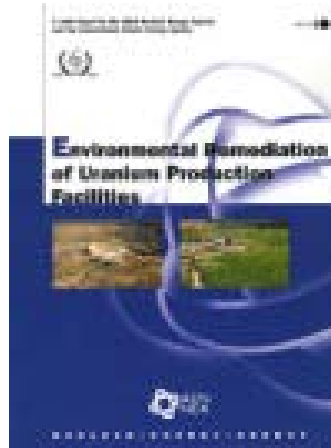
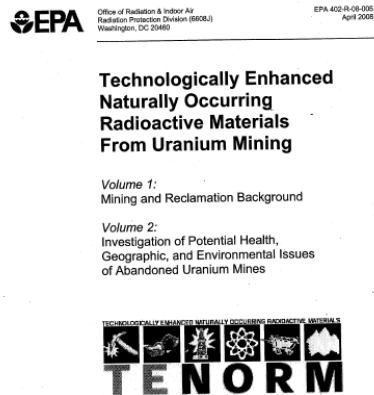
## Heap Leaching



## In Situ Leach Recovery ISL/ISR



# Uranium Mining and Milling Background



U.S. Environmental Protection Agency, 2008, “Technologically Enhanced Naturally Occurring Radioactive Materials From Uranium Mining, Volumes I and 2 .

<http://www.epa.gov/radiation/tenrom/pubs.html>

NEA/IAEA/OECD 2002—Nuclear Energy Agency, International Atomic Energy Agency, and Organization for Economic Cooperation and Development. *Environmental Remediation of Uranium Production Facilities*. Paris, France, and Vienna, Austria: 2002.

NAS 1999—National Academy of Sciences. *Evaluation of Guidelines for Exposures to Technologically Enhanced Naturally Occurring Radioactive Materials*. Washington, DC: National Academy Press, 1999. [http://www.nap.edu/openbook.php?record\\_id=6360](http://www.nap.edu/openbook.php?record_id=6360)



# Uranium Mining and Milling Background

- Radionuclides, heavy metals, and radon are all potential hazards associated with uranium mining and milling
- Regulatory requirements affect selected reclamation techniques. Water and radionuclide cleanups are a significant factor
- U.S. Department of Energy (2000) 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 Superfund cleanups may be much more:
  - Estimate of preferred alternative for Midnite open pit mine (WA) is \$123 million, plus annual operation and maintenance of \$870,000 for over 100 years





# EPA's Regulatory Authorities For Uranium Facilities--CAA

## Clean Air Act (CAA):

### Radon emissions

- Underground uranium mines 40 CFR Part 61, Subpart B Limits effective dose to member of public  $\leq 10$  mrem/yr (0.1 mSv/yr)
- Active new uranium mill tailings impoundments 40 CFR Part 61, Subpart W (includes evaporation ponds) must meet specific construction and disposal requirements
- Facilities subject to Subpart B and W must obtain construction approvals from EPA in accordance with 40 CFR Part 61, Subpart A, and meet annual reporting requirements



# EPA's Regulatory Authorities For Uranium Facilities--CAA

- 40 CFR Part 61, Subpart W promulgated on 12/15/1989  
-- Applies to radon emissions from operating uranium mill tailings -- flux standard: 20 pCi/m<sup>2</sup>-sec
- After 12/15/1989, new impoundments must meet one of two new work practices to achieve at least equivalent emissions reductions
  - Phased disposal – Impoundment size of 40 acres or less
  - Continuous disposal – dewatered tailings with no more than 10 acres uncovered
  - Both must meet design, construction, groundwater monitoring standards at 40 CFR 192.32(a)



# EPA's Regulatory Authorities For Uranium Facilities--CWA

## Clean Water Act (CWA):

40 CFR Part 440, Subpart C—Uranium, radium and Vanadium ores subcategory

- Limits emissions from mines, mills and ISL facilities
- Requires National Pollution Discharge Elimination System (NPDES) permits for discharges into navigable waters of the U.S.
- Effluent limitations for metals and radionuclides and limits on storm water discharges



# EPA's Regulatory Authorities For Uranium Facilities--UMTRCA

## Uranium Mill Tailings Radiation Control Act (UMTRCA)

- Establishes health, safety and environmental protection standards utilized by U.S. Nuclear Regulatory Commission (NRC) and its Agreement States, and U.S. Department of Energy (DOE) for their oversight of uranium and thorium extraction facility licensing, operations, sites, and wastes
- These regulations apply to byproduct material from conventional mills, In Situ Leach/Recovery (ISL/ISR) facilities, and heap leach facilities, but not conventional mines (open pit or underground)



# EPA's Regulatory Authorities For Uranium Facilities--UMTRCA

Under UMTRCA, EPA authority limited:

- Issue health, safety, environmental protection standards for use by NRC and its Agreement States, DOE
- Concurrence role over NRC regulations to implement EPA standards
- Facility licensing/operations (mills in operation 1978 or later) overseen by NRC or its Agreement States
- Reclamation of closed conventional mills and cleanup of lands/buildings contaminated by mill tailings overseen by DOE with NRC concurrence
- EPA's UMTRCA authorized regulations in 40 CFR Part 192



# EPA's Regulatory Authorities For Uranium Facilities--UMTRCA

- Over 25 years since 40 CFR part 192 originally issued, ~15 years since last update for groundwater protection
- Standards include:
  - Design and construction requirements for mill tailings impoundments (liners, monitoring and monitoring wells at points of compliance)
  - Cross-reference RCRA regulatory requirements
  - Radon emission standards—
    - Releases of radon-222 not to exceed 20 pCi/m<sup>2</sup>-sec(0.74 Bq/m<sup>2</sup>/sec)



# EPA's Regulatory Authorities For Uranium Facilities —UMTRCA

- Limits on groundwater concentrations of hazardous substances including radionuclides—concentration limits must not exceed whichever is higher:
  - Background level of that constituent, or
  - MCLs listed in 40 CFR Part 192, including radionuclides (radium-226 and 228, gross alpha), molybdenum and uranium
- or
- Regulatory authority (NRC or its Agreement States) may establish alternate concentration limits (to be satisfied at the point of compliance) provided:
  - after considering practicable corrective actions, limits are as low as reasonably achievable,
  - the determination has taken into consideration 20 factors enumerated in EPA specific RCRA regulations (40 CFR 264.94 (b))
  - standards are satisfied at all points >500 meters from edge of the disposal area and/or outside the site boundary



# EPA's Regulatory Authorities For Uranium Facilities —UMTRCA

- Remediation standards for contaminated soils/buildings
  - Concentration of radium-226 not to exceed background level by more than—
    - 5 pCi/g (0.185 Bq/g), averaged over the first 15 cm of soil below the surface, and
    - 15 pCi/g (0.555 Bq/g), averaged over 15 cm thick in layers of soil more than 15 cm below the surface
  - Gamma radiation  $\leq$  20 microRoentgens (mR) (20  $\mu$ Sv) per hour above background





# EPA's Regulatory Authorities For Uranium Facilities— UMTRCA

- Requirements for:
  - monitoring,
  - corrective action,
  - dewatering of tailings,
  - installation of radon barrier
  - post-closure monitoring
- Allows for acceptance of uranium 11(e)(2) byproduct material or materials similar to physical-chemical-radiological characteristics of uranium mill tailings and associated wastes (alternate feed)
- Provides environmental protection standards for operating thorium mills



# EPA's Regulatory Authorities For Uranium Facilities— UMTRCA

Under UMTRCA authority, EPA 40 CFR Part 192 standards provide for groundwater protection during production and for aquifer restoration following production. As implemented by NRC in 10 CFR Part 40 Appendix A:

- Protection includes the surficial aquifer
- During operations, and prior to closure, monitoring and corrective actions are required to protect groundwater at compliance point(s) from excursions
- Applies to impoundments and other surface and subsurface facilities



# EPA's Regulatory Authorities For Uranium Facilities— UMTRCA

Under UMTRCA authority, EPA 40 CFR Part 192

- As implemented by NRC in 10 CFR Part 40, Appendix A:
- Restoration Standards require groundwater hazardous constituents to be restored to background or maximum concentration limits, whichever is higher
- After considering practicable corrective actions, Alternate Concentration Limits may be applied for by the operator, and granted by NRC (or its Agreement States) for each contaminant:
  - provided limits are as low as reasonably achievable,
  - the determination has taken into consideration factors enumerated in EPA Resource Conservation and Recover Act authorized regulations, and NRC regulations



# EPA's Regulatory Authorities For Uranium Facilities— UMTRCA

Upon emplacement of radon barrier:

Monitoring of radon required to demonstrate compliance with radon standard

Uranium byproduct materials to be managed to comply with

- 40 CFR Part 190 uranium fuel cycle radiation protection standards, exposure limit to member of public to radiation dose of 25 millirems (0.25 mSv) annually to the whole body, 75 millirems (0.75 mSv) annually to the thyroid, and 25 millirems (0.25 mSv) to any other body organ
- 40 CFR Part 440, Subpart C effluent discharge standards
- Limits of radiation doses from radon emissions from surface impoundments to as far below the Federal Radiation Protection Guides as is practicable at each licensed site



# EPA's Regulatory Authorities For Uranium Facilities— UMTRCA

- Mill closure requirements reflected in NRC 10 CFR Part 40, Appendix A
  - Impoundment closure
  - Surface restoration to meet 40 CFR Part 192 radiation protection standards for soil, water, buildings and equipment
- Operators of mills also work with the DOE to achieve closure standards.
- In accordance with UMTRCA, tailings impoundments overseen by DOE in perpetuity
- DOE obtains general license from NRC. Oversight coordination between DOE and NRC over closed sites



# EPA's Regulatory Authorities For Uranium Facilities— UMTRCA

After closure period:

Disposal areas shall comply with RCRA closure performance standard (40 CFR 264.111) (unless having met radium soil cleanup standards for closed mills) and shall be designed to provide reasonable assurance of control of radiological hazards to:

- Be effective for one thousand years, to the extent reasonably achievable, and, in any case, for at least 200 years, and,
- Limit releases of radon-222 from uranium byproduct materials to the atmosphere so as to not exceed an average release rate of 20 pCi/m<sup>2</sup>-sec (0.74 Bq/m<sup>2</sup>/sec)



# EPA's Regulatory Authorities For Uranium Facilities— SDWA

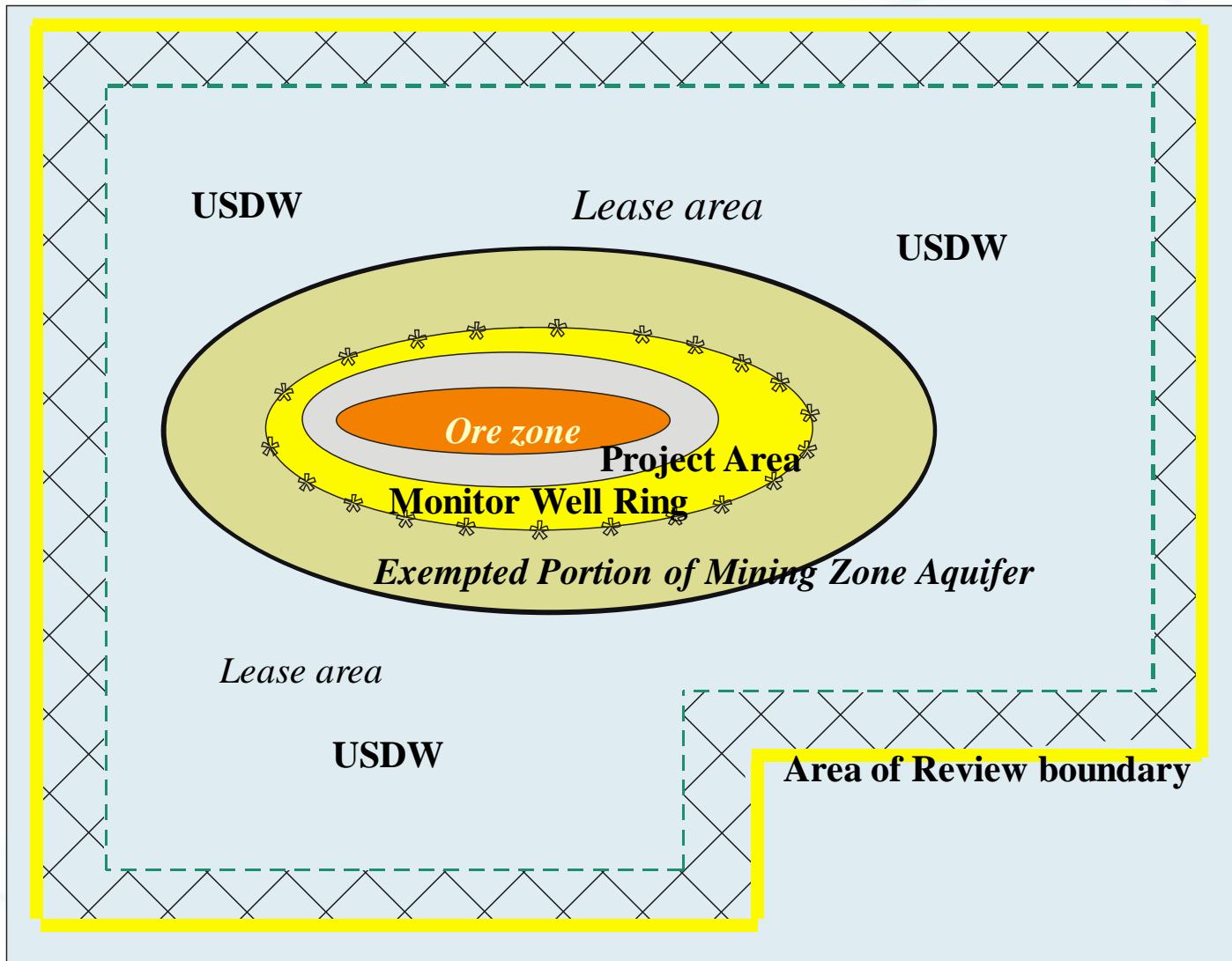
## Safe Drinking Water Act (SDWA)

EPA promulgated regulations 40 CFR Parts 144-146

- EPA issues underground injection control well permits (Class III) for uranium ISL/ISR facilities, and waste disposal wells (Classes I and V)
- EPA issues aquifer exemptions for aquifers or portions of aquifers from SDWA protections
- EPA has granted primacy to some states for UIC and Aquifer Exemption approvals, but not Virginia



# EPA's Regulatory Authorities For Uranium Facilities— SDWA





# EPA's Regulatory Authorities For Uranium Facilities— RCRA

## Resource Conservation and Recovery Act

- Hazardous waste permitting in accordance with the (regulations in 40 CFR Parts 260-265) generally applies only to non-radioactive material associated with the site operations (petroleum, hazardous chemicals, etc.)
- Corrective actions for facilities in Virginia have for the most part been delegated to the State



# EPA's Regulatory Authorities For Uranium Facilities— CERCLA

## Comprehensive Environmental Response, Compensation and Liability Act

- “Memorandum of Understanding Between the Environmental Protection Agency and the Nuclear Regulatory Commission: Consultation and Finality on Decommissioning and Decontamination of Contaminated Sites” dated October 9, 2002
  - Continues basic policy of EPA deferral to NRC decision-making in the decommissioning of NRC-licensed sites except in certain circumstances, and establishes the procedures to govern the relationship between the agencies in connection with the decommissioning of sites at which those circumstances arise



# Ongoing EPA Regulatory Reviews

- 40 CFR Part 61, Subpart W issued under CAA authority
- 40 CFR Part 192 issued under UMTRCA authority
- Regulations for financial surety under CERCLA Section 108(b)



# Ongoing EPA Regulatory Reviews

- 40 CFR Part 61, Subpart W issued under CAA authority
  - Review began after receiving Notice of Intent to Sue (NOI) by two Colorado environmental groups
    - Based on EPA's alleged failure to review & revise regulation within ten years after enactment of Clean Air Act Amendments of 1990 (11/15/2000)
    - Plaintiffs filed suit against EPA in October 2008
    - Settlement agreement reached November 2009



# Ongoing EPA Regulatory Reviews

- While performing early research for the NOI, EPA determined uranium ISL/ISR and heap leach impoundments are subject to Subpart W:
  - Preconstruction approval, impoundment construction and operation requirements in 40 CFR Part 192 cross referenced in Subpart W
- Annual reporting requirements, notification in advance of testing



# Ongoing EPA Regulatory Reviews

40 CFR Part 192 issued under UMTRCA authority

Existing regulations and standards in both 40 CFR Part 192, and Subpart W are being reviewed to determine if they are still appropriate in light of:

- Dominant use of ISL/ISR, now principal means of uranium recovery in U.S., and for heap leach facilities
  - Lack of provisions in current regulations
  - Different measurement methods needed for assessing radon emissions at evaporation ponds than for mills (Method 115 of 40 CFR Part 61, Subpart W)
  - We requested that ISL/ISR facilities provide radon flux data from their evaporation ponds
- Technology and design, historical performance of mill tailings impoundments and ISL/ISRs



# Ongoing EPA Regulatory Reviews

Existing regulations and standards are being reviewed to determine if they are still appropriate also in light of:

- Changes in risk and dose factors for radiation/radon,
- Principal scenarios for exposure,
- Subsistence and cultural lifestyles of affected communities including Tribal, EJ and children's health issues
- Free release of some facility sites after decommissioning  
-- implications for 40 CFR Part 192



# Ongoing EPA Regulatory Reviews

Existing regulations and standards are being reviewed to determine if they are still appropriate also in light of:

- Changes in EPA protective standards for hazardous substances in groundwater and drinking water for 40 CFR Part 192
- Changes in economics of extraction & site remediation
- Potential for uranium/thorium extraction in different geographic locations
- Court cases





# Ongoing EPA Regulatory Reviews

- EPA under court order currently conducting a rulemaking review of CERCLA Section 108(b)-- to establish surety requirements consistent with the degree and duration of risk associated with the production, transportation, treatment, storage or disposal of hazardous substances.
- Federal Register notice, July 2009 identified hardrock mining as the first industrial class for which EPA would develop financial responsibility requirements including uranium. 7% of NPL sites are mining/smelting; \$2.5 billion was spent on NPL mining sites (21%)
- Work group under way.



# Coordination and Stakeholder Input

For further information on 40 CFR Part 61,  
Subpart W review

<http://www.epa.gov/radiation/neshaps/subpartw/rulemaking-activity.html>

Site contains current and historical rulemaking documents, presentations, contact information, useful links

**Email address for additional public input:**

[Subpartw@epa.gov](mailto:Subpartw@epa.gov)



# Ongoing EPA Regulatory Reviews

## 40 CFR Part 192

### Interactive Internet Site – Discussion Forum

<http://blog.epa.gov/milltailingsblog/>

- Site for public input on discussion topics for this review
- Calendar of events
- Library of relevant documents



**Email address for additional public input:**

[UraniumReview@epa.gov](mailto:UraniumReview@epa.gov)



# Ongoing EPA Regulatory Reviews

Financial Responsibility Requirements under CERCLA Section 108(b) for Classes of Facilities in the Hard Rock Mining Industry

<http://yosemite.epa.gov/opei/rulegate.nsf/byRIN/2050-AG61?opendocument>



Thank You !

