

# **U.S. EPA Superfund Radiation Policy and Guidance**

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# EPA Addresses Site Cleanup Under Several Laws, Programs

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- ◆ Comprehensive Environmental Response, Compensation & Liability Act, CERCLA or “Superfund”
- ◆ National Contingency Plan (NCP) is regulation for CERCLA
- ◆ National Priorities List (NPL) guides EPA on which sites need further attention



# Purpose

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- ◆ Provide brief description of CERCLA process
- ◆ Provide overview of CERCLA remedy (long-term cleanup) selection requirements:
  - » Focus on radionuclides
- ◆ Provide overview of key EPA CERCLA guidance and tools that specifically address radionuclides
  - » Radionuclides are also addressed with other hazardous substances under general EPA CERCLA guidelines
  - » Uranium mining sites addressed within same framework as other radiation sites

# **Part 1.**

# **What does Superfund Address**

# Superfund sites: Number and Progress

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- ◆ 1,279 NPL sites
  - » 56 are radiation sites
  - » **8 are uranium mine sites**
- ◆ 61 more sites proposed for NPL
  - » 1 is a radiation site
- ◆ 1,084 NPL sites have progressed to “construction completion”
  - » 37 are radiation sites
  - » **6 are uranium mine sites**

# What does a Superfund Site look like?

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- ◆ There are many different types of Superfund sites.
  - » See following 4 pages for examples of radioactively contaminated sites.

# Nuclear Metals Inc. - Massachusetts



# Abandoned **Uranium Mines** Project – Navajo Nation

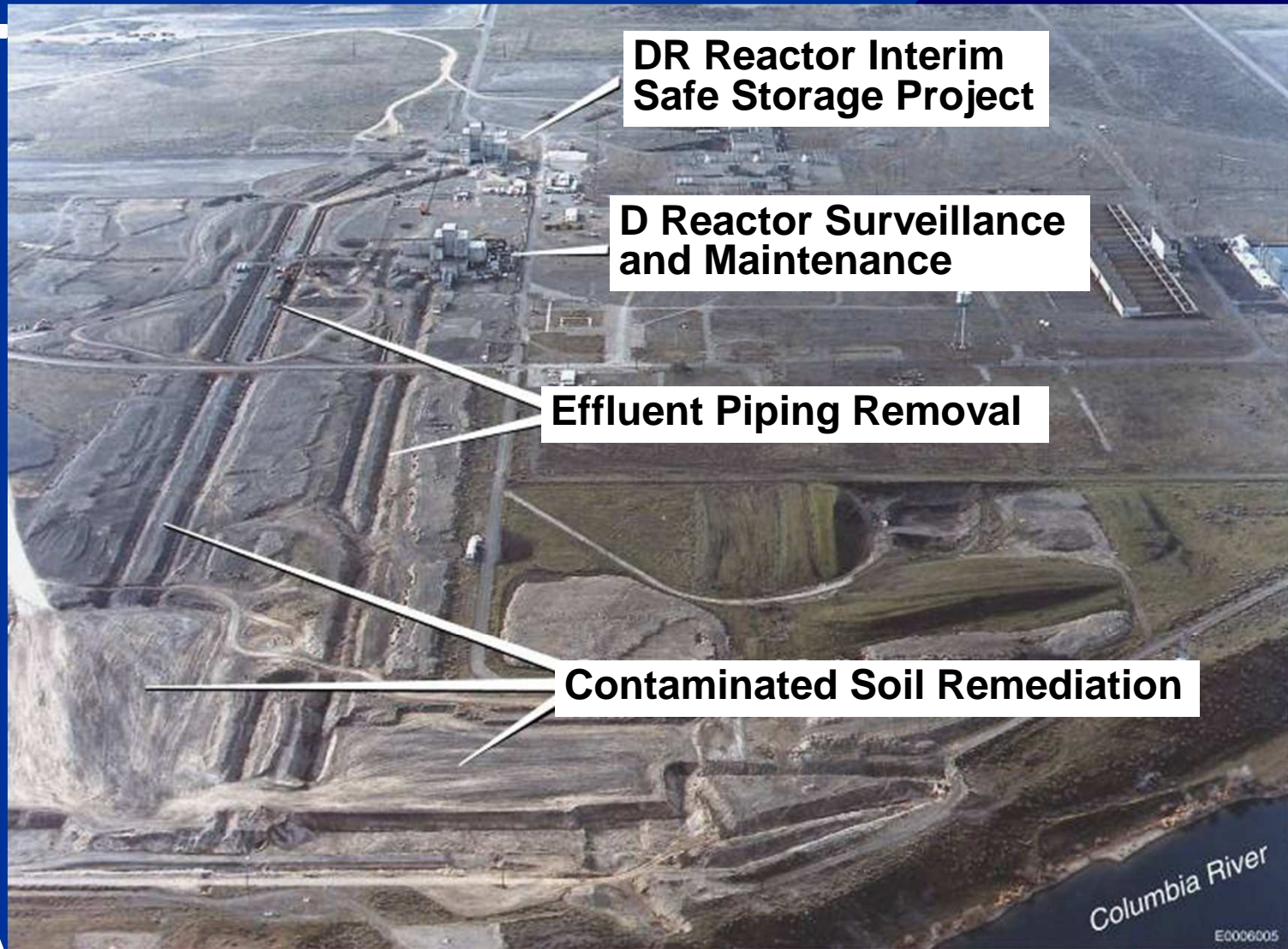




# Welsbach/General Gas Mantle – New Jersey



# Hanford – D Reactor / DR Reactor Remediation



# CERCLA Decision-making

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- ◆ CERCLA cleanup decisions are made site-specifically
  - » Must comply with law (CERCLA) and regulations (NCP)
- ◆ EPA Regional site managers
  - » Removals – On Scene Coordinators (OSCs)
  - » Remedial (and NTC-removals) – Remedial Project Managers (RPMs)



# Part 2. Regulatory Framework

# Nine CERCLA Remedy Selection Criteria

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- ◆ Two threshold criteria (both must be met)
  1. Protect human health and the environment
  2. Comply (attain or waive) with other federal and state laws: Applicable or Relevant and Appropriate Requirements (ARARs)
    - Protect current or future sources of drinking water (e.g., attain MCLs or more stringent state standards)



# Nine CERCLA Remedy Selection Criteria (continued)

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- ◆ 6 CERCLA ARAR waivers
  1. Interim Measure
  2. Greater Risk to Health and the Environment
  3. Technical Impracticability
  4. Equivalent Standard of Performance
  5. Inconsistent Application of State Requirements
  6. Fund Balancing



# Nine CERCLA Remedy Selection Criteria (continued)

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- ◆ Five balancing criteria (used to evaluate between potential remedies that meet threshold criteria)
  1. Long-term effectiveness and permanence
  2. Reduction of waste toxicity, mobility, or volume
  3. Short-term effectiveness
  4. Implementability
  5. Cost





# Nine CERCLA Remedy Selection Criteria (continued)

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- ◆ Two modifying criteria (information from public comment period that may modify remedial action)
  1. State acceptance
  2. Community acceptance



# CERCLA Cleanup Levels

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- ◆ ARARs often determine cleanup levels
- ◆ Where ARARs are not available or protective, EPA sets site-specific cleanup levels that
  - » For carcinogens, represent an increased cancer risk of  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$ 
    - $10^{-6}$  used as “point of departure”
    - PRGs are established at  $1 \times 10^{-6}$
  - » For non-carcinogens, will not result in adverse effects to human health (hazard index (HI) <1)
- ◆ Address ecological concerns
- ◆ To-be-considered (TBC) material may help determine cleanup level

# CERCLA Cleanup Levels Are **NOT** Based On

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- ◆ NRC decommissioning requirements (e.g., 25, 100 mrem/yr dose limits) 10 CFR 20 Subpart E
  - » If used as an ARAR,  $10^{-6}$  still used as point of departure, and  $10^{-4}$  to  $10^{-6}$  risk range must be met
- ◆ Guidance outside risk range and/or if expressed as a dose (# mrem/year). This includes:
  - » DOE orders, NRC guidance (e.g., NUREGs), ICRP guidance, IAEA guidance, NCRP guidance, ANSI/HPS guidance, EPA/DHS PAGs, and Federal guidance

# **Part 3. Guidance for EPA staff**

# Site consistency

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- ◆ To help facilitate compliance with NCP and cleanup sites, EPA Headquarters provides:
  - » Guidance documents
  - » Models (calculators)
  - » Training (developed with State led ITRC)
- ◆ Available for free on the internet

# Guidance: CERCLA Cleanup

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- ◆ *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination (8/22/97)*  
OSWER Directive 9200.4-18
- ◆ Radioactive contaminants at CERCLA sites are governed by the NCP like all other contaminants
  - » Cleanups based on ARARs or risk range
  - » Groundwater restored to beneficial reuse
  - » Use reasonably anticipated land use

# EPA/ITRC CERCLA Policy and Guidance Training

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- ◆ Four modules provide:
  1. Radiation Regulatory Background and Case Studies
  2. Overview of CERCLA Requirements
  3. EPA CERCLA Radiation Guidance and Tools
  4. Challenges of Long-Term Management of Radiation Sites

# EPA/ITRC CERCLA Policy and Guidance Training, cont.

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- ◆ Five Live Internet rad CERCLA Policy Training sessions have been conducted
  - » 838 total participants, including 163 EPA employees
- ◆ An archived version of a live training session is available at:
  - » [http://www.clu-in.org/conf/itrc/radscleanup\\_060507/](http://www.clu-in.org/conf/itrc/radscleanup_060507/)
- ◆ Archived version was accessed by users 3,282 times between January 1, 2008 and August 26, 2009.





# Common Rad ARARs

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- ◆ **Radium and thorium in soil** (40 CFR Part 192 (UMTRCA))
  - » 5 pCi/g [0.185 Bq/g] *over background*
- ◆ **Radon in buildings** (40 CFR Part 192 (UMTRCA))
  - » 0.02 working levels of radon-220 and -222 decay products
- ◆ **Outdoor radon** (40 CFR Part 192 (UMTRCA) 40 CFR Part 61 (CAA))
  - » 20 pCi/m<sup>2</sup>-s [0.74 Bq/m<sup>2</sup>-s] of radon-222

## Common Rad ARARs (continued)

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- ◆ NRC Low Level Waste (10 CFR Part 61 (AEA))

- » 25 mrem/yr [0.25 mSv/yr] whole body, 75 mrem/yr [0.75 mSv/yr] to the thyroid, and 25 mrem/yr [0.25 mSv/yr] to any critical organ other than the thyroid

- This is different dose methodology than 25, 100 mrem/yr [0.25, 1 mSv/yr] NRC decommissioning standard

- ◆ State water quality standards

# Common Rad ARARs (continued)

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- ◆ Federal drinking water MCLs (40 CFR Part 141 (SDWA))
  - » 5 pCi/l [0.185 Bq/l] of radium-226 and -228 combined
  - » 4 mrem/yr [0.04 mSv/yr] from beta particles and photon emitters to total body or any internal organ
  - » 15 pCi/l [0.555 Bq/l] for gross alpha particle activity (excluding radon and uranium)
  - » 30 micrograms per liter of uranium
- ◆ Uranium in groundwater (40 CFR Part 192 (UMTRCA))
  - » 30 pCi/l [1.11 Bq/l] of uranium-234 and -238 combined
- ◆ State MCLs if more stringent than federal

# Guidance: UMTRCA Soil ARAR

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- ◆ *Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA sites (2/12/98) OSWER Directive 9200.4-25*
- ◆ **Guidance on radium and thorium subsurface soil cleanup levels**
- ◆ **Attain 5 pCi/g [0.185 Bq/g], not 15 pCi/g [0.555 Bq/g], in subsurface**
  - » 15 pCi/g [0.555 Bq/g], is “finding tool” for UMTRCA sites where subsurface contamination is high,
  - » and was expected to achieve 5 pCi/g [0.185 Bq/g] or less, therefore
  - » 15 pCi/g [0.555 Bq/g], is “relevant and appropriate” at CERCLA sites only when it will achieve 5 pCi/g [0.185 Bq/g] or less

# Risk-based Cleanup Levels for Radioactive Contamination

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- ◆ Radiation cleanup levels expressed as risk levels, **not** mrem [mSv]
- ◆ Superfund uses “slope factors” in Health Effects Assessment Summary Tables (HEAST) instead of dose conversion tables to estimate cancer risk from radioactive contaminants
  - » HEAST has been updated with new information from Federal Guidance 13
    - Based on information in ICRP 72

# Guidance: Risk Assessment Q&A

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- ◆ *Radiation Risk Assessment at CERCLA Sites: Q&A* (12/99) OSWER Directive 9200.4-31P
- ◆ Provides overview of current EPA guidance for radiation risk assessment
- ◆ Written for users familiar with Superfund but not radiation
- ◆ Adds some new guidance
  - » Dose assessment only for ARAR compliance
  - » No dose-based TBCs (including **No** 15 mrem/yr [0.15 mSv/yr])
  - » Direct exposure rate may supplement sampling

# Guidance: Rad SSG

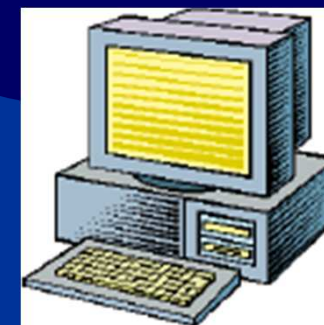
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- ◆ Soil Screening Guidance for Radionuclides [rad SSG] documents (10/00) OSWER Directives 9355.4-16A and 9355.4-16
  - » User Guide
  - » Technical Background Document
- ◆ Guidance to screen out areas, pathways, and/or radionuclides early in the process
- ◆ Consistent with 1996 chemical SSG
  - »  $1 \times 10^{-6}$  and MCLs (leaching from soil)
  - » Residential land use
  - » Survey procedures for site characterization
  - » Evaluates 5 soil to groundwater models
  - » Accounts for technical differences of radiation

# Guidance: Rad PRG Calculator

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- ◆ Calculator to establish PRGs, when:
  - » ARAR is either not available or sufficiently protective (e.g., 25 mrem/yr [0.25 mSv/yr] or more)
- ◆ Electronic equations (risk and leaching to groundwater) also are on Internet
  - »  $1 \times 10^{-6}$  and MCLs (leaching from soil)
  - » Accounts for technical differences of radiation (e.g., gamma, plant uptake)





# Guidance: Rad PRG Calculator (continued)

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- ◆ Eight scenarios/land uses available

- |                    |                        |
|--------------------|------------------------|
| 1. Residential     | 5. Fish ingestion      |
| 2. Agricultural    | 6. Tap water           |
| 3. Indoor workers  | 7. Soil to groundwater |
| 4. Outdoor workers | 8. Air                 |

- ◆ Chemical SSL Internet equations should be used for chemical toxicity of uranium
- ◆ EPA developed Internet-based training with States (ITRC) on calculator and radiation risk assessment
  - » [http://www.clu-in.org/conf/itrc/rads\\_051507/](http://www.clu-in.org/conf/itrc/rads_051507/)

# Guidance: ARAR Dose Calculator

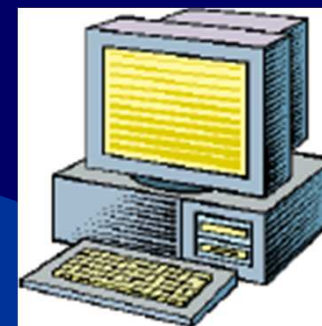
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◆ Calculator to establish Dose Compliance Concentrations (DCC) for single dose limit ARARs requiring a dose assessment

◆ Eight scenarios/land uses available

- |                    |                   |
|--------------------|-------------------|
| 1. Residential     | 5. Fish ingestion |
| 2. Agricultural    | 6. Tap water      |
| 3. Indoor workers  | 7. Soil to water  |
| 4. Outdoor workers | 8. Air            |

◆ Equations similar to those used for PRG calculator, except dose conversion factors used instead of slope factors



# EPA/ITRC Radiation Risk Training

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- ◆ Four modules provide:
  1. Background and Regulatory Case Studies
  2. Existing Practices in Radiation Risk Assessment
  3. **Use of Radiation PRG Calculator (*tutorial on using PRG and ARAR dose calculator*)**
  4. **Case Study Application for PRG Calculator**

# EPA/ITRC Radiation Risk Training, cont.

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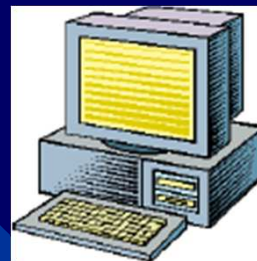
- ◆ Eight Live Internet rad CERCLA Policy Training sessions have been conducted
  - » 1,047 total participants, including 165 EPA employees
- ◆ An archived version of a live training session is available at:
  - » [http://www.clu-in.org/conf/itrc/rads\\_051507/](http://www.clu-in.org/conf/itrc/rads_051507/)
- ◆ Archived version was accessed by users 1,710 times between January 1, 2008 and August 26, 2009.



# Guidance: Building PRG (BPRG) Calculator

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- ◆ Calculator to establish  $1 \times 10^{-6}$  risk based PRGs for the reuse of radioactively contaminated buildings.
- ◆ Equations and parameters are derived from latest EPA chemical methodology (e.g., assessment at WTC)
  - » Adjusted to account for technical differences posed by radiation
- ◆ EPA and ITRC Internet-based training on BPRG calculator and D&D
  - » [http://www.clu-in.org/conf/itrc/radsdd\\_040308/](http://www.clu-in.org/conf/itrc/radsdd_040308/)



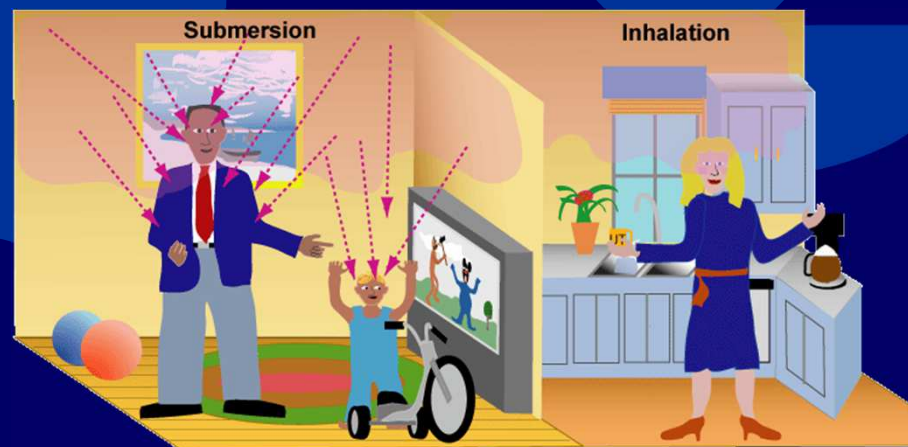
# Guidance: Building PRG (BPRG) Calculator (continued)

- ◆ BPRG calculator includes 2 land use scenarios
  - » Residential
  - » Indoor worker

- ◆ Both land uses include 3 exposure routes

- » Settled dust
- » Ambient air
- » Direct external exposure

- 5 Room sizes and 4 receptor locations, both
  - Surface
  - Volumetric



# Building Dose Cleanup Concentrations (BDCC) ARAR Dose Calculator

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- ◆ BDCC Purpose: to establish BCCs for Inside Buildings for single dose limit ARARs (# mrem/yr)
- ◆ BDCC includes 2 land use scenarios (Residential, Indoor Worker)
- ◆ 2 land uses include 3 exposure routes (Settled dust, Fixed Direct External 3-D, Ambient Air)
- ◆ Equations similar to those used for BPRG calculator, except dose conversion factors used instead of slope factors



# Surfaces PRG (SPRG) Calculator

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- ◆ Establish  $1 \times 10^{-6}$  risk based PRGs for radioactively contaminated **outside** hard surfaces (e.g., slabs, pavement, sidewalks, sides of buildings)
- ◆ Derived from rad PRG and BPRG calculators





# SPRG Exposure Scenarios

- ◆ SPRG includes 3 land use scenarios
  - » Residential
  - » Indoor Worker
  - » Outdoor Worker
- ◆ 3 land uses include 3 exposure routes
  - » Settled dust (pave and unpaved street level)
  - » Fixed Direct External 3-D (street level)
    - Surface and Volumetric
  - » Fixed Direct External 2-D (slabs)
    - Surface and Volumetric



# Surface Dose Cleanup Concentrations (SDCC) ARAR Dose Calculator

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- ◆ SDCC Purpose: to establish DCCs for Outside Hard Surfaces for single dose limit ARARs (# mrem/yr)
- ◆ SDCC includes 3 land use scenarios (Residential, Indoor Worker, Outdoor Worker)
- ◆ 3 land uses include 3 exposure routes (Settled dust, Fixed Direct External 3-D, Fixed Direct External 2-D (slabs))
- ◆ Equations similar to those used for SPRG calculator, except dose conversion factors used instead of slope factors



# EPA/ITRC Radiation D&D Training

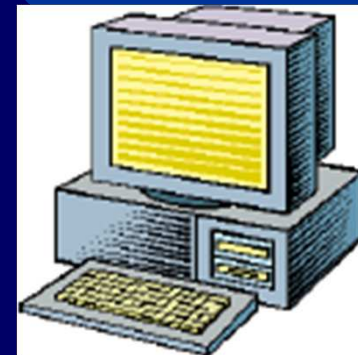
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- ◆ Four modules provide:
  1. Introduction and Regulatory Basis for D&D
  2. Factors for Implementing D&D
  3. **Preliminary Remediation Goal (PRG) Calculators (*tutorial on using BPRG, SPRG, BDCC, and SDCC calculators*)**
  4. Case Studies and Lessons Learned

# Radiation D&D Training, cont.

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- ◆ Five Live Internet rad CERCLA Policy Training sessions have been conducted
  - » 731 total participants, including 101 EPA employees
- ◆ An archived version of a live training session is available at:
  - » [http://www.clu-in.org/conf/itrc/radsdd\\_040308/](http://www.clu-in.org/conf/itrc/radsdd_040308/)
- ◆ Archived version was accessed by users 2,046 times between January 1, 2008 and August 26, 2009.



# Guidance: Uranium in Groundwater

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- ◆ *Use of Uranium Drinking Water Standards Under 40 CFR 141 and 40 CFR 192 as Remediation Goals for Groundwater at CERCLA Sites (11/6/01) OSWER Directive 9283.1-14*
- ◆ Guidance on the use of MCL and UMTRCA **uranium standards as ARARs for groundwater**
- ◆ When both standards are ARARs, must attain or waive both
  1. **30 micrograms per liter of total uranium**
  2. **30 pCi/l [1.11 Bq/l] of uranium-234 and 238 combined**
- ◆ Use MCL ARAR point of compliance for UMTRCA
- ◆ Includes a list of radionuclides under 4 mrem/year beta and 15 pCi/l [0.555 Bq/l] alpha MCLs

# Tools and Guidance under Development

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1. Radionuclide Ecological Benchmark calculator
2. MNA for inorganics (metals and radionuclides)



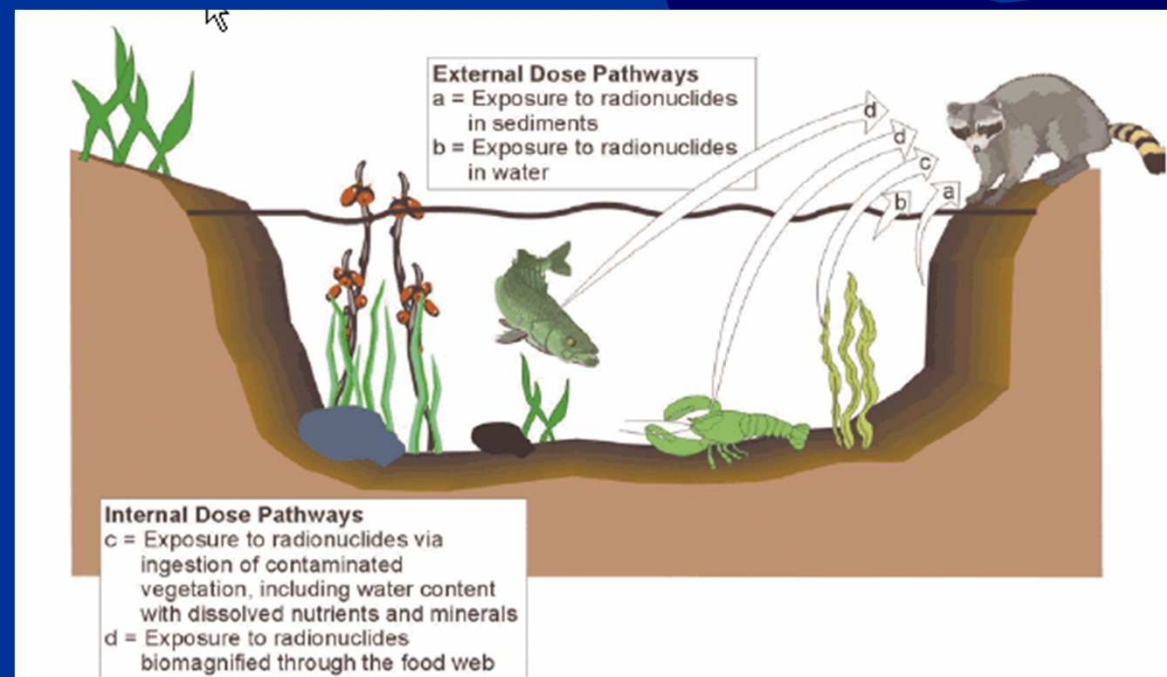
# Radionuclide Ecological Benchmark (REB) Calculator

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- ◆ Establish risk-based Biota Concentration guides (BCGs), or ecological benchmarks, for radioactively contaminated sites
- ◆ Derived from DOE Graded Approach guidance
  - » Includes same dose levels for tissue death
  - » Strong recommendation to look at chemical eco effects

# REB Exposure Scenarios

- ◆ Includes 12 animal or plant benchmark scenarios
  - » 6 generic composite only
  - » 6 species-specific/site-specific

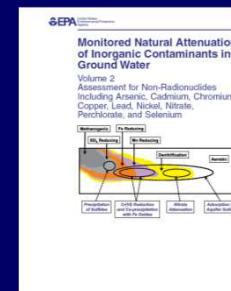
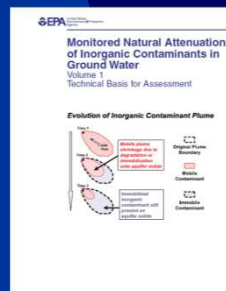






# Technical Background Documents for MNA Guidance for Inorganics

- ◆ 3 Technical Reports “Monitored Natural Attenuation of Inorganic Contaminants in Ground Water”
  - » “Volume 1 - Technical Basis for Assessment” 2007
  - » “Volume 2 - Assessment for Non-Radionuclides Including Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Nitrate, Perchlorate, and Selenium” 2007
  - » “Volume 3 - Assessment for Radionuclides Including Americium, Cesium, Iodine, Plutonium, Radium, Radon, Strontium, Technecium, Thorium, Tritium, Uranium” 2010



# **Part 4.**

## **Communication within EPA**

# Meetings with EPA Staff

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- ◆ EPA has had 11 annual meetings with regional and HQ staff who work on radiation sites, to discuss:
  - » Lessons learned (things not to repeat)
  - » Success stories (things to do again)
  - » Need for new guidance/tools
- ◆ Regional staff determine agenda
- ◆ Meeting locations picked by regional staff on basis of field trip (e.g., sites, disposal facilities)

# Email Lists

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- ◆ EPA HQ maintains email list of regional staff working on radiation sites, to distribute:
  - » Draft guidance for comments
  - » Final guidance
  - » Queries to assist in site-specific issues

# Internet and Intranet

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- ◆ All guidance (documents, models) on CERCLA radiation approach are on the internet

<http://www.epa.gov/superfund/health/contaminants/radiation/index.htm>

- ◆ Other policy related items on the intranet
  - » regulatory support documents
  - » letters to other entities
  - » analytical studies
  - » presentations from past meetings

# Part 5. Involving Stakeholders

# Community Involvement

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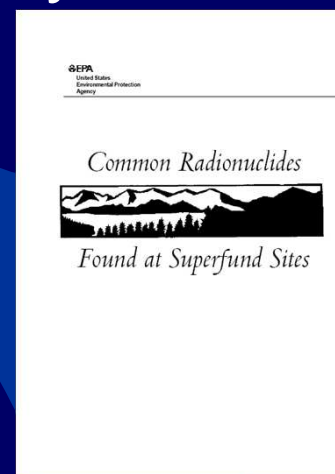
- ◆ EPA has many tools to facilitate meaningful involvement by communities near sites
- ◆ EPA hosts a community involvement national conference
- ◆ EPA has 2 tools designed specifically for use at radiation sites



# Booklet: Common Radionuclides

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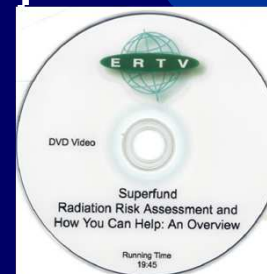
- ◆ *Common Radionuclides Found at Superfund Sites (7/02) OSWER Directive 9200.1-34*
- ◆ Booklet for the general public. It contains information on
  - » Health effects of radionuclides commonly found at Superfund sites
  - » EPA policies for cleaning up these radionuclides



# Video: Radiation Risk Assessment

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- ◆ *Superfund Radiation Risk Assessment and How you can Help, an Overview (3/05) OSWER Directive 9200.4-37*
- ◆ Video for the general public. It contains information on:
  - » The Superfund risk assessment process when addressing radioactive contamination
  - » How the public is involved site-specifically



# Part 6. International Outreach

# Role of International Information

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- ◆ EPA does not use risk management framework used by ICRP/IAEA and most other agencies addressing radiation
- ◆ EPA does use technical information from international guidance
  - » EPA has contractual agreement with Oak Ridge National Lab (Keith Eckerman) which also produces much of health effect material for ICRP
  - » EPA slope factors for risk are modified from ICRP dose conversion factors
  - » EPA PRG calculator uses IAEA transfer coefficients

# International Information Sharing

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- ◆ Representatives from France, UK, Russia, Norway have presented at EPA internal meeting and conducted site visits
- ◆ ASN host EPA visit of 3 French sites
- ◆ EA hosted EPA RPM for SRS visit to Sellafield for one week
- ◆ EA hosting EPA RPM for Livermore site working at Sellafield for 6 months

# Part 7

## New Initiatives

# Uranium Mines Stakeholder Involvement

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- ◆ EPA Regions 6 and 9 host annual meeting with Navajo Nation agencies and public to discuss issues related to uranium mine cleanup
- ◆ In request from other Tribes, EPA has started looking at some form of sustained involvement on uranium mining issues in other affected areas of the country

# Financial Assurance

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- ◆ Under Section 108(b) of CERCLA, EPA is working on regulations for financial assurance for high risk industrial sectors based on historical costs of cleanups
  - » Hardrock mining, including uranium mining, is included in the first tier of regulations under development



# For More Copies or Information

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- ◆ Guidance documents are on Superfund Radiation Webpage:
  - » <http://www.epa.gov/superfund/health/contaminants/radiation/index.htm>
- EPA/ITRC training on EPA Superfund radiation approach
  - » [http://www.clu-in.org/conf/itrc/radscleanup\\_060507/](http://www.clu-in.org/conf/itrc/radscleanup_060507/)
- ◆ Guidance documents for overall cleanup level issues are on Superfund Remedy Decisions Webpage:
  - » <http://www.epa.gov/superfund/policy/remedy/sfremedy/index.htm>
- ◆ For further information or questions, Stuart Walker
  - » Phone: (703) 603-8748
  - » Fax: (703) 603-9133
  - » Email: [Walker.Stuart@epa.gov](mailto:Walker.Stuart@epa.gov)

Questions



Answers