

U.S. EPA Superfund Remedial Program's Approach for Risk and Dose Assessment when addressing Radioactive Contamination

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EPA Addresses Site Cleanup Under Several Laws, Programs

- ◆ This talk discusses only the Comprehensive Environmental Response, Compensation & Liability Act, CERCLA or "Superfund"
- ◆ National Contingency Plan (NCP) is regulation for CERCLA
- ◆ National Priorities List (NPL) guides EPA's remedial program on which sites need further attention



Purpose

- ◆ Provide brief description of CERCLA remedial program process
- ◆ Provide overview and comparison of key EPA CERCLA remedial program guidance and tools that specifically address radionuclides
 - » Radionuclides are also addressed with other hazardous substances under general EPA CERCLA guidelines



Part 1.
Technical Guidance & Tools
for the Superfund Remedial
Program



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Nine CERCLA Remedy Selection
Criteria – Two Threshold

- ◆ 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)



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CERCLA Cleanup Levels

- ◆ 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 1×10^{-6} to 1×10^{-4}
 - 10^{-6} used as “point of departure”
 - PRGs are established at 1×10^{-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

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CERCLA Cleanup Levels Are NOT Based On

- ◆ NRC decommissioning requirements (e.g., 25, 100 mrem/yr mrem/yr [0.25, 1 mSv/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



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Risk-based Cleanup Levels for Radioactive Contamination

- ◆ Superfund uses radiation cleanup levels expressed as risk levels, not mrem [mSv]
- ◆ Superfund uses “slope factors” instead of dose conversion tables to estimate cancer risk from radioactive contaminants
 - » Slope factors have been updated with new information from ICRP 107



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Site consistency

- ◆ To help facilitate compliance with NCP and cleanup sites, EPA Headquarters provides:
 - » Guidance documents
 - » Models (calculators)
 - » Training (developed with State led ITRC)
 - » 13 Annual Meetings with EPA Regions
- ◆ Guidance, models, training are available for free on the internet



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Guidance: Risk Assessment Q&A *Old Superseded*

- ◆ *Radiation Risk Assessment at CERCLA Sites: Q&A* (12/99) OSWER Directive 9200.4-31P
- ◆ Provides overview of **then** 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

New 2014 Risk Assessment Q&A issued June 2014

- ◆ *Radiation Risk Assessment at CERCLA Sites: Q&A* (5/2014) OSWER Directive 9200.4-40
- ◆ Provides overview of **current** EPA guidance for radiation risk assessment
- ◆ Written for users familiar with Superfund but not radiation

2014 Risk Q&A -- Reflect Superfund guidance issued since 1999

1. Rad SSG User Guide 2000
2. Rad SSG TBD 2000
3. PRG calculator 2002
4. Common Rads found at Superfund sites 2002
5. DCC calculator 2004
6. SF Rad Risk Assessment & How You Can Help 2005
7. BPRG calculator 2006
8. SPRG calculator 2009
9. BDCC calculator 2010
10. SDCC calculator 2010
11. **CPM calculator 2015?**
12. **Eco calculator 2015?**

2014 Risk Q&A -- Update Policies Based on Newer Science

- ◆ For an effective dose standard ARAR to be considered protective, it should be 12 mrem/yr [0.12 mSv/yr] or less.
 - » Change from 15 mrem/yr [0.15 mSv/yr] based on risk to dose estimate in Federal Guidance 13
 - » Cleanup levels not based on an ARAR continue to be based on cancer risk range (10⁻⁴ to 10⁻⁶) **not** dose

2014 Risk Q&A -- Update Policies Based on Newer Science, cont.

- ◆ To comply with UMTRCA indoor radon standard as an ARAR, users may assume the following concentrations correspond to 0.02 Working Levels:
 - » 5 pCi/l of Rn-222
 - » 7.5 pCi/l of Rn-220
- ◆ The methodology for making these conversions is discussed in ICRP "Lung Cancer Risk from Radon and Progeny"

2014 Risk Q&A -- More consistency on Risk Assessments (Rad & Chem)

- ◆ Explain what type of circumstances these Superfund guidance and tools are recommended
- ◆ Reiterate more strongly that risk assessments (e.g., models used) should be consistent with chemicals at site and with other regional sites
- ◆ Don't use a steady state model for chemical and a transfer/dynamic model for radionuclides
 - » Such as using RSL calculator for chemicals then RESRAD for radionuclides

2014 Risk Q&A -- More consistency on Surveys (Rad & Chem)

- ◆ Explain what type of circumstances these Superfund guidance and tools are recommended
- ◆ Reiterate more strongly that site surveys (e.g., characterization and confirmation) should be consistent with chemicals at site and with other regional sites
- ◆ Don't use not-to-exceed (NTE) for chemicals and area averaging (AA) for radionuclides for residential
 - » NTE for residential cleanup of chemicals but AA approach like MARSIMM for the radionuclides



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Guidance: Rad SSG

- ◆ 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
 - » 1×10^{-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



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Guidance: Rad PRG Calculator

- ◆ Calculator to establish PRGs, when:
 - » ARAR is either not available or sufficiently protective (e.g., greater than 12 mrem/yr [0.12 mSv/yr])
- ◆ Electronic equations (risk and leaching to groundwater) also are on Internet
 - » 1×10^{-6} and MCLs (leaching from soil)
 - » Accounts for technical differences of radiation (e.g., gamma, plant uptake)



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Guidance: Rad PRG Calculator (continued)

- ◆ Ten scenarios/land uses available

- | | |
|-------------------|------------------------|
| 1. Residential | 6. Outdoor workers |
| 2. Farmer | 7. Fish ingestion |
| 3. Recreator | 8. Tap water |
| 4. Construction | 9. Soil to groundwater |
| 5. Indoor workers | 10. Air |

- ◆ Chemical RSL 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/



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Guidance: ARAR Dose Calculator

- ◆ 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. Farmer | 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



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Guidance: Building PRG (BPRG) Calculator

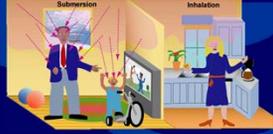
- ◆ Calculator to establish 1×10^{-6} risk based PRGs for the reuse of radioactively contaminated buildings.
- ◆ Equations and parameters are derived from latest EPA chemical methodology (e.g., assessment at WTC which used 1×10^{-4} cleanup level)
 - » Adjusted to account for technical differences posed by radiation
- ◆ EPA and ITRC Internet-based training on BPRG calculator and D&D
 - » http://www.clu-in.org/conf/itrc/radsdd_040308/



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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



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Building Dose Cleanup Concentrations (BDCC) ARAR Dose Calculator

- ◆ 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



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Surfaces PRG (SPRG) Calculator

- ◆ Establish 1×10^{-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



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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

- ◆ 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



Part 2. Involving Stakeholders at Superfund Remedial Program Sites



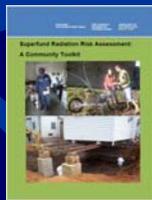
Community Involvement

- ◆ 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
 - EPA works with stakeholders to develop site-specific tools for local communities



Toolkit: Radiation Risk Assessment *New – issued June 2014*

- ◆ *Superfund Radiation Risk Assessment: A Community Toolkit*
- ◆ Collection of 22 fact sheets for the general public. It contains fact sheets on
 - » Superfund and Radiation
 - » Superfund risk assessment process at radiation sites
 - » Each of the 6 PRG and DCC calculators



Video: Radiation Risk Assessment

- ◆ *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 3. Radiation Risk Assessment Guidance under Development for the Superfund Remedial Program



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Radionuclide Ecological Benchmark (REB) Calculator

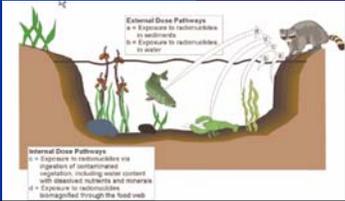
- ◆ Establish risk-based Biota Concentration guides (BCGs), or ecological benchmarks, for radioactively contaminated sites
- ◆ Fits with Superfund framework for developing eco benchmarks
- ◆ Derived from DOE Graded Approach guidance
 - » Includes same dose levels for tissue death
 - » Strong recommendation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



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REB Exposure Scenarios

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



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CPM Calculator Scenarios

- ◆ The CPM calculator has three major sub calculators based on the field survey scenario:
 1. Ground based scanning of surface contamination
 2. Ground based scanning of volumetric contamination
 3. Air based scanning of contamination (*under consideration*)



CPM tool caveats

- ◆ The CPM tool is intended to facilitate use of Real-Time measurement techniques to supplement sampling **NOT** replace sampling
- ◆ The CPM tool only addresses gamma emitters
- ◆ The CPM tool assumes uniform contamination



For More Copies or Information

- ◆ 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/
- ◆ Guidance documents for overall cleanup level issues are on Superfund Remedy Decisions Webpage:
 - » <http://www.epa.gov/superfund/policy/remedy/sfremedy/index.htm>
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