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Welcome – Thanks for joining us.
ITRC's Internet-based Training Program

Radiation Site Cleanup: CERCLA Requirements and Guidance

Associated ITRC Documents:

- Determining Cleanup Goals at Radioactively Contaminated Sites: Case Studies (RAD-2, April 2002)
- Issues of Long-Term Stewardship: State Regulators' Perspectives (RAD-3, July 2004)

This training is co-sponsored by the EPA Office of Superfund Remediation and Technology Innovation

The ITRC Radionuclides Team's "Determining Cleanup Goals at Radioactively Contaminated Sites: Case Studies" (RAD-2, April 2002) examines the factors influencing variations in cleanup level development at various radioactively contaminated sites and underscores the need for training to enhance consistency in remedy selection for radiological contaminants. Since most radioactively contaminated DOE and DOD sites are developing cleanup goals under CERCLA authority, there is a need for training that elaborates on the methodology used to select remedies under EPA's approach for CERCLA sites. This training course has been collaboratively developed by the ITRC Radionuclides Team and EPA's Superfund Office to meet these needs. The focus of this training is EPA's guidance for remediating radioactively contaminated sites, which can facilitate cleanups that are consistent with how chemical contaminants are addressed, except where technical differences posed by radiation are addressed. In addition to CERCLA cleanup and its associated guidance, this course introduces the participants to long term stewardship (LTS) challenges related to the large radioactively contaminated sites. This understanding of LTS issues are integral to the cleanup process and decisions made at the radiation sites. Course modules have the following specific purposes:

Module 1 - Regulatory Background and Case Studies: Provide an overview of the regulatory requirements for cleanup of radioactive waste

Module 2 & 3 - EPA CERCLA Radiation Requirements and Guidance: Explain EPA remedy selection policy, in particular those guidance documents and tools that address radioactively contaminated sites

Module 4 - Beyond Cleanup: Long-Term Management of Radioactive Sites – This module focuses on the challenges of long term stewardship of large radiation sites, identified by the ITRC Radionuclides Team in their document "Issues of Long-Term Stewardship: State Regulators' Perspective" (RAD-3, July 2004)

ITRC (Interstate Technology and Regulatory Council) www.itrcweb.org

Training Co-Sponsored by: EPA Office of Superfund Remediation and Technology Innovation (www.clu-in.org)

ITRC Course Moderator: Mary Yelken (myelken@earthlink.net)

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ITRC (www.itrcweb.org) – Shaping the Future of Regulatory Acceptance

- Network
  - State regulators
  - Federal government
  - Industry
  - Consultants
  - Academia
  - Community stakeholders
- Documents
  - Technical and regulatory guidance documents
  - Technology overviews
  - Case studies
- Training
  - Internet-based
  - Classroom

Host Organization

ECOS

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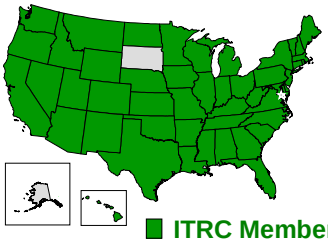

ITRC Member State

Federal Partners

DOE DOD EPA

The Interstate Technology and Regulatory Council (ITRC) is a state-led coalition of regulators, industry experts, citizen stakeholders, academia and federal partners that work to achieve regulatory acceptance of environmental technologies and innovative approaches. ITRC consists of 49 states (and the District of Columbia) that work to break down barriers and reduce compliance costs, making it easier to use new technologies and helping states maximize resources. ITRC brings together a diverse mix of environmental experts and stakeholders from both the public and private sectors to broaden and deepen technical knowledge and advance the regulatory acceptance of environmental technologies. Together, we're building the environmental community's ability to expedite quality decision making while protecting human health and the environment. With our network approaching 7,500 people from all aspects of the environmental community, ITRC is a unique catalyst for dialogue between regulators and the regulated community.

For a state to be a member of ITRC their environmental agency must designate a State Point of Contact. To find out who your State POC is check out the "contacts" section at www.itrcweb.org. Also, click on "membership" to learn how you can become a member of an ITRC Technical Team.

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ITRC Course Topics Planned for 2007

Popular courses from 2006

- Characterization, Design, Construction, and Monitoring of Bioreactor Landfills
- Direct Push Well Technology for Long-term Monitoring
- Evaluate, Optimize, or End Post-Closure Care at MSW Landfills
- Perchlorate: Overview of Issues, Status and Remedial Options
- Planning & Promoting Ecological Re-use of Remediated Sites
- Real-Time Measurement of Radionuclides in Soil
- Remediation Process Optimization Advanced Training
- Risk Assessment and Risk Management
- Site Investigation and Remediation for Munitions Response Projects

New in 2007

- Performance-based Environmental Management
- Protocol for Use of Five Passive Samplers
- Survey of Munitions Response Technologies
- Vapor Intrusion Pathway: A Practical Guideline
- More in development…

Training dates/details at

www.itrcweb.org

Training archives at

http://cluin.org/live/archive.cfm

More details and schedules are available from www.itrcweb.org under “Internet-based Training.”

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Radiation Site Cleanup: CERCLA Requirements and Guidance

Logistical Reminders

- Phone line audience
  - ✓ Keep phone on mute
  - ✓ *6 to mute, *7 to un-mute to ask question during designated periods
  - ✓ Do NOT put call on hold
- Simulcast audience
  - ✓ Use ? at the top of each slide to submit questions
- Course time = 2¼ hours

Presentation Overview

- Introduction and course overview
- Module 1: Radiation regulatory background and case studies
- Module 2: Overview of CERCLA requirements
- Questions and answers
- Module 3: CERCLA radiation guidance and tools
- Module 4: Beyond clean-up: challenges of long-term management of radiation sites
- Links to additional resources
- Your feedback
- Questions and answers

Introduction and Course Overview – Provides the overview and learning expected from this course

Module 1 - Regulatory Background and Case Studies: Provide an overview of the regulatory requirements for cleanup of radioactive waste

Module 2 & 3 - EPA CERCLA Radiation Requirements and Guidance: Explain EPA remedy selection policy, in particular those guidance documents and tools that address radioactively contaminated sites

Module 4 - Beyond Cleanup: Long-Term Management of Radioactive Sites – This module focuses on the challenges of long term stewardship of large radiation sites, identified by the ITRC Radionuclides Team in their document “Issues of Long-Term Stewardship: State Regulators’ Perspective” (RAD-3, July 2004)

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Meet the ITRC Instructors

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Tom Schneider has worked for Ohio EPA in the area of radioactive site remediation since 1990. In his present capacity with Ohio EPA's Office of Federal Facilities Oversight, Mr. Schneider manages a team (composed of staff and contractors) charged with implementing Ohio's oversight and environmental monitoring program at the U.S. Department of Energy (DOE) Fernald site. Tom has a Masters of Science (M.S.) Degree in Natural Resources from the Ohio State University and a Bachelors of Science (B.S.) Degree in Biology from the University of Dayton. He is co-leader of the ITRC Radionuclides Team.

Carl Spreng worked as an energy exploration geologist after receiving BS and MS degrees in Geology from BYU. Since 1992 he has worked for the Colorado Department of Public Health and Environment as a project manager overseeing environmental restoration at DOE's Rocky Flats site. He currently also serves as co-team leader of the Radionuclides Team of the Interstate Technology and Regulatory Council (ITRC).

Robin Anderson has a BS in Chemistry from Washington State University, Pullman, Washington. She has approximately 25 years of service to the EPA, much of which centered on site cleanup and waste management. Robin Anderson has worked in the Superfund program in the Office of Superfund and Technology Innovation since 1989 on issues related to remedy selection, and compliance with applicable, or relevant, and appropriate requirements.

Stuart Walker has a BA in political science and economics from the American University in Washington, DC and a MPA in policy analysis and development from George Washington University in Washington, DC. He has over 15 years in EPA working either on regulatory compliance or regulation development. Stuart Walker has been employed by U.S. EPA since 1990 in either the Superfund program (the Office of Superfund Remediation and Technology Innovation) or the Office of Radiation and Indoor Air working on issues regarding the cleanup of contaminated sites. His primary areas of responsibility include serving as the Superfund program's national lead on issues regarding radioactively contaminated CERCLA sites. In this latter role, Stuart develops national policy for characterization, cleanup and management of radioactive contamination at CERCLA sites. Previously Stuart was the lead staff person on remedy selection issues for EPA's CERCLA reauthorization team.

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ITRC Radionuclides Team

- Facilitate the cleanup of radioactively contaminated federal facilities by fostering dialogue between states, stakeholders, and federal agencies in order to increase awareness of issues and procedures at sites in other states, encourage regulatory cooperation, and share technological successes and approaches
- Current state members
  - Colorado
  - New Jersey
  - New Mexico
  - Ohio
  - Tennessee
  - Washington

Made up of state and federal regulators, Dept. Energy personnel, consultants, and citizen stakeholders primarily from states with large DOE sites.

Facilitate communication and experience sharing among sites

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ITRC Team Products and Activities

- Radiation Reference Guide: Relevant Organizations and Regulatory Terms (RAD-1, December 1999)
- Determining Cleanup Goals at Radioactively Contaminated Sites: Case Studies (RAD-2, April 2002)
- Issues of Long-Term Stewardship: State Regulators' Perspectives (RAD-3, July 2004)
- Real-Time Data Collection for Radionuclides: Measurement Technologies, Methodologies, Case Studies and Regulatory Issues (RAD-4, February 2006)
- Radiation Risk Assessment Internet-based Training with USEPA
- Real-Time Radiation Internet-based Training

Details available in Links page at end of presentation or directly at www.itrcweb.org

The products above have been developed by ITRC's Radionuclides Team – details at www.itrcweb.org

D & D – Decommissioning and Decontamination

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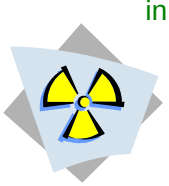
Major Federal Laws on Radiation Protection

- Atomic Energy Act (1954)
  - Weapons development, nuclear power plants
- Marine Protection, Research, and Sanctuaries Act (1972)
- Energy Reorganization Act (1974)
- Safe Drinking Water Act (1974)
  - Permissible levels (MCLs) of radionuclides in drinking water systems
- Clean Air Act Amendments (1977)
  - NESHAPS
- Uranium Mill Tailings Radiation Control Act of 1978 - UMTRCA (1978)
  - Uranium mining/milling
- Comprehensive Environmental Response, Compensation, and Liability Act - CERCLA (1980)
  - Site cleanup
- Nuclear Waste Policy Act (1982)
  - Yucca Mountain



Regulations are complex due to:

multiple agencies,

overlapping authorities, and

multiple categories of radioactive materials.

UMTRCA – Uranium Mill Tailings Radiation Control Act

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act

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Major Categories of Radioactive Materials

- Source materials *
- Special nuclear material *
- By-product materials and mill tailings *
- Naturally occurring radioactive material (NORM)
- Naturally occurring or accelerator-produced radioactive material (NARM)

* Associated with atomic energy production

Agencies regulating nuclear materials:

U.S. Environmental Protection Agency (EPA)

U.S. Nuclear Regulatory Commission (NRC)

U.S. Department of Transportation (DOT)

U.S. Department of Energy (DOE)

Defense Nuclear Facility Safety Board (DNFSB)

Various state agencies

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What you will learn……

To facilitate remedy selection and cleanup at radioactively-contaminated sites by explaining CERCLA requirements and policy

- Development of clean-up levels in case studies from sites contaminated with radionuclides
- Overview of CERCLA requirements for cleanup of radioactive contamination
- CERCLA cleanup criteria and cleanup levels
- CERCLA radiation guidance
- Common radiological ARARs
- Challenges of long-term management of radiation sites

ARAR- Applicable or Relevant and Appropriate Requirements

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Training Course Overview

MODULE 1: **Radiation regulatory background and case studies**

MODULE 2: **Overview of CERCLA requirements**

MODULE 3: **CERCLA radiation guidance and tools**

MODULE 4: **Beyond clean-up: challenges of long-term management of radiation sites**

This training is meant to provide an overview of cleanup and long-term management of radioactively contaminated sites. Since most rad sites are regulated by CERCLA and its risk-based standards, the ITRC Radionuclides team developed this training to assist the site managers, state regulators and others associated with cleanup and management of rad sites.

The first module, describing the cleanup at various radioactively contaminated sites within the DOE complex, is based on the ITRC's Radionuclides Team's document "Determining Cleanup Goals at Radioactively Contaminated Sites: Case Studies" (RAD-2, April 2002). Since DOE has the largest share of radioactively contaminated sites and the biggest cleanup effort, we chose ot focus on the major DOE sites for the case studies.

Module 2 and 3 provide overview of CERCLA requirements and specific guidance related to these requirements. These provide detailed information on what is expected for cleanup at CERCLA sites and what are the tools/guidance available to comply with the requirements.

Module 4 introduces challenges of post cleanup long-term management and related publication developed by ITRC Radionuclides Team [Based on ITRC document: "Issues of Long-Term Stewardship: State Regulators' Perspectives" (RAD-3, July 2004)]

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Acronyms

AEA	Atomic Energy Act
ALARA	As Low As Reasonably Achievable
ARARs	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
DCF	Dose Conversion Factor
EDE	Effective Dose Equivalent
HEAST	Health Effects Assessments Summary Tables
HI	Hazard Index
HRS	Hazard Ranking System
ICRP	International Commission on Radiological Protection
LTRA	Long-Term Response Actions
MCLs	Maximum Contaminant Levels
MOU	Memorandum of Understanding
mrem	millirem
NARM	Naturally Occurring or Accelerator-Produced Radioactive Material
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NORM	Naturally Occurring Radioactive Material

Acronym list for reference

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Acronyms (continued)

NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NTC	Non-Time Critical
OSC	On Scene Coordinator
OSWER	Office of Solid Waste and Emergency Response
PA/SI	Preliminary Assessment/Site Investigation
pCi	picocurie
PRB	Permeable Reactive Barrier
PRG	Preliminary Remedial Goal
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RESRAD	Computer model for Residual Radioactive materials
RfD	Reference Dose
RI/FS	Remedial Investigation/ Feasibility Study
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RPM	Remedial Project Manager
SDWA	Safe Drinking Water Act
SSG	Soil Screening Guidance
SSL	Soil Screening Level
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978
WL	Working Level

Acronym list for reference

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Radiation Site Cleanup: CERCLA Requirements and Guidance

MODULE 1:

Radiation Regulatory Background and Case Studies

No associated notes

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ITRC Radionuclides Team

"Determining Cleanup Goals at Radioactively Contaminated Sites: Case Studies"

(RAD-2, April 2002)

Download at: www.itrcweb.org under "Guidance Documents"

This document published in 2002 summarizes the various regulatory standards and requirements that dictate cleanup at radioactively contaminated sites. It reports processes used to develop cleanup levels and presents case studies from 12 selected sites to demonstrate variations in decision-making framework and basis. This document can be found at

www.itrcweb.org

Click on → Guidance Documents (under ITRC icon)

Click on → Radionuclides

Click on → Determining Cleanup Levels at Radioactively-Contaminated Sites (PDF file)

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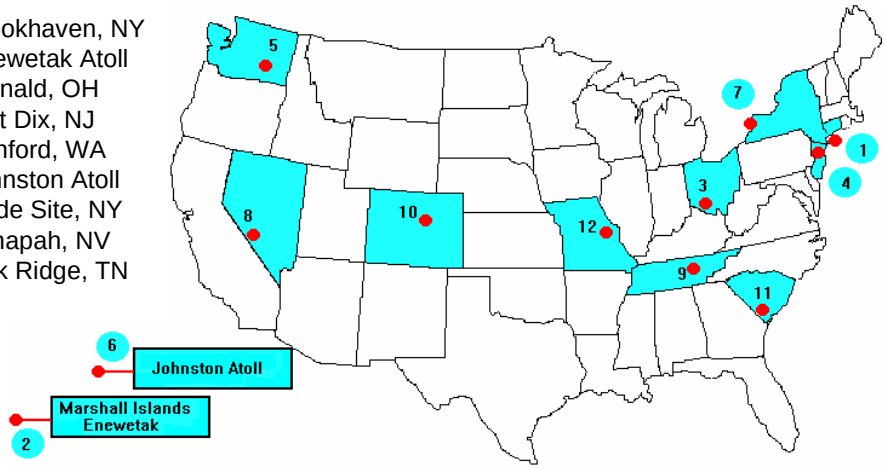
Case Studies

1. Brookhaven, NY
2. Enewetak Atoll
3. Fernald, OH
4. Fort Dix, NJ
5. Hanford, WA
6. Johnston Atoll
7. Linde Site, NY
8. Tonapah, NV
9. Oak Ridge, TN



10. Rocky Flats, CO
11. Savannah River Site, SC
12. Weldon Spring, MO

Case studies:

Brookhaven National Laboratory, New York

Enewetak Atoll, Marshall Islands

Fernald Environmental Management Project, Ohio

Fort Dix, New Jersey

Hanford Site, Washington

Johnston Atoll

Linde Site, New York

Nevada Test Site and Associated Ranges, Tonapah, Nevada

Oak Ridge, Tennessee

Rocky Flats, Colorado

Savannah River Site, South Carolina

Weldon Spring Site, Missouri

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Radiological Cleanup Standards: Variation and Influence

Different Regulatory Authorities

↓

Different Regulatory Standards

↓

Different Methodologies for Calculating Cleanup Goals

Cleanup authorities:

CERCLA

RCRA

NRC decommissioning criteria

DOE orders

State radiation control regulations

Etc.

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Case Studies

- Differences in cleanup levels due to differences in
  - Regulatory authority
  - Radiation standards / ARARs
  - Health assessment approaches
  - Land uses / exposure scenarios
  - Computer codes
  - Input parameters
  - Physical settings
  - State and community acceptance
  - Types of cleanup goals reported

No associated notes

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Major U.S. Radiation Standards

Regulation	Agency	Standard / Numerical limit
General public	NRC	100 millirem/year
Uranium mill tailings	EPA; NRC	Ra-226/228: 5/15 pCi/g (surface/subsurface) Rn-222: 20 pCi/m^2-sec (outdoors) Rn-220/222: 0.02 working levels (indoors) U234/238: 30 pCi/L
High-level waste operations	NRC	100 millirem/year
Spent fuel, high-level and TRU waste	EPA	All pathways: 15 millirem/year Groundwater: 4 millirem/year
Low-level waste	NRC	25 millirem/year (75 mrem/year to thyroid)

Not a comprehensive list – most major radiation standards.

There are more standards than those listed in the table. For example, the Uranium Mill Tailings regulations have other standards such as 0.5 pCi per liter limit for radon at the perimeter of a disposal site (40 CFR 192.02 (b) (2)) and a 20 micro-roentgen per hour over background standard for occupied or habitable buildings.

There is a compliance criteria in the Drinking Water Standards for beta radiation – 50 picocuries per liter [40 CFR 191.03(a)]

The complete set of standards under the Uranium Fuel Cycle are 25 millirem/year (whole body), 25 millirem/year (per other critical organ) and 75 millirem/year (thyroid) [40 CFR 191.03 (a)].

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Major U.S. Radiation Standards (continued)

Regulation	Agency	Standard / Numerical limit
Drinking water	EPA	Ra-226/228: 5 pCi / L U: 30 µg/L Gross alpha: 15 pCi / L Beta/photon (man-made): 4 millirem/yr
Uranium fuel cycle	EPA	25 millirem/yr
Superfund (CERCLA) cleanup	EPA	1 in 10,000 to 1 in 1,000,000 (10^{-4}-10^{-6}) increased lifetime risk of getting cancer
Decommissioning	NRC	25 millirem/yr (up to 100 mrem/yr)
Occupational standards	OSHA	5,000 millirem/yr (all workers)
Occupational standards	NRC	5,000 millirem/yr (radiation workers)
NESHAPS air pollutants	EPA	10 millirem/year to nearest offsite receptor

Most states have radiological drinking water standards which are potential ARARs.

Most existing standards are expressed in dose.

In addition, existing standards, CERCLA site decision makers must also consider risk.

There are more standards than those listed in the table. For example, the Uranium Mill Tailings regulations have other standards such as 0.5 pCi per liter limit for radon at the perimeter of a disposal site (40 CFR 192.02 (b) (2)) and a 20 micro-roentgen per hour over background standard for occupied or habitable buildings.

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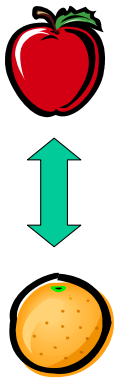
Terminology Used at Case Study Sites



- Preliminary Remediation Goals
- Soil Screening Levels
- ***Action Levels***
- Risk-Based Concentrations
- **Cleanup Standards**
- ALARA Goal Levels
- Soil Cleanup Criteria
- Derived Concentration Guideline Levels
- **Final Remediation Levels**
- Remedial Goal Options
- Allowable Residual Soil Concentrations
- Guideline Concentrations
- **Release Criteria**

No associated notes

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Example Case Study: Oak Ridge – Melton Valley Watershed

Radionuclide	10^{-4} Risk (pCi/g)	25 mrem/yr Dose (pCi/g)	Limiting criteria for selection
Cesium-137	14	40	Risk
Cobalt-60	7.4	8.4	Risk
Curium-244	2300	950	Dose
Europium-154	11	18	Risk
Lead-210	450	270	Dose
Radium-226	5 *(Alternative*	*-Concentration)*	ARAR
Strontium-90	1200	3400	Risk
Uranium-233	5100	5500	Risk
Uranium-234	6500	6000	Dose
Uranium-235	81	170	Risk
Uranium-238	310	850	Risk

Oak Ridge Case Study (see Table 18 in *Determining Cleanup Levels at Radioactively-Contaminated Sites,* 2002). Oak Ridge calculated soil concentrations for the Melton Valley Record of Decision using input parameters for risk calculations and dose calculations that were as equivalent as possible. The risk levels represent a 10^{-4} incremental lifetime cancer risk. The more conservative value for each radionuclide was then selected as the cleanup level. The cleanup level for radium was based on an ARAR value.

•Neither approach necessarily leads to more conservative cleanup values than the other.

Rocky Flats Case Study (see Tables 20-22 in *Determining Cleanup Levels at Radioactively-Contaminated Sites,* 2002). In 1996, dose calculations (15 mrem/year) were compared to risk calculations (1×10^{-4}). Re-calculations in 2002 again compared dosed-based values (25 mrem) to risk-based values (1×10^{-5}).

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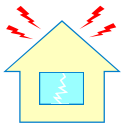
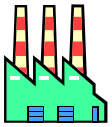
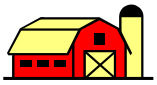
Case Studies

Selection of Exposure Scenarios







	Resident	Rancher	Farmer	Park/open space user	Commercial industrial	Fish wildlife service	Ecotourist	Homesteader	Subsurface
Brookhaven	●				●				
Enewetak	●		●						●
Fernald			●	●					
Fort Dix	●				●				
Hanford	●								
Johnston Atoll	●					●	●	●	
Linde Site					●				
Nevada	●	●	●		●				
Oak Ridge					●				
Savannah River					●				
Rocky Flats	●			●	●	●			
Weldon Spring	●		●	●		●			

See Table 4 in *Determining Cleanup Goals at Radioactively-Contaminated Sites* (RAD-2, 2002).

Download at www.itrcweb.org

Selecting appropriate current and future land use and exposure scenarios is a critical step in calculating cleanup levels:

•Residential/agricultural scenario ➔ usually allow unrestricted use of a site

•Other scenarios ➔ institutional controls required

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Case Studies – Pathway Contributions from Calculated Residential Cleanup Levels for Plutonium

Site:	Clean Slate (1997)	Hanford (1997)	Johnston Atoll (2000)	Rocky Flats (1996)	Rocky Flats (2002)
Cleanup Level (pCi/g)	**200**	**35**	**2.1- 210**	**252**	**116**
Basis	100 mrem/yr dose to various receptors	15 mrem/yr dose to resident	10^{-6} to 10^{-4} risk to wildlife researcher	15 mrem/yr dose to resident	10^{-5} risk to refuge worker
Pathway:					
-inhalation	**30%**	**30%**	**5%**	**93%**	**49%**
-soil ingestion	**31%**	**23%**	**87%**	**6%**	**50%**
-water	**0%**	**0%**	**0%**	**0%**	**0%**
-plant ingestion	**29%**	**45%**	**0%**	**1%**	**0%**
-other	**10%**	**1%**	**8%**	**0%**	**1%**

Updated from Table 27 in *Determining Cleanup Goals at Radioactively-Contaminated Sites* (RAD-2, 2002).

1. Variation in cleanup levels from site to site.
2. Variation in pathway contributions from site to site.

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Basis for Calculated Plutonium Soil Concentrations

Site:	*Exposure Scenario*	*Concentration (pCi/g)*	*Date (Basis / Authority)*
Enewetak	Residential Agricultural Food-gathering Subsurface	40 80 160 400	1973 (NEPA, Atomic Energy Act (AEA))
Fernald	Park user (on site) Resident farmer (off site)	77 9	1995 (CERCLA)
Fort Dix	-Not described- Resident	8 26	1992 (EPA guidance) 2000 (state statute)
Hanford Reservation	Rural resident Commercial/Industrial	34 245	1995 (draft proposed rule, Part 196)
Johnston Atoll	-ALARA- Fish & wildlife researcher Resident EcoTourist Homesteader	13.5 2.1–210 1.9–190 38–3800 0.32–32	1989 (EPA guidance) 2000 (CERCLA)

See Table 25 in *Determining Cleanup Goals at Radioactively-Contaminated Sites* (RAD-2, 2002). The slide shows the basis for calculating soil cleanup concentrations for Plutonium at various sites. Note that most of the sites are dictated by CERCLA authority.

Shows:

•which exposure scenarios were assessed

•how cleanup levels at the same site vary depending on land use assumptions.

•residential scenario is 3-7 times more conservative than industrial/commercial

<u>Enewetak</u>

•Nuclear weapons test site in Marshal Islands (1946-58)

•Defense Nuclear Agency report (1981)

<u>Ft. Dix</u>

•USAF site on an US Army base

•BOMARC missile accident (1960)

•DOE ROD: 4 mrem/year → 8 pCi/g (1992)

•NJ Standards: 15 mrem/year → 26 pCi/g (2000)

<u>Hanford</u>

•Washington Department of Health

•PRGS: 15 mrem/year; calculated using RESRAD version 5.7

<u>Fernald</u>

•Cleanup levels developed by DOE/USEPA/Ohio EPA

•10^{-6} risk (on site receptors); 10^{-5} risk (off site receptors)

<u>Johnston Atoll</u> – 13.5 pCi/g established as cleanup level by EPA Region 9 since it had previously been achieved and thus was considered ALARA; equivalent to 7.1 x 10^{-6} residential risk; 2000 values recommended in Defense Threat Reduction Agency report which used RESRAD version 5.82 to calculate.

27

Fernald – Waste Pit 5 Excavation

View to the east of sludges exposed in the Waste Pit 5 excavation with the On-Site Disposal Facility in the background (2004).

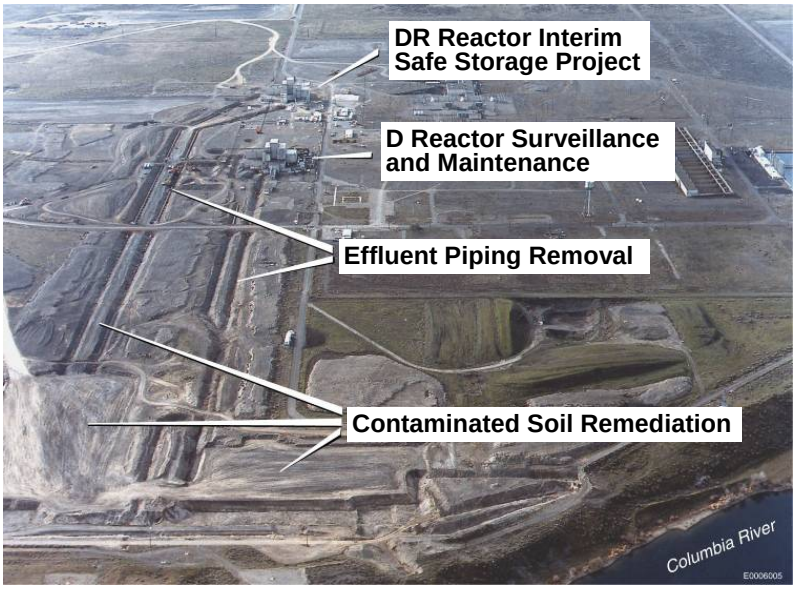
28

Fernald – On-Site Disposal Facility

View to the west from the top of the On-Site Disposal Facility (2004).

29

Hanford – D Reactor / DR Reactor Remediation



No associated notes

30

Johnston Island – Thor Missile

The Thor missile used in the Bluegill Prime nuclear device test in 1962. This missile and test device caught fire and was destroyed on the launch pad.

31

Basis for Calculated Plutonium Soil Concentrations (continued)

Site:	*Exposure Scenario*	*Concentration (pCi/g)*	*Date (Basis / Authority)*
Lawrence Livermore NL	Resident Industrial/Office worker	2.5 10	1998 (Soil Screening Level (SSL) guidance)
Rocky Flats (Cleanup Agreement)	Office worker Open space user Resident	1088 1429 252	1996 (draft proposed rule, Part 196)
Rocky Flats (PRGs)	Resident Office worker Open space user	2.5 10 17.5	2000 (CERCLA)
Rocky Flats (Cleanup Agreement)	Wildlife refuge worker Rural resident Office worker Open space user	116 28 81 114	2002 (CERCLA)

See Table 25 in *Determining Cleanup Goals at Radioactively-Contaminated Sites* (RAD-2, 2002).

Lawrence Livermore National Laboratory (CA)

•Big Trees Park (offsite);

•EPA Region 9 soil screening levels (1998);

•not intended as cleanup levels

Rocky Flats – DOE/USEPA/ CDPHE:

1996 – Action levels based on a 15-mrem annual dose (withdrawn draft Part 196); used RESRAD version 5.61

2000 – PRGs are 10^{-6} risk

2002 – Refuge worker and resident action levels are derived from probabilistic risk calculations (10^{-5} risk using the 95th percentile of risk distribution); Wildlife refuge worker action level set at 50 pCi/g – well below the calculated value; office worker and open space user action levels correspond to point estimates of a 10^{-5} risk. These risk-based action levels are more conservative than RESRAD-calculated 25-mrem/year dose levels, derived to satisfy ARARs.

32

Rocky Flats - Colorado

One of DOE's closure sites; view to the northwest.

33

Rocky Flats – Remediation at 903 Pad

Removal of plutonium-contaminated soil occurred under large, moveable tent structures.

34

Rocky Flats – Building Decontamination & Decommissioning

Some of the decontamination and decommissioning work at Rocky Flats.

35

Conclusions from ITRC Case Studies

- Determining cleanup levels and selecting remedies can involve complex and emotional issues; each cleanup action should be evaluated on its own merits
- Cleanup numbers used at one site should not be used to justify similar cleanup numbers at another site
- The risk assessment and risk management processes should be distinct and separate

See Section 6 in *Determining Cleanup Goals at Radioactively-Contaminated Sites* (RAD-2, 2002).

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Conclusions from ITRC Case Studies (continued)

- Consistency within given risk assessment approaches is a worthwhile and achievable goal
- Land use assumptions have major consequences for cleanup levels, cleanup costs, and long-term stewardship
- Training would help lend consistency to assessment of risks and selection of remedies during cleanup

See Section 6 in *Determining Cleanup Goals at Radioactively-Contaminated Sites* (RAD-2, 2002).

Many DOE sites are being regulated by CERCLA authority (Joint Policy EPA and DOE, 1995)*, which requires the sites to cleanup on the basis of acceptable risk range calculated by methods defined by EPA. The next two modules elaborate on the details of CERCLA requirements and the EPA guidance issued to assist at various stages of cleanup at radioactively contaminated sites.

**Policy on Decommissioning DOE Facilities under CERCLA*, May 22, 1995.

37

Radiation Site Cleanup: CERCLA Requirements and Guidance

MODULE 2: Overview of CERCLA Requirements

By the end of the module, the participants should be able to:

- Become acquainted with the overall CERCLA process
- Understand the CERCLA remedy selection process

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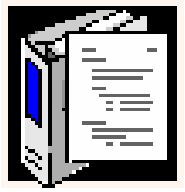
EPA Addresses Site Cleanup Under Several Laws, Programs

- 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



The Environmental Protection Agency (EPA) Office of Superfund Remediation and Technology Innovation (OSRTI) is responsible for implementing a key U.S. law regulating cleanup: the Comprehensive Environmental Response, Compensation and Liability Act, CERCLA, nicknamed "Superfund."

Congress established the Superfund Program in 1980 to locate, investigate, and clean up the worst sites nationwide.

A comprehensive regulation known as the National Oil and Hazardous Substances Pollution Contingency Plan or NCP contains the guidelines and procedures for implementing the Superfund program. The purpose of the Superfund program is to protect human health and the environment over the long term from releases or potential releases of hazardous substances from abandoned or uncontrolled hazardous waste sites.

The NPL is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation.

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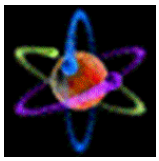
Purpose

- Provide brief description of CERCLA process with a focus on radionuclides
  - Some information on listing Superfund sites
  - Overview of CERCLA remedy selection
- To establish background for module 3

Radioactive contamination at a site is addressed in the same manner as other hazardous substances at CERCLA sites and is subject to the same remedy selection requirements



The focus of this module is on how radiation is addressed by the Superfund program, consistent with CERCLA and the NCP.

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CERCLA Programs

- Removal actions – emergencies and other short-term response actions
  - Emergencies
  - Time-critical actions
  - Non-time-critical actions

- Remedial – long-term response actions

CERCLA distinguishes between short-term and long-term responses to threats posed by hazardous substances. Short-term responses, also referred to as removal actions, address immediate threats to public health and the environment. EPA differentiates among three types of removal response alternatives according to the urgency of the situation. EPA defines the following types of removal actions:

1. Classic Emergencies. Those actions where the release requires that on-site activities be initiated within minutes or hours of the determination that a removal action is appropriate.
2. Time-Critical Actions. Those actions where, based on an evaluation of the site, EPA determines that less than six months is available before site activities must be initiated.
3. Non-Time-Critical Actions. Those actions where, based on an evaluation of the site, EPA determines that more than six months is available before on-site activities must begin. Non-time critical removals are usually conducted by the Remedial Program (see below)

Long-term responses, also called remedial actions, involve complex and highly contaminated sites that often require several years to fully study the problem, develop a permanent remedy, and cleanup the hazardous waste. These are the sites that most people think of when they hear about the Superfund program, which is known more formally as the Remedial Program.

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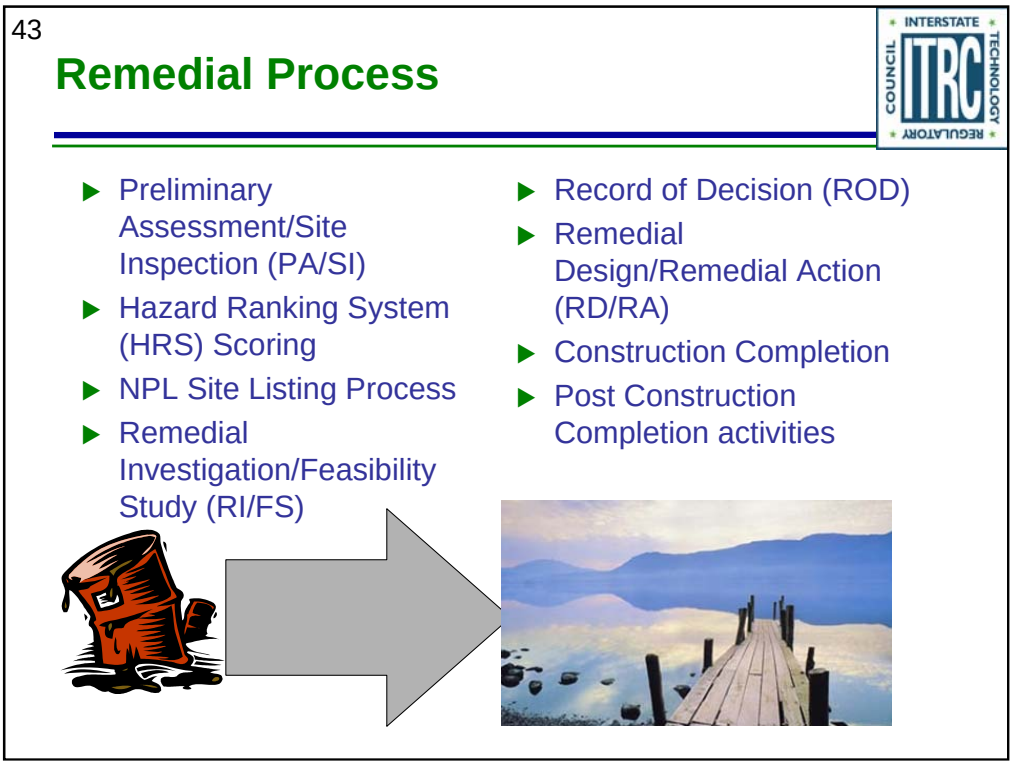
Nuclear Metals Inc. - Massachusetts

Part of removal action (this is capping and fencing of a holding basin) at this NPL site. Subsequent remedial actions will also be conducted at the site.

42

Abandoned Uranium Mines Project – Navajo Nation

Part of a removal action of radioactively contaminated structures at this non-NPL site.



The Superfund cleanup process begins with site discovery or notification to EPA of possible releases of hazardous substances. Sites are discovered by various parties, including citizens, State agencies, and EPA Regional offices. Once discovered, sites are entered into the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS), EPA's computerized inventory of potential hazardous substance release sites. EPA then evaluates the potential for a release of hazardous substances from the site through these steps in the Superfund cleanup process:

• Preliminary Assessment/Site Inspection (PA/SI) — investigations of site conditions

• HRS Scoring — screening mechanism used to place sites on the National Priorities List (NPL)

• NPL Site Listing Process — list of the most serious sites identified for possible Federal long-term cleanup

• Remedial Investigation/Feasibility Study (RI/FS) — determines the nature and extent of contamination

• Record of Decision (ROD) — selects and explains which cleanup alternatives will be used at sites cleaned up under CERCLA remedial authority.

• Remedial Design/Remedial Action (RD/RA) — preparation and implementation of plans and specifications for applying site remedies

• Construction Completion — identifies completion of construction necessary for cleanup

• Post Construction Completion — ensures that Superfund response actions provide for the long-term protection of human health and the environment. Included here are Long-Term Response Actions (LTRA), Operation and Maintenance, Institutional Controls, Five-Year Reviews, Remedy Optimization, and NPL Deletion

EPA uses these steps to determine and implement the appropriate response to threats posed by releases of hazardous substances.

EPA has a website with links to further information about the Superfund cleanup process at:
http://www.epa.gov/superfund/action/process/sfproces.htm

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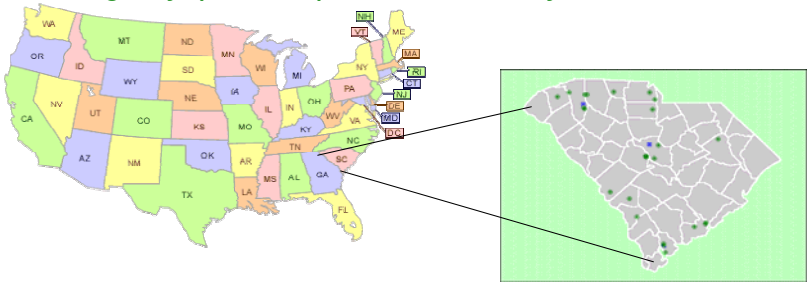
Listing Sites on Superfund's NPL

- NPL sites may be listed through
  - HRS scoring
  - State designated release as top priority
  - Agency for Toxic Substances and Disease Registry (ATSDR) health advisory



NPL site map (represented above) is at:
http://www.epa.gov/superfund/sites/npl/npl.htm

Section 105 of CERCLA required EPA to establish criteria for determining priorities among releases or threatened releases of hazardous substances for the purpose of taking remedial action. In response, EPA developed a model to systematically rank hazardous waste sites with regard to their relative threat to human health and the environment. This model, the Hazard Ranking System (HRS), was adopted by EPA in 1982 and later revised in December 1990 (see 55 Federal Register 51532 (12/14/90) as codified in 40 CFR Part 300, Appendix A). Uniform application of the HRS by the EPA, States, Tribes, and their contractors enables EPA to identify and prioritize hazardous waste sites that warrant further investigation.

Section 105(d) provides that "Any person who is, or may be affected by a release or threatened release of a hazardous substance or pollutant or contaminant, may petition the President to conduct a preliminary assessment (PA) of the hazards to public health and the environment . . . If the [Administrator] has not previously conducted a preliminary assessment of such release, the [Administrator] shall, within 12 months after receipt of any such petition, complete such assessment or provide an explanation of why an assessment is not appropriate." 42 U.S.C. § 9605(d). Executive Order 12580 (January 29, 1987) delegates this responsibility to the EPA Administrator (unless the facility is under the jurisdiction, custody or control of a federal agency). If the PA indicates that a release or threatened release may pose a threat to human health or the environment, Section 105(d) also requires the Administrator to evaluate the release or threatened release under the HRS to determine if such release or threatened release should be placed on the NPL. Moreover, EPA included these obligations and the process for carrying them out in the NCP (See 40 CFR 300.420(b)(5) and 300.425).

In addition to the HRS, there are two other mechanisms for listing a release on the NPL. The first is by having a State designate a release as the State's top priority (42 USC 9605(a)(8)(B)). The second mechanism allows listing a release if the Agency for Toxic Substances and Disease Registry (ATSDR) has issued a health advisory recommending dissociation of individuals from the release, and EPA determines the release poses a significant threat to public health and that it will be more cost-effective to respond using remedial rather than removal authorities (40 CFR 300.425(c)(3)).

To find NPL sites in your state, go to the map on the following webpage and click on your state: http://www.epa.gov/superfund/sites/npl/npl.htm.

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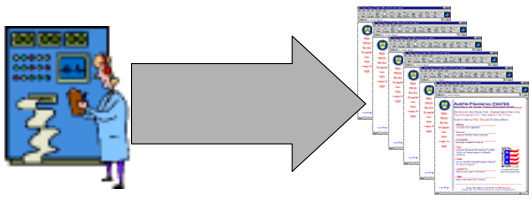
NPL Listings - HRS Scoring

- Sites evaluated for listing by HRS scoring
- Sites scoring over 28.5 may be placed on NPL
- HRS scoring sensitive to
  - Targets (i.e., affected populations with greater weight given to actual rather than potential exposures)
  - Observed releases (especially over HRS benchmarks)
  - Bioaccumulation in the food chain or sensitive environments



EPA has developed a multi-phase evaluation process to determine and implement the appropriate responses to releases of hazardous substances to the environment. This site assessment process includes four primary screening activities: Pre-CERCLIS Screening, Preliminary Assessment (PA), Site Inspection (SI), and HRS scoring.

At the conclusion of each phase of the site assessment process, generally EPA applies the HRS model to derive a preliminary site score. The site score is used to determine whether further investigation is necessary or whether the site should receive a "No Further Remedial Action Planned" (NFRAP) designation. A NFRAP designation means that further remedial assessment under the Federal Superfund program is not planned, although Superfund removal assessment and/or action may still take place. Aside from the NFRAP designation, sites are subject to several other outcomes. Sites that present an immediate danger to human health and the environment may be referred to the removal program for emergency response. Sites can also be referred to the State or to other programs for further consideration (i.e., deferral to RCRA Corrective Action Authorities).

After completion of the site evaluation, compiled data are used to score a site using scoresheets based on the HRS model. Under the HRS, numerical values are assigned to a site based on various aspects of the site and its immediate surroundings through the evaluation of four pathways: (1) groundwater migration; (2) surface water migration; (3) soil exposure; and (4) air migration. The scoring system for each pathway is based on a number of individual factors grouped into three factor categories: (1) likelihood of release/exposure; (2) waste characteristics; and (3) targets (i.e., affected populations, etc.). In general, sites generating a score of 28.50 or greater can be proposed to the NPL.

For more information on HRS scoring, take EPA's internet based Hazard Ranking System training course at: http://www.epa.gov/superfund/resources/hrstrain/hrstrain.htm

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NPL Listings - HRS Benchmarks

- HRS benchmarks include
  - Cancer risk
  - Reference concentrations for non carcinogens
  - Maximum Contaminant Levels (MCLs) under the Safe Drinking Water Act (SDWA)
  - Uranium Mill Tailings Radiation Control Act (UMTRCA) soil standards
- HRS benchmarks are not based on millirem/year

The HRS score for mixed waste sites reflects the combined potential hazards posed by both the radioactive and other hazardous substances.

Under CERCLA, EPA is required to give high priority for listing on the NPL sites that have led to closing drinking water wells or contamination of principal drinking water wells. To respond to this mandate, EPA added health-based benchmarks, including MCLs, to the groundwater pathway for the HRS. The HRS includes cancer and noncancer risk based benchmarks, and other standards including soil standards in 40 CFR Part 192. For further discussion of the HRS benchmarks, see pages 51547 to 51549, and benchmarks for radionuclides on page 51667, of the HRS final rule (55 FR 51532, December 14, 1990).

Exceeding a benchmark is very important for HRS scoring purposes. If people are exposed to concentrations three times background and above a health-based benchmark, then the affected population is multiplied by ten to assign points toward site score. For example:

• samples from a private drinking water well serving six people indicates concentrations of toluene at levels three times background and above the MCL. That well provides 60 points. However,

• if the sample indicated levels three times above background but below the MCL, then the well provides 6 points.

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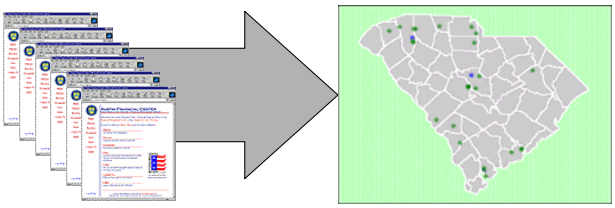
NPL Listings – Proposed/Final

1. Sites are proposed for NPL in Federal register
2. Public comments are received
3. EPA policy is to receive Governor's concurrence letter prior to finalizing listing
4. EPA listings on NPL are subject to legal challenges



To propose a site based on its HRS score, a detailed and defensible HRS Scoring Package must be prepared. This phase of data collection brings together all of the information collected during the site assessment process. The final product of this phase is the proposed HRS score. A public docket for a proposed site is maintained by EPA regional offices and includes the HRS Package and supporting references. Once a site is proposed to the NPL in the Federal Register, all interested parties (e.g., NRC licensees and other companies, the affected community, state and local governments, and other federal agencies including NRC) may submit comments on that proposal, and whether the score at proposal is appropriate. As with other rulemakings, EPA considers these comments and addresses specific issues related to the HRS scoring of the site when determining whether to finalize a site listing. Of course, federal agencies (e.g., NRC) may also be asked their views through the OMB review process (See E.O. 12866). The HRS score may change due to public comments. Those sites that are not proposed or finalized to the NPL are often candidates for cleanup activities by states, Tribes or local governments.

In addition, since 1995, EPA has had a policy of not listing sites on the NPL without a letter of concurrence on behalf of the Governor of the state in which the site is located. If the state government considers EPA's listing of any site to pose a detriment to the orderly cleanup of the site or to be inappropriate for any other reason, EPA expects that the Governor will not concur. Under this policy EPA did propose one site against governor opposition, but has not finalized the site.

If EPA finalizes the site listing, non-federal parties, including NRC licensees, may file a petition with the D.C. Circuit of the US Court of Appeals challenging EPA's action.

EPA has a website with links to further information about the NPL listing process at:
http://www.epa.gov/superfund/sites/npl/npl_hrs.htm

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CERCLA Decision-making

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

The EPA officials with primary responsibility for directing response efforts and coordinating all activities at the scene of a discharge or release include On-Scene Coordinators (OSCs) and Remedial Project Managers (RPMs).

The OSC is the Federal official designated to coordinate and direct Superfund removal actions. The RPM is the official designated to manage remedial and /or other response actions at NPL sites.

To ensure the effectiveness of response actions, both OSCs and RPMs are responsible for coordinating with EPA Regional staff (e.g., Regional Administrator, Office of Regional Counsel), EPA Headquarters staff, and other Federal, State, and local agencies.

CERCLA cleanup decisions need to be consistent with the statute (CERCLA) and its implementing regulation the NCP.

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Nine CERCLA Remedy Selection Criteria

- Two threshold criteria (both must be met)
  1. Protect human health and the environment
  2. Comply 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)

The NCP sets forth nine criteria for selecting Superfund remedial actions. These evaluation criteria are the standards by which all remedial alternatives are assessed and are the basis of the remedy selection process. The criteria can be separated into three levels: threshold, balancing, and modifying. The first two criteria are known as **"threshold"** criteria. While every Superfund site is unique (whereby cleanups must be tailored to the specific needs of each site), the threshold requirements must be met at every site:

1. CERCLA requires that all remedial actions at Superfund sites must be protective of human health and the environment. Therefore, cleanup actions are developed with a strong preference for remedies that are highly reliable, provide long-term protection, and provide treatment of the principle threat to permanently and significantly reduce the volume, toxicity, or mobility of the contamination.

2. CERCLA specifically requires Superfund actions to attain or waive the standards and requirements found in other state and federal environmental laws and regulations. This mandate is known as compliance with "applicable or relevant and appropriate requirements" or ARARs.

   Site cleanups should protect groundwaters that are current or potential sources of drinking water to drinking water standards whenever practicable. The standards include federal Maximum Contaminant Levels (MCL) promulgated under the Safe Drinking Water Act and more stringent state drinking water standards.

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Nine CERCLA Remedy Selection Criteria (continued)

- 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

Five of the criteria are known as the **"balancing"** criteria. These criteria are factors with which tradeoffs between alternatives are assessed so that the best option will be chosen, given site-specific data and conditions.

The criteria balance long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; and cost.

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Nine CERCLA Remedy Selection Criteria (continued)

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

The final two criteria are called **"modifying"** criteria: new information or comments from the state or the community may modify the preferred remedial action alternative or cause another alternative to be considered. EPA believes the "modifying" criteria concerning new information or comments from the community is important. In many instances, communities are able to provide valuable information on local history, citizen involvement, and site conditions.

To ensure community participation, EPA specifically requires the party conducting the cleanup to conduct a number of activities. For example, EPA conducts community interviews and develops a community relations plan to help EPA determine the community's level of interest in the site, major concerns and issues. EPA creates an information repository and administrative record for every site and makes it available to community members. EPA also develops a document specifically for the community which explains the various clean up options being considered, holds at least one meeting to explain the options and invites the community to submit comments on them. EPA also make funding available to eligible community members so they may obtain technical assistance to better understand the often complex issues associated with cleaning up a Superfund site. By identifying the public's concerns, EPA is able to fashion a response that more effectively addresses the community's need.

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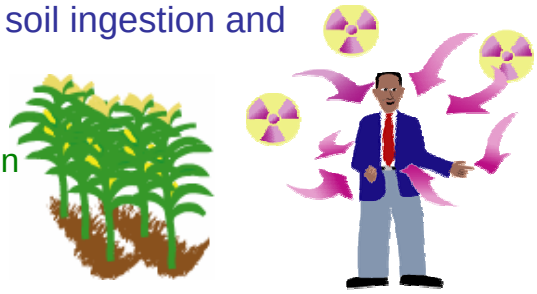
Radioactive Contamination

- All radionuclides are carcinogens
  - Uranium also has noncancer toxicity effects
- Radionuclides are addressed in the same framework as chemical contamination
- Radioactive contamination exposure pathways include (in addition to soil ingestion and dust inhalation)
  - Gamma radiation
  - Produce consumption



At Superfund radiation sites, EPA generally evaluates potential human health risks based on the radiotoxicity (i.e., the adverse health effects caused by ionizing radiation), rather than on the chemical toxicity, of each radionuclide present. Uranium, in soluble form, is a kidney toxin at mass concentrations slightly above background levels, and is the only radionuclide for which the chemical toxicity has been identified to be comparable to or greater than the radiotoxicity, and for which a reference dose (RfD) has been established to evaluate chemical toxicity. For radioisotopes of uranium, both effects (radiogenic cancer risk and chemical toxicity) should be considered.

Risks from radionuclide exposures should be estimated in a manner analogous to that used for chemical contaminants. That is, the estimates of intakes by inhalation and ingestion and the external exposure over the period of exposure estimated for the land use (e.g., 30 years residential, 25 years commercial/industrial) from the exposure assessment should be coupled with the appropriate slope factors for each radionuclide and exposure pathway. Only excess cancer risk should be considered for most radionuclides (except for uranium). The total incremental lifetime cancer risk attributed to radiation exposure is estimated as the sum of the risks from all radionuclides in all exposure pathways.

Excess cancer risk from both radionuclides and chemical carcinogens should be summed to provide an estimate of the combined risk presented by all carcinogenic contaminants. An exception would be cases in which a person reasonably cannot be exposed to both chemical and radiological carcinogens. Similarly, the chemical toxicity from uranium should be combined with that of other site-related contaminants.

Radiation risk assessments include most of the same exposures that are assessed for exposure to chemicals (such as soil ingestion, fugitive dust inhalation, and drinking water). Risk assessments for radiation also include exposure to external gamma radiation, radon, and consumption of produce (e.g., fruit, vegetables, milk, and beef) grown at the site. Radiation risk assessments do not assess dermal exposure since this exposure pathway is considered insignificant in relation to other exposures that are assessed.

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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

Compliance with the requirements of other laws, ARARs, is often the determining factor in establishing cleanup levels at CERCLA sites. However, where ARARs are not available or are not sufficiently protective, EPA generally sets site-specific remediation levels for: 1) carcinogens at a level that represents an upper-bound lifetime cancer risk to an individual of between 10^{-4} to 10^{-6}; and for 2) non-carcinogens such that the cumulative risks from exposure will not result in adverse effects to human populations (including sensitive sub-populations) that may be exposed during a lifetime or part of a lifetime, incorporating an adequate margin of safety. Such is the case for the non-carcinogenic risks of uranium. The specified cleanup levels account for exposures from all potential pathways, and through all media (e.g., soil, ground water, surface water, sediment, air, structures, and biota).

The 10^{-4} to 10^{-6} cancer risk range can be interpreted to mean that a highly exposed individual may have a 1 in 10,000 to 1 in 1 million increased chance of developing cancer because of exposure to a site-related carcinogen. 10^{-6} is used as the point of departure for determining cleanup goals. Preliminary Remediation Goals (PRGs) are established at

1×10^{-6}. PRGs are identified early in the CERCLA process. PRGs are modified as needed at the end of the Remedial Investigation (RI) or during the Feasibility Study (FS) based on site-specific information from the baseline risk assessment. Ultimately the remediation levels are selected through the use of the nine NCP remedy selection criteria.

To assess the potential for cumulative noncarcinogenic effects posed by multiple contaminants, EPA has developed a hazard index (HI). The HI is derived by adding the noncancer risks for site contaminants with the same target organ or mechanism of toxicity. When the HI exceeds 1.0, there may be concern for adverse health effects due to exposure to multiple contaminants.

While cleanups will generally achieve a risk level within 10^{-4} to 10^{-6} for carcinogenic risk, risks of greater than 1×10^{-4} may be acceptable under appropriate circumstances. CERCLA guidance states that "the upper boundary of the risk range is not a discrete line at 1×10^{-4}, although EPA generally uses 1×10^{-4} in making risk management decisions. A specific risk estimate around 10^{-4} may be considered acceptable if justified based on site-specific conditions" (see page 4 of the *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* April 22, 1991 and page 5 of the *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination* August 22, 1997).

"To be considered" materials (TBCs) are criteria, advisories, guidance, and proposed standards that are not legally enforceable but contain information that would be helpful in carrying out, or in determining the level of protectiveness of, selected remedies. Because TBCs are not ARARs, their identification and use are not mandatory.

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CERCLA Cleanup Levels Are NOT Based On

- 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). These documents include
  - DOE orders, NRC guidance (e.g., NUREGs), ICRP guidance, NCRP guidance, ANSI/HPS guidance, EPA/DHS PAGs, and Federal guidance

The Nuclear Regulatory Commission (NRC) Radiological Criteria for License Termination (decommissioning rule) was issued on July 21, 1997. The NRC decommissioning rule set an allowable cleanup level of 25 millirem per year (mrem/yr) effective dose equivalent (EDE) as the primary standard with exemptions allowing dose limits up to 100 mrem/yr EDE. EPA has determined that the dose limits in this rule should generally not be used to establish preliminary remediation goals (PRG) under CERCLA.

Guidance that provides for cleanups outside the risk range (greater than 10^{-4}), is not protective under CERCLA and should not be used to establish cleanup levels.

Site decision-makers should not use dose-based guidance rather than the CERCLA risk range in developing cleanup levels. This is because, for several reasons, using dose-based guidance would result in unnecessary inconsistency regarding how radiological and non-radiological (chemical) contaminants are addressed at CERCLA sites. These reasons include: (1) estimates of risk from a given dose estimate may vary by an order of magnitude or more for a particular radionuclide, and (2) dose-based guidance generally begins an analysis for determining a site-specific cleanup level at a minimally acceptable risk level rather than the 10^{-6} point of departure set forth in the NCP.

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Key Thoughts to Remember

- Radionuclides are also addressed with other hazardous substances under general EPA CERCLA guidelines
- CERCLA remedy selection based primarily on risk and ARARs

The next module would elaborate on details of guidance and tools issued by EPA to assist during the various stages of cleanup at radioactively contaminated sites.

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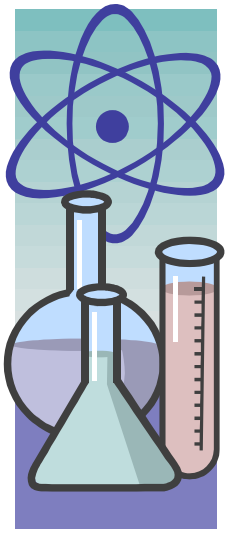
Questions and Answers



No associated notes.

57

Radiation Site Cleanup: CERCLA Requirements and Guidance

MODULE 3: CERCLA Radiation Guidance and Tools

By the end of the module, the participants should be able to:

•Be able to use CERCLA guidance appropriately at a site to address radioactive contamination

•The guidance documents and calculating tools discussed in this module are part of a continuing effort by EPA's Office of Superfund Remediation and Technology Innovation (OSRTI) to provide updated guidance for addressing radioactively contaminated sites consistent with EPA's guidance for addressing chemically contaminated sites, except to account for the technical differences between radionuclides and chemicals.

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Purpose

- Provide overview of all current EPA CERCLA guidance and tools (OSWER Directives) that specifically address radionuclides
  - Help participants understand which guidance or tool they should consult to facilitate compliance with CERCLA and the NCP
  - Provide information on key points in guidance and tools

Training is needed since EPA has issued since 1997 numerous new CERCLA guidance and tools for radionuclides

This module will provide a brief overview of guidance documents that were developed to address policy issues (such as interpretation of particular ARARs) and electronic tools for addressing radioactively contaminated sites.

EPA conducts CERCLA response actions consistent with the statue and the NCP. EPA has developed numerous guidance/policies to aid the Region in implementing the program on a site-specific basis.

The guidance documents discussed in this module are part of a continuing effort by EPA's Office of Superfund Remediation and Technology Innovation (OSRTI) to provide updated guidance for addressing radioactively contaminated sites consistent with our guidance for addressing chemically contaminated sites, except to account for the technical differences between radionuclides and chemicals. This effort is intended to facilitate compliance with the NCP at radioactively contaminated sites while incorporating the improvements to the Superfund program that have been implemented through Administrative Reforms.

Cleanup levels may vary at different sites, or different portions of the same site, for many reasons including the guidance documents and potential ARARs that were available at the time the cleanup decision was made.

In general, if a new requirement is promulgated after the ROD is signed, and the requirement is determined to be an ARAR, the remedy should be examined in light of the new requirement (at the 5-year review or earlier) to ensure that the remedy is still protective. If the remedy is still protective, it would not have to be modified, even though it does not meet the new requirement.

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Guidance: CERCLA Cleanup

- *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

This memorandum provides clarifying guidance for establishing protective cleanup levels for radioactive contamination at CERCLA sites.

In particular, this memo clarifies that:

1. Cleanups of radionuclides are governed by the risk range (generally 10^{-4} to 10^{-6}) for all carcinogens established in the NCP when ARARs are not available or are not sufficiently protective. It includes determination that dose limits in the Nuclear Regulatory Commission's (NRC) decommissioning rule (e.g., 25/100 mrem/yr) at 10 CFR Part 20 Subpart E, should generally not be used to establish cleanup levels under CERCLA.

2. Response actions for contaminated groundwater at radiation sites must attain (or waive as appropriate) Maximum Contaminant Levels (MCL) promulgated under the Safe Drinking Water Act as ARARs when groundwaters are potential or current sources of drinking water. MCLs should generally be attained throughout the plume (i.e., in the aquifer). In making decisions on groundwater protection, consult *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Groundwater at CERCLA Sites* (OSWER Directive 9355.7-04), October 1996, which may be found on the Internet at

   http://www.epa.gov/superfund/resources/gwguide/index.htm

2. Land uses that will be available following completion of a response action are determined as part of the remedy selection process and consider the reasonably anticipated land use or uses along with other factors. In developing land use assumptions, consult the guidance provided in the memorandum entitled *Land Use in the CERCLA Remedy Selection Process* (OSWER Directive 9355.7-04), May 25, 1995, which may be found on the Internet at http://www.epa.gov/superfund/resources/landuse.pdf

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Common Rad ARARs

- Radium and thorium (40 CFR Part 192 (UMTRCA))
  - 5 pCi/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^2-s of radon-222

40 CFR 192.12(a)(1), 192.32(b)(2)(i), and 192.41(c): 5 picocuries per gram (pCi/g) in excess of background of radium-226 or -228 as a protective health-based level for the cleanup of the top 15 centimeters of soil. This ARAR is also often used for thorium-230 and -232.

40 CFR 192.12(b)(1): radon-220 and -222 decay product concentration, including background, not to exceed 0.02 working levels (WL).

40 CFR 192.02(b), 61.192, 61.222(a), and 61.252: average release rate of 20 pCi per square meter per second of radon-222.

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Common Rad ARARs (continued)

- NRC Low Level Waste (10 CFR Part 61 (AEA))
  - 25 mrem/yr whole body, 75 mrem/yr to the thyroid, and 25 mrem/yr to any critical organ other than the thyroid
    - This is different dose methodology than 25, 100 mrem/yr NRC decommissioning standard
- State water quality standards

10 CFR 61.41: NRC Low Level Waste disposal standards for allowable exposures to the public of 25 mrem/yr to the whole body, 75 mrem/yr to the thyroid, and 25 mrem/yr to any critical organ other than the thyroid.

Most states have issued Water Quality Standards for surface water that address radionuclides. The federal government has also issued effluent standards (40 CFR 440.30 to 440.34) for uranium, radium, and vanadium mining. The only radionuclide federal water quality criteria are for “general farmstead uses,” which are strontium-90 at 10 pCi/l, radium-226 at 3 pCi/l, and 1,000 pCi/l gross alpha activity for other radionuclides.

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Common Rad ARARs (continued)

- Federal MCLs (40 CFR Part 141 (SDWA))
  - 5 pCi/l of radium-226 and -228 combined
  - 4 mrem/yr from beta particles and photon emitters to total body or any internal organ
  - 15 pCi/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 of uranium-234 and -238 combined
- State MCLs if more stringent than federal

40 CFR 141.66: Federal MCLs drinking water standards that address radionuclides. Most states have their own drinking water standards which, if more stringent than federal MCLs, are potential ARARs.

40 CFR 192 Table 1 to Subpart A: groundwater standard at uranium mill tailing sites.

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Guidance: UMTRCA Soil ARAR

- *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, not 15 pCi/g, in subsurface
  - 15 pCi/g is “finding tool” for UMTRCA sites where subsurface contamination is high,
  - and was expected to achieve 5 pCi/g or less, therefore
  - 15 pCi/g is “relevant and appropriate” at CERCLA sites only when it will achieve 5 pCi/g or less

This memorandum provides guidance regarding the circumstances under which the subsurface soil cleanup criteria in 40 CFR Part 192 promulgated under the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) should be considered an ARAR for radium or thorium in developing a response action under CERCLA.

For uranium mill tailing sites, EPA has established 5 picocuries per gram (pCi/g) of radium as a protective health-based level for the cleanup of the top 15 centimeters of soil, and 15 pCi/g of radium as a “finding tool” for locating and remediating discrete deposits of high activity tailings.

Since thorium decays into radium, these regulations for radium under 40 CFR Part 192.12 have often been used as ARARs at Superfund sites for thorium contaminated soil.

This memo provides guidance regarding when 5 pCi/g of radium or thorium is an ARAR or otherwise recommended cleanup level for any 15 centimeters of subsurface radium or thorium contaminated soil other than the first 15 centimeters.

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Welsbach/General Gas Mantle – New Jersey

One of the CERCLA NPL sites using the UMTRCA soil standards as an ARAR to establish remedial goals.

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Guidance: NRC Criterion 6(6)

- *Remediation Goals for Radioactively Contaminated CERCLA Sites Using the Benchmark Dose Cleanup Criteria in 10 CFR Part 40 Appendix A, I, Criterion 6(6)* (4/11/00) OSWER Directive 9200.4-35P
- Guidance on radium, thorium, and uranium cleanup levels in soil and buildings
- "Benchmark dose" estimated using 5 pCi/g of radium (UMTRCA soil standard as ARAR both in the surface and the subsurface)
- "Compliance dose" from all radionuclides (except radon) combined (soil and buildings) less than or equal to benchmark dose

This memorandum provides guidance regarding the circumstances under which the "benchmark dose" criteria in the NRC standard under 10 CFR 40 Appendix A, I, Criterion 6(6) should be considered a potential ARAR in developing a response action under CERCLA for sites with radium-226, radium-228, thorium-230, thorium-232, uranium-234, and/or uranium-238 as contaminants of concern.

Because of the interrelationship between the standards under 40 CFR Part 192 and those under Criterion 6(6), this memorandum should be used in conjunction with the memorandum entitled *Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites* (OSWER Directive 9200.4-25, February 12, 1998).

Criterion 6(6) requires that an estimate be made of the level of radiation, called a "benchmark dose," that an individual would receive after that site has been cleaned up to the radium soil levels under 40 CFR Part 192.12.

The mrem/yr level of the benchmark dose then becomes the maximum level of radiation, the "compliance dose," that an individual may be exposed to from all radionuclides, except radon, in both the soil and buildings at the site.

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NRC Criterion 6(6) (continued)

- 6(6) potential ARAR only if UMTRCA radium 5/15 pCi/g standards also ARARs
- For 6(6) to set cleanup levels under CERCLA, then:
  - Benchmark dose < 15 mrem/yr, and
  - Compliance concentrations must be protective (10^{-4} to 10^{-6})
- Dose and risk assessments conducted using EPA methods (e.g., exposure parameters and land use assumptions)

The Criterion 6(6) rule is a supplement to the radium standards of 40 CFR Part 192, to address other site-related radionuclides. Therefore, when the 5 pCi/g and 15 pCi/g standards under EPA's soil cleanup rule under UMTRCA are not relevant and appropriate requirements (RAR) for either radium-226 and/or radium-228, the Criterion 6(6) rule is generally not appropriate. In addition, when supplemental standards in 40 CFR Part 192, Subpart C are used instead of EPA's UMTRCA 5/15 pCi/g soil standards as RARs, then the Criterion 6(6) rule is generally not appropriate.

If a site-specific dose assessment indicates that the radium benchmark dose will be above 15 mrem/yr EDE (the dose limit that EPA generally considers minimally acceptable under CERCLA) then the NRC rule should generally not be used to establish cleanup levels at that CERCLA site. In addition to the dose assessments that are required to show compliance with Criterion 6(6) as a RAR, a site-specific risk assessment must generally be conducted to confirm that the residual levels allowed to meet the compliance dose evaluation, are sufficiently protective (e.g., generally meets the 10^{-4} to 10^{-6} risk range, and a HI less than 1) to be used as cleanup levels under CERCLA.

When the Criterion 6(6) rule is considered a RAR, then dose assessments that are conducted to develop the benchmark dose for a site and show compliance of remediation goals for soil and structures with the benchmark dose (the "compliance dose"), should be conducted on a site-specific basis, using Superfund reasonably maximum exposure (RME) scenario parameters that are consistent with the reasonably anticipated land use of the site.

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Risk-based Cleanup Levels for Radioactive Contamination

- Radiation cleanup levels expressed as risk levels, **not** mrem
- Superfund uses "slope factors" in Health Effects Assessment Summary Tables (HEAST) instead of dose conversation 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

Cleanup levels for radioactive contamination at CERCLA sites are generally expressed in terms of risk levels, rather than mrem, as a unit of measure. CERCLA guidance recommends the use of slope factors in the EPA Health Effects Assessment Summary Tables (HEAST) when estimating cancer risk from radioactive contaminants. Some of you may be more familiar with estimating millirem using dose conversion factors, rather than basing cleanup on site-specific risk assessment.

HEAST uses updated health effects information from International Commission on Radiological Protection (ICRP) Publication 72 for determining health effects from internal (ingestion and inhalation) exposure. Most federal and state programs primarily use either information from ICRP 26 and 30 or ICRP 2.

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Guidance: Risk Assessment Q&A

- *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)
  - Direct exposure rate may supplement sampling

This fact sheet provides an overview of current EPA guidance for risk assessment and related topics for radioactively contaminated CERCLA sites. It provides answers to several commonly asked questions regarding risk assessments at radioactively contaminated CERCLA sites.

This fact sheet provides further guidance that

1. Dose assessments should only be conducted under CERCLA where necessary to demonstrate ARAR compliance (e.g., 40 CFR 61 Subparts H and I, and 10 CFR 61.41).

2. Dose recommendations, including 15 mrem/yr, in guidance should not be used as TBCs to establish cleanup levels. Cleanup levels not based on an ARAR should be based on the carcinogenic risk range (generally 10^{-4} to 10^{-6}, with 10^{-6} as the point of departure and 1×10^{-6} used for PRGs) and expressed in terms of risk ($\# \times 10^{-\#}$)

3. Estimates of risk based on direct exposure rate measurements of penetrating radiation may be useful:

   – during early site assessment efforts to communicate the relative risk posed by elevated areas

   – as a real-time method for indicating that remedial objectives are being met during the conduct of the response action

   – when the source of radiation is highly irregular (inside a contaminated structure) instead of being an infinite plane, which is the standard assumption used during risk assessments

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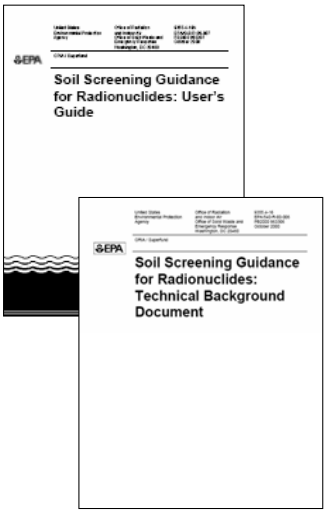
Guidance: Rad SSG

- 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 x 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



These guidance documents provide information on soil screening for radionuclides when setting remediation goals at CERCLA sites with radioactive contamination.

The guidance is intended to be used early in the CERCLA process to screen out areas of sites, exposure pathways, or radionuclides of concern from further consideration, assuming certain conditions are present, or to determine that further study is warranted at a site. Its use may significantly reduce the time it takes to complete soil investigations and cleanup actions at some sites, as well as improve the consistency of these actions across the nation. The guidance was written to enhance the efficiency of remedial investigation/feasibility study (RI/FS) work at NPL sites but may be utilized at corrective action sites or voluntary cleanup sites where site conditions are similar.

The guidance includes procedures for conducting site surveys.

The *Technical Background Document* (TBD) contains an evaluation of five detailed soil to groundwater vadose zone models (HYDRUS, MULTIMED-DP, FECTUZ, CHAIN, CHAIN 2D) for more complete site conditions. The report *Simulating Radionuclide Fate and Transport in the Unsaturated Zone: Evaluation and Sensitivity Analyses of Select Computer Models* provides a more detailed technical analysis of these five models. This report supports the information provided in the TSD on determining the general applicability of the models to subsurface conditions, and an assessment of each model's potential applicability to the soil screening process. The report is available:

as one file

http://www.epa.gov/ada/download/reports/600R02082/600R02082-full.pdf

or broken into sections

http://www.epa.gov/ada/download/reports/600R02082/600R02082.pdf

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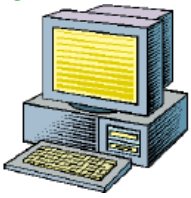
Guidance: Rad PRG Calculator

- Calculator to establish PRGs, when:
  - ARAR is either not available or sufficiently protective (e.g., 25 mrem/yr or more)
- Electronic equations (risk and leaching to groundwater) also are on Internet
  - $1x10^{-6}$ and MCLs (leaching from soil)
  - Accounts for technical differences of radiation (e.g., gamma, plant uptake)



This electronic calculator provides information on establishing Preliminary Remediation Goals (PRGs) for radionuclides at CERCLA sites with radioactive contamination.

PRGs for CERCLA are:

1. Concentrations based on ARARs
2. Risk-based concentrations, derived from equations combining standardized exposure assumptions with EPA toxicity data.

The electronic calculator presents risk-based standardized exposure parameters and equations that should be used for calculating radionuclide PRGs for residential, commercial/industrial, and agricultural land use exposures, tap water and fish ingestion exposures. The calculator also presents PRGs to protect groundwater which are determined by calculating the concentration of radioactively contamination leaching from soil to groundwater that will meet MCLs or risk-based concentrations.

The calculator may be found at: http://epa-prgs.ornl.gov/radionuclides/

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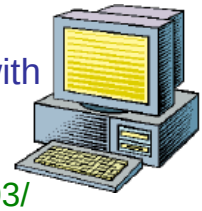
Guidance: Rad PRG Calculator (continued)

- Seven scenarios/land uses available
  1. Residential
  2. Agricultural
  3. Indoor workers
  4. Outdoor workers
  5. Fish ingestion
  6. Tap water
  7. Soil to groundwater
- 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_072903/



To determine PRGs for the chemical toxicity of uranium and other chemicals, go to the Soil Screening Guidance (for chemicals) webpage http://www.epa.gov/superfund/resources/soil/index.htm.

Completion of Radionuclide PRG calculator has led to the development of Internet-based training on the use of this tool, entitled “Radiation Risk/Dose Assessment: Updates and Tools.” This training is being developed collaboratively by EPA with the Radionuclides Team of the Interstate Technology and Regulatory Council (ITRC), a state-led coalition working together with industry and stakeholders to achieve regulatory acceptance of environmental technologies. This training clarifies the variations between the dose approach used at some sites and EPA’s risk-based approach. The focus is EPA’s new radiation risk assessment tools, which can facilitate better decision making for accelerated cleanups.

This training has been archived. You will be able to listen to the presentation with questions and answers from the original briefing. The course takes 2 hours and 15 minutes.

http://www.clu-in.org/conf/itrc/rads_072903/.

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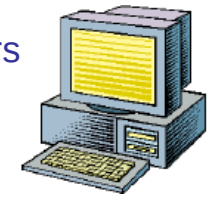
Guidance: ARAR Dose Calculator

- Calculator to establish Dose Compliance Concentrations (DCC) for single dose limit ARARs requiring a dose assessment
- Six scenarios/land uses available
  1. Residential
  2. Agricultural
  3. Indoor workers
  4. Outdoor workers
  5. Fish ingestion
  6. Tap water
- Equations similar to those used for PRG calculator, except dose conversion factors used instead of slope factors



An approach similar to that taken for calculation of PRGs may also be used to calculate soil "**compliance concentrations**" based upon various methods of dose calculation.

A set of simple equations for target dose rate (e.g., either critical organ dose or single limits), radionuclide dose conversion factor (DCF), and intake/exposure parameters will be presented for use in calculating soil cleanup concentrations. These equations will be identical to those in the PRG for Radionuclides, except that the target dose rate (ARAR based) will be substituted for the target cancer risk (1×10^{-6}), the period of exposure is one year to indicate year of peak dose, and a DCF will be used in place of the slope factor.

Please note that the target dose rate is generally a cleanup level when a dose standard is an ARAR (other than single dose limits greater than 15 mrem/yr such as NRC's 25/100 mrem/yr decommissioning rule), while the target risk number of 10^{-6} is a preliminary number.

Site decision-makers should choose the DCFs (ICRP 2, 30, or 60) required by the ARAR. Note that this calculator does not address ICRP 2. If DCFs are not specified within the regulation (for example, specifically required for compliance within the Code of Federal Regulations for a federal standard that is being complied with as an ARAR), then site decision-makers should generally use ICRP 2 DCFs for whole body and critical organ dose limits (e.g., 25/75/25 and 25/75 mrem/yr dose limits), and generally use ICRP 60 DCFs for single limit standards (e.g., 10 mrem/yr).

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Guidance: Uranium in Groundwater

- *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 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 alpha MCLs

This memorandum addresses the use of uranium standards in 40 CFR Part 141 (MCL drinking water standards issued under the Safe Drinking Water Act) and 40 CFR Part 192 (groundwater standards issued under UMTRCA) when setting remediation goals for groundwaters that are current or potential sources of drinking water at CERCLA sites.

Attachments to this guidance include:

1. A list of radionuclides that are addressed by the 15 pCi/l gross alpha MCL

2. A list of radionuclide concentrations calculated using the 4 mrem/yr beta particles and photon emitters MCL standard.

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Remediating Groundwater Example: Pump and Treat, Hanford, Washington

There are a number of strategies for addressing radioactively contaminated groundwater, including: pump and treat, monitored natural attenuation, hydraulic containment, slurry walls, and permeable reactive barrier walls.

One of the CERCLA federal facility sites using a pump and treat system. Pump and treat systems at Hanford have been used to remove a variety of contaminants including hexavalent chromium, strontium-90, carbon tetrachloride, nitrate, technetium-99, and uranium.

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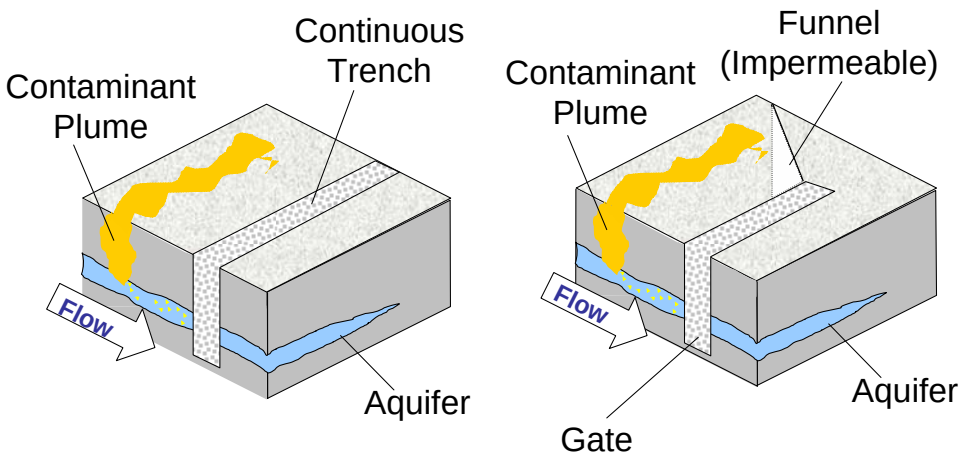
Remediating Groundwater Example: 2 Types of Permeable Reactive Barriers



Diagrams of the two most common construction techniques for Permeable Reactive Barriers (PRBs) to address groundwater contamination:

1. continuous PRBs; and
2. funnel and gate PRBs.

Continuous PRBs function by transecting the plume flow path and are placed by trenching and backfilling with a reactive material. The reactive material allows the groundwater to pass under its natural hydraulic gradient. Funnel and gate PRBs consist of impermeable walls of interlocking sheet pilings or slurry walls that make up the "funnel", and direct the contaminated region of groundwater to a "gate(s)" containing the permeable zone of reactive material. The gate is either left in place or configured as a cassette that is replaced after the material loses its reactivity

ITRC has a team focused on PRBs issues. ITRC is offering an internet training on PRBs developed by the PRB team. You may find information about this training on the ITRC's website: www.itrcweb.org.

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Guidance: HQ Rad Consultation

- *Headquarters Consultation for Radioactively Contaminated Sites* (7/26/00) OSWER Directive 9200.1-33P
- Guidance to EPA Regions to consult with Headquarters when considering
  - On-site waste management of rad waste
  - Potential national precedent setting issue
- Sites covered by consultation guide
  - Fund- and PRP-lead CERCLA sites
  - Available for other CERCLA and RCRA Corrective Action sites

This memorandum requests that EPA regional offices consult with EPA Headquarters on CERCLA response decisions involving (1) onsite management (e.g., capping of material in place, building disposal cells) of radioactive materials, or (2) when there is a potential national precedent setting issue related to a radioactive substance, pollutant, or contaminant.

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Guidance: NRC Evaluations

- *Evaluation of Facilities Currently or Previously Licensed NRC sites under CERCLA* (2/17/00) OSWER Directive 9272.0-15P
- Guidance on how to determine if an NRC cleanup meets CERCLA levels of protection
- Protectiveness evaluations of NRC decommissioning
  - EPA determination made using site-specific information, **not** dose limits in NRC rule
- Evaluating need for CERCLA response action – NPL listing and removal

This memorandum provides interim guidance to clarify EPA's role under CERCLA at facilities previously or currently licensed by NRC. This guidance is in response to EPA increasingly receiving requests to either 1) conduct response actions under CERCLA at previously or currently licensed facilities, or 2) make a determination if a past or proposed NRC decommissioning would meet CERCLA cleanup levels.

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MOU with NRC

- *Memorandum of Understanding Between the Environmental Protection Agency and the Nuclear Regulatory Commission: Consultation and Finality on Decommissioning and Decontamination of Contaminated Sites* (signed by EPA 9/30/02 and NRC 10/9/02) OSWER Directive 9295.8-06
- Provides framework for EPA CERCLA coordination with NRC during NRC site decommissioning
  - When NRC will request EPA review
- Does **not** affect how CERCLA cleanup levels are selected

EPA and the Nuclear Regulatory Commission (NRC) developed this Memorandum of Understanding (MOU) to identify the interactions of the two agencies for only the decommissioning and decontamination of NRC-licensed sites and the ways in which those responsibilities will be exercised. Except for Section VI, which addresses corrective action under the Resource Conservation and Recovery Act (RCRA), this MOU is limited to the coordination between EPA, when acting under its CERCLA authority, and NRC, when a facility licensed by the NRC is undergoing decommissioning, or when a facility has completed decommissioning, and the NRC has terminated its license. EPA believes that implementation of the MOU between the two agencies will ensure that future confusion about dual regulation does not occur regarding the cleanup and reuse of NRC-licensed sites.

Under the MOU, NRC will contact EPA when:

1. groundwater contamination is present in excess of MCLs
2. NRC is considering under 10 CFR 20.1403, a restricted release
3. NRC is considering under 10 CFR 20.1404, a site-specific allowable dose of greater than 25 mrem/yr (EPA estimates corresponds to a cancer risk of approximately 5 x 10-4), or
4. radioactive soil contamination in excess concentrations in Table 1 of the MOU (these concentrations correlate to a cancer risk of 1 x 10-4, a noncancer Hazard Index (HI) of 1, or a common federal soil Applicable or Relevant and Appropriate Requirement (ARAR)).

This MOU was distributed through a transmittal memo entitled “Distribution of Memorandum of Understanding between EPA and the Nuclear Regulatory Commission” (OSWER 9295.8-06a, October 9, 2002). This transmittal note includes guidance to the EPA Regions to facilitate Regional compliance with the MOU and to clarify that the MOU does not affect CERCLA actions that do not involve NRC (e.g., the MOU does not establish cleanup levels for CERCLA sites).

On November 5, 2002, NRC hosted a public meeting concerning implementation of the MOU.

Letters between EPA and NRC concerning site-specific implementation of the MOU are posted on the EPA’s website.

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Booklet: Common Radionuclides

- *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

The information in this booklet is intended to help the general public understand more about the various common radionuclides found at Superfund sites. The booklet contains 12 radionuclide-specific fact sheets that answer questions such as: How can a person be exposed to the radionuclide?, How can it affect human health?, How does it enter and leave the body?, What levels of exposure result in harmful effects?, and What recommendations has EPA made to protect human health from the radionuclide?

In addition to the radionuclide fact sheets, the booklet contains a "Introduction and Glossary" section with general information about cleanup levels for radioactively contaminated Superfund sites and for an explanation of some of the words that appear in each of the radionuclide fact sheets.

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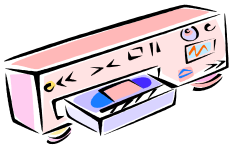
Video: Radiation Risk Assessment

- *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



This 19 minute video describes the Superfund risk assessment process for radioactive contamination: what it is, how it works, and most importantly, how members of the public can be involved.

This radiation video is similar to a previous EPA chemical risk video entitled "Superfund Risk Assessment and How you can Help, an Overview" that runs 11 minutes and was issued in 1999. This radiation video provides a similar approach to explaining risk assessment for radionuclides as was done for chemicals, while touching on some of the important differences. This 1999 chemical videotape may be found at the following website:

http://www.epa.gov/superfund/resources/radiation/radvideo.htm

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Key Thoughts to Remember

- Understand which EPA CERCLA guidance and tools to consult to address your site's circumstances
- New guidance and tools may be issued in the future. Continue to check
  - Superfund Radiation Webpage http://www.epa.gov/superfund/resources/radiation/index.htm
  - Superfund Remedy Decisions webpage http://www.epa.gov/superfund/action/guidance/remedy/index.htm

For large DOE sites with radioactive contamination, it is generally assumed that there would be some residual contamination left on the site after cleanup and closure of the site. It would also have some of the ongoing remedies in place that would require long-term monitoring and surveillance. The ITRC Radionuclides Team has studied the long-term management challenges of technology and implementation for the States with closure sites. The following module would elaborate on this effort and other guidance developed by the ITRC Radionuclides team to better manage these sites in the long term.

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Radiation Site Cleanup: CERCLA Requirements and Guidance

MODULE 4: Beyond Cleanup: Challenges of Long-Term Management of Radiation Sites

In addition to CERCLA cleanup and its associated guidance, this course introduces the participants to long term stewardship (LTS) challenges related to the large radioactively contaminated sites. This understanding of LTS issues are integral to the cleanup process and decisions made at the radiation sites. This module focuses on the challenges of long term stewardship of large radiation sites, identified by the ITRC Radionuclides Team in their document “Issues of Long-Term Stewardship: State Regulators’ Perspective” (RAD-3, July 2004)

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Purpose

- To elaborate on state regulators' perspective on challenges of long-term management of the radiation sites
  - *Issues of Long-Term Stewardship: State Regulators' Perspectives* (RAD-3, July 2004)

Effective cleanup of sites could benefit from understanding issues of long-term stewardship early in the process. Here Long-Term Stewardship (LTS) is the federally implemented institutions, controls, information, and mechanisms necessary to protect the public and the environment from legacy waste deemed impractical, unsafe, or too costly to remediate to free-release standards. According to US DOE, LTS includes land use controls, maintenance, and information management.

ITRC Radionuclides Team developed a detailed survey and published the survey results in the document titled "Issues of Long-Term Stewardship: State Regulators' Perspectives," published in 2004.

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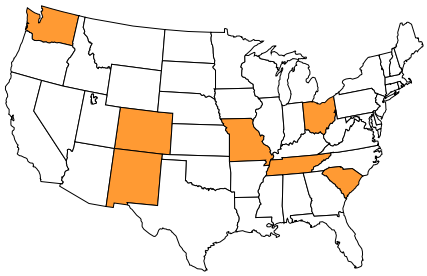
State Regulator Survey

- Focus on state regulators' perspectives on Long-Term Stewardship (LTS) technology needs and implementation challenges
- Targeted participants were regulators from states with major DOE sites and were knowledgeable on LTS issues
- 7 Sections, 165 questions, multiple choice and write-in



Survey Respondents by State
CO, MO, NM, OH, SC, TN, WA

Respondents came from 7 states. With more than one respondent from each of the 7. States contacted but not participating included Idaho and Nevada.

This was a large survey…..165 questions. We had 31 respondents for a greater than 75% response rate.

We emphasized that this was a survey of individuals not states. The views are individual perspectives not State positions.

Web based survey using radio buttons and fill in the blanks.

• LTS – Long-Term Stewardship

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Long-Term Stewardship (LTS) Components in the Survey

- Physical/engineering controls
- Institutional/administrative controls
- Monitoring and maintenance
- Information management systems and repositories
- Periodic review of the remedy

•Physical/Engineering Controls – Implemented to treat or stabilize contamination to physically contain or isolate waste, or to prevent access

•Institutional/Administrative Controls – Control exposure to hazardous substances by establishing governmental controls and providing legal enforcement tools

•Monitoring and Maintenance – Ongoing environmental monitoring to determine the effectiveness of the remedy, improve understanding of the contaminant interactions with the site, and support maintenance of engineered controls to guide decisions on when and how to modify LTS activities.

•Information Management Systems and Repositories - Maintenance of environmental data and other information relevant to the remedy including public communications.

•Periodic review of the remedy, and, if need be, alteration of the remedy.

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Engineering and Institutional Controls

- Need to invest in technology for ensuring better controls for restricted site use
- A comprehensive program is needed to increase awareness of land use/institutional controls
- Successful utilization of land use controls requires use and development of technology
- Awareness is key to effectiveness of land use and institutional controls

No associated notes.

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Monitoring and Maintenance

- Technology is important to addressing the challenges of LTS as technology limitations are affecting the ability of sites to successfully implement LTS
- Monitoring is essential for groundwater and disposal facilities
- Monitoring ecosystems health is important
- Land-use controls require monitoring to ensure their continued effectiveness – important for early detection of system failure

No associated notes.

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Information Management

- Ensuring functional accessibility of data is a high priority
- Successful information management requires the ability to access, update, store, and disseminate data across multiple generations
- Strengthening information systems will improve management of records and information/data for current and future generations

No associated notes.

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Relevant Survey Conclusions: Periodic Review / Communication

- Communication is widely recognized as both a challenge and essential for successful LTS
- LTS success requires active public outreach that is interactive and builds relationships
- Successful implementation of LTS requires strong stakeholder involvement
- Education and guidance on LTS technologies would be beneficial
- Citizens Advisory Boards (CABs) have proven to be effective communication methods for getting local community, tribal, and state values factored into the cleanup decisions

No associated notes.

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Path Forward for ITRC Radionuclides Team

- Build on these findings and work on products in collaboration with federal agencies
- On-going work on finalizing the Decontamination and Decommissioning product
  - Publish document – Fall 2007
  - Internet-based Training – 2008

No associated notes.

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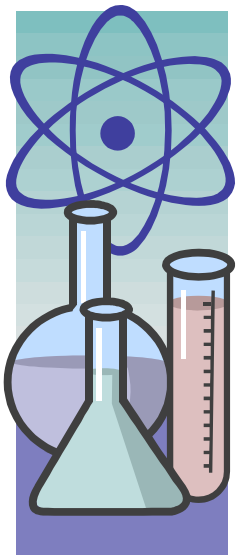
Thank You for Participating

- Links to additional resources
  - http://clu-in.org/conf/itrc/radscleanup/resource.cfm
- 2nd question and answer session

Thank you for participating in ITRC Internet-based training.

To get more information on ITRC – Go to: www.itrcweb.org



Links to additional resources:
http://clu-in.org/conf/itrc/radscleanup/resource.cfm

Your feedback is important – please fill out the form at:
http://clu-in.org/conf/itrc/radscleanup/

The benefits that ITRC offers to state regulators and technology developers, vendors, and consultants include:

✓Helping regulators build their knowledge base and raise their confidence about new environmental technologies

✓Helping regulators save time and money when evaluating environmental technologies

✓Guiding technology developers in the collection of performance data to satisfy the requirements of multiple states

✓Helping technology vendors avoid the time and expense of conducting duplicative and costly demonstrations

✓Providing a reliable network among members of the environmental community to focus on innovative environmental technologies

How you can get involved with ITRC:

✓Join an ITRC Team – with just 10% of your time you can have a positive impact on the regulatory process and acceptance of innovative technologies and approaches

✓Sponsor ITRC's technical team and other activities

✓Be an official state member by appointing a POC (State Point of Contact) to the State Engagement Team

✓Use ITRC products and attend training courses

✓Submit proposals for new technical teams and projects