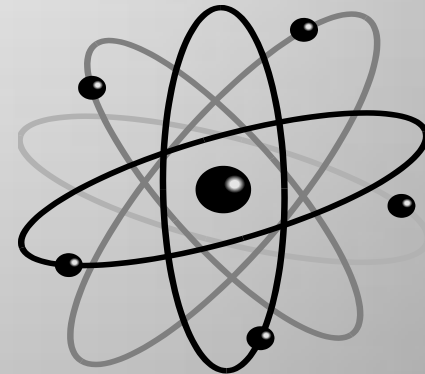


Overview of Radiation Concepts & Regulatory Structure

Radiation Basics, Definitions

Types of Ionizing Radiation

- Radioactive materials will emit both ionizing particles and waves during decay
- Particles
 - Alpha particles
 - Beta particles
 - Neutrons
- Energy waves or “rays”
 - Gamma rays
 - X-rays
- These types of ionizing radiation interact with matter by depositing energy when they are moving



Exposure, Contamination, Dose

Contamination: Contamination results when a radioactive material (a gas, liquid, or solid) is somewhere you don't want it

Exposure: Radiation exposure occurs when the body absorbs radiation from an external source

Dose = measurement of radiation energy deposited in tissue

Units of Measure

Units

Exposure\Dose = Roentgen



- 1 “R” is a relatively large radiation exposure
- Exposure measured in smaller fractions of an “R”
 - milliR (mR) (1/1,000 of R)
 - microR (μ R) (1/1,000,000,000 of R)
- **Typical background exposure rates are 5 to 10 μ R/hr**

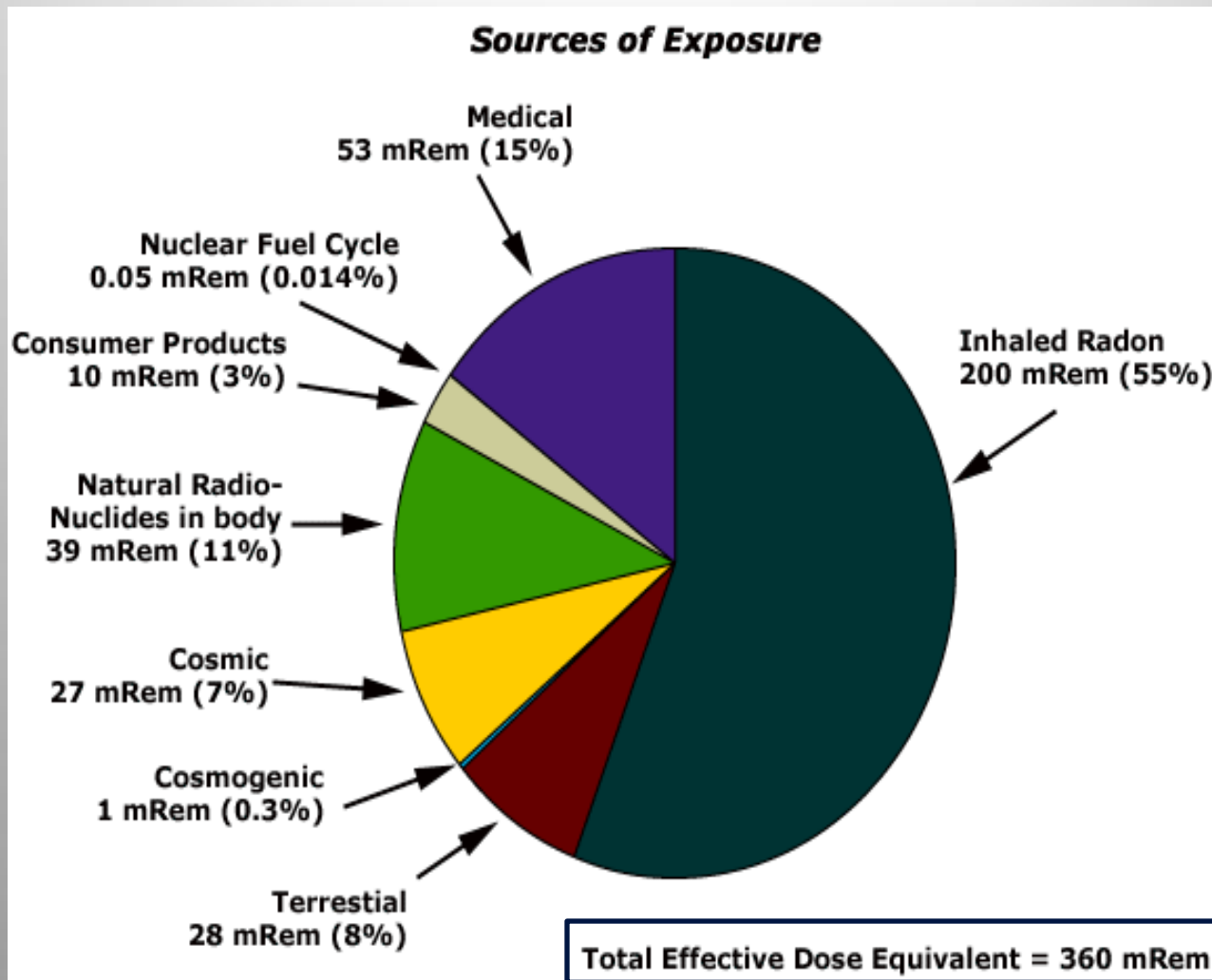
Units of Measure

Units (Cont.)

Radioactivity = Curie (Ci)

- 1 “Ci” of radioactivity is considered a large amount
- Radioactivity measured in smaller fractions of a Curie
 - pico Curie (pCi) (i.e. 1/1,000,000,000,000 of Curie)
- The amount of radioactive material present = amount of radioactivity found in a gram or liter of the substance.....(pCi/g), or (pCi/L)

Sources of Radiation Exposure



Doses in Perspective

Source	Exposure
Average U.S. annual exposure – all sources	360 mR/year
Average U.S. annual exposure – including medical/diagnostic	720 mR/year
Chest X-ray	5-10 mR
CT Scan	1,000 – 2,000 mR
Annual dose limit for radiation workers	5,000 mR/year
Emergency limit (saving major property)	10,000 mR/event
Emergency limit (saving life)	25,000 mR/event
Biological health effects observable (blood changes)	50,000 mR
Lethal radiation dose (50% lethality)	450,000 mR

Exposure Pathways

- How, specifically, does TENORM present an exposure concern?
 - Inhalation, ingestion, direct exposure
- How, specifically, does TENORM present an exposure concern to the general public?
 - Inappropriate disposal (illegal dumping)
 - Recycling of contaminated components
 - Liquid discharges

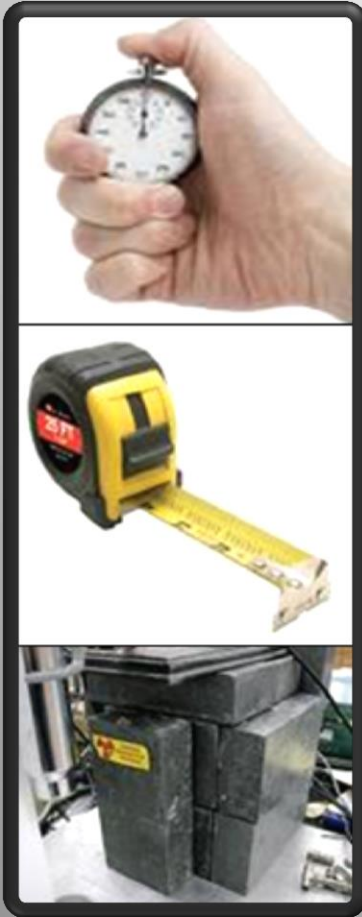


A Regulators' Guide to the
Management of Radioactive
Residuals from Drinking Water
Treatment Technologies



Exposure Pathways

Mitigating External Radiation



- **TIME** – minimize time spent near a source to minimize radiation exposure
- **DISTANCE** – radiation dose rates fall off rapidly with distance; increase the distance between you and a source to minimize radiation exposure
- **SHIELDING** – put something between you and the source to minimize radiation exposure

Exposure Pathways

Mitigating Inhalation, Ingestion, & Exposure



- **Proper and safe disposal** – Modernized landfill design, construction, and operations.....monitoring, reporting, waste screening, daily cover.
- **Training** – Limit exposure pathways by recognizing hazards and avoiding them.
- **Prevent dispersal** – Covered during transport, dust control, etc.

Existing Regulatory Requirements

(ARM 17.50 Subchapters 5-13)

- Landfill Siting
 - *Location criteria and restrictions*
- Waste Group/Class
 - *TENORM is Group II waste = Class II facility*
- Landfill Design and Construction
 - *Must be protective of uppermost aquifer*
 - *Design must be approved by P.E. and DEQ*
 - *Must submit CQA/CQC plans and reports*
- Landfill Operation
 - *Hours, dust control, daily cover, etc...*
- Landfill Monitoring
 - *Ground water sampled at least twice per year*
 - *Certified by professional groundwater scientist*
 - *Air monitoring new for TENORM facilities*

Existing Regulatory Requirements

(ARM 17.50 Subchapters 5-13)

- Storm water control
 - *Must control run-on and run-off from 24-hour, 25-year event*
 - *MPDES permit required for discharge*
 - *Permit requires storm water analysis*
- Leachate Collection and Removal System
 - *Maintain less than one-foot leachate on liner*
 - *Leachate management requirements*
- Financial Assurance and Closure/Post-closure Care
 - *FA funded prior to waste acceptance*
 - *Post-closure monitoring and care requirements*

Conclusions

The goal for the proposed TENORM rules is to protect human health and the environment by:

- Establishing TENORM-specific standards to minimize exposure to humans and the environment:
 - Waste Characterization
 - Waste Acceptance Criteria
 - ✓ Dual waste acceptance criteria
 - Dose exposure limits and concentration limits
 - Waste Screening
 - Additional ground water and air monitoring
 - Spill reporting

Reference Documents

- “Radiation: Facts, Risks, and Realities”, US EPA. EPA-402-K-10-008 April 2012
- “A System’s Guide to the Management of Radioactive Residuals from Drinking Water Treatment Technologies” EPA 816-F-06-012 August 2006
- “Suggested Guidelines for the Disposal of Drinking Water Treatment Wastes Containing Naturally Occurring Radionuclides” EPA July 1990
- “Radionuclides Notice of Data Availability Technical Support Document” EPA March 2000
- “Potential Radiological Doses Associated with the Disposal of Petroleum Industry NORM via Landspreading” Argonne National Laboratory DOE/BC/W-31-109-ENG-38-5 December 1998

