



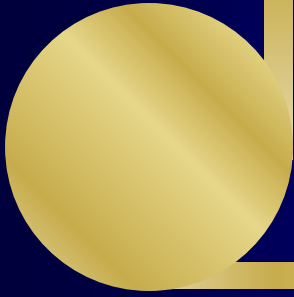
**U.S. NRC**

UNITED STATES NUCLEAR REGULATORY COMMISSION

*Protecting People and the Environment*

**HRTD**  
Human Resources  
Training & Development

# SOURCES OF RADIATION IN OUR ENVIRONMENT



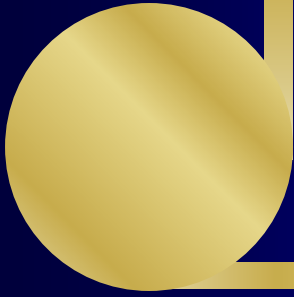
# Background Radiation

Cosmic Rays

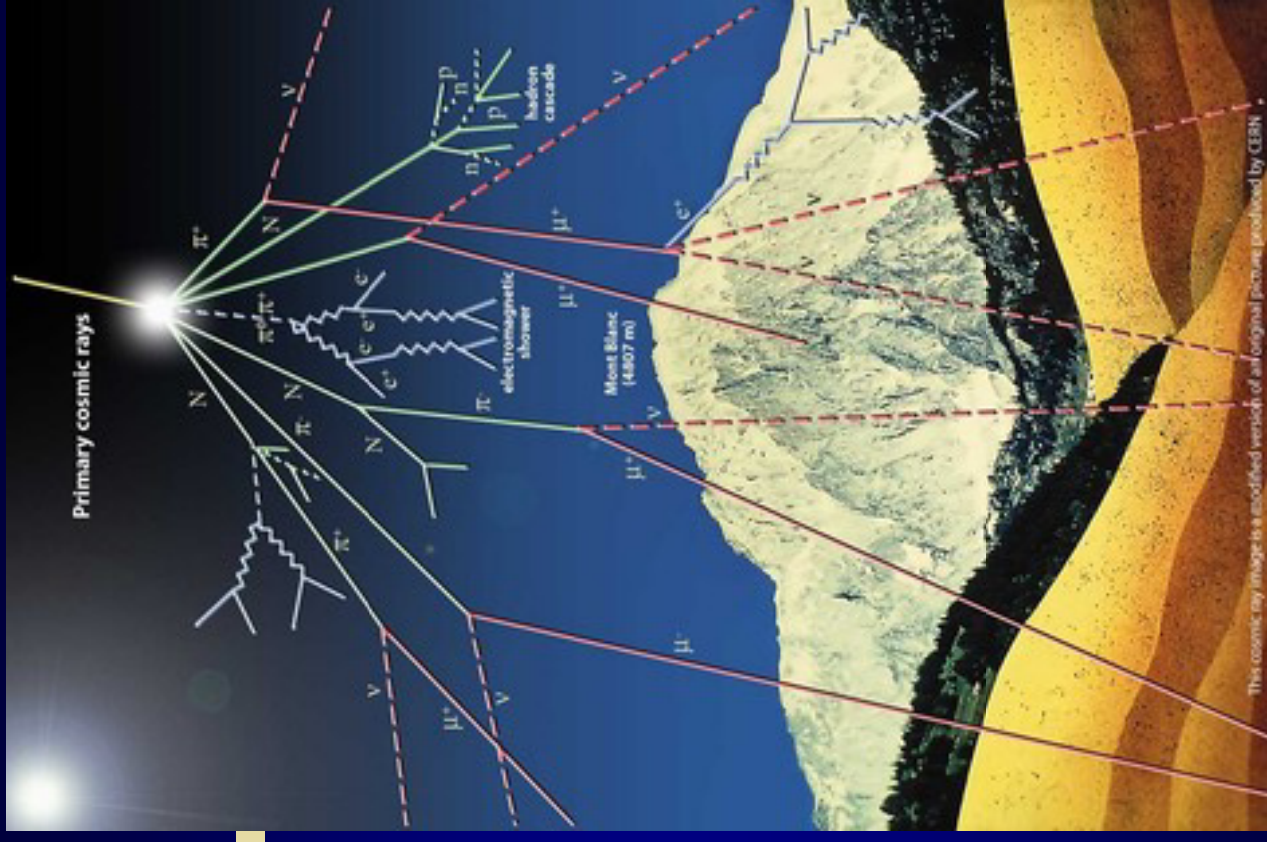
Sources  
In the  
Earth

Sources in  
Your Body

Radon



# Cosmic rays interacting with upper atmosphere



# Cosmic Rays

## Annual Effective Dose

US Average

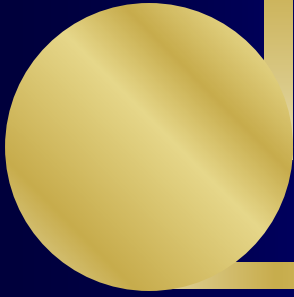
30 mrem/y

Ft. Collins, CO

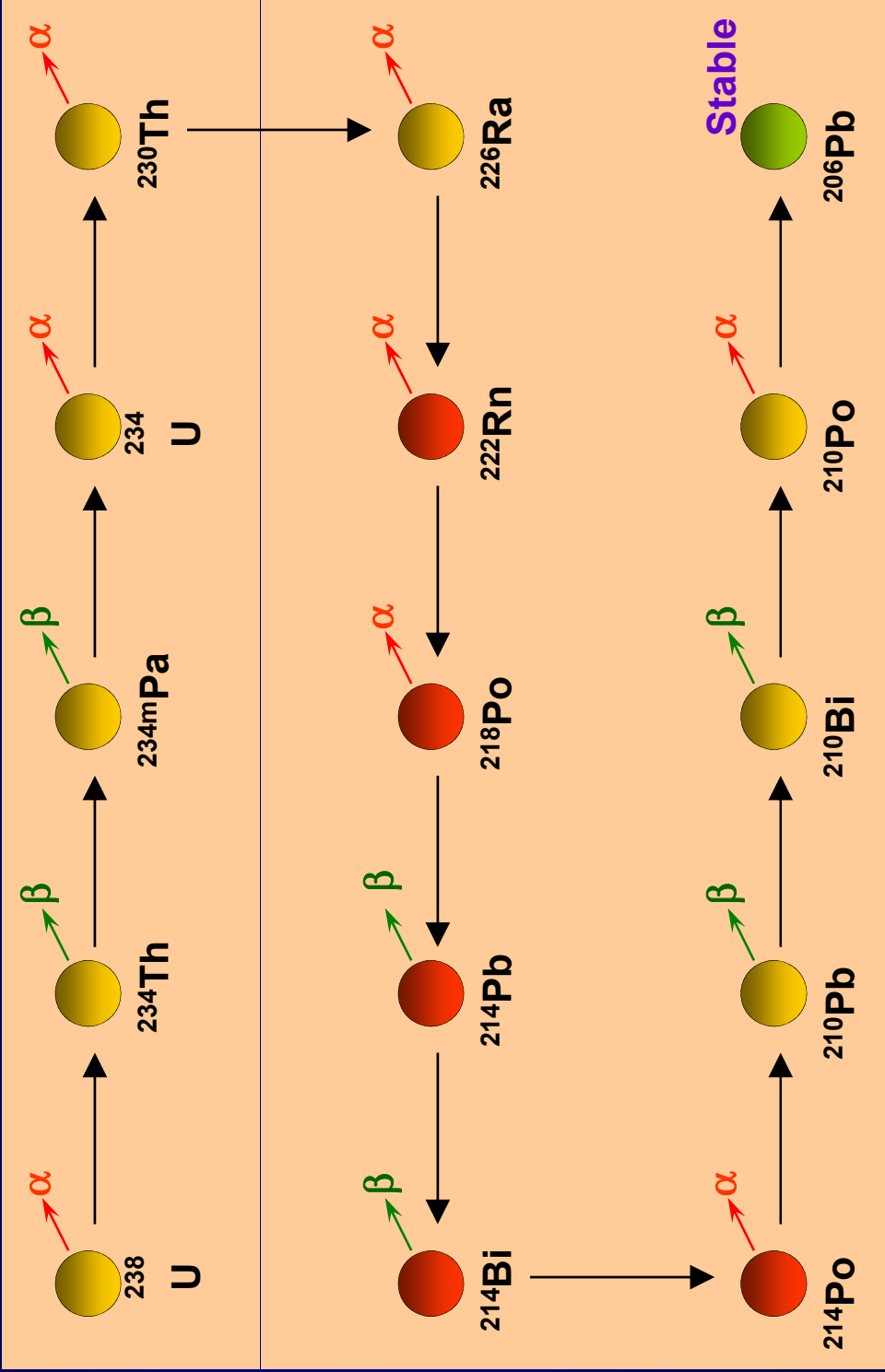
60 mrem/y

Aspen, CO

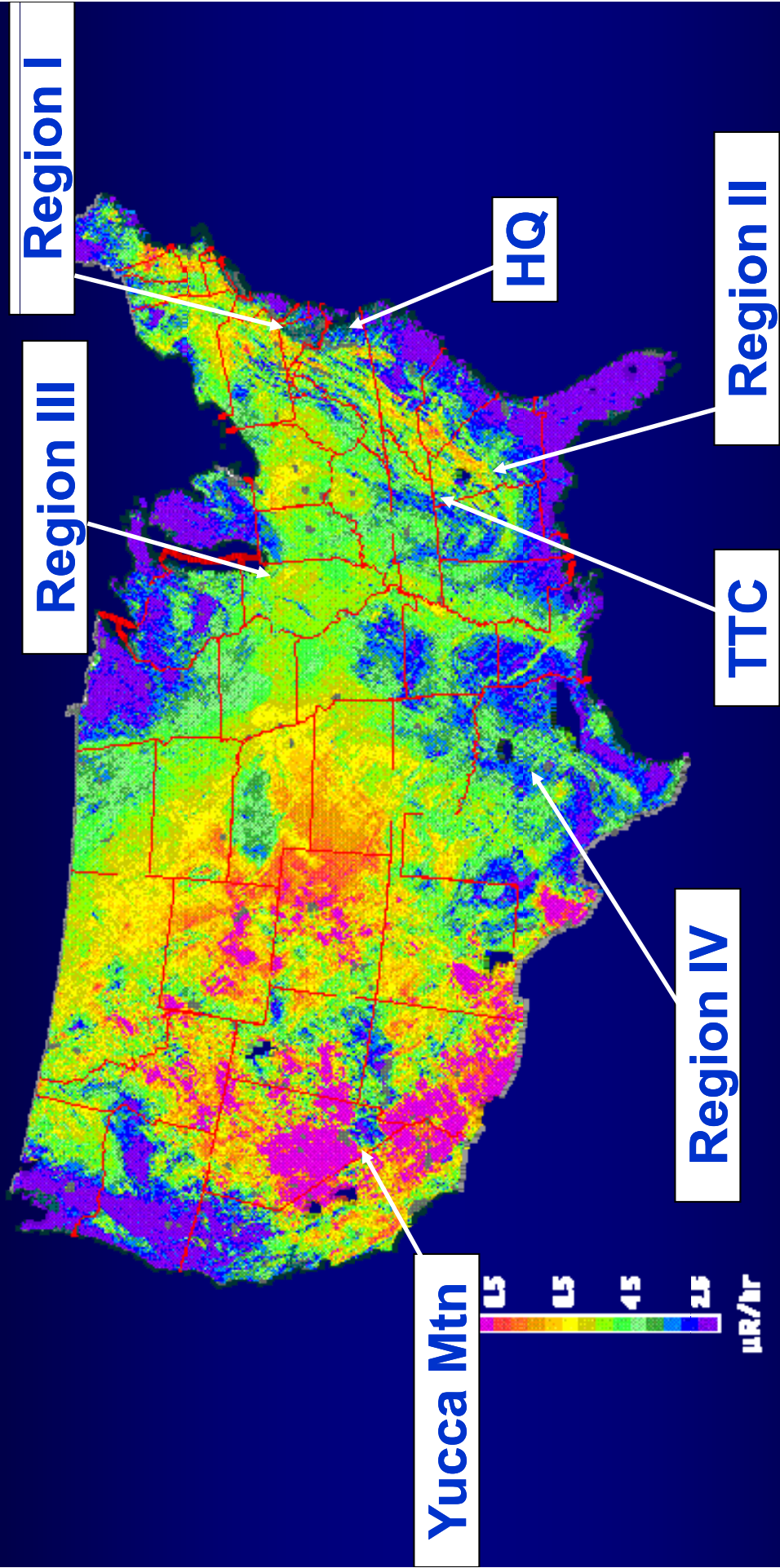
120 mrem/y



# $^{238}\text{U}$ Decay Chain



# Terrestrial Gamma-Ray Exposure at 1m above ground



Source of data: U.S. Geological Survey Digital Data Series 0028-5, 1993

# Terrestrial Radioactivity

Annual Effective Dose

US Average

30 mrem/y

Colorado

60 mrem/y

# Background Radiation Doses

The average annual background dose from cosmic & terrestrial sources:

Location	Dose (mrem)
U.S.	56
YM Surface Facilities	150



# Internal Radioactivity

Resident in tissues and organs

$^{40}\text{K}$

$^{238}\text{U}$  and progeny

Annual Effective Dose Equivalent

40 mrem/y



# Radon

Originates from decay of Ra  
in rocks and soil

Nobel Gas:  
Chemically Inert



# Radon

**Average Outdoor Concentration**

**0.4 pCi/l**

**Average Indoor Concentration**

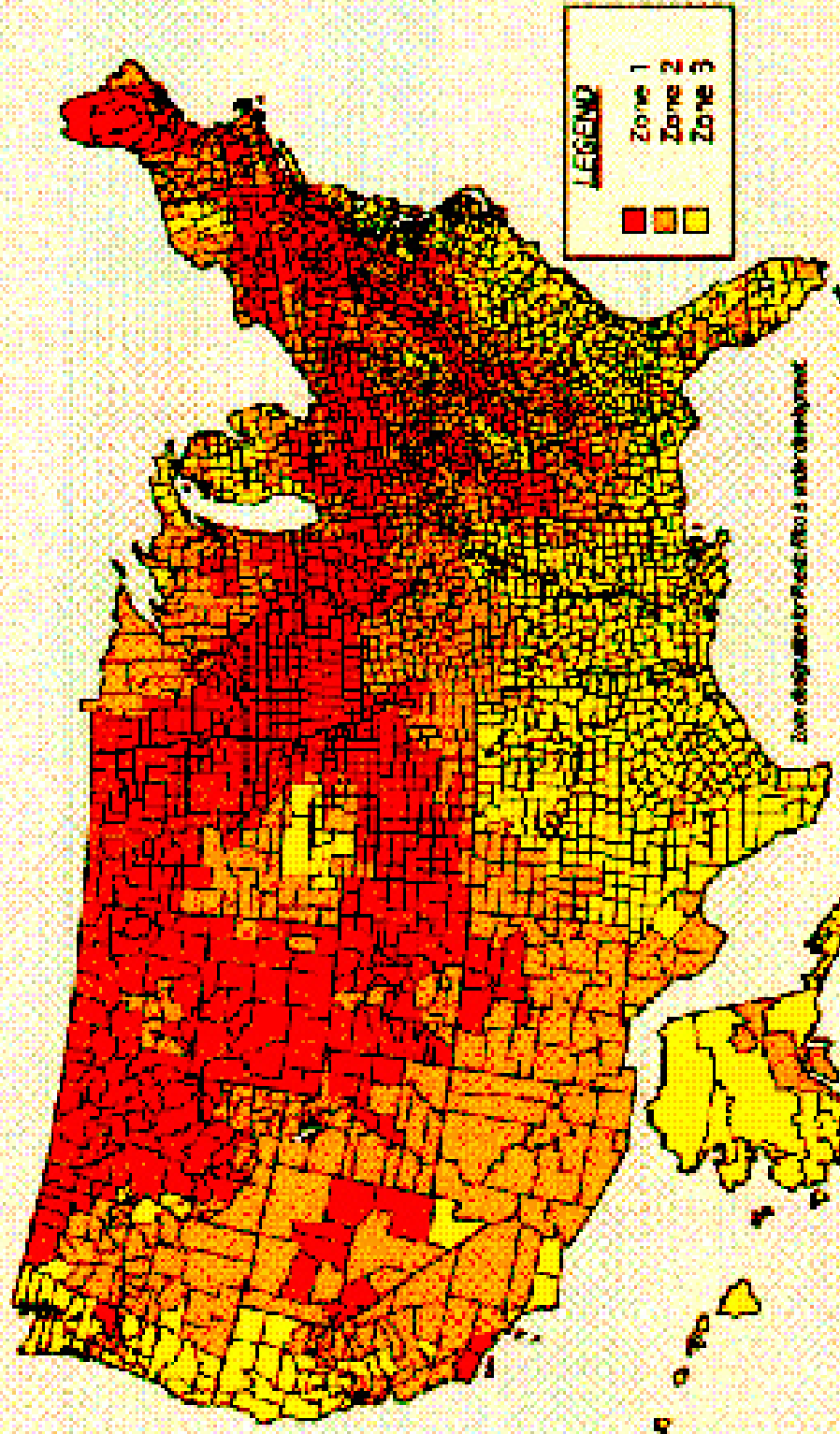
**1.2 pCi/l**

**Average Indoor Concentration**

**In Colorado**

**3 pCi/l**

# EPA Map of Radon Zones



**LEGEND**

Red	Zone 1
Orange	Zone 2
Yellow	Zone 3

Zone designations for Puerto Rico is under development.

The information on this map is preliminary and is intended to assist in the development of radon action plans. EPA also encourages states to conduct radon surveys in areas of high radon potential.

**DISCLAIMER:** Overall, the EPA Map of Radon Zones does not provide all radon information. EPA also encourages states to conduct radon surveys in areas of high radon potential.



Inset - Preliminary Zone designation

Color	Zone	Range of radon measurements (short-term, closed building)
Red	1	Greater than 4 pCi/L
Orange	2	Between 2 and 4 pCi/L
Yellow	3	Less than 2 pCi/L

# Radon

Annual Effective Dose

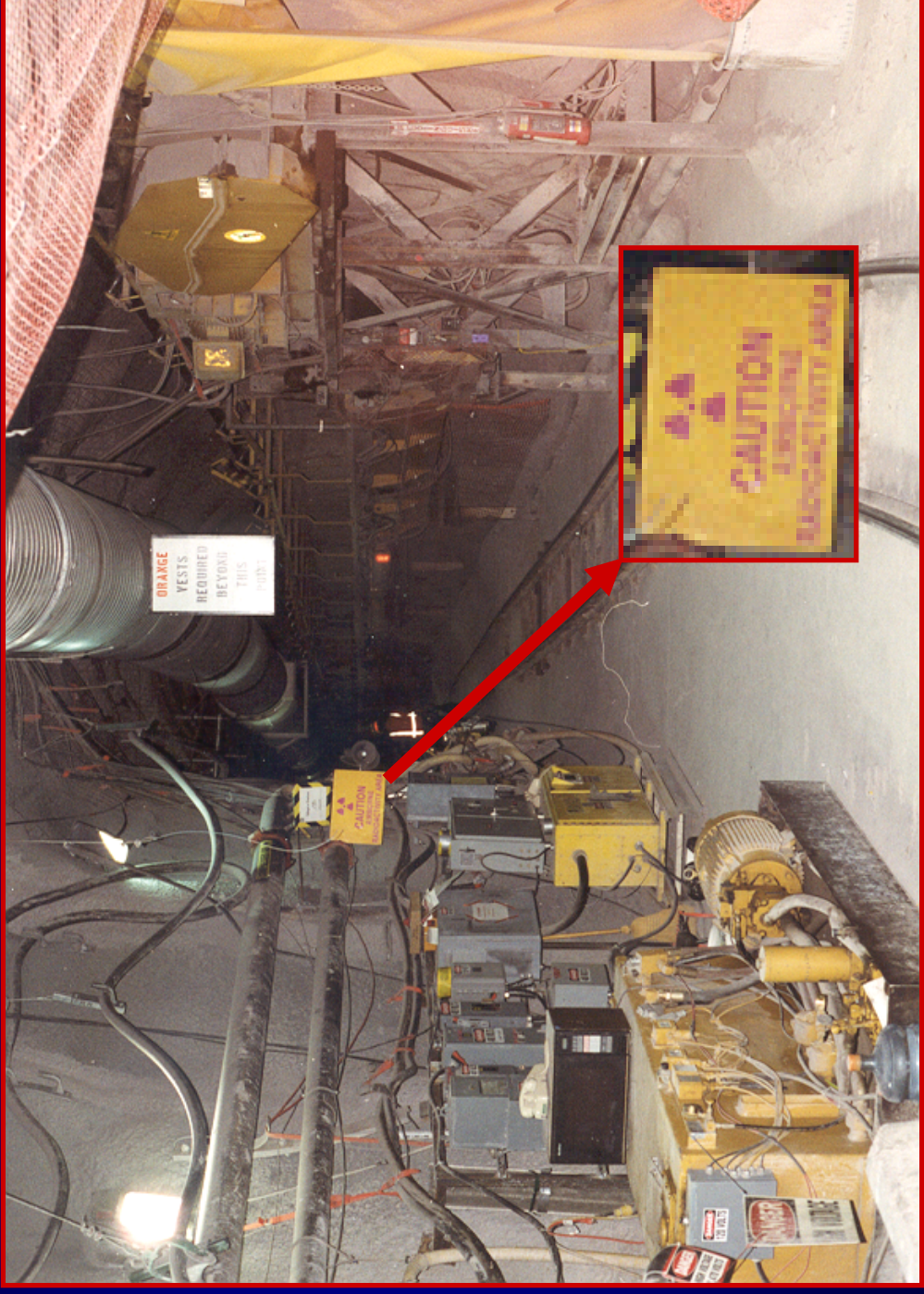
USA

200 mrem/y

Colorado

350 mSv/y

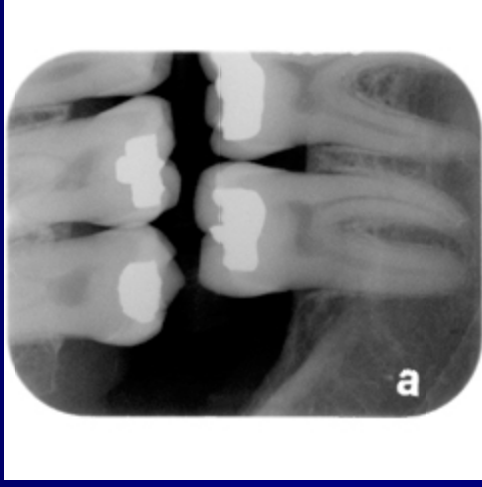
# Airborne Radioactivity Area Sign at Yucca Mountain



# Human-Produced Radiation



**Cancer  
treatment**



**Dental  
X-rays**



**Radiography with  
Ir-192 (30-100 Ci  
per capsule)**

# Medical Examinations

X-ray Procedures	mrem
Abdomen	40
Chest	6
Pelvis	60
Dental	3
Mammography	40
CT (full body)	130
Nuclear medicine	400

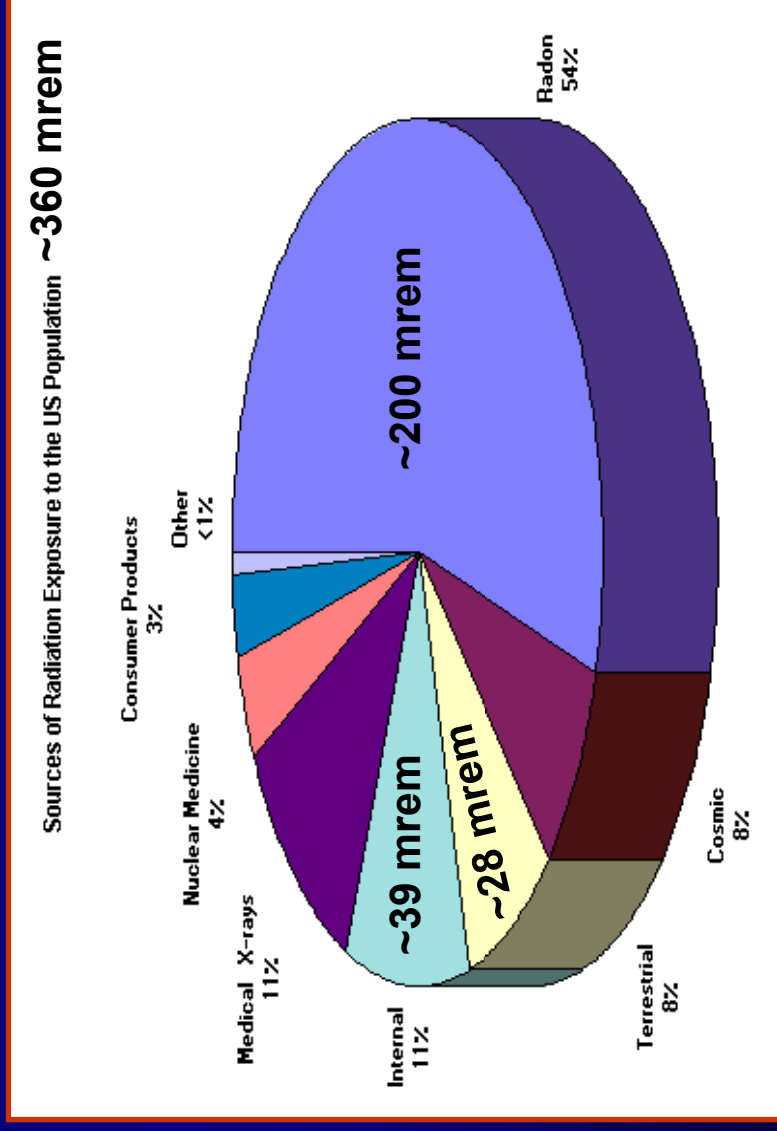


# Background Radiation

Background radiation does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission

(10 CFR Part 20)

Natural Background  
vs  
Artificial Background



# Background Radiation Doses

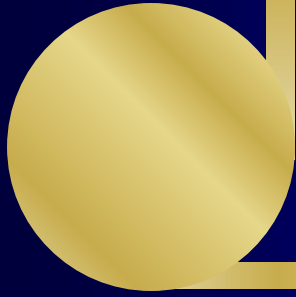
- **Current 10 CFR Part 63 Annual Public Dose Limit is 15 mrem from YM activities**
- **Revised 10 CFR Part 63 - after 10K yrs, public limit will increase to 350 mrem from YM activities**
- **Reasoning:**
  - **average background from all sources in Amargosa Valley is 350 mrem**
  - **average background in Colorado is 700 mrem**
  - **an additional 350 mrem from YM activities would increase Amargosa Valley background to 700 mrem - this matches Colorado background**

# Pre-Closure Radiological Impacts - Workers

Source (FEIS Table F-7 unless specified)	Dose Rate (mrem/year)
<b>Radon:</b> (a) surface via exhaust ventilation (b) subsurface air (Table F-2)	small relative to (b) 200
External exposure (direct radiation) from unloading and handling CSNF/HLW	200
External exposure (direct radiation) from naturally occurring radioactivity in the subsurface drift walls	50
Exposure (inhalation and/or direct radiation) from radioactive emissions from handling CSNF/HLW	Less than 1

# Pre-Closure Radiological Impacts - Workers

Source (DOE Pre-Closure Safety Analysis)	Dose Rate (mrem/year)
External exposure (direct radiation) from unloading and handling CSNF/HLW – subsurface workers	380
External exposure (direct radiation) from unloading and handling CSNF/HLW – surface workers	2,200 (exceeds DOE's ALARA goal of 500 mrem/yr)



**THE  
END**