

WHY CONCERN FOR PLUTONIUM AT AN ENRICHED URANIUM REPROCESSING PLANT

Plutonium present in fuel we process



Plutonium handled experimentally
in various labs

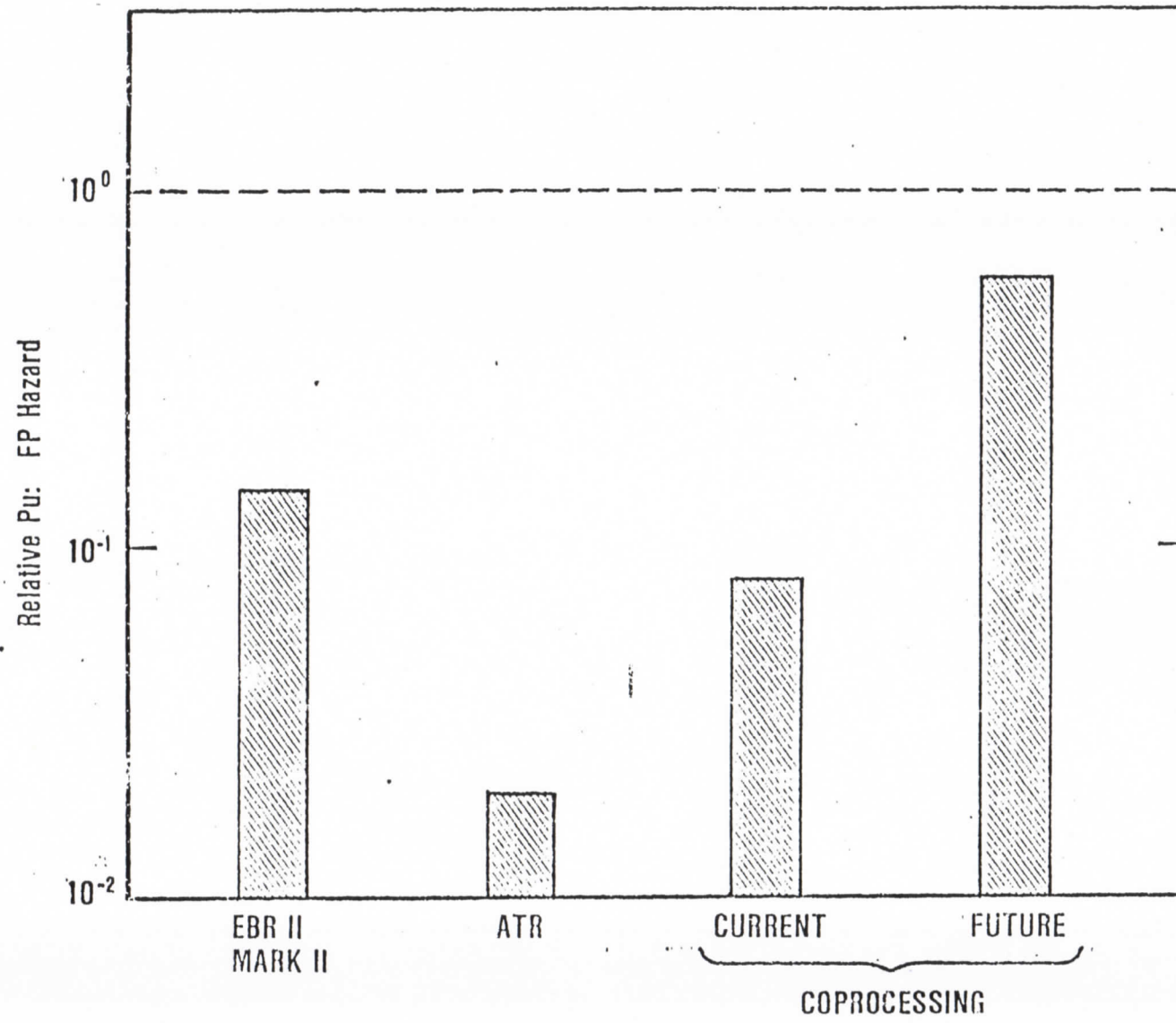
Some recent examples:

- Y Cell
- D Cell
- K Cell
- Mass Lab
- Stack Effluent
- Solvent Burner
- Np Process

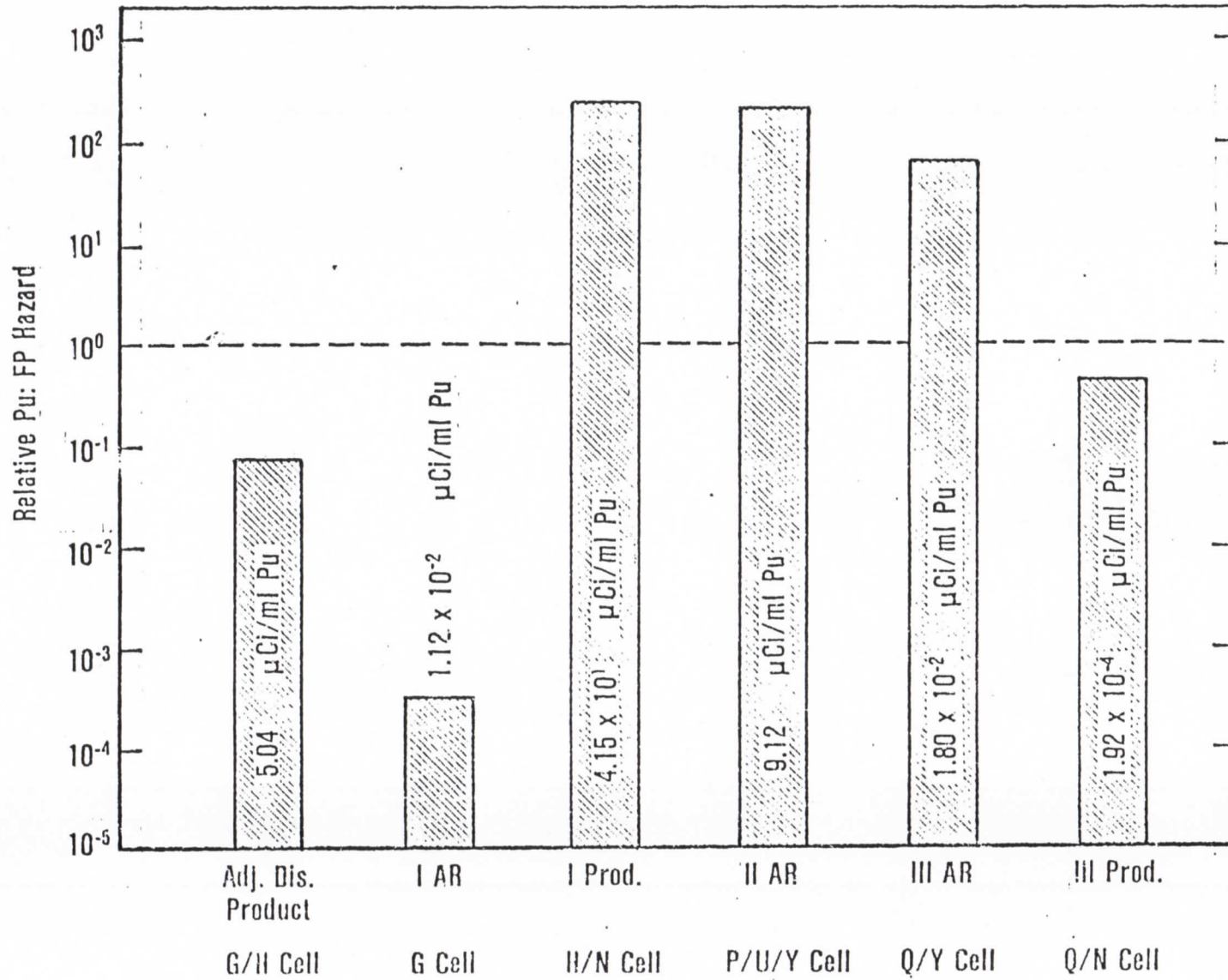
$$\text{Relative Hazard Index (RHI)} = \sum_j \frac{(Ci)_j}{RCG_j}$$

$$\text{Relative Pu: FP Hazard} = \frac{RHI_{Pu}}{RHI_{FP}}$$

RELATIVE HAZARD IN FUEL ELEMENTS



EBR II MARK II FUEL



CONTROL DIFFICULTIES

External

Air

Significant Levels Low (12 cpm in 8 hr)
Background Cover (300-3000 cpm)

Surface

Shielding

Water

Monitoring Difficulties

Soil

Monitoring Difficulties & Techniques

Internal

Levels of Concern

Activity

Mass

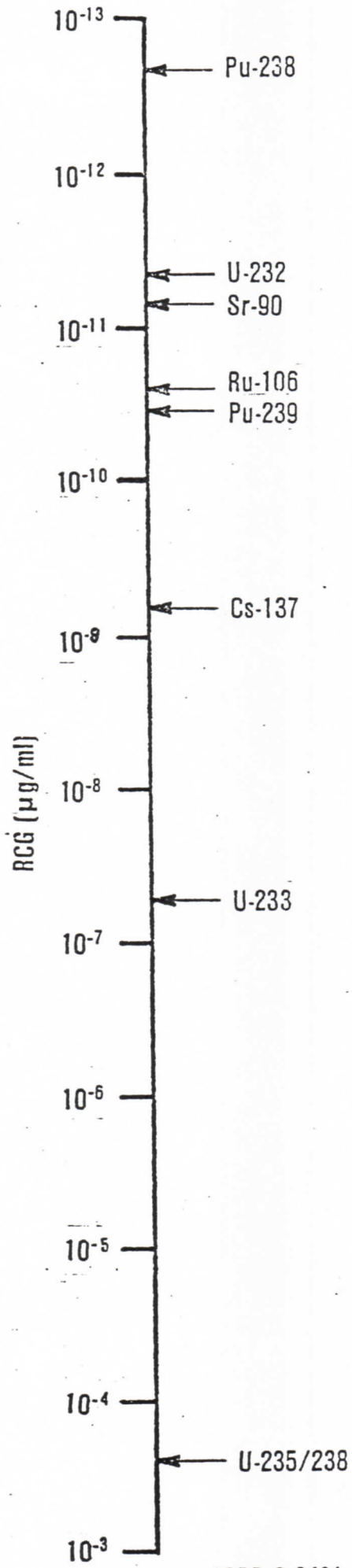
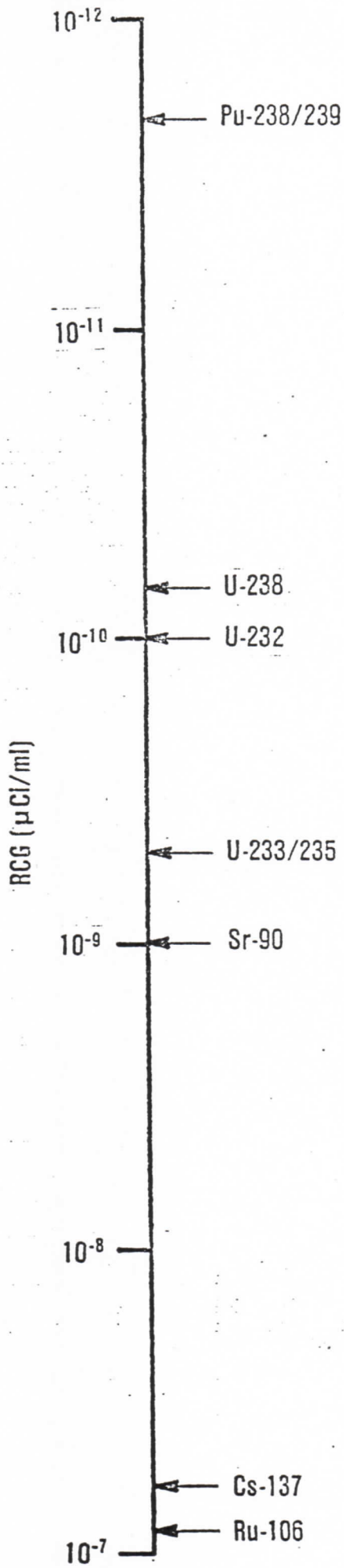
Monitoring Techniques

WBC

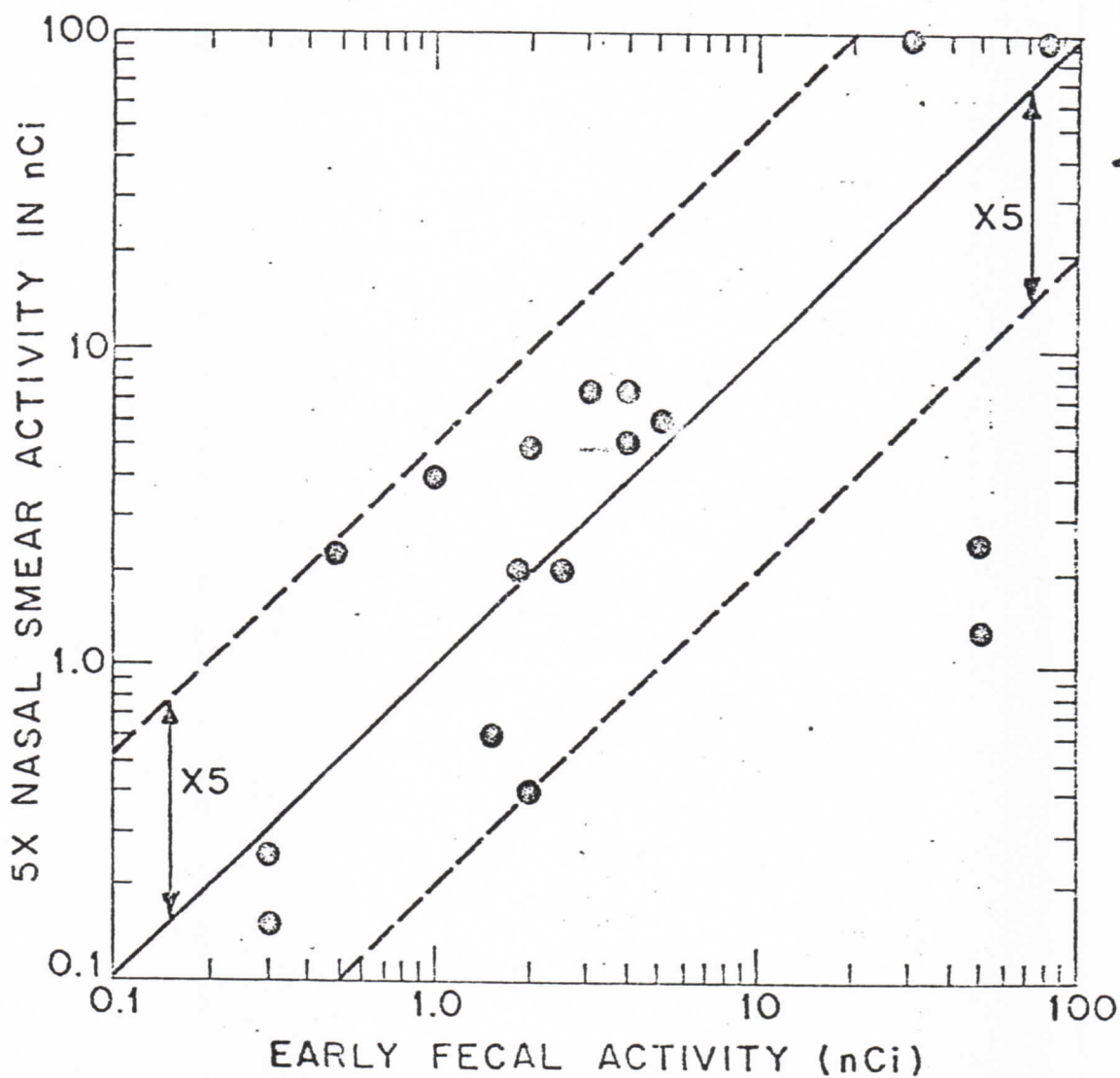
Bio Assay

Wounds

Nose - Swabs



CORRELATION OF NASAL SMEAR AND EARLY FECAL ACTIVITY



X AND GAMMA RAY YIELDS

<u>ISOTOPE</u>	<u>HALF-LIFE</u>	<u>GAMMA RAY</u>		<u>X-RAY</u>	
		<u>ENERGY</u> <u>KEV</u>	<u>YIELD</u> <u>%</u>	<u>ENERGY</u> <u>KEV</u>	<u>YIELD</u> <u>%</u>
U-235	7.13 x 10 ⁸ y	95	9		
		110	5		
		144	12		
		165	>4		
		185	55		
		205	4		
Pu-238	86.4 y	43.8	3.8 x 10 ⁻³	17	11
		99	8 x 10 ⁻³		
		150	1 x 10 ⁻³		
		MORE			
Pu-239	2.436 x 10 ⁴ y	37	1.6 x 10 ⁻³	17	6
		52	6.4 x 10 ⁻³		
		120	9.6 x 10 ⁻⁴		
		380	9.6 x 10 ⁻⁴		
		MORE			
Pu-240	6.58 x 10 ³ y	45.3	9 x 10 ⁻³	17	4
Pu-241	13.0 y	145	2.8 x 10 ⁻⁴		

INTERNAL EXPOSURE TO PLUTONIUM

Inhalation

Lung

Limiting Pathway at ICPP

Ingestion

Bone

GI Tract Absorption only 0.003%

Absorption

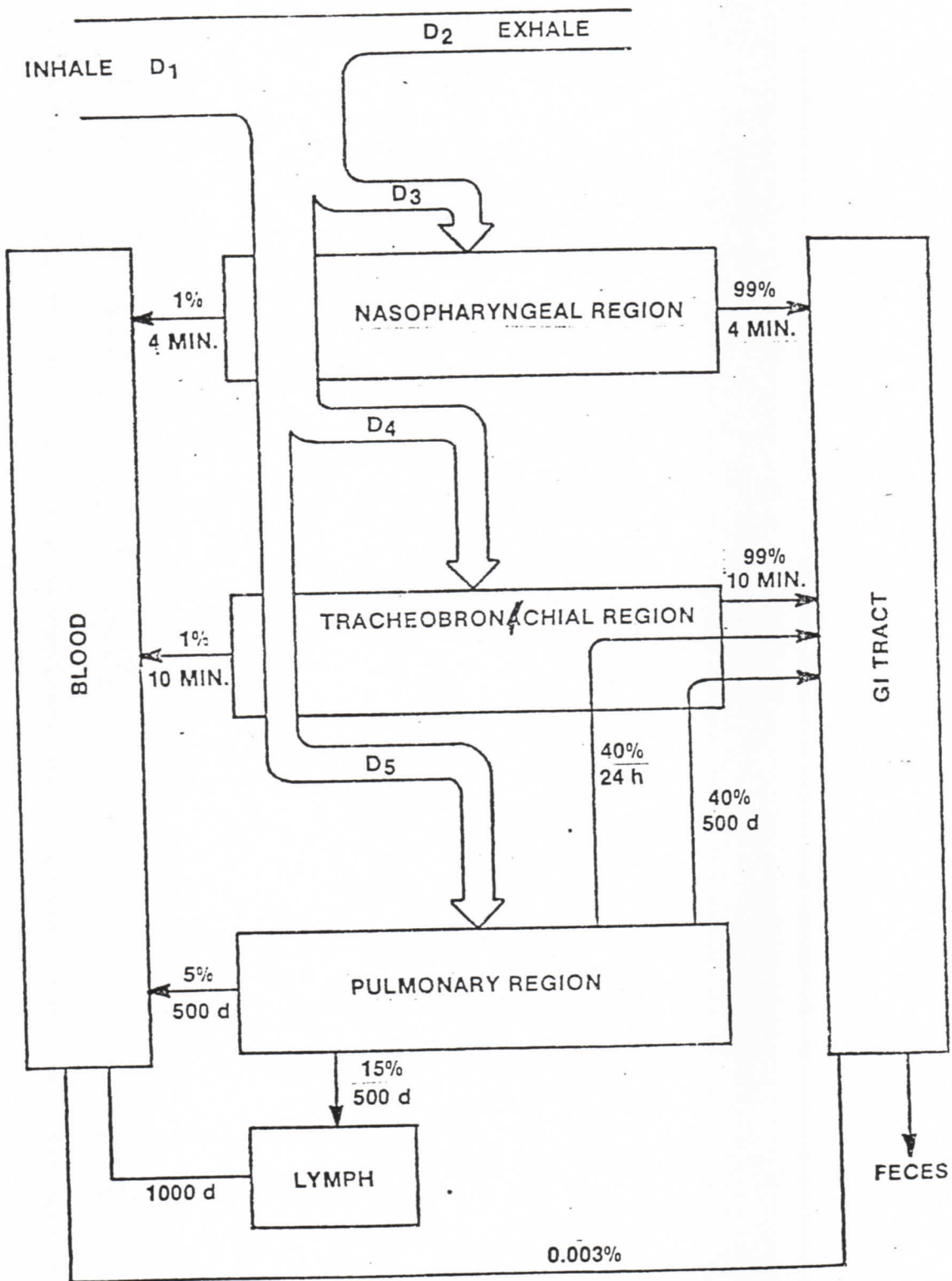
Bone

.4 N \sim 0.002%/Hr

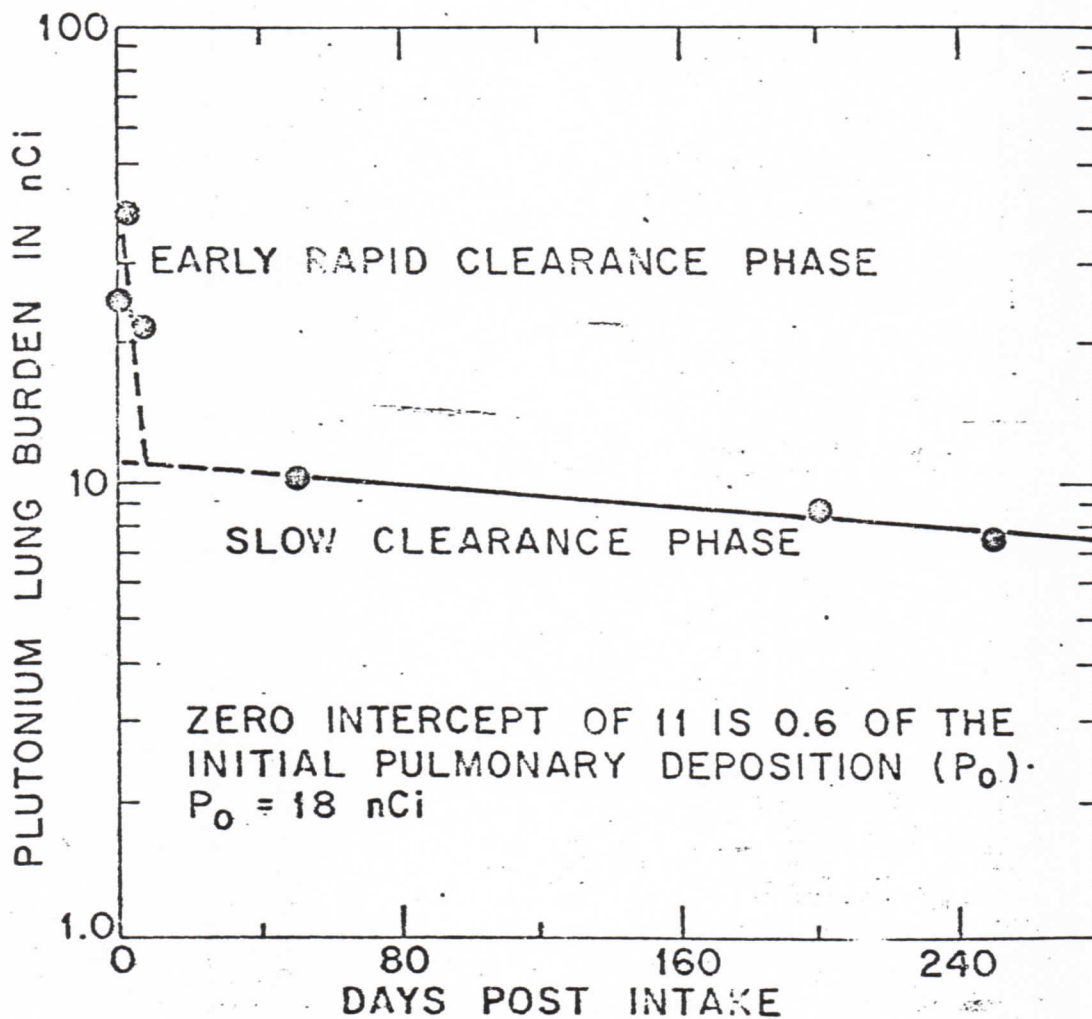
Wounds

Bone if not excised

PLUTONIUM INHALATION ICRP DEPOSITION AND RETENTION MODEL



LUNG COUNTER EXAMINATION DATA - CASE 1



PLUTONIUM IN BODY

	<u>MPBB (μ Ci)</u>	<u>Biological Half-Life</u>
Lung	0.016	500 day
Bone	0.04	100-200 Year

PLUTONIUM AND URANIUM COMPARISONS

Hazards	<u>Pu-238</u>	<u>Pu-239</u>	<u>U-235</u>
Air Concentrations (μ Ci/cc)	2×10^{-12}	2×10^{-12}	5×10^{-10}
Mass (μ g/cc)	1.1×10^{-13}	3.3×10^{-11}	2.3×10^{-4}
Maximum Permissible Body Burdens			
Activity (μ Ci)	0.04 (Bone)	0.04 (Bone)	0.06 (Bone)
	0.015 (Lung)	0.016 (Lung)	0.03 (Kidney)
Mass (μ gm)	0.002 (Bone)	0.65 (Bone)	3×10^4 (Bone)
	0.0009 (Lung)	0.26 (Lung)	10^4 (Kidney)

TOXIC CONCENTRATION COMPARISONS

ARSENIC 500 $\mu\text{G}/\text{M}^3$

PHOSGENE 400 $\mu\text{G}/\text{M}^3$

LEAD 200 $\mu\text{G}/\text{M}^3$

BERYLLIUM 2 $\mu\text{G}/\text{M}^3$

PLUTONIUM-239 $3.2 \times 10^{-5} \mu\text{G}/\text{M}^3$

ENVIRONMENTAL CONCERN

DETECTION CAPABILITIES

LEVELS OF CONCERN

BACKGROUND LEVELS

ANALYTICAL PROCEDURES

POLITICAL VS "REAL" HAZARDS

ROCKY FLATS EXPERIENCE

PLANT PROCEDURES

1. Assume $\alpha = \overline{Pu}$
2. Respiratory Protection — Full Face Masks
3. Clothing
 - Leave Contamination at Source
 - Disrobing exposure potential
4. Waste
 - >10 nCi/gm (22200 dpm)
 - 20-Year Containers
5. Source Control
 - Ventilation
 - Procedure for Leaving Area
 - Self Monitoring
6. Effluent Control

FURTHER REASONS FOR CONCERN

Avoid Exposure

Little bit goes a long way

Avoid Incidents

Exposure

ENICO Image

Reports

Commitments

Anticipate/Prepare Rather Than React

Planning

Precautions

Attitudes