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MOUND LABORATORY PLUTONIUM STUDY

PRESENTATION TO THE SCIENTIFIC REVIEW PANEL

D. R. ROGERS
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J. R. McCLAIN

FEB. 19, 1975

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JUL 01 1996
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Monsanto

MOUND LABORATORY

Miamisburg, Ohio

operated by

MONSANTO RESEARCH CORPORATION

a subsidiary of Monsanto Company

for the

UNITED STATES ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

U. S. Government Contract No. AT 33-1-GEN 52

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MOUND PLUTONIUM STUDY

TOPICS

- **Locations of Contamination**
- **Results of Sampling**
- **Health and Safety Analysis**
- **Source of Contamination**
- **On-Site/Off-Site Actions**

MOUND PLUTONIUM STUDY

OBJECTIVES:

1. Evaluating the inventory of plutonium-238 in the environment at Mound Laboratory
2. Determining the source of the plutonium-238
3. Alleviating any potential health hazard to the general public

MOUND PLUTONIUM STUDY

PROJECT DIRECTOR

**Consultant
Review Group**

**Advisory
Review Group**

<u>Scientific Advisor</u>	<u>Sampling & Analysis</u>	<u>Engineering Design & Service</u>	<u>Specialists</u>
Identify cause	Develop plan for <ul style="list-style-type: none">- Waterways- Perimeter- On-site	Develop plan to eliminate offsite situation	Law - Finance - Communications
Review scientific validity of operations	Manage operations	Civil Engineering for entire area	Expertise as required
Recommend sample location changes based on incoming data		Coordinate all work in Engineering Department and other areas	

**MOUND
PLUTONIUM
STUDY**

PLANS REVIEWED BY:

- **Monsanto**
- **AEC**
- **Montgomery County Health Dept.**
- **Miami Conservancy District**
- **Ohio Dept. of Health**
- **Ohio EPA**
- **U. S. EPA**
- **Consultants**
 - **U.S.D.A.**
 - **Private Companies**
 - **Universities**

SAMPLE LOCATIONS
GREAT MIAMI RIVER

APPROXIMATELY 10 MI. DOWNSTREAM OF MOUND LABORATORY

ESTIMATED NUMBER OF ANALYSES

Composite	175
Profile/1' Section	850
Water	142
Suspended Solids	138
Vegetation	26
Water Table	4
Runoff	5
	<hr/>
	1340*

***Additional Analysis of Fish/Small Animals
Found at Sample Locations not Included.**

SUMMARY RESULTS

QUALITY CONTROL

- **Duplicate or Split Samples**
 - **U. S. EPA**
 - **HASL**
 - **LFE**
- **Blanks**
- **Operation Sheets**
- **Q.C. Inspections**
- **Data Reviews**

[illegible]

CONSULTANTS

Specialties

Hydrology

Sedimentation

Soil Chemistry

Geology

Ecology

Biology

Universities

Georgia Tech

Emory University

Wright State University

Private Company

Dames and Moore

Governmental Agencies

USGS

Miami Conservancy District

USDA

TYPES OF SAMPLES TAKEN

- **Air**
- **Water**
- **Soil (Sediment)**
- **Vegetation**
- **Fish**

TYPICAL CANAL
SAMPLING LOCATION

TYPICAL POND & RUN-OFF HOLLOW

SAMPLING LOCATION

TYPICAL RIVER
SAMPLING LOCATION

CHAUTAUQUA DAM
SAMPLING LOCATION

Curie (Ci) is Basic Radiation Unit

Pu-238 Has About 17 Ci/gram

n Ci/g = nano curie of Pu-238/gram of Soil

$$\text{nano} = \frac{1}{1,000,000,000}$$

SUMMARY OF RESULTS

	Low nCi/g	High nCi/g
North Pond	<.0001	0.0022
South Pond	"	0.208
North Canal	"	4.56
Runoff Hollow	"	0.0266
Off Site Ditch	"	0.596
South Canal	"	3.80
Overflow Creek	"	0.189
River	"	0.0367
Background	.0000002	
50 Miles		
Blanks	<.0001	
Baseline in Park	.0004	
²³⁹ Pu Fallout	.000006

Distribution of Pu in Waterways

Total Inventory 5.2 ± 2.5 Curies
 -1.0

HEALTH AND SAFETY ANALYSIS

**ISOTOPIC COMPOSITION (TYPICAL) OF
MOUND LABORATORY Pu-238**

<u>Plutonium Isotope</u>	<u>Principal Decay</u>	<u>Half-Life (years)</u>	<u>Wt %</u>
236	α	2.85	0.0001
238	α	87.78	80.0
239	α	24082	16.5
240	α	6537	2.7
241	β	14.35	0.7
242	α	3.87×10^5	0.1

PLUTONIUM-238 IMPURITIES

<u>Isotope</u>	<u>Wt %</u>	<u>Remarks</u>
^{234}U	~ 0.19	Increases With Decay of Pu-238
^{237}Np	0.03	
^{241}Am	0.05	Increases With Decay of Pu-241
^{231}Pa	< 0.1	
^{232}Th		
^{232}U		
^{235}U		
^{236}U		
^{227}Ac		

POTENTIAL HAZARDS OF ^{238}Pu TO MAN

- **External Radiation – Insignificant**
- **Internal Radiation – Uptake in Body**

PATHWAYS TO MAN

- **Ingestion**
- **Absorption**
 - **Skin**
 - **Wounds**
- **Inhalation**

4 nCi

1.6 nCi

NCRP AND ICRP CONCENTRATION GUIDES

	Concentration Guides
Water	$5 \times 10^{-6} \mu\text{Ci/ml}$
Air	$1 \times 10^{-12} \mu\text{Ci/ml}$
Soil	None
Sediment	None

**EVALUATION OF HEALTH AND SAFETY
UNDER PRESENT CONDITIONS**

MATERIAL ANALYZED	RCG	FOUND	% RCG	PERMISSIBLE* INGESTION AMOUNT
SEDIMENT	NONE	4.56 nc/g	—	0.9 LB/YR
WATER	$5 \times 10^{-6} \mu\text{c/ml}$	$1 \times 10^{-8} \mu\text{c/ml}$	0.3	—
AIR	$1 \times 10^{-12} \mu\text{c/cm}^3$	$3 \times 10^{-15} \mu\text{c/cm}^3$	0.3	—
VEGETATION (GRASS)	NONE	$3 \times 10^{-3} \text{nc/g}$	—	1400 LB/YR
VEGETATION (ALGAE)	NONE	$1 \times 10^{-1} \text{nc/g}$	—	42 LB/YR
FISH (EDIBLE PORTION)	NONE	$5 \times 10^{-6} \text{nc/g}$	—	> 800,000 LB/YR

* INGESTION OF THIS AMOUNT COULD POTENTIALLY RESULT IN AN UPTAKE OF 0.057 nc/yr.

BEHAVIOR OF ^{238}Pu IN MOUND LABORATORY SEDIMENT

- Examination of Sediment (LFE) Shows Very Few Discrete Particles
- Solubility Studies in 8 M HNO_3 (ORNL) Indicate That The Nature of The Pu in This Sediment is Not Particulate PuO_2
- Recent Tests Show Pu IS Strongly Sorbed Onto The Soil (Pu is Fixed on Soil)

EVALUATION OF HEALTH HAZARD IN AREA NEAR MOUND LAB.

Considerations

- **Water & Air Concentrations Below
Concentration Guide**
- **Sediment Under Water, Moist or Over-
grown With Vegetation**
- **The Solubility of Pu-Sediment in Water
is Very Low**

THERE IS NO HEALTH HAZARD

COMPARISON OF THE CONDITIONS USED
BY HEALY AND BY MOUND LABORATORY

<u>Considerations</u>	<u>Conditions Assumed by Healy</u>	<u>Conditions at Mound Laboratory</u>
Extent of Contamination	Wide Spread ~39 sq miles	Very Small ~0.01 sq miles
Physical Nature of Contamination	PuO ₂ Fallout (Not Fixed)	Pu Sorbed on Sediment (Fixed to Sediment)
Nature of Climate and Soil	Arid Western Soil	Moist Fertile Ohio Soil Mostly Clay
Nature of the Area	Wide Open Level Plain	Recessed Canal in River Valley - Lined With Trees
Solubility of Pu	Considered Soluble or Nearly Soluble	Solubility Very Low $\frac{\text{Pu Concentration in Water}}{\text{Pu Concentration in Sediment}} = \frac{1}{100,000}$

SEDIMENT ^{238}Pu DECISION GUIDE
BASED ON INGESTION AND THE FOOD CHAIN

INGESTION OF:	DECISION GUIDE (nc/g)	
	OCT. 1974	FEB. 1975
SEDIMENT	52	52
WATER	500	520
VEGETATION	>1000	>1000
ANIMALS	> 84	129
FISH	84	>1000
HIGHEST SEDIMENT CONCENTRATION 4.6 nc/g		

SEDIMENT ^{238}Pu DECISION GUIDE
BASED ON ABSORPTION

ABSORPTION THROUGH: DECISION GUIDE
(nc/g)

	OCT. 1974	FEB. 1975
SKIN	590	> 1000
WOUNDS	59-590	> 1000
HIGHEST SEDIMENT CONCENTRATION		4.6

SEDIMENT ²³⁸Pu DECISION GUIDE

BASED ON INHALATION CANAL AREA ALLOWED TO DRY

INHALATION DUE TO:	DECISION GUIDE (nc/g)	
	OCT. 1974	FEB. 1975
DUST LOADING	250	250
WIND SUSPENSION	90-350	183-1300
RESUSPENSION FACTOR (Localized)	188	188
HOME CONTAMINATION	300	100
PERSONAL CLOTHING (Contamination)	300	150
HIGHEST SEDIMENT CONCENTRATION		4.6

SOURCE OF PLUTONIUM

ACTION PLAN

ON SITE ACTIONS TAKEN/PLANNED

Temporary Dams

Hillside Soil Removal

Hillside Ground Cover

Retention Basins/Drainage Upgrade

Overflow Basin

OFF SITE ACTION

CONCLUSION: No Health Hazard

ACTION:

Maintain Surveillance

Long Term Agreement - Site Condition

Analysis Reviewed by Outside Experts

DETAILED HEALTH AND SAFETY ANALYSIS

**COMPARISON OF THE CONDITIONS USED
BY HEALY AND BY MOUND LABORATORY**

<u>Considerations</u>	<u>Conditions Assumed by Healy</u>	<u>Conditions at Mound Laboratory</u>
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Nature of the Area	Wide Open Level Plain	Recessed Canal in River Valley - Lined With Trees
Solubility of Pu	Considered Soluble or Nearly Soluble	Solubility Very Low $\frac{\text{Pu Concentration in Water}}{\text{Pu Concentration in Sediment}} = \frac{1}{100,000}$

**MAXIMUM CONCENTRATION AND INVENTORY OF PLUTONIUM
OFF-SITE NEAR MOUND LABORATORY**

LOCATION	PLUTONIUM INVENTORY (curies)	HIGHEST CONCENTRATION (nc/g)
RUN-OFF HOLLOW	0.0018	0.031
DRAINAGE DITCH	0.082	0.749
NORTH CANAL	1.65	4.56
SOUTH POND	0.0058	0.031
NORTH POND	0.0020	0.006
SOUTH CANAL	3.17	3.80
OVERFLOW CREEK	0.076	0.074
OVERFLOW CREEK OUTFALL	0.260	0.240
RIVER REMOTE FROM OUTFALL	<0.03 curies/mile	<0.0001

COMPARISON OF YYN AND YYS PROFILES

SEDIMENT PROPERTIES

MOSTLY CLAY

LOW WATER PERMEABILITY

DRYS TO VERY HARD, DIFFICULT TO GRIND
MATERIAL

LARGE ION EXCHANGE CAPACITY

CALCAREOUS (CaCO_3)

HIGH ACID NEUTRALIZATION CAPACITY

AGGLOMERATES IN NATURAL WATER

REMAINS AGGLOMERATED IN DRY STATE

CHEMICAL CONSTITUENTS OF SEDIMENT

CLAY (Mostly hydromicas)

ORGANIC MATERIALS

WATER

PHYSICAL COMPOSITION OF SEDIMENT

COMPONENTS	COMPOSITION	
	A	B
	(%)	
CLAY AND SILT	92	49
FINE SAND	8	28
MEDIUM SAND	—	10
COARSE SAND	—	5
FINE GRAVEL	—	6
COARSE GRAVEL	—	2

OTHER SEDIMENT PROPERTIES

PROPERTY	VALUE
pH OF WATER IN EQUILIBRIUM WITH SEDIMENT	7.5–8.3
ACID NEUTRALIZATION CAPACITY	4 meg/g
ION EXCHANGE CAPACITY	20 meg/100g

SEDIMENT PARTICLE SIZE DISTRIBUTION

< 50 μ

AGGLOMERATE PARTICLE SIZE DISTRIBUTION

< 50 μ

CONTAMINATED SEDIMENT CHARACTERISTICS

LOW Pu SOLUBILITY IN NATURAL WATER

LITTLE OR NO PuO_2 PARTICULATES

Pu IS SORBED STRONGLY TO SEDIMENT (Fixed)

Pu CONCENTRATION INCREASES WITH
SURFACE AREA

Pu CONCENTRATION INCREASES ONLY SLIGHTLY
WITH DECREASING PARTICLE SIZE IN AGGLOM-
ERATED SEDIMENT

BEHAVIOR OF ^{238}Pu IN MOUND LABORATORY SEDIMENT

- Examination of Sediment (LFE) Shows Very Few Discrete Particles
- Solubility Studies in 8M HNO_3 (ORNL) Indicate That The Nature of The Pu in This Sediment is Not Particulate PuO_2
- Recent Tests Show Pu IS Strongly Sorbed Onto The Soil (Pu is Fixed on Soil)

DISTRIBUTION RATIOS (WATER/SEDIMENT) AND SOLUBILITY OF PLUTONIUM FROM SEDIMENT.

Solution	Distribution Ratio Water/Sediment	Solubility(%) (20 ml Solution/1 g Sediment)
	$D_{w/s}$	S
NATURAL WATER	1×10^{-5}	$2 \times 10^{-2}\%$
DILUTE ACID INITIAL pH=1 FINAL pH=5.5	1×10^{-5}	$2 \times 10^{-2}\%$
MODERATE ACID FINAL pH=1	1.6×10^{-3}	3.1%
HIGH ACID (8M HNO ₃)*	2.5×10^{-1}	83%
MODERATE BASE (0.1M NaOH)	Clay disperses	(61%)**
COMPLEXING AGENT (.1M CITRATE)*	4.2×10^{-2}	46%

* TAMURA (ORNL)

** Pu BELIEVED TO BE SORBED TO COLLOIDAL CLAY SUSPENSION

SORPTION OF Pu ON
SEDIMENT (A)
 $D_{w/s}$ vs pH

PATHWAYS TO MAN

DIRECT INGESTION OF SEDIMENT

$$\text{DECISION GUIDE} = \frac{B_s / T_e}{G_s F_{m/GI}} = 476-635 \text{ nc/g}$$

B_s	PERMISSIBLE BODY BURDEN	4 nc
T_e	YEARS OF EXPOSURE	70 yr
G_s	AMOUNT OF SEDIMENT INGESTED	3 or 4 g/yr
$F_{m/GI}$	FRACTION OF PLUTONIUM ABSORBED BY MAN THROUGH THE GI TRACT.	3×10^{-5}

INGESTION OF FISH GROWN IN WATER IN EQUILIBRIUM WITH SEDIMENT

$$\text{DECISION GUIDE} = \frac{B_s / T_e}{G_f D_{w/s} F_{f/w} F_{m/GI}} = 42300 \text{ nc/g}$$

B	PERMISSIBLE BODY BURDEN	4 nc
T _e	YEARS OF EXPOSURE	70 yr
G _f	AMOUNT OF FISH INGESTED (10% of total fish ingested)	900 g/yr
D _{w/s}	RATIO OF WATER TO SEDIMENT CON.	1 x 10 ⁻⁵
F _{f/w}	RATIO OF FISH TO WATER CONCENTRATION (Edible Portion)	5
F _{m/GI}	FRACTION OF Pu ABSORBED BY MAN THROUGH GI TRACT	3 x 10 ⁻⁵

INGESTION OF ANIMALS (COW)

$$\text{DECISION GUIDE} = \frac{B_s / T_e}{G_a F_{a/s} F_{m/GI}} = 1290 \text{ nc/g}$$

B_s	PERMISSIBLE BODY BURDEN	4 nc
T_e	YEARS OF EXPOSURE	70 yr
G_a	AMOUNT OF MUSCLE INGESTED (10% of total muscle ingested)	7400 g/yr
$F_{a/s}$	RATIO OF MUSCLE TO SOIL CONCENTRATION	2×10^{-4}
$F_{m/GI}$	FRACTION OF Pu ABSORBED BY MAN THROUGH GI TRACT	3×10^{-5}

INGESTION OF WATER IN EQUILIBRIUM WITH SEDIMENT

$$\text{DECISION GUIDE} = \frac{B_s / T_e}{G_w D_{w/s} F_{m/GI}} = 5220 \text{ nc/g}$$

B_s	PERMISSIBLE BODY BURDEN	4 nc
T_e	YEARS OF EXPOSURE	70 yr
G_w	AMOUNT OF WATER INGESTED (10% of total water ingested)	36500 g/yr
$D_{w/s}$	RATIO OF WATER TO SEDIMENT CONCENTRATION	1×10^{-5}
$F_{m/GI}$	FRACTION OF Pu ABSORBED BY MAN THROUGH GI TRACT	3×10^{-5}

INGESTION OF VEGETATION GROWING IN SEDIMENT

$$\text{DECISION GUIDE} = \frac{B_s / T_e}{G_v F_{v/s} F_{m/GI}} = 13040 \text{ nc/g}$$

B_s	PERMISSIBLE BODY BURDEN	4 nc
T_e	YEARS OF EXPOSURE	70 yrs
G_v	AMOUNT OF VEGETATION INGESTED (10% of total vegetation ingested)	7300 g/yr
$F_{v/s}$	RATIO PLANT TO SOIL CONCENTRATION (Assume one year old plants)	2×10^{-5}
$F_{m/GI}$	FRACTION Pu ABSORBED BY MAN FROM GI TRACT	3×10^{-5}

**SEDIMENT ^{238}Pu DECISION GUIDE
BASED ON INGESTION AND THE FOOD CHAIN**

INGESTION OF:	DECISION GUIDE (nC/g)
SEDIMENT	52
WATER	520
VEGETATION	> 1000
ANIMALS	129
FISH	> 1000
HIGHEST SEDIMENT CONCENTRATION	4.6 nc/g

ABSORPTION OF PLUTONIUM THROUGH SKIN

$$\text{DECISION GUIDE} = \frac{B_s / T_e}{(G/a)_s A_m R_{abs} S_{w/s}} = 61780 \text{ nc/g}$$

B_s	PERMISSIBLE BODY BURDEN	4 nc
T_e	YEARS OF EXPOSURE	70 yr
G/a	AMOUNT OF SEDIMENT PER UNIT AREA (10% of total on skin)	0.1 g/m^2
A_m	SURFACE AREA STANDARD MAN	1.85 m^2
R_{abs}	RATE OF ABSORPTION OR SOLUBLE Pu	$5 \times 10^{-2} / \text{yr}$
$S_{w/s}$	FRACTION OF Pu IN SOLUBLE FORM	1×10^{-4}

ABSORPTION OF PLUTONIUM THROUGH WOUNDS

$$\text{DECISION GUIDE} = \text{DC}_{\text{Skin}} \frac{(R_w/R_s)}{(A_w/A_s)} = 61780 \text{ nc/g}$$

DC_{Skin}	DECISION GUIDE FOR ABSORPTION THROUGH SKIN	61780 nc/g
R_w/R_s	RATIO OF ABSORPTION RATES WOUND TO SKIN	100
A_w/A_s	FRACTION OF SKIN WOUNDED	0.01

SEDIMENT ^{238}Pu DECISION GUIDE
BASED ON ABSORPTION

ABSORPTION THROUGH:	DECISION GUIDE (nc/g)
SKIN	> 1000
WOUNDS	> 1000
HIGHEST SEDIMENT CONCENTRATION	4.6

INHALATION DUST LOADING

$$\text{DECISION GUIDE} = \frac{\text{RCG(AIR)}}{C_p \cdot A_s / A_p} = 1000\text{-}2500 \text{ ng/g}$$

RCG(AIR)	PERMISSIBLE AIR CONCENTRATION	10^{-9} ng/cm^3 ($1 \times 10^{-12} \mu\text{g/cm}^3$)
C_p	CONCENTRATION OF PARTICULATES IN AIR	$40 \times 10^{-12} \text{ g/cm}^3$ $100 \times 10^{-12} \text{ g/cm}^3$
A_s	AREA OF CONTAMINATED SEDIMENT	0.01 sq. miles
A_p	AREA SUPPLYING PARTICULATES TO AIR	> 1 sq. mile

WIND PLUME PARAMETERS

INHALATION WIND RESUSPENSION

$$\text{DECISION GUIDE} = \frac{\text{RCG(AIR)}}{\left(\frac{\chi \bar{\mu}}{R_p \Omega_w} \right) \left(\frac{R_p}{\bar{\mu}^2} \right) \bar{\mu} (G/a)_w} = \frac{1830-13000}{\text{nc/g}}$$

RCG(AIR)	PERMISSIBLE AIR CONCENTRATION	$1 \times 10^{-3} \text{ nc/m}^3$ $(1 \times 10^{-12} \mu\text{c/cm}^3)$
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$\left(\frac{\chi \bar{\mu}}{R \Omega_w} \right)$	WIND SUSPENSION PLUME PARAMETER (Unstable)	$\sim \text{N-S} \quad 34.1$ $\sim \text{E-W} \quad 4.8$
--	---	---

$\left(\frac{R_p}{\bar{\mu}^2} \right)$	WIND PICK UP RATE CONSTANT (20 yr old GMX deposit)	$2 \times 10^{-12} \text{ sec/m}^2$
--	--	-------------------------------------

$\bar{\mu}$	WIND VELOCITY (11 mph)	5 m/s
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$(G/a)_w$	SEDIMENT AVAILABLE FOR SUSPENSION PER UNIT AREA	1600 g/m^2
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RESUSPENSION FACTOR

$$K = \left(\frac{\text{AIRBORNE CONCENTRATION } \text{nc/m}^3}{\text{SURFACE CONCENTRATION } \text{nc/m}^2} \right) \text{m}^{-1}$$

SUMMARY OF RESUSPENSION TESTS ON OUTDOOR SOIL

NATURE OF CONTAMINATION	DISTURBANCE	$K \text{ m}^{-1}$
FRESH FALLOUT	LOW	10^{-7} to 10^{-6}
FRESH FALLOUT	AUTO. TRAFFIC	10^{-6} to 10^{-5}
AGED FALLOUT (20 yrs)	LOW	$\sim 10^{-9}$
^{91}Y SORBED ON SOIL	LOW	$\sim 10^{-9}$
^{238}Pu SORBED ON SOIL	LOW	$\sim 10^{-9}$
AT MOUND LABORATORY	HIGH (Soil moist)	$\sim 10^{-8}$

INHALATION (RESUSPENSION FACTOR)

$$\text{DECISION GUIDE} = \frac{\text{RCG(AIR)}}{K(m^{-1}) (G/a)_r F_t} = 1880 \text{ nc/g}$$

RCG(AIR)	PERMISSIBLE AIR CONCENTRATION	$1 \times 10^{-3} \text{ nc/m}^3$ $(1 \times 10^{-12} \mu\text{c/cm}^3)$
$K(m^{-1})$	RESUSPENSION FACTOR	10^{-9}
$(G/a)_r$	RESUSPENDABLE SEDIMENT PER UNIT AREA	1600 g/m^2
F_t	FRACTION OF TIME EXPOSED (8 hours/day everyday)	< 0.33

INHALATION PERSONAL CLOTHING CONTAMINATION

$$\text{DECISION GUIDE} = \frac{\text{RCG(AIR)}}{K(m^{-1}) (G/a)_c F_t} = 1500 \text{ nc/g}$$

RCG(AIR)	PERMISSIBLE AIR CONCENTRATION	$1 \times 10^{-3} \text{ nc/m}^3$ $(1 \times 10^{-12} \mu\text{c/cm}^3)$
$K(m^{-1})$	RESUSPENSION FACTOR (Clothing)	10^{-6}
$(G/a)_c$	GRAM SEDIMENT PER UNIT AREA OF CLOTHING	1 g/m^2
F_t	FRACTION OF TIME EXPOSED	0.67

INHALATION HOME CONTAMINATION (RESUSPENSION FACTORS)

$$\text{DECISION GUIDE} = \frac{\text{RCG (AIR)}}{K(m^{-1}) (G/a)_h F_t} = 1000 \text{ nc/g}$$

RCG (AIR)	PERMISSIBLE AIR CONCENTRATION	$1 \times 10^{-3} \text{ nc/m}^3$ $(1 \times 10^{-12} \mu\text{c/cm}^3)$
$K(m^{-1})$	RESUSPENSION FACTOR (Indoors)	10^{-6} m^{-1}
$(G/a)_h$	GRAMS OF SEDIMENT PER UNIT AREA OF THE HOME (10% of total deposition)	1 g/m^2
F_t	FRACTION OF TIME EXPOSED	1.0

**SEDIMENT ²³⁸Pu DECISION GUIDE
BASED ON INHALATION**

CANAL AREA ALLOWED TO DRY

INHALATION DUE TO:	DECISION GUIDE (nc/g)
DUST LOADING	250
WIND SUSPENSION	183-1300
RESUSPENSION FACTOR (LOCALIZED)	188
HOME CONTAMINATION	100
PERSONAL CLOTHING CONTAMINATION	150
HIGHEST SEDIMENT CONCENTRATION	4.6