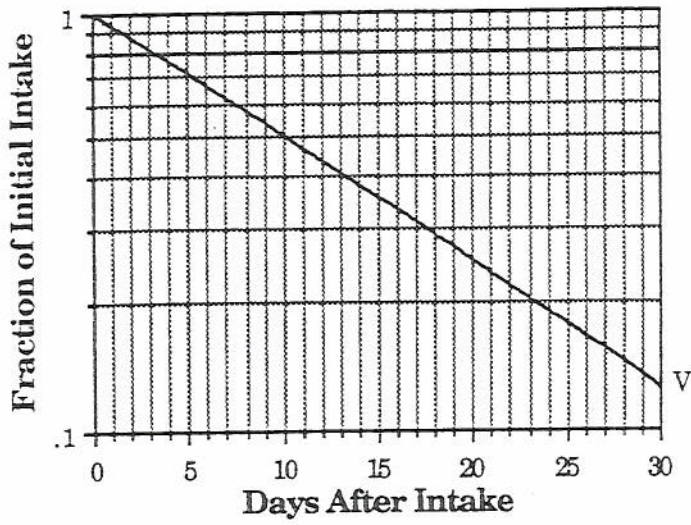
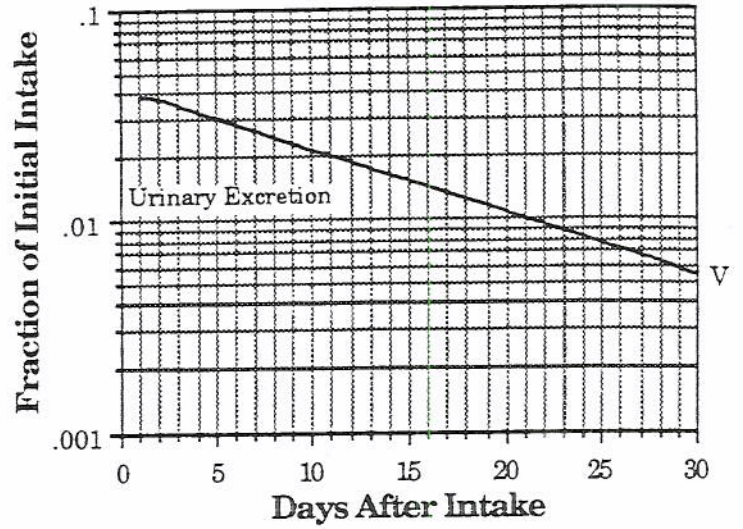


Radionuclide Internal Dose Information

H-3 Retention Fraction



H-3 Excretion Fraction



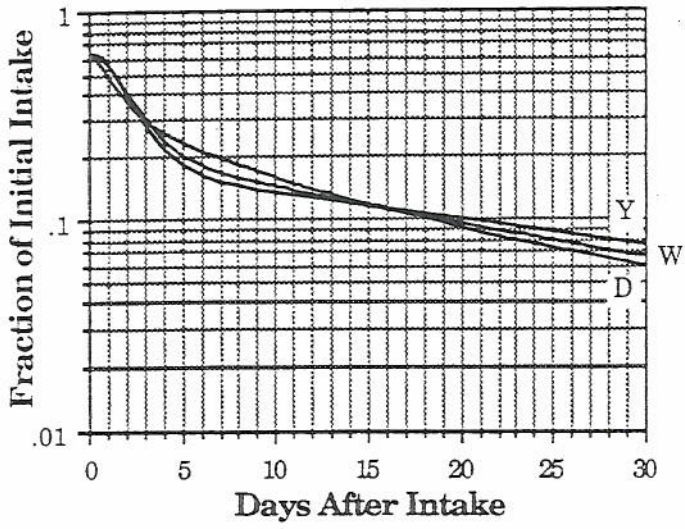
Notes

H-3

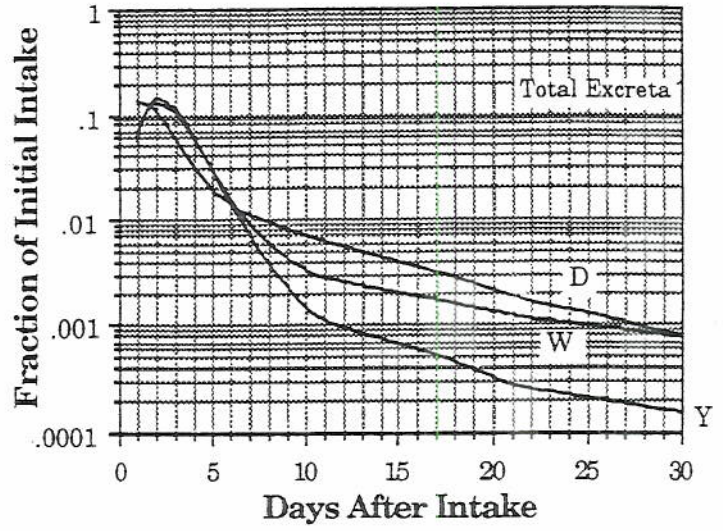
(All CDE and CEDE in mrem; ALI's in μCi)

Class	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
Vapor	1.0	1.73E-11	1.73E-11	1.73E-11	1.73E-11	1.73E-11	1.73E-11	1.73E-11
CDE per μCi Inhaled =		0.06	0.06	0.06	0.06	0.06	0.06	0.06
CEDE per μCi Inhaled =		0.016	0.010	0.008	0.008	0.002	0.002	0.019
		h eff	h Based (S)ALI	h Based (N)ALI	10% Rule	10% Rule	(S)ALI	(N)ALI
CEDE per μCi Inhaled =		1.73E-11	78113	781128	h eff	(S)ALI	(S)ALI	(N)ALI
		0.06	78113	781128 (All)	0.06	78113	80000	800000
Inhaled/Skin Absorbed Retention				Urinary Excretion	DAC (V) = 2E-5			
Vapor				Vapor	DAC-hr = 48000 nCi *			
Days	Fract			Fract	DAC-hr = 3.0 mrem (ALI)			
0.1	0.993				DAC-hr = 2.88 mrem (h)			
0.2	0.986				* Skin abs + inhalation			
0.3	0.979				"Properly Based ALI/DAC"			
0.4	0.972				ALI = 78000 μCi			
0.5	0.966				DAC (V) = 1.6E-05			
0.6	0.959				DAC-hr = 38400 nCi*			
0.7	0.952				DAC-hr = 2.54 mrem (ALI)			
0.8	0.946				DAC-hr = 2.38 mrem (h)			
0.9	0.939				* Skin abs + inhalation			
1	0.936			3.85E-2				
2	0.873			3.76E-2				
3	0.814			3.51E-2				
4	0.760			3.27E-2				
5	0.709			3.05E-2	Misc			
6	0.661			2.85E-2	Data			
7	0.617			2.66E-2	T 1/2 = 12.35 y			
8	0.575			2.48E-2	β^- 18.6 keV			
9	0.537			2.31E-2	γ ..			
10	0.501			2.16E-2	Γ = 0.0			
20	0.250			1.08E-2	mR/hr per Ci at 1 meter			
30	0.125			5.37E-3				
40	0.062			2.68E-3				
50	0.031			1.34E-3				
60	0.016			6.69E-4				
70	7.76E-3			3.34E-4				
80	3.87E-3			1.67E-4				
90	1.93E-3			8.33E-5				
100	9.66E-4			4.16E-5				
200	9.30E-7			4.01E-8				

Cr-51 Retention Fractions



Cr-51 Excretion Fractions



Notes

Cr-51

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
Y	0.1	2.03E-11	1.58E-11	5.34E-10	1.87E-11	1.39E-11	1.08E-11	5.26E-11
CDE per μCi Inhaled =		0.08	0.06	1.98	0.07	0.05	0.04	0.19
CEDE per μCi Inhaled =		0.02	0.01	0.24	0.01	0.00	0.00	0.06

*Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	0.33	14967	25306	0.26	18983	20000	30000

Days	Whole Body Retention			Total Excreta		
	D	W	Y	D	W	Y
0.1	0.628	0.635	0.637			
0.2	0.615	0.630	0.635			
0.3	0.601	0.625	0.632			
0.4	0.586	0.620	0.628			
0.5	0.570	0.613	0.623			
0.6	0.554	0.605	0.615			
0.7	0.537	0.596	0.606			
0.8	0.521	0.586	0.595			
0.9	0.505	0.574	0.583			
1	0.489	0.562	0.570	1.34E-1	6.14E-2	5.38E-2
2	0.366	0.419	0.410	1.11E-1	1.30E-1	1.45E-1 f
3	0.298	0.306	0.287	5.88E-2	1.02E-1	1.13E-1 f
4	0.260	0.240	0.218	3.14E-2	5.83E-2	6.19E-2 f
5	0.234	0.204	0.182	1.94E-2	3.05E-2	3.04E-2 f
6	0.214	0.183	0.163	1.40E-2	1.62E-2	1.47E-2
7	0.198	0.169	0.152	1.12E-2	9.26E-3	7.29E-3
8	0.183	0.159	0.144	9.44E-3	5.91E-3	3.88E-3
9	0.171	0.151	0.138	8.15E-3	4.23E-3	2.28E-3
10	0.159	0.144	0.133	7.11E-3	3.33E-3	1.49E-3
20	9.08E-2	9.53E-2	9.88E-2	2.10E-3	1.31E-3	3.19E-4
30	5.98E-2	6.56E-2	7.51E-2	7.77E-4	7.57E-4	1.52E-4
40	4.20E-2	4.58E-2	5.74E-2	3.79E-4	4.90E-4	9.29E-5
50	3.02E-2	3.21E-2	4.40E-2	2.28E-4	3.31E-4	6.45E-5
60	2.19E-2	2.26E-2	3.38E-2	1.53E-4	2.29E-4	4.73E-5
70	1.59E-2	1.59E-2	2.60E-2	1.07E-4	1.59E-4	3.53E-5
80	1.16E-2	1.12E-2	1.99E-2	7.57E-5	1.10E-4	2.65E-5
90	8.46E-3	7.94E-3	1.53E-2	5.40E-5	7.67E-5	2.00E-5
100	6.19E-3	5.62E-3	1.18E-2	3.86E-5	5.35E-5	1.51E-5
200	2.93E-4	1.95E-4	8.57E-4	1.38E-6	1.50E-6	9.60E-7
300	1.62E-5	8.29E-6	6.31E-5	5.18E-8	4.53E-8	6.53E-8
400	1.02E-6	4.38E-7	4.67E-6			

DAC (Y) = $8\text{E-}6$
 DAC-hr = 9600 nCi
 DAC-hr = 2.4 mrem (ALI)
 DAC-hr = 3.16 mrem (h)

"Properly Based ALI/DAC"
 ALI = 15000 μCi
 DAC (Y) = $6.3\text{E-}6$
 DAC-hr = 7560 nCi
 DAC-hr = 2.52 mrem (ALI)
 DAC-hr = 2.50 mrem (h)

Misc.
 Data
 $T_{1/2} = 27.7$ d
 $\beta = 315$
 $\gamma = 320$ 9.80%
 $\Gamma = 16$
 mR/hr per Ci at 1 meter

Ingestion Model

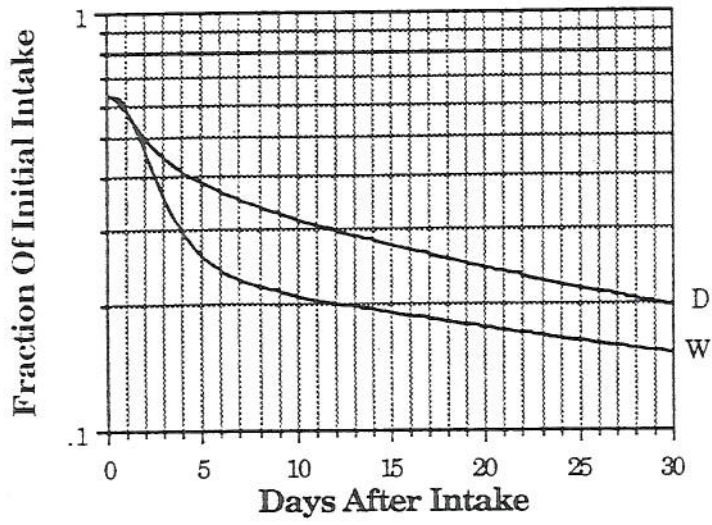
f1 is either 0.01 or 0.1
 However, h eff is the same for both

h eff = $3.98\text{E-}11$ Sv/Bq
 0.15 mrem/ μCi

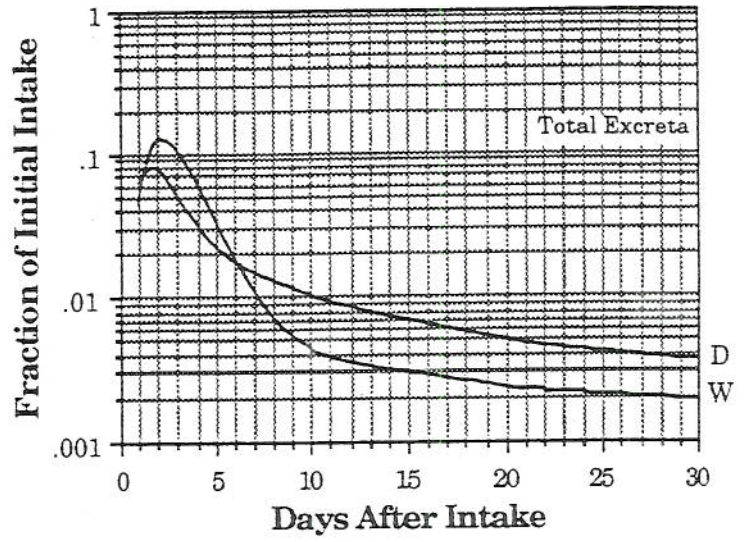
45% of the Y Class inhalation dose

Note: f - fecal excretion >90%

Mn-54 Retention Fractions



Mn-54 Excretion Fractions



Notes

Mn-54

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
W	0.1	7.09E-10	8.59E-10	6.66E-09	1.10E-09	1.25E-09	7.40E-10	1.72E-09
CDE per μCi Inhaled =		2.6	3.2	24.6	4.1	4.6	2.7	6.4
CEDE per μCi Inhaled =		0.7	0.5	3.0	0.5	0.1	0.1	1.9

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	1.81E-09	745	2029	6.3	790	800	2000
	6.7	745	2029 (Lung)				

Days	Whole Body Retention		Total Excreta	
	D Fract	W Fract	D Fract	W Fract
0.1	0.638	0.639		
0.2	0.635	0.638		
0.3	0.631	0.637		
0.4	0.626	0.634		
0.5	0.619	0.631		
0.6	0.612	0.626		
0.7	0.604	0.620		
0.8	0.595	0.613		
0.9	0.586	0.604		
1	0.577	0.593	6.10E-2	4.42E-2
2	0.496	0.465	7.98E-2	1.28E-1 f
3	0.444	0.357	5.07E-2	1.07E-1 f
4	0.411	0.293	3.20E-2	6.33E-2 f
5	0.388	0.258	2.26E-2	3.42E-2
6	0.369	0.238	1.77E-2	1.88E-2
7	0.353	0.227	1.49E-2	1.11E-2
8	0.339	0.219	1.30E-2	7.30E-3
9	0.327	0.213	1.16E-2	5.39E-3
10	0.316	0.208	1.03E-2	4.36E-3
20	0.242	0.175	5.06E-3	2.35E-3
30	0.196	0.151	3.56E-3	1.90E-3
40	0.160	0.130	2.83E-3	1.61E-3
50	0.132	0.113	2.31E-3	1.39E-3
60	0.108	0.098	1.89E-3	1.20E-3
70	0.089	0.085	1.56E-3	1.04E-3
80	0.073	0.073	1.28E-3	9.00E-4
90	0.060	0.063	1.05E-3	7.79E-4
100	0.050	0.055	8.66E-4	6.74E-4
200	7.02E-3	1.29E-2	1.23E-4	1.60E-4
300	9.95E-4	3.01E-3	1.74E-5	3.75E-5
400	1.41E-4	6.96E-4	2.46E-6	8.75E-6

DAC (W) = 3E-7
 DAC-hr = 360 nCi
 DAC-hr = 2.25 mrem (ALI)
 DAC-hr = 2.41 mrem (h)

"Properly Based ALI/DAC"

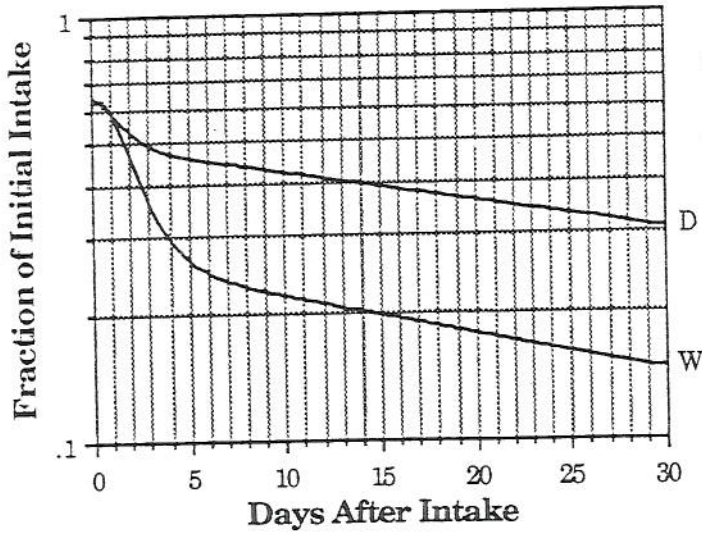
ALI = 750 μCi
 DAC (W) = 3.1E-07
 DAC-hr = 372 nCi
 DAC-hr = 2.48 mrem (ALI)
 DAC-hr = 2.49 mrem (h)

Misc. Data
 T 1/2 = 312 d
 EC
 γ 834.8 100%
 Γ = 470
 mR/hr per Ci at 1 meter

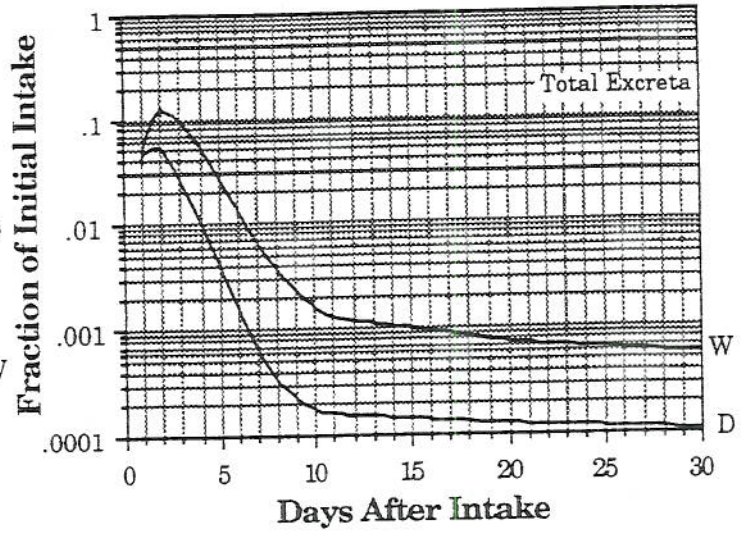
Ingestion Model
f1 is 0.1 for all forms
h eff = 7.48E-10 Sv/Bq 2.77 mrem/ μCi
41% of the W Class inhalation dose

Note: f - fecal excretion >90%

Fe-59 Retention Fractions



Fe-59 Excretion Fractions



Notes

Fe 59

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
D	0.1	3.32E-09	3.01E-09	3.50E-09	3.18E-09	2.91E-09	2.95E-09	5.81E-09
CDE per μCi Inhaled =		12.3	11.1	13.0	11.8	10.8	10.9	21.5
CEDE per μCi Inhaled =		3.1	1.7	1.6	1.4	0.3	0.3	6.4

*Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	4.00E-09	338	2815	14.8	338	300	3000

(LLI Wall)

Days	Whole Body Retention		Total Excreta		f	f
	D Fract	W Fract	D Fract	W Fract		
0.1	0.638	0.638				
0.2	0.636	0.637				
0.3	0.634	0.635				
0.4	0.629	0.633				
0.5	0.624	0.629				
0.6	0.618	0.624				
0.7	0.611	0.618				
0.8	0.604	0.610				
0.9	0.597	0.601				
1	0.589	0.591	4.02E-2	3.87E-2	f	f
2	0.526	0.463	5.44E-2	1.19E-1	f	f
3	0.491	0.358	2.69E-2	9.76E-2	f	f
4	0.472	0.297	1.10E-2	5.56E-2	f	f
5	0.461	0.264	4.24E-3	2.81E-2	f	f
6	0.452	0.246	1.66E-3	1.38E-2	f	f
7	0.444	0.235	7.03E-4	7.00E-3	f	f
8	0.437	0.228	3.50E-4	3.80E-3	f	f
9	0.430	0.222	2.21E-4	2.30E-3	f	f
10	0.423	0.217	1.73E-4	1.58E-3	f	f
20	0.361	0.177	1.25E-4	7.46E-4	f	f
30	0.308	0.146	1.07E-4	5.61E-4	f	f
40	0.263	0.120	9.10E-5	4.22E-4	f	f
50	0.224	9.95E-2	7.76E-5	3.18E-4	f	f
60	0.191	8.26E-2	6.62E-5	2.39E-4	f	f
70	0.163	6.88E-2	5.64E-5	1.81E-4	f	f
80	0.139	5.74E-2	4.81E-5	1.36E-4		
90	0.118	4.80E-2	4.11E-5	1.04E-4		
100	0.101	4.03E-2	3.50E-5	7.88E-5		
200	2.06E-2	7.49E-3	7.13E-6	6.00E-6		
300	4.19E-3	1.49E-3	1.45E-6	6.94E-7		
400	8.54E-4	3.01E-4	2.96E-7	1.04E-7		

DAC (D) = $1\text{E-}7$
 DAC-hr = 120 nCi
 DAC-hr = 2.00 mrem (ALI)
 DAC-hr = 1.78 mrem (h)

"Properly Based ALI/DAC"

ALI = 340 μCi
 DAC (D) = $1.4\text{E-}07$
 DAC-hr = 168 nCi
 DAC-hr = 2.47 mrem (ALI)
 DAC-hr = 2.49 mrem (h)

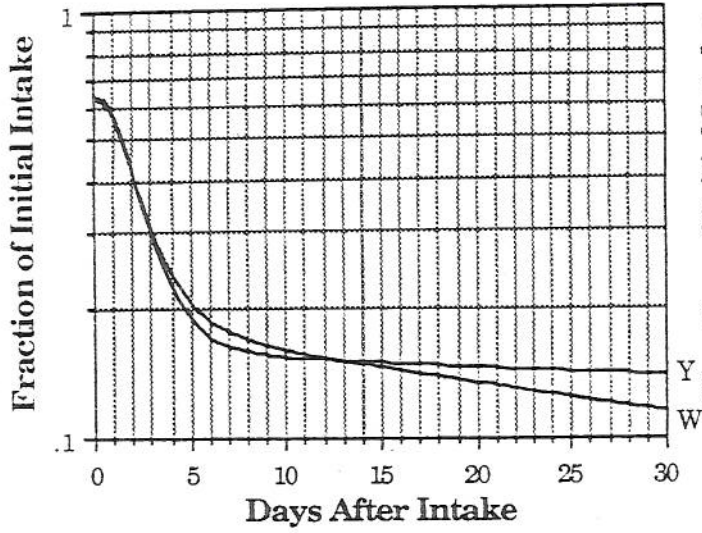
Misc. Data
 T 1/2 = 45.1 d
 β 475
 γ 192 3.1%
 1099.2 56.5%
 1291.6 43.2%

Γ = 640
 mR/hr per Ci at 1 meter

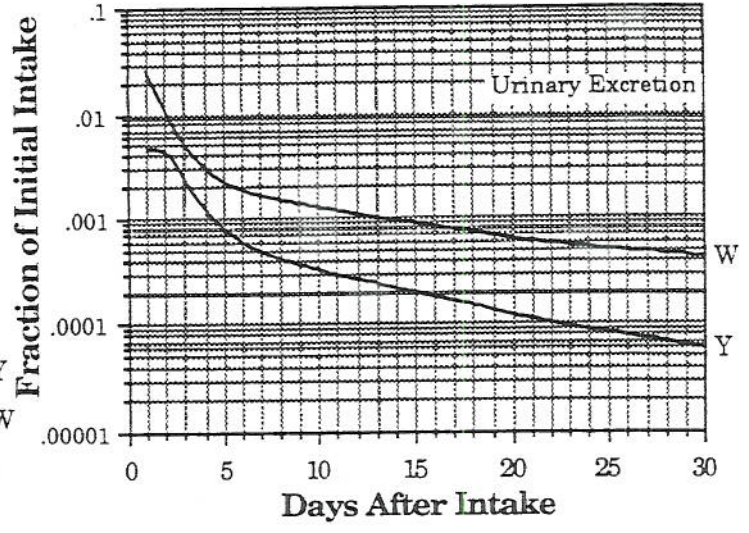
Ingestion Model
f1 is 0.1 for all forms
h eff = $1.81\text{E-}9$ Sv/Bq 6.7 mrem/ μCi
45% of the D Class inhalation dose

Note: f - fecal excretion >90%

Co-57 Retention Fractions



Co-57 Excretion Fractions



Notes

Co-57

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
Y	0.05	1.24E-10	3.75E-10	1.69E-08	5.88E-10	4.52E-10	2.71E-10	8.22E-10
CDE per μCi Inhaled =		0.5	1.4	62.5	2.2	1.7	1.0	3.0
CEDE per μCi Inhaled =		0.1	0.2	7.5	0.3	0.1	0.0	0.9

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	2.45E-09	551	800	7.5	666	700	800
	9.1	551	800 (Lung)				

Whole Body Retention

W Y

Days Fract Fract

0.1	0.635	0.639
0.2	0.630	0.638
0.3	0.626	0.637
0.4	0.620	0.634
0.5	0.613	0.629
0.6	0.606	0.624
0.7	0.598	0.616
0.8	0.588	0.606
0.9	0.577	0.595
1	0.565	0.582
2	0.421	0.422
3	0.306	0.295
4	0.240	0.224
5	0.204	0.188
6	0.185	0.170
7	0.175	0.162
8	0.168	0.158
9	0.163	0.155
10	0.159	0.153
20	0.134	0.145
30	0.115	0.139
40	1.00E-1	0.134
50	8.76E-2	0.129
60	7.68E-2	0.124
70	6.74E-2	0.120
80	5.94E-2	0.116
90	5.24E-2	0.111
100	4.63E-2	0.108
200	1.57E-2	7.48E-2
300	7.22E-3	5.23E-2
400	4.26E-3	3.69E-2

Urinary Excretion
W Y
Fract Fract

	2.58E-2	4.64E-3
	1.09E-2	4.63E-3
	5.10E-3	2.38E-3
	3.02E-3	1.27E-3
	2.23E-3	8.08E-4
	1.87E-3	6.00E-4
	1.65E-3	4.89E-4
	1.49E-3	4.18E-4
	1.35E-3	3.66E-4
	1.25E-3	3.26E-4
	6.33E-4	1.23E-4
	4.19E-4	6.02E-5
	3.29E-4	3.94E-5
	2.79E-4	3.16E-5
	2.49E-4	2.85E-5
	2.20E-4	2.61E-5
	1.95E-4	2.43E-5
	1.72E-4	2.27E-5
	1.52E-4	2.14E-5
	5.70E-5	1.66E-5
	1.80E-5	1.16E-5
	6.76E-6	8.52E-6

DAC (Y) = $3\text{E-}7$
 DAC-hr = 360 nCi
 DAC-hr = 2.57 mrem (ALI)
 DAC-hr = 3.27 mrem (h)

"Properly Based ALI/DAC"

ALI = 550 μCi
 DAC (Y) = $2.3\text{E-}07$
 DAC-hr = 276 nCi
 DAC-hr = 2.51 mrem (ALI)
 DAC-hr = 2.51 mrem (h)

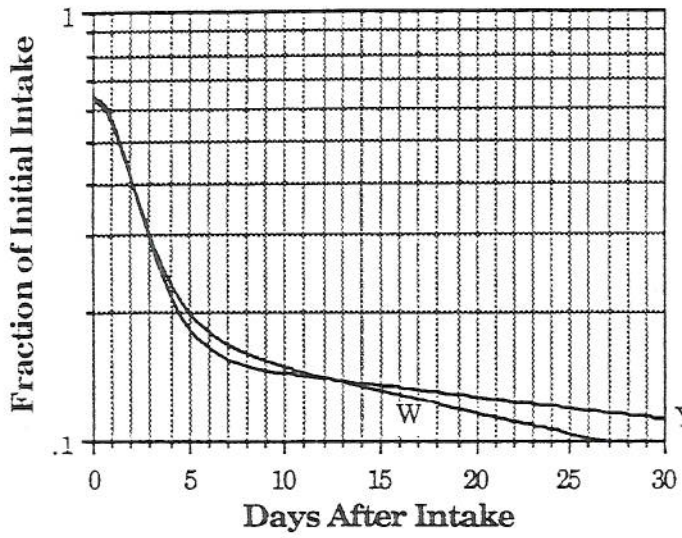
Misc. Data

T 1/2 = 270 d
 β 129
 γ 14.4 9.5%
 122.1 85.6%
 136.4 10.6%

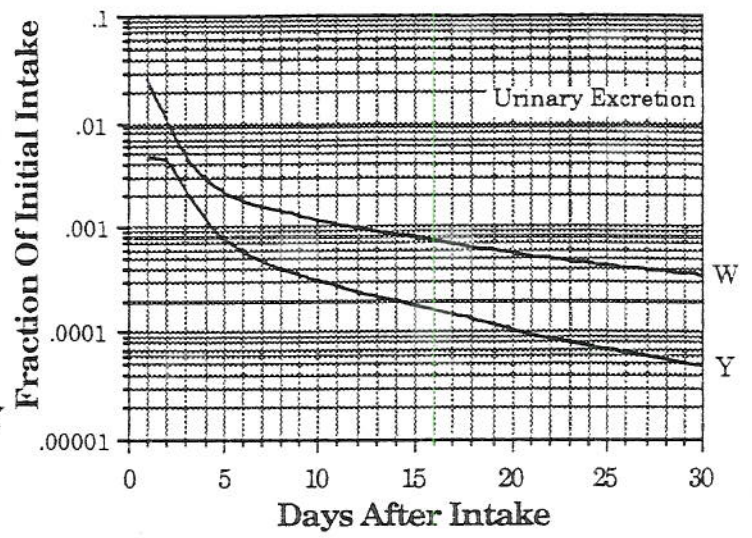
Γ = 65
 mR/hr per Ci at 1 meter

Ingestion Model
f1 is 0.05 for oxides, hydroxides f1 is 0.3 for others
h (.05) = 0.74 mrem/ μCi h (.3) = 1.18 mrem/ μCi
8% & 13% of the Y Class inhalation dose

Co-58 Retention Fractions



Co-58 Excretion Fractions



Notes

Co-58

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
Y	0.05	6.17E-10	9.37E-10	1.60E-08	9.23E-10	6.93E-10	8.72E-10	1.89E-09
CDE per μCi Inhaled =		2.3	3.5	59.2	3.4	2.6	3.2	7.0
CEDE per μCi Inhaled =		0.6	0.5	7.1	0.4	0.1	0.1	2.1

*Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	2.94E-09	460	845	7.1	704	700	800
	10.9	460	845 (Lung)				

Days	Whole Body Retention		Urinary Excretion	
	W	Y	W	Y
0.1	0.634	0.638		
0.2	0.629	0.637		
0.3	0.624	0.635		
0.4	0.618	0.632		
0.5	0.611	0.627		
0.6	0.604	0.621		
0.7	0.595	0.612		
0.8	0.584	0.602		
0.9	0.573	0.591		
1	0.560	0.577	2.56E-2	4.60E-3
2	0.415	0.416	1.08E-2	4.56E-3
3	0.300	0.288	4.99E-3	2.33E-3
4	0.233	0.217	2.94E-3	1.23E-3
5	0.197	0.181	2.16E-3	7.79E-4
6	0.178	0.164	1.79E-3	5.74E-4
7	0.166	0.154	1.56E-3	4.65E-4
8	0.159	0.149	1.40E-3	3.95E-4
9	0.153	0.145	1.27E-3	3.44E-4
10	0.148	0.143	1.15E-3	3.03E-4
20	0.116	0.126	5.47E-4	1.06E-4
30	9.27E-2	0.112	3.37E-4	4.84E-5
40	7.51E-2	0.100	2.46E-4	2.95E-5
50	6.10E-2	9.00E-2	1.94E-4	2.20E-5
60	4.98E-2	8.07E-2	1.58E-4	1.80E-5
70	4.07E-2	7.23E-2	1.29E-4	1.54E-5
80	3.33E-2	6.49E-2	1.06E-4	1.33E-5
90	2.73E-2	5.82E-2	8.77E-5	1.16E-5
100	2.25E-2	5.22E-2	7.23E-5	1.01E-5
200	3.70E-3	1.77E-2	1.04E-5	3.02E-6
300	8.29E-4	6.02E-3	1.60E-6	1.03E-6
400	2.37E-4	2.05E-3	2.93E-7	3.66E-7

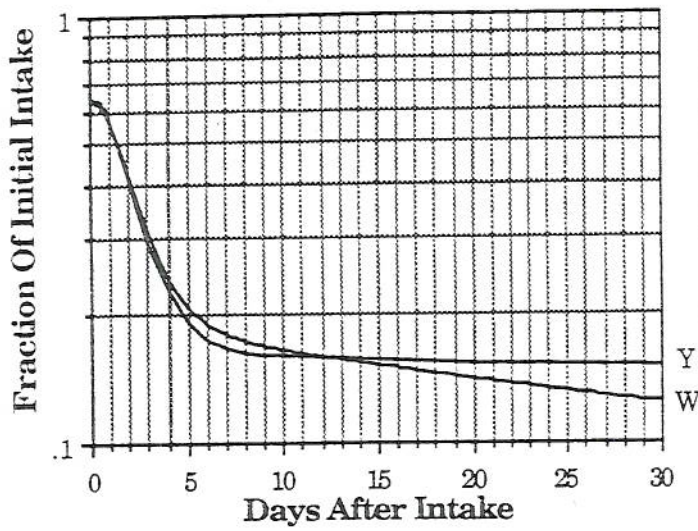
DAC (Y) = 3E-7
 DAC-hr = 360 nCi
 DAC-hr = 2.57 mrem (ALI)
 DAC-hr = 3.92 mrem (h)

"Properly Based ALI/DAC"
 ALI = 460 μCi
 DAC (Y) = 1.9E-07
 DAC-hr = 230 nCi
 DAC-hr = 2.50 mrem (ALI)
 DAC-hr = 2.51 mrem (h)

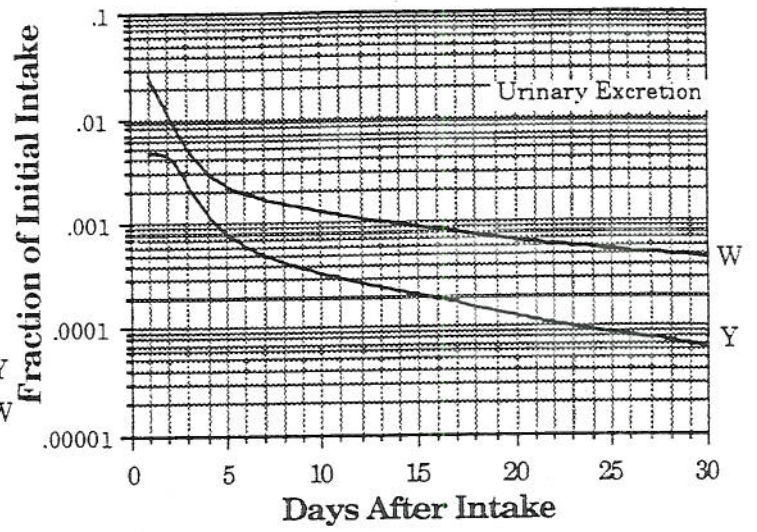
Misc Data		
T 1/2 =	70.8 d	
EC		85%
$\beta+$	474	15%
γ	511	30%
	810	100%
	864	0.69%
	1674.7	0.52%
Γ =	550	
mR/hr per Ci at 1 meter		

Ingestion Model	
f1	is 0.05 for oxides, hydroxides
f1	is 0.3 for others
h (.05)	= 2.99 mrem/ μCi
h (.3)	= 3.58 mrem/ μCi
27% & 33% of the Y Class inhalation dose	

Co-60 Retention Fractions



Co-60 Excretion Fractions



Notes

Co-60

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
Y	0.05	4.76E-09	1.84E-08	3.45E-07	1.72E-08	1.35E-08	1.62E-08	3.60E-08
CDE per μCi Inhaled =		17.6	68.1	1276.5	63.6	50.0	59.9	133.2
CEDE per μCi Inhaled =		4.4	10.2	153.2	7.6	1.5	1.8	40.0

*Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	5.91E-08	23	39	153.2	33	30	40

Days	Whole Body Retention		Urinary Excretion	
	W	Y	W	Y
0.1	0.635	0.639		
0.2	0.630	0.638		
0.3	0.626	0.637		
0.4	0.620	0.634		
0.5	0.614	0.630		
0.6	0.607	0.624		
0.7	0.599	0.617		
0.8	0.589	0.607		
0.9	0.578	0.596		
1	0.566	0.583	2.59E-2	4.64E-3
2	0.423	0.424	1.10E-2	4.64E-3
3	0.308	0.297	5.13E-3	2.40E-3
4	0.242	0.226	3.05E-3	1.28E-3
5	0.206	0.190	2.26E-3	8.17E-4
6	0.188	0.173	1.90E-3	6.08E-4
7	0.177	0.165	1.67E-3	4.97E-4
8	0.171	0.161	1.51E-3	4.26E-4
9	0.166	0.158	1.38E-3	3.74E-4
10	0.163	0.157	1.27E-3	3.33E-4
20	0.140	0.152	6.62E-4	1.28E-4
30	0.123	0.149	4.48E-4	6.43E-5
40	0.109	0.146	3.59E-4	4.30E-5
50	0.098	0.144	3.11E-4	3.52E-5
60	0.088	0.142	2.78E-4	3.17E-5
70	0.079	0.140	2.50E-4	2.97E-5
80	0.071	0.138	2.26E-4	2.83E-5
90	0.064	0.136	2.05E-4	2.70E-5
100	0.058	0.134	1.85E-4	2.60E-5
200	2.44E-2	1.17E-1	6.86E-5	1.99E-5
300	1.40E-2	1.02E-1	2.70E-5	1.74E-5
400	1.03E-2	8.92E-2	1.27E-5	1.59E-5

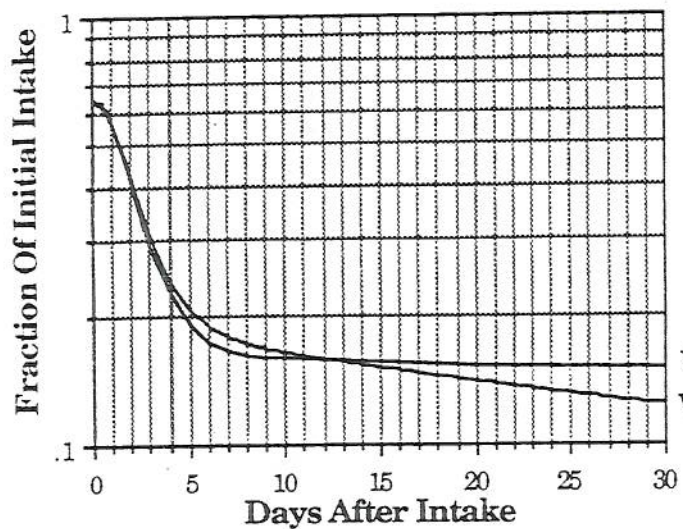
DAC (Y) = 1E-8
 DAC-hr = 12 nCi
 DAC-hr = 2.0 mrem (ALI)
 DAC-hr = 2.62 mrem (h)

"Properly Based ALI/DAC"
 ALI = 23 μCi
 DAC (Y) = 9.6E-09
 DAC-hr = 12 nCi
 DAC-hr = 2.50 mrem (ALI)
 DAC-hr = 2.52 mrem (h)

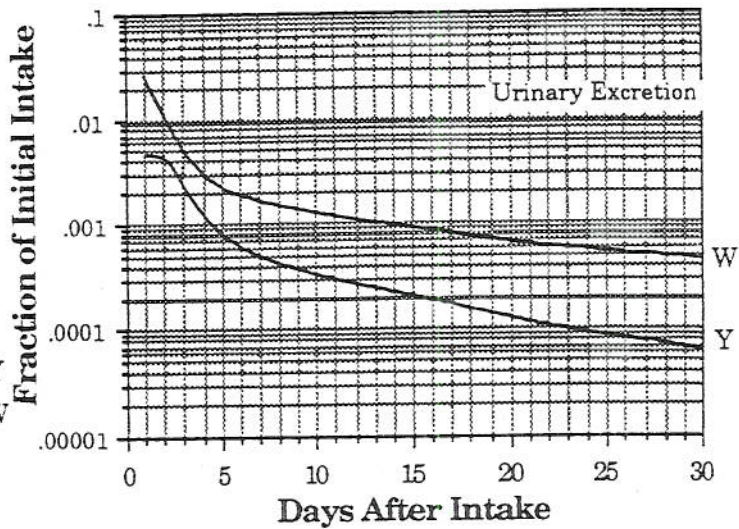
Misc Data
 T 1/2 = 5.27 y
 β^- 314
 γ 1173.2 100%
 1332.5 100%
 Γ = 1320
 mR/hr per Ci at 1 meter

Ingestion Model
f1 is 0.05 for oxides, hydroxides
f1 is 0.3 for others
h (.05) = 10.25 mrem/ μCi
h (.3) = 26.94 mrem/ μCi
5% & 12% of the Y Class inhalation dose

Co-60 Retention Fractions



Co-60 Excretion Fractions



Notes

Co-60

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
W	0.05	4.05E-09	4.16E-09	3.57E-08	4.25E-09	3.54E-09	3.72E-09	7.65E-09
CDE per μCi Inhaled =		15.0	15.4	132.1	15.7	13.1	13.8	28.3
CEDE per μCi Inhaled =		3.7	2.3	15.9	1.9	0.4	0.4	8.5

* Evaluation of W Class for Co-60

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	8.94E-09	151	379	29.4	170	200	400
	33.1	151	379 (Lung)				

Days	Whole Body Retention		Urinary Excretion	
	W Fract	Y Fract	W Fract	Y Fract
0.1	0.635	0.639		
0.2	0.630	0.638		
0.3	0.626	0.637		
0.4	0.620	0.634		
0.5	0.614	0.630		
0.6	0.607	0.624		
0.7	0.599	0.617		
0.8	0.589	0.607		
0.9	0.578	0.596		
1	0.566	0.583	2.59E-2	4.64E-3
2	0.423	0.424	1.10E-2	4.64E-3
3	0.308	0.297	5.13E-3	2.40E-3
4	0.242	0.226	3.05E-3	1.28E-3
5	0.206	0.190	2.26E-3	8.17E-4
6	0.188	0.173	1.90E-3	6.08E-4
7	0.177	0.165	1.67E-3	4.97E-4
8	0.171	0.161	1.51E-3	4.26E-4
9	0.166	0.158	1.38E-3	3.74E-4
10	0.163	0.157	1.27E-3	3.33E-4
20	0.140	0.152	6.62E-4	1.28E-4
30	0.123	0.149	4.48E-4	6.43E-5
40	0.109	0.146	3.59E-4	4.30E-5
50	0.098	0.144	3.11E-4	3.52E-5
60	0.088	0.142	2.78E-4	3.17E-5
70	0.079	0.140	2.50E-4	2.97E-5
80	0.071	0.138	2.26E-4	2.83E-5
90	0.064	0.136	2.05E-4	2.70E-5
100	0.058	0.134	1.85E-4	2.60E-5
200	2.44E-2	1.17E-1	6.86E-5	1.99E-5
300	1.40E-2	1.02E-1	2.70E-5	1.74E-5
400	1.03E-2	8.92E-2	1.27E-5	1.59E-5

DAC (W) = 7E-8
 DAC-hr = 84 nCi
 DAC-hr = 2.1 mrem (ALI)
 DAC-hr = 2.78 mrem (h)

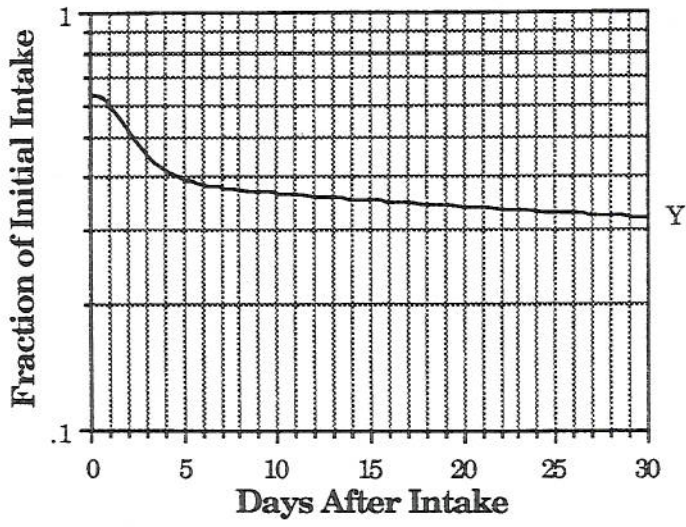
"Properly Based ALI/DAC"

ALI = 150 μCi
 DAC (W) = 6.3E-08
 DAC-hr = 76 nCi
 DAC-hr = 2.52 mrem (ALI)
 DAC-hr = 2.53 mrem (h)

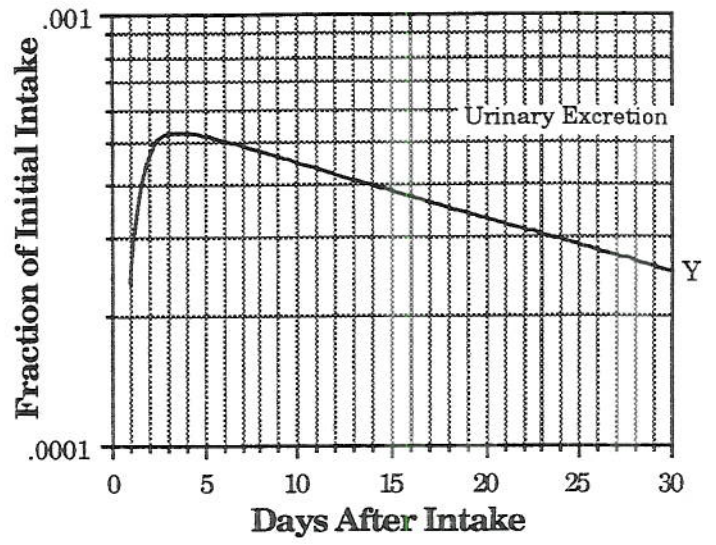
Misc Data
 T 1/2 = 5.27 y
 β^- = 314
 γ = 1173.2 100%
 = 1332.5 100%
 Γ = 1320
 mR/hr per Ci at 1 meter

Ingestion Model
f1 is 0.05 for oxides, hydroxides f1 is 0.3 for others
h (.05) = 10.25 mrem/ μCi h (.3) = 26.94 mrem/ μCi
31% & 81% of the W Class inhalation dose

Zn-65 Retention Fraction



Zn-65 Excretion Fraction



Notes

Zn-65

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
Y	0.5	2.03E-09	3.08E-09	2.10E-08	3.62E-09	3.36E-09	3.02E-09	4.66E-09
CDE per μCi Inhaled =		7.5	11.4	77.7	13.4	12.4	11.2	17.3
CEDE per μCi Inhaled =		1.9	1.7	9.3	1.6	0.4	0.3	5.2

*Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	5.51E-09	245	644	17.5	285	300	600
	20.4	245	644 (Lung)				

Days	Whole Body Retention	Urinary Excretion
	Y Fract	Y Fract
0.1	0.639	
0.2	0.639	
0.3	0.637	
0.4	0.636	
0.5	0.633	
0.6	0.630	
0.7	0.625	
0.8	0.620	
0.9	0.612	
1	0.605	2.36E-4
2	0.520	4.79E-4
3	0.454	5.25E-4
4	0.416	5.28E-4
5	0.396	5.20E-4
6	0.385	5.06E-4
7	0.378	4.93E-4
8	0.373	4.78E-4
9	0.369	4.64E-4
10	0.366	4.49E-4
20	0.340	3.32E-4
30	0.319	2.50E-4
40	0.301	1.92E-4
50	0.285	1.52E-4
60	0.272	1.23E-4
70	0.259	1.03E-4
80	0.247	8.84E-5
90	0.237	7.74E-5
100	0.227	6.95E-5
200	1.50E-1	3.78E-5
300	1.01E-1	2.47E-5
400	6.70E-2	1.63E-5

DAC (Y) = $1\text{E-}7$
 DAC-hr = 120 nCi
 DAC-hr = 2.0 mrem (ALI)
 DAC-hr = 2.45 mrem (h)

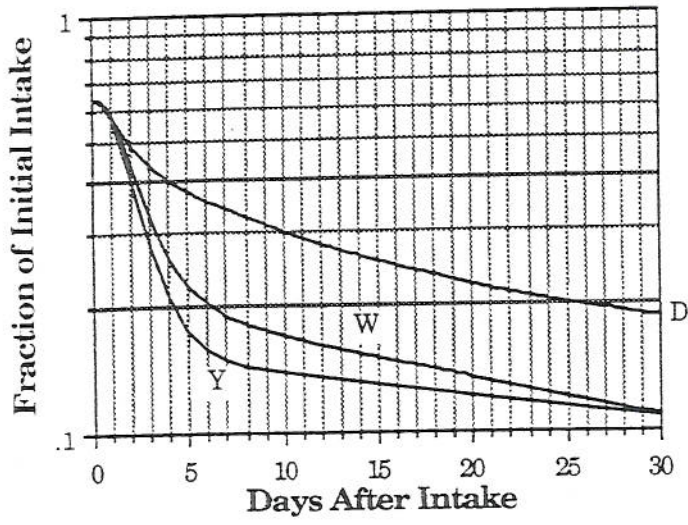
"Properly Based ALI/DAC"

ALI = $250 \mu\text{Ci}$
 DAC (Y) = $1.0\text{E-}07$
 DAC-hr = 120 nCi
 DAC-hr = 2.40 mrem (ALI)
 DAC-hr = 2.45 mrem (h)

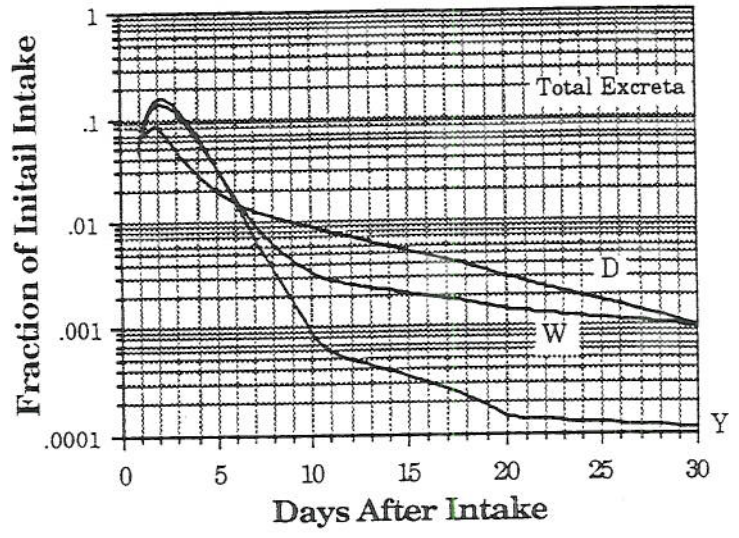
Misc Data
 T 1/2 = 243.8 d
 $\beta+$ 327
 γ 511 2.8%
 1115.5 50.8%
 Γ = 270
 mR/hr per Ci at 1 meter

Ingestion Model
f1 is 0.5 for all forms
h eff = $3.9\text{E-}9 \text{ Sv/Bq}$ $14.4 \text{ mrem}/\mu\text{Ci}$
70% of the Y Class inhalation dose

Zr-95 Retention Fractions



Zr-95 Excretion Fractions



Notes

Zr-95

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
D	2E-3	1.88E-09	1.91E-09	2.17E-09	1.30E-08	1.03E-07	1.44E-09	2.28E-09
CDE per μCi Inhaled =		7.0	7.1	8.0	48.1	381.1	5.3	8.4
CEDE per μCi Inhaled =		1.7	1.1	1.0	5.8	11.4	0.2	2.5

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	6.39E-09	211	131	18.9	264	300	100

Days	Whole Body Retention			Total Excreta			Y	f	f	f	f	f	f	f	f	f	f	f	
	D	W	Y	D	W	Y													
0.1	0.637	0.638	0.638																
0.2	0.635	0.637	0.638																
0.3	0.631	0.635	0.636																
0.4	0.625	0.632	0.633																
0.5	0.619	0.629	0.629																
0.6	0.611	0.624	0.623																
0.7	0.601	0.616	0.615																
0.8	0.593	0.608	0.605																
0.9	0.583	0.598	0.593																
1	0.574	0.588	0.581	5.89E-2	4.49E-2	5.16E-2													
2	0.487	0.445	0.417	7.96E-2	1.35E-1	1.57E-1													
3	0.434	0.328	0.286	4.87E-2	1.13E-1	1.27E-1													
4	0.401	0.259	0.213	2.91E-2	6.60E-2	7.06E-2													
5	0.376	0.221	0.175	1.98E-2	3.46E-2	3.46E-2													
6	0.356	0.201	0.158	1.54E-2	1.81E-2	1.62E-2													
7	0.341	0.188	0.148	1.28E-2	1.00E-2	7.65E-3													
8	0.325	0.180	0.143	1.12E-2	6.12E-3	3.67E-3													
9	0.313	0.174	0.14	9.90E-3	4.22E-3	1.84E-3													
10	0.300	0.169	0.138	8.81E-3	3.24E-3	8.93E-4													
20	0.222	0.134	0.121	2.94E-3	1.45E-3	1.45E-4													
30	0.184	0.109	0.107	9.95E-4	9.73E-4	1.13E-4													
40	0.159	0.091	0.096	3.40E-4	7.12E-4	9.46E-5													
50	0.141	0.076	0.085	1.21E-4	5.40E-4	8.21E-5													
60	0.127	0.063	0.076	4.73E-5	4.20E-4	7.23E-5													
70	0.113	0.054	0.067	2.19E-5	3.29E-4	6.40E-5													
80	0.102	0.045	0.06	1.29E-5	2.59E-4	5.67E-5													
90	0.091	0.039	0.054	9.27E-6	2.05E-4	5.02E-5													
100	0.082	0.033	0.048	7.54E-6	1.61E-4	4.44E-5													
200	2.80E-2	8.00E-3	0.015	2.43E-6	1.54E-5	1.36E-5													
300	1.00E-2	3.00E-3	0.005	8.28E-7	1.57E-6	4.12E-6													
400	3.00E-3	1.00E-3	0.001	2.82E-7	1.97E-7	1.25E-6													

DAC (D) = 5E-8
 DAC-hr = 60 nCi
 DAC-hr = 1.0 mrem (ALI)
 DAC-hr = 1.42 mrem (h)

"Recommended ALI/DAC"

(N)ALI = 130 μCi
 (S)ALI = 210 μCi
 DAC (Y) = 8.8E-08 *
 DAC-hr = 106 nCi
 DAC-hr = 2.52 mrem (ALI)
 DAC-hr = 2.51 mrem (h)

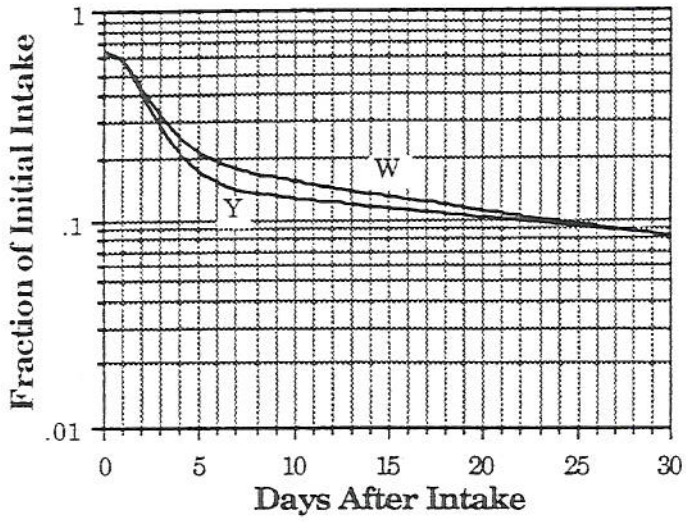
* Zr-95 limited to 1200 DAC-hrs/yr
 or 1000 DAC-hrs/yr to be conservative

Misc
 Data
 T 1/2 = 64.4 d
 β^- 396
 γ 724.2 44.2%
 756.7 54.8%
 Γ = 410
 mR/hr per Ci at 1 meter

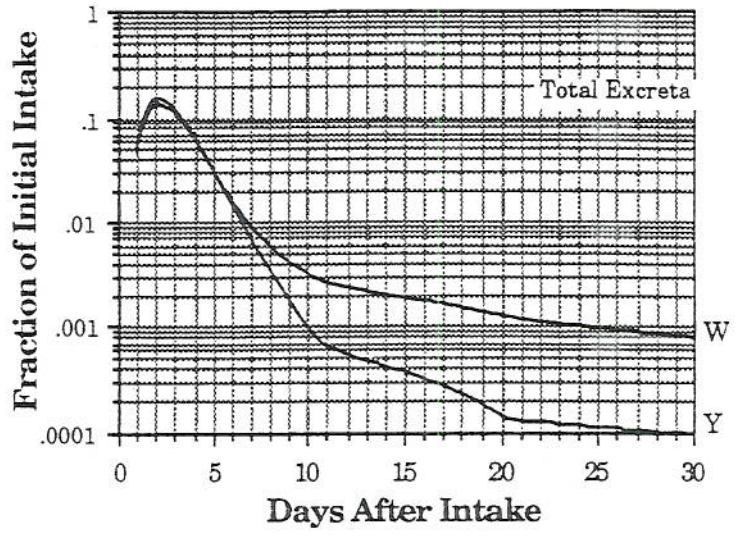
Ingestion Model
f ₁ is 0.002 for all forms
h eff = 1.02E-9 Sv/Bq 3.77 mrem/ μCi
16% of the D Class inhalation dose

Note: f - fecal excretion >90%

Nb-95 Retention Fractions



Nb-95 Excretion Fractions



Notes

Nb-95

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
Y	0.01	4.32E-10	4.07E-10	8.32E-09	4.42E-10	5.13E-10	3.58E-10	1.07E-09
CDE per μCi Inhaled =		1.6	1.5	30.8	1.6	1.9	1.3	4.0
CEDE per μCi Inhaled =		0.40	0.23	3.69	0.20	0.06	0.04	1.19

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	1.57E-09	862	1624	4.5	1107	1000	2000
	5.8	862	1624 (Lung)				

Days	Whole Body Retention		Total Excreta		f
	W Fract	Y Fract	W Fract	Y Fract	
0.1	0.637	0.638			
0.2	0.636	0.636			
0.3	0.633	0.634			
0.4	0.630	0.631			
0.5	0.626	0.626			
0.6	0.620	0.620			
0.7	0.612	0.611			
0.8	0.603	0.601			
0.9	0.593	0.589			
1	0.582	0.576	4.51E-2	5.10E-2	f
2	0.438	0.411	1.33E-1	1.53E-1	f
3	0.319	0.280	1.10E-1	1.22E-1	f
4	0.249	0.207	6.37E-2	6.76E-2	f
5	0.211	0.170	3.32E-2	3.29E-2	f
6	0.190	0.152	1.73E-2	1.55E-2	f
7	0.177	0.141	9.60E-3	7.24E-3	f
8	0.167	0.135	5.91E-3	3.49E-3	f
9	0.160	0.131	4.08E-3	1.77E-3	
10	0.154	0.127	3.13E-3	9.66E-4	
20	0.110	0.102	1.27E-3	1.44E-4	
30	0.082	0.083	7.90E-4	9.59E-5	
40	0.061	0.067	5.44E-4	7.23E-5	
50	0.046	0.055	3.89E-4	5.73E-5	
60	0.035	0.044	2.84E-4	4.61E-5	
70	0.026	0.036	2.08E-4	3.73E-5	
80	0.020	0.029	1.53E-4	3.02E-5	
90	0.015	0.024	1.13E-4	2.44E-5	
100	0.012	0.019	8.37E-5	1.98E-5	
200	8.79E-4	2.43E-3	4.65E-6	2.45E-6	
300	7.66E-5	3.07E-4	3.25E-8	3.02E-7	
400	7.17E-6	3.87E-5	2.50E-8		

DAC (Y) = 5E-7
 DAC-hr = 600 nCi
 DAC-hr = 3.0 mrem (ALI)
 DAC-hr = 3.48 mrem (h)

"Properly Based ALI/DAC"

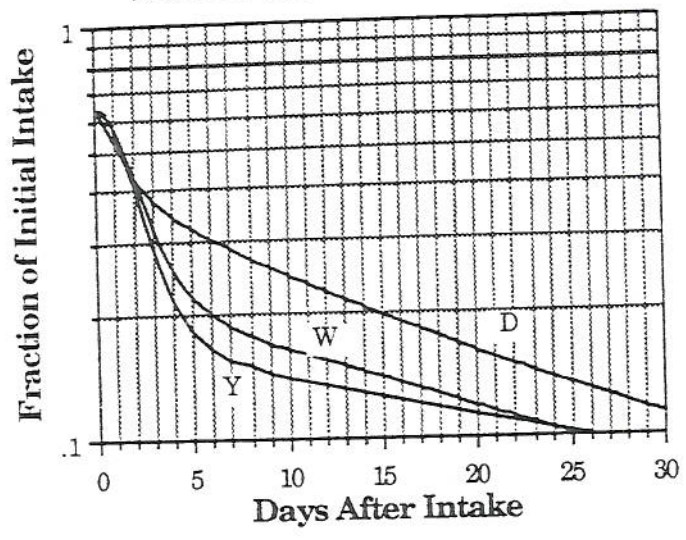
ALI = 860 μCi
 DAC (Y) = 3.6E-07
 DAC-hr = 432 nCi
 DAC-hr = 2.51 mrem (ALI)
 DAC-hr = 2.51 mrem (h)

Misc
 Data
 T 1/2 = 35.2 d
 β^- = 160
 γ = 765.8 99%
 Γ = 420
 mR/hr per Ci at 1 meter

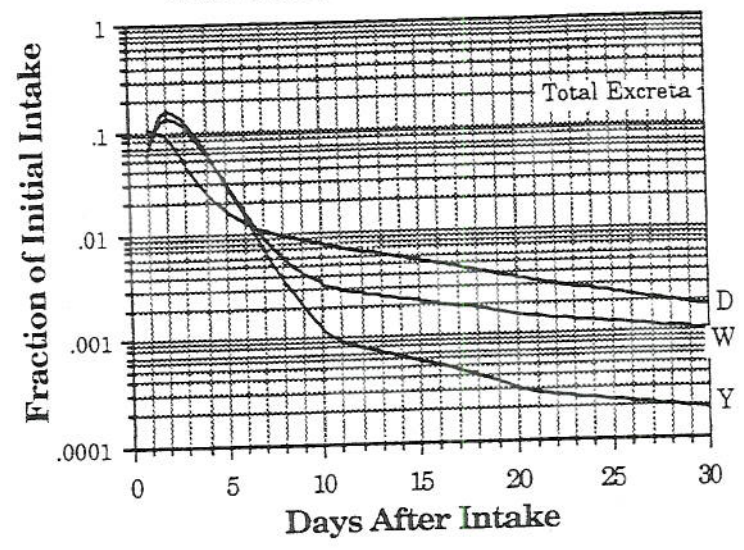
Ingestion Model
f1 is 0.01 for all forms
h eff = 6.95E-10 Sv/Bq 2.57 mrem/ μCi
44% of the Y Class inhalation dose

Note: f - fecal excretion >90%

Ru-103 Retention Fractions



Ru-103 Excretion Fractions



Notes

Ru-103

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
Y	0.05	3.07E-10	3.11E-10	1.56E-08	3.19E-10	2.37E-10	2.57E-10	1.25E-09
CDE per μCi Inhaled =		1.1	1.2	57.7	1.2	0.9	1.0	4.6
CEDE per μCi Inhaled =		0.3	0.2	6.9	0.1	0.0	0.0	1.4

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	2.42E-09	558	866	7.8	642	600	900

Days	Whole Body Retention			Total Excreta		
	D Fract	W Fract	Y Fract	D Fract	W Fract	Y Fract
0.1	0.631	0.636	0.638			
0.2	0.621	0.633	0.637			
0.3	0.611	0.629	0.635			
0.4	0.600	0.625	0.631			
0.5	0.588	0.62	0.626			
0.6	0.576	0.614	0.619			
0.7	0.563	0.606	0.611			
0.8	0.550	0.597	0.601			
0.9	0.538	0.586	0.590			
1	0.527	0.575	0.576	1.02E-1	5.34E-2	5.19E-2 f
2	0.430	0.435	0.416	8.71E-2	1.29E-1	f 1.50E-1
3	0.376	0.322	0.290	4.72E-2	1.05E-1	f 1.19E-1 f
4	0.343	0.254	0.219	2.59E-2	6.12E-2	f 6.57E-2 f
5	0.321	0.218	0.183	1.68E-2	3.21E-2	f 3.22E-2 f
6	0.302	0.198	0.165	1.28E-2	1.67E-2	1.54E-2 f
7	0.286	0.185	0.154	1.08E-2	9.37E-3	7.49E-3
8	0.271	0.176	0.148	9.47E-3	5.87E-3	3.75E-3
9	0.258	0.168	0.143	8.54E-3	4.15E-3	2.05E-3
10	0.246	0.163	0.139	7.80E-3	3.27E-3	1.25E-3
20	0.160	0.118	0.113	3.45E-3	1.56E-3	3.04E-4
30	0.112	8.74E-2	9.27E-2	1.71E-3	1.02E-3	1.84E-4
40	8.30E-2	6.54E-2	7.63E-2	9.47E-4	7.09E-4	1.25E-4
50	6.30E-2	4.95E-2	6.32E-2	5.74E-4	5.07E-4	9.15E-5
60	4.90E-2	3.77E-2	5.20E-2	3.66E-4	3.66E-4	6.98E-5
70	3.80E-2	2.88E-2	4.33E-2	2.46E-4	2.70E-4	5.45E-5
80	3.00E-2	2.20E-2	3.59E-2	1.69E-4	1.99E-4	4.32E-5
90	2.41E-2	1.69E-2	2.97E-2	1.17E-4	1.47E-4	3.44E-5
100	1.94E-2	1.31E-2	2.46E-2	8.20E-5	1.09E-4	2.78E-5
200	2.63E-3	1.18E-3	3.83E-3	3.44E-6	5.62E-6	3.77E-6
300	4.12E-4	1.45E-4	6.05E-4	3.25E-7	3.34E-7	5.69E-7
400	6.63E-5	2.13E-5	9.48E-5	4.69E-8	2.59E-9	8.75E-8

DAC (Y) = 3E-7
 DAC-hr = 360 nCi
 DAC-hr = 3.00 mrem (ALI)
 DAC-hr = 3.24 mrem (h)

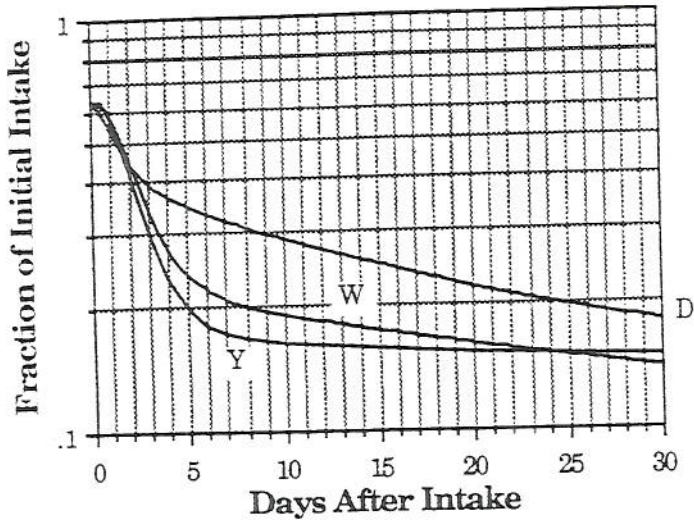
"Properly Based ALI/DAC"
 ALI = 560 μCi
 DAC (Y) = 2.3E-07
 DAC-hr = 276 nCi
 DAC-hr = 2.46 mrem (ALI)
 DAC-hr = 2.48 mrem (h)

Misc Data
 T 1/2 = 39.4 d
 β^- 210
 γ 497.1 86.4%
 610.3 5.3%
 Γ = 260
 mR/hr per Ci at 1 meter

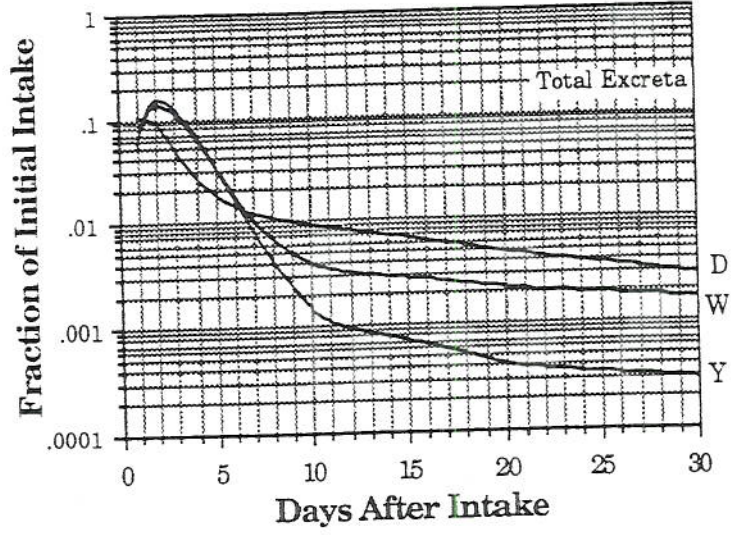
Ingestion Model
f1 is 0.05 for all forms
h eff = 8.24E-10 Sv/Bq 3.05 mrem/ μCi
34% of the Y Class inhalation dose

Note: f - fecal excretion >90%

Ru-106 Retention Fractions



Ru-106 Excretion Fractions



Notes

Ru-106

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
Y	0.05	1.30E-09	1.78E-09	1.04E-06	1.76E-09	1.61E-09	1.72E-09	1.20E-08
CDE per μCi Inhaled =		4.8	6.6	3848.0	6.5	6.0	6.4	44.4
CEDE per μCi Inhaled =		1.2	1.0	461.8	0.8	0.2	0.2	13.3

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	478.4	10	13	461.8	11	10	10

Days	Whole Body Retention			Total Excreta		
	D Fract	W Fract	Y Fract	D Fract	W Fract	Y Fract
0.1	0.632	0.637	0.639			
0.2	0.623	0.635	0.639			
0.3	0.614	0.632	0.638			
0.4	0.604	0.629	0.635			
0.5	0.592	0.624	0.631			
0.6	0.581	0.619	0.625			
0.7	0.569	0.612	0.618			
0.8	0.557	0.604	0.608			
0.9	0.546	0.594	0.598			
1	0.535	0.584	0.585	1.04E-1	5.42E-2	5.27E-2 f
2	0.443	0.449	0.429	8.99E-2	1.33E-1	f 1.54E-1 f
3	0.394	0.337	0.304	4.94E-2	1.10E-1	f 1.24E-1 f
4	0.365	0.271	0.233	2.76E-2	6.52E-2	f 7.00E-2 f
5	0.347	0.236	0.198	1.81E-2	3.47E-2	f 3.49E-2 f
6	0.331	0.218	0.181	1.40E-2	1.84E-2	1.69E-2 f
7	0.319	0.206	0.172	1.20E-2	1.05E-2	8.36E-3
8	0.307	0.199	0.167	1.07E-2	6.65E-3	4.25E-3
9	0.297	0.194	0.165	9.83E-3	4.78E-3	2.36E-3
10	0.288	0.19	0.163	9.13E-3	3.83E-3	1.46E-3
20	0.219	0.161	0.154	4.72E-3	2.14E-3	4.16E-4
30	0.180	0.14	0.148	2.74E-3	1.63E-3	2.94E-4
40	0.155	0.122	0.143	1.77E-3	1.33E-3	2.35E-4
50	0.138	0.108	0.138	1.26E-3	1.11E-3	2.00E-4
60	0.125	9.60E-2	0.133	9.38E-4	9.38E-4	1.79E-4
70	0.114	8.60E-2	0.130	7.37E-4	8.07E-4	1.63E-4
80	0.106	7.70E-2	0.126	5.90E-4	6.96E-4	1.51E-4
90	9.90E-2	6.90E-2	0.122	4.79E-4	6.02E-4	1.41E-4
100	9.30E-2	6.30E-2	0.118	3.93E-4	5.21E-4	1.33E-4
200	6.00E-2	2.70E-2	8.80E-2	7.89E-5	1.29E-4	8.65E-5
300	4.50E-2	1.60E-2	6.60E-2	3.57E-5	3.67E-5	6.25E-5
400	3.50E-2	1.10E-2	5.00E-2	2.47E-5	1.37E-6	4.60E-5

DAC (Y) = 5E-9
 DAC-hr = 6 nCi
 DAC-hr = 3.0 mrem (ALI)
 DAC-hr = 2.87 mrem (h)

"Properly Based ALI/DAC"
 ALI = 10 μCi
 DAC (Y) = 4.2E-09
 DAC-hr = 5 nCi
 DAC-hr = 2.50 mrem (ALI)
 DAC-hr = 2.39 mrem (h)

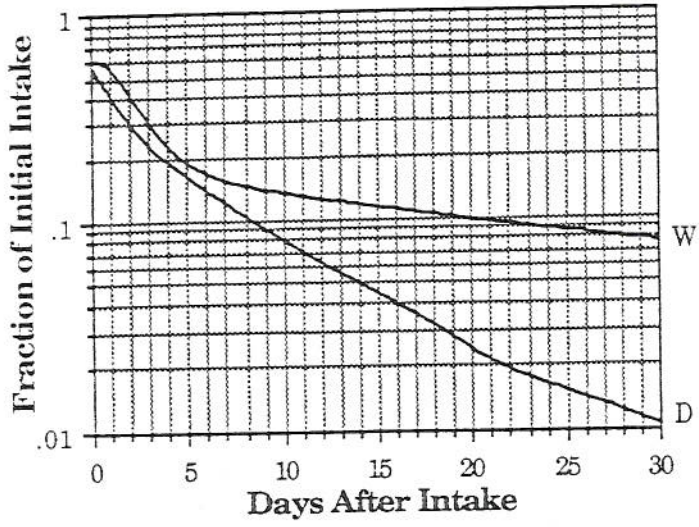
Misc Data
 T 1/2 = 368 d
 β^- = 3540
 γ = 511.8 20.6%
 621.8 9.8%
 1050.1 1.5%
 Γ = 170
 mR/hr per Ci at 1 meter

B, Gammas from Rh-106 daughters

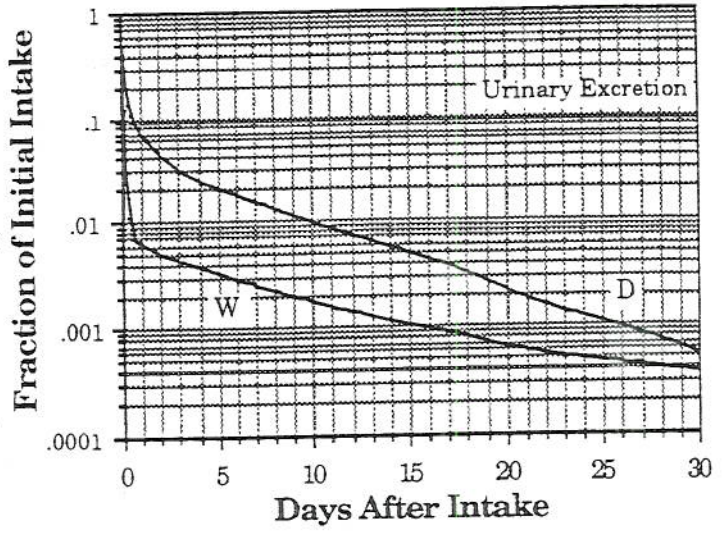
Ingestion Model
f _I is 0.05 for all forms
h eff = 7.40E-9 Sv/Bq 27.38 mrem/ μCi
6% of the Y Class inhalation dose

Note: f - fecal excretion >90%

Sb-124 Retention Fractions



Sb-124 Excretion Fractions



Notes

Sb-124

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
W	0.01	1.04E-09	8.94E-10	4.14E-08	1.09E-09	1.24E-09	6.74E-10	4.18E-09
CDE per μCi Inhaled =		3.8	3.3	153.2	4.0	4.6	2.5	15.5
CEDE per μCi Inhaled =		1.0	0.5	18.4	0.5	0.1	0.1	4.6

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	6.80E-09	199	326	20.8	240	200	300
	25.2	199	326 (Lung)				

Days	Whole Body Retention		Urinary Excretion	
	D	W	D	W
0.1	0.562	0.616	0.495	0.122
0.2	0.530	0.610	0.204	2.87E-2
0.3	0.511	0.607	0.135	1.13E-2
0.4	0.495	0.603	0.111	7.93E-3
0.5	0.480	0.600	9.90E-2	7.21E-3
0.6	0.465	0.594	9.10E-2	6.92E-3
0.7	0.449	0.586	8.40E-2	6.72E-3
0.8	0.435	0.578	7.80E-2	6.51E-3
0.9	0.421	0.568	7.30E-2	6.32E-3
1	0.406	0.557	6.90E-2	6.15E-3
2	0.294	0.414	4.20E-2	4.96E-3
3	0.229	0.296	3.00E-2	4.25E-3
4	0.188	0.225	2.40E-2	3.70E-3
5	0.160	0.187	2.00E-2	3.24E-3
6	0.137	0.166	1.74E-2	2.84E-3
7	0.119	0.153	1.50E-2	2.50E-3
8	0.103	0.145	1.29E-2	2.21E-3
9	9.00E-2	0.138	1.11E-2	1.96E-3
10	7.90E-2	0.133	9.53E-3	1.74E-3
20	2.40E-2	9.80E-2	2.17E-3	6.52E-4
30	1.05E-2	7.60E-2	5.21E-4	3.60E-4
40	6.68E-3	6.00E-2	1.46E-4	2.54E-4
50	5.11E-3	4.70E-2	5.78E-5	1.96E-4
60	4.14E-3	3.70E-2	3.37E-5	1.57E-4
70	3.42E-3	2.90E-2	2.48E-5	1.26E-4
80	2.84E-3	2.30E-2	1.99E-5	1.01E-4
90	2.36E-3	1.80E-2	1.64E-5	8.13E-5
100	1.96E-3	1.41E-2	1.36E-5	6.55E-5
200	3.09E-4	1.28E-3	2.14E-6	7.09E-6
300	4.84E-5	1.19E-4	3.38E-7	7.44E-7
400	7.65E-6	1.16E-5	5.31E-8	7.87E-8

DAC (W) = 1E-7
 DAC-hr = 120 nCi
 DAC-hr = 3.0 mrem (ALI)
 DAC-hr = 3.02 mrem (h)

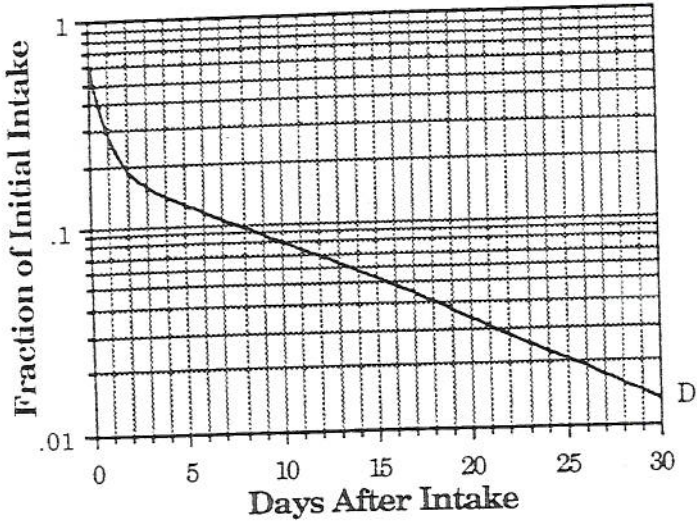
"Properly Based ALI/DAC"

ALI = 200 μCi
 DAC (W) = 8.3E-08
 DAC-hr = 100 nCi
 DAC-hr = 2.50 mrem (ALI)
 DAC-hr = 2.52 mrem (h)

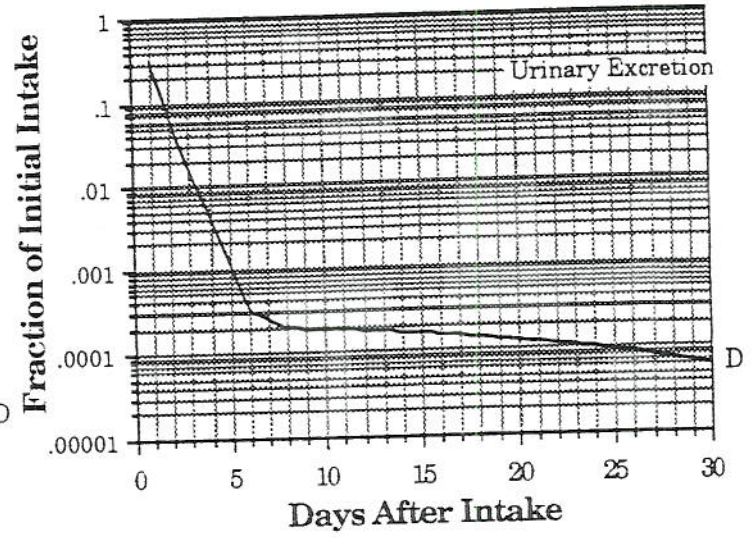
Misc Data
 T 1/2 = 60.2 d
 β^- 2310
 γ 602.7 98.1%
 645.8 7.2%
 722.8 11.8%
 968.2 1.9%
 1045.1 1.9%
 1325.5 1.5%
 1368.2 2.6%
 1691 50.0%
 2091.2 6.0%
 Γ = 980
 mR/hr per Ci at 1 meter

Ingestion Model
f1 is 0.01 for all forms
h eff = 2.74E-9 Sv/Bq 10.14 mrem/ μCi
40% of the W Class inhalation dose

I-131 Retention Fraction



I-131 Excretion Fraction



Notes

I-131

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
D	1.0	2.53E-11	7.88E-11	6.57E-10	6.26E-11	5.73E-11	2.92E-07	8.03E-11
CDE per μCi Inhaled =		0.1	0.3	2.4	0.2	0.2	1080.4	0.3
CEDE per μCi Inhaled =		0.0	0.0	0.3	0.0	0.0	32.4	0.1

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	8.89E-09	152	46	32.4	154	200	50
	32.9	152	46 (Thy)				

Days	Whole Body Retention D Fract
0.1	0.584
0.2	0.521
0.3	0.468
0.4	0.425
0.5	0.388
0.6	0.357
0.7	0.331
0.8	0.309
0.9	0.290
1	0.274
2	0.187
3	0.155
4	0.137
5	0.125
6	0.114
7	0.104
8	9.55E-2
9	8.74E-2
10	8.00E-2
20	3.27E-2
30	1.32E-2
40	5.29E-3
50	2.11E-3
60	8.42E-4
70	3.35E-4
80	1.33E-4
90	5.30E-5
100	2.11E-5

Days	Urinary Excretion D Fract
1	3.04E-1
2	6.24E-2
3	1.62E-2
4	4.47E-3
5	1.31E-3
6	3.29E-4
7	2.53E-4
8	2.01E-4
9	1.90E-4
10	1.88E-4
20	1.27E-4
30	6.25E-5
40	2.77E-5
50	1.16E-5
60	4.78E-6
70	1.93E-6
80	7.76E-7
90	3.11E-7
100	1.24E-7

DAC (D) = $2\text{E}-8$
 DAC-hr = 24 nCi
 DAC-hr = 0.6 mrem (ALI)
 DAC-hr = 0.8 mrem (h)

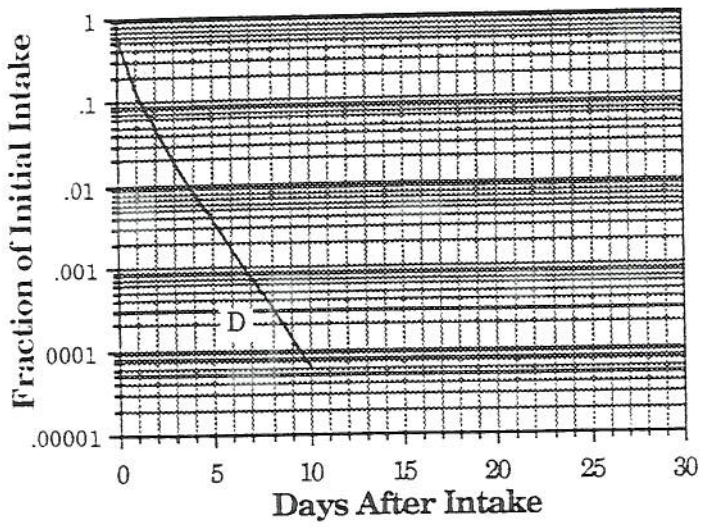
"Recommended ALI/DAC"
 (N)ALI = 46 μCi
 (S)ALI = 150 μCi
 DAC (D) = $6.3\text{E}-08$ *
 DAC-hr = 76 nCi
 DAC-hr = 2.52 mrem (ALI)
 DAC-hr = 2.49 mrem (h)

* I-131 limited to 600 DAC-hrs/yr
 or 500 DAC-hrs/yr to be conservative

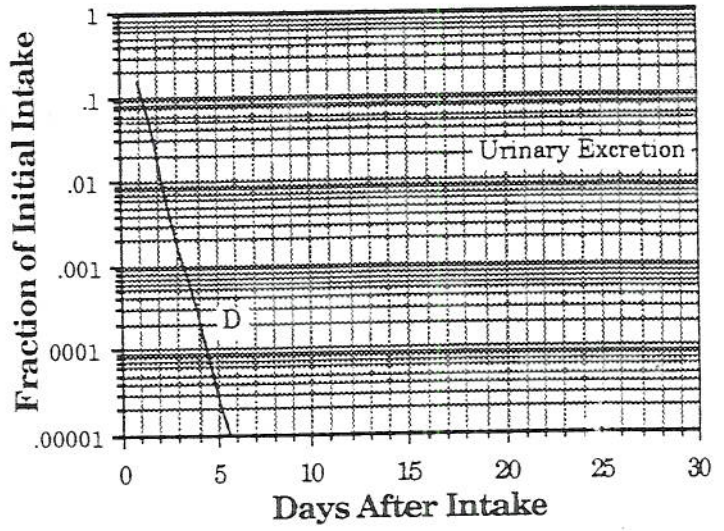
Misc Data		
T 1/2 =	8.04 d	
β^-	606	
γ	80.2	2.6%
	284.3	6.1%
	364.5	81.2%
	637	7.3%
	722.9	1.8%
$\Gamma =$	220	
mR/hr per Ci at 1 meter		

Ingestion Model
f1 is 1.0 for all forms
h eff = $1.44\text{E}-8$ Sv/Bq 53.28 mrem/ μCi
162% of the D Class inhalation dose

I-133 Retention Fraction



I-133 Excretion Fraction



Notes

I-133

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
D	1.0	1.95E-11	2.94E-11	8.20E-10	2.72E-11	2.52E-11	4.86E-08	5.00E-11
CDE per μCi Inhaled =		0.1	0.1	3.0	0.1	0.1	179.8	0.2
CEDE per μCi Inhaled =		0.0	0.0	0.4	0.0	0.0	5.4	0.1

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	1.58E-09	853	278	5.4	927	900	300
	5.9	853	278				(Thy)

Whole Body Retention
D

Days	Fract
0.1	0.544
0.2	0.452
0.3	0.378
0.4	0.319
0.5	0.272
0.6	0.233
0.7	0.201
0.8	0.175
0.9	0.153
1	0.134
2	4.49E-2
3	1.82E-2
4	7.93E-3
5	3.52E-3
6	1.58E-3
7	7.08E-4
8	3.17E-4
9	1.42E-4
10	6.39E-5
20	2.08E-8

Urinary Excretion
D
Fract

1.49E-1
1.50E-2
1.90E-3
2.58E-4
3.71E-5
4.55E-6
1.76E-6
6.69E-7
3.10E-7
1.50E-7

DAC (D) = $1\text{E}-7$
 DAC-hr = 120 nCi
 DAC-hr = 0.67 mrem (ALI)
 DAC-hr = 0.71 mrem (h)

"Recommended ALI/DAC"

(N)ALI = 280 μCi

(S)ALI = 850 μCi

DAC (D) = $3.5\text{E}-07$ *

DAC-hr = 420 nCi

DAC-hr = 2.47 mrem (ALI)

DAC-hr = 2.48 mrem (h)

* I-133 limited to 600 DAC-hrs/yr
 or 500 DAC-hrs/yr to be conservative

Misc

Data

T 1/2 = 20.3 h

β^- 1270

γ 529.5 87.5%

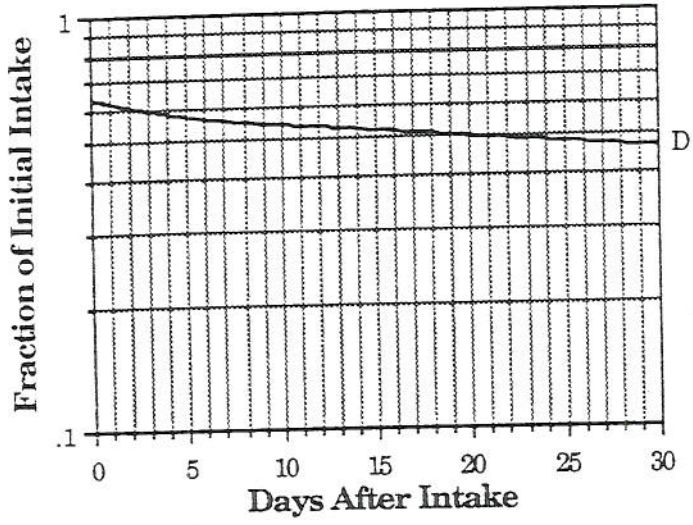
875.3 4.6%

Γ = 260

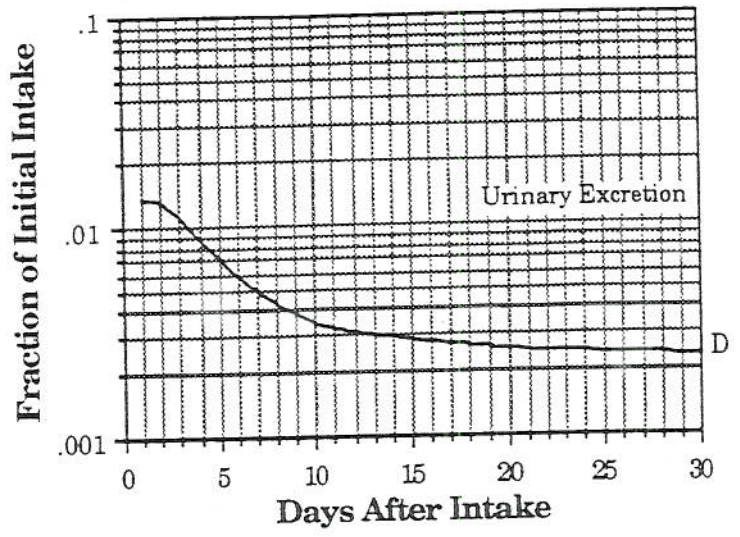
mR/hr per Ci at 1 meter

Ingestion Model
f1 is 1.0 for all forms
h eff = $2.80\text{E}-9$ Sv/Bq 10.36 mrem/ μCi
176% of the D Class inhalation dose

Cs-134 Retention Fraction



Cs-134 Excretion Fraction



Notes

Cs-134

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
D	1.0	1.30E-08	1.08E-08	1.18E-08	1.18E-08	1.10E-08	1.11E-08	1.39E-08
CDE per μCi Inhaled =		48.1	40.0	43.7	43.7	40.7	41.1	51.4
CEDE per μCi Inhaled =		12.0	6.0	5.2	5.2	1.2	1.2	15.4

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	1.25E-08	108	972	46.4	108	100	1000
			(SI Wall)				

Days	Whole Body Retention	Urinary Excretion
	D Fract	D Fract
0.1	0.638	
0.2	0.636	
0.3	0.635	
0.4	0.633	
0.5	0.631	
0.6	0.629	
0.7	0.628	
0.8	0.626	
0.9	0.623	
1	0.621	1.35E-2
2	0.605	1.33E-2
3	0.590	1.10E-2
4	0.579	8.84E-3
5	0.569	7.13E-3
6	0.561	5.86E-3
7	0.554	4.95E-3
8	0.549	4.29E-3
9	0.543	3.82E-3
10	0.539	3.48E-3
20	0.499	2.54E-3
30	0.464	2.34E-3
40	0.432	2.19E-3
50	0.402	2.03E-3
60	0.374	1.89E-3
70	0.348	1.76E-3
80	0.323	1.64E-3
90	0.301	1.52E-3
100	0.280	1.41E-3
200	1.36E-1	6.88E-4
300	6.60E-2	3.34E-4
400	3.20E-2	1.63E-4

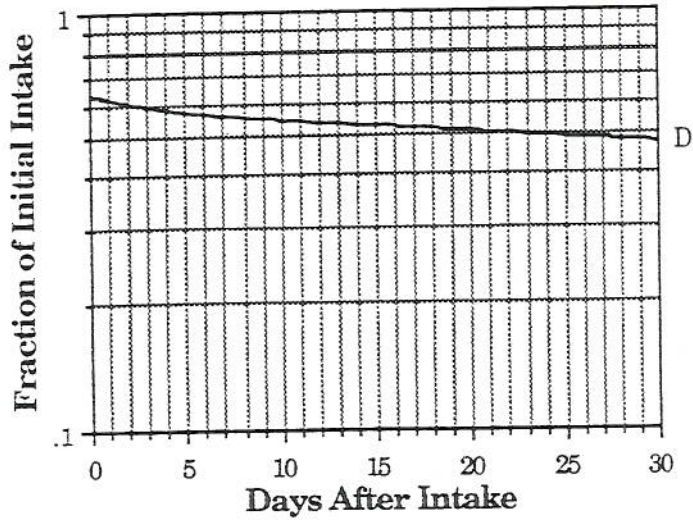
DAC (D) = 4E-8
 DAC-hr = 48 nCi
 DAC-hr = 2.4 mrem (ALI)
 DAC-hr = 2.23 mrem (h)

"Properly Based ALI/DAC"
 ALI = 110 μCi
 DAC (D) = 4.6E-08
 DAC-hr = 55 nCi
 DAC-hr = 2.51 mrem (ALI)
 DAC-hr = 2.56 mrem (h)

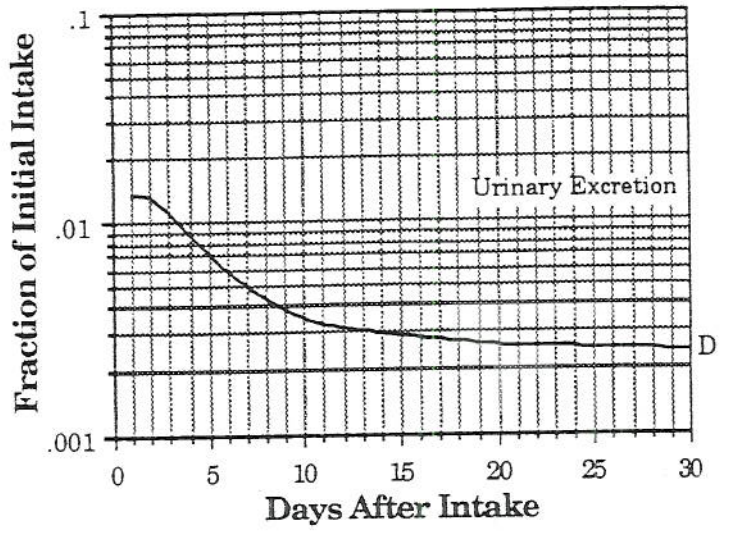
Misc Data
 T 1/2 = 2.06 y
 β^- 662
 γ 563.3 8.4%
 569.3 15.4%
 604.7 97.6%
 795.8 85.4%
 801.8 8.7%
 1167.9 1.8%
 1365.1 3.0%
 Γ = 870
 mR/hr per Ci at 1 meter

Ingestion Model
f1 is 1.0 for all forms
h eff = 1.98E-8 Sv/Bq 73.26 mrem/ μCi
158% of the D Class inhalation dose

Cs-137 Retention Fraction



Cs-137 Excretion Fraction



Notes

Cs-137

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
D	1.0	8.76E-09	7.84E-09	8.82E-09	8.30E-09	7.94E-09	7.93E-09	9.12E-09
CDE per μCi Inhaled =		32.4	29.0	32.6	30.7	29.4	29.3	33.7
CEDE per μCi Inhaled =		8.1	4.4	3.9	3.7	0.9	0.9	10.1

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	8.63E-09	157	1482	31.9	157	200	1000

(SI Wall)

Days	Whole Body Retention		Urinary Excretion	
	D	Fract	D	Fract
0.1	0.638			
0.2	0.636			
0.3	0.635			
0.4	0.633			
0.5	0.631			
0.6	0.629			
0.7	0.628			
0.8	0.626			
0.9	0.624			
1	0.622		1.35E-2	
2	0.606		1.33E-2	
3	0.592		1.10E-2	
4	0.581		8.87E-3	
5	0.572		7.16E-3	
6	0.564		5.89E-3	
7	0.558		4.97E-3	
8	0.553		4.32E-3	
9	0.548		3.85E-3	
10	0.543		3.51E-3	
20	0.508		2.59E-3	
30	0.476		2.41E-3	
40	0.447		2.26E-3	
50	0.419		2.12E-3	
60	0.394		1.99E-3	
70	0.369		1.87E-3	
80	0.347		1.75E-3	
90	0.325		1.64E-3	
100	0.305		1.54E-3	
200	0.161		8.16E-4	
300	8.55E-2		4.32E-4	
400	4.52E-2		2.29E-4	

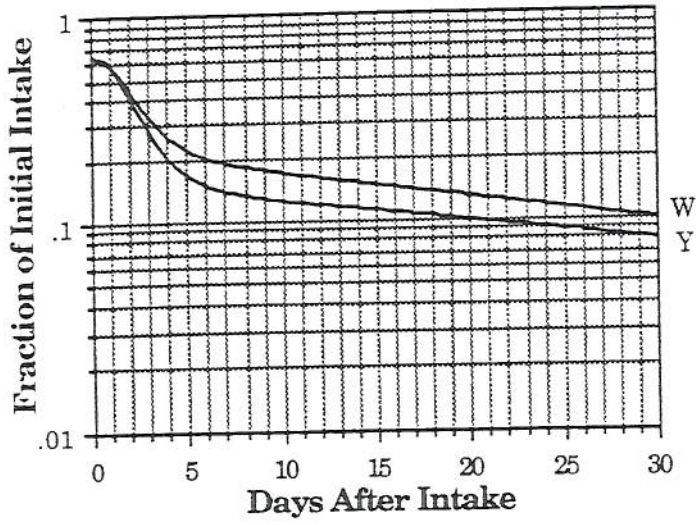
DAC (D) = 6E-8
 DAC-hr = 72 nCi
 DAC-hr = 1.8 mrem (ALI)
 DAC-hr = 2.3 mrem (h)

"Properly Based ALI/DAC"
 ALI = 160 μCi
 DAC (D) = 6.7E-08
 DAC-hr = 80 nCi
 DAC-hr = 2.51 mrem (ALI)
 DAC-hr = 2.57 mrem (h)

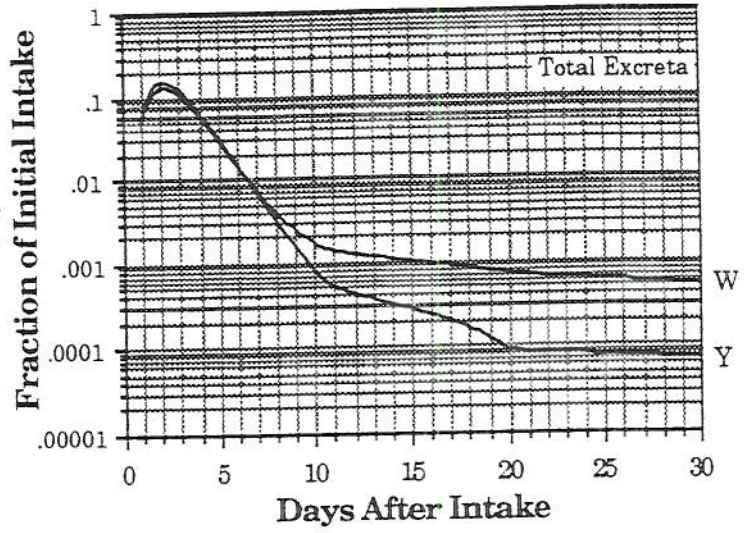
Misc
 Data
 T 1/2 = 30.1 y
 β^- = 514
 γ = 661.6 84.6%
 Γ = 330
 mR/hr per Ci at 1 meter

Ingestion Model
f1 is 1.0 for all forms
h eff = 1.35E-8 Sv/Bq 50 mrem/ μCi
157% of the D Class inhalation dose

Ce-141 Retention Fractions



Ce-141 Excretion Fractions



Notes

Ce-141

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
Y	3E-4	5.54E-11	4.46E-11	1.67E-08	8.96E-11	2.54E-10	2.55E-11	1.26E-09
CDE per μCi Inhaled =		0.2	0.2	61.8	0.3	0.9	0.1	4.7
CEDE per μCi Inhaled =		0.05	0.02	7.41	0.04	0.03	0.00	1.40

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule	10% Rule	(S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	2.42E-09	558	809	h eff	(S)ALI	(S)ALI	(N)ALI	
	9.0	558	809	8.3	601	600	800	(Lung)

Days	Whole Body Retention		Total Excreta		f	f
	W	Y	W	Y		
0.1	0.638	0.638				
0.2	0.636	0.636				
0.3	0.634	0.634				
0.4	0.631	0.631				
0.5	0.627	0.626				
0.6	0.621	0.619				
0.7	0.614	0.611				
0.8	0.606	0.600				
0.9	0.596	0.588				
1	0.584	0.575	f	4.13E-2	5.10E-2	f
2	0.442	0.409	f	1.30E-1	1.54E-1	f
3	0.326	0.277	f	1.07E-1	1.23E-1	f
4	0.258	0.204	f	6.10E-2	6.76E-2	f
5	0.222	0.167	f	3.07E-2	3.27E-2	f
6	0.202	0.148	f	1.50E-2	1.52E-2	f
7	0.190	0.138	f	7.57E-3	7.00E-3	f
8	0.182	0.132	f	4.09E-3	3.27E-3	f
9	0.176	0.127	f	2.46E-3	1.58E-3	f
10	0.170	0.124	f	1.68E-3	7.96E-4	f
20	0.129	0.099	f	7.18E-4	8.91E-5	f
30	0.099	0.079	f	5.07E-4	7.06E-5	f
40	0.076	0.063	f	3.57E-4	5.63E-5	f
50	0.059	0.051	f	2.52E-4	4.48E-5	f
60	0.046	0.041	f	1.78E-4	3.58E-5	f
70	0.036	0.033	f	1.26E-4	2.85E-5	f
80	0.028	0.026	f	8.92E-5	2.27E-5	f
90	0.022	0.021	f	6.32E-5	1.81E-5	f
100	0.017	0.017	f	4.48E-5	1.44E-5	f
200	1.73E-3	1.82E-3		1.57E-6	1.50E-6	f
300	1.94E-4	1.99E-4		7.45E-8		
400	2.23E-5	2.18E-5				

DAC (Y) = 2E-7
 DAC-hr = 240 nCi
 DAC-hr = 2.0 mrem (ALI)
 DAC-hr = 2.16 mrem (h)

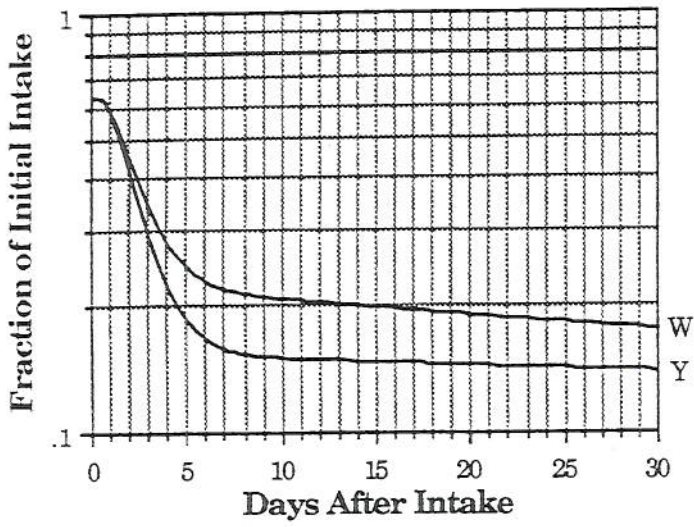
"Properly Based ALI/DAC"
 ALI = 560 μCi
 DAC (Y) = 2.3E-07
 DAC-hr = 276 nCi
 DAC-hr = 2.46 mrem (ALI)
 DAC-hr = 2.48 mrem (h)

Misc
 Data
 T 1/2 = 32.4 d
 β - 581
 γ 145.5 48%
 Γ = 35
 mR/hr per Ci at 1 meter

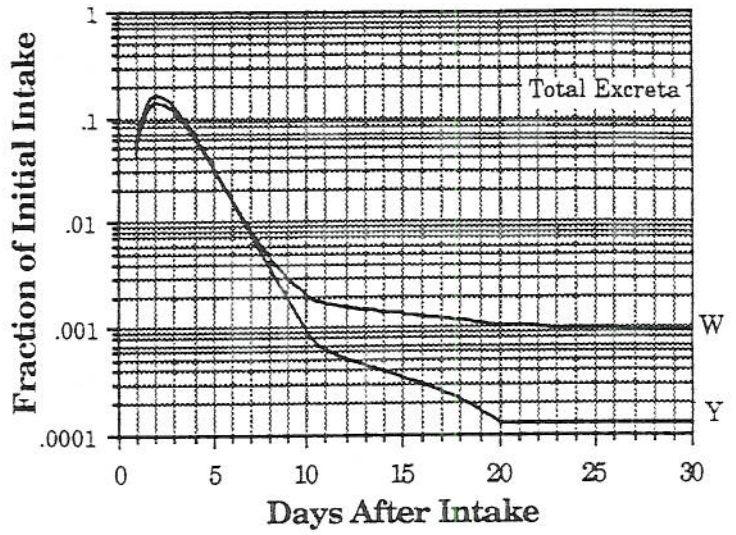
Ingestion Model
f1 is 3E-04 for all forms
h eff = 7.83E-10 Sv/Bq 2.90 mrem/ μCi
32% of the Y Class inhalation dose

Note: f - fecal excretion >90%

Ce-144 Retention Fractions



Ce-144 Excretion Fractions



Notes

Ce-144

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
Y	3E-4	2.39E-10	3.48E-10	7.91E-07	2.88E-09	4.72E-09	2.92E-10	1.91E-08
CDE per μCi Inhaled =		0.9	1.3	2926.7	10.7	17.5	1.1	70.7
CEDE per μCi Inhaled =		0.2	0.2	351.2	1.3	0.5	0.0	21.2

*Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	1.01E-07	13	17	351.2	14	10	20
	374.7	13	17 (Lung)				

Days	Whole Body Retention		Total Excreta	
	W Fract	Y Fract	W Fract	Y Fract
0.1	0.639	0.639		
0.2	0.639	0.639		
0.3	0.638	0.638		
0.4	0.636	0.635		
0.5	0.633	0.632		
0.6	0.629	0.626		
0.7	0.623	0.619		
0.8	0.615	0.609		
0.9	0.606	0.598		
1	0.596	0.586	f 4.20E-2	5.20E-2 f
2	0.459	0.424	f 1.35E-1	1.60E-1 f
3	0.345	0.293	f 1.13E-1	1.30E-1 f
4	0.278	0.220	f 6.58E-2	7.29E-2 f
5	0.244	0.183	f 3.37E-2	3.60E-2 f
6	0.226	0.166	f 1.68E-2	1.70E-2 f
7	0.217	0.157	f 8.64E-3	7.99E-3 f
8	0.212	0.153	f 4.75E-3	3.81E-3 f
9	0.208	0.151	f 2.91E-3	1.87E-3 f
10	0.206	0.150	f 2.03E-3	9.62E-4 f
20	0.189	0.144	f 1.05E-3	1.29E-4 f
30	0.175	0.139	f 8.93E-4	1.24E-4 f
40	0.163	0.135	f 7.61E-4	1.19E-4 f
50	0.152	0.130	f 6.49E-4	1.14E-4 f
60	0.142	0.126	f 5.55E-4	1.10E-4 f
70	0.134	0.122	f 4.73E-4	1.06E-4 f
80	0.126	0.118	f 4.04E-4	1.02E-4 f
90	0.120	0.114	f 3.46E-4	9.91E-5 f
100	0.113	0.110	f 2.96E-4	9.55E-5 f
200	7.58E-2	7.95E-2	6.85E-5	6.54E-5 f
300	5.60E-2	5.75E-2	2.16E-5	4.49E-5 f
400	4.26E-2	4.17E-2	1.05E-5	3.08E-5 f

DAC (Y) = 6E-9
 DAC-hr = 7.2 nCi
 DAC-hr = 3.6 mrem (ALI)
 DAC-hr = 2.7 mrem (h)

"Properly Based ALI/DAC"

ALI = 13 μCi
 DAC (Y) = 5.4E-09
 DAC-hr = 6 nCi
 DAC-hr = 2.49 mrem (ALI)
 DAC-hr = 2.43 mrem (h)

Misc
 Data
 T 1/2 = 284.2 d
 β^- 310
 γ 80.1 1.6%
 133.5 10.8%
 $\Gamma = 40$
 mR/hr per Ci at 1 meter

Ingestion Model
f1 is 3E-04 for all forms
h eff = 5.68E-9 Sv/Bq 21.0 mrem/ μCi
6% of the Y Class inhalation dose

Note: f - fecal excretion >90%

Rb-88

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
D	1.0	1.31E-12	1.43E-12	1.47E-10	1.45E-12	1.47E-12	1.37E-12	1.38E-11
CDE per μCi Inhaled =		0.00	0.01	0.54	0.01	0.01	0.01	0.05
CEDE per μCi Inhaled =		0.001	0.001	0.065	0.001	0.000	0.000	0.015

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule	10% Rule	(S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	2.26E-11	59844	91929	h eff	(S)ALI	(S)ALI	(N)ALI	
	0.084	59844	91929	0.079	63317	60000	90000	(Lung)

Days	Whole Body Retention	Urinary Excretion
	D	D
	Fract	Fract
0.1	2.35E-3	
0.2	8.59E-6	
0.3	3.15E-8	
0.4		
0.5		
0.6		
0.7		
0.8		
0.9		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
20		
30		
40		
50		
60		
70		
80		
90		
100		
200		
300		
400		

DAC (D) = $3\text{E}-5$
 DAC-hr = 36000 nCi
 DAC-hr = 3.00 mrem (ALI)
 DAC-hr = 2.88 mrem (h)

"Properly Based ALI/DAC"
 ALI = 60000 μCi
 DAC (D) = $2.5\text{E}-05$
 DAC-hr = 30000 nCi
 DAC-hr = 2.50 mrem (ALI)
 DAC-hr = 2.52 mrem (h)

Misc Data
 T 1/2 = 17.8 m
 β^- 5300
 γ 898 14.5%
 1836 22.1%
 2678 2.0%

Γ = 320
 mR/hr per Ci at 1 meter

Cs-138

(All CDE and CEDE in mrem; ALI's in μCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
D	1.0	3.28E-12	4.02E-12	1.59E-10	3.95E-12	3.55E-12	3.57E-12	2.06E-11
CDE per μCi Inhaled =		0.012	0.015	0.588	0.015	0.013	0.013	0.076
CEDE per μCi Inhaled =		0.0030	0.0022	0.0706	0.0018	0.0004	0.0004	0.0229

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	0.101	49372	84991 (Lung)	0.088	57080	60000	80000

Days	Whole Body Retention	Urinary Excretion	DAC (D) =
	D	D	DAC-hr =
0.1	0.028		24000 nCi
0.2	0.001		2.0 mrem (ALI)
0.3			2.42 mrem (h)

"Properly Based ALI/DAC"
 ALI = 50000 μCi
 DAC (D) = 2.1E-05
 DAC-hr = 25200 nCi
 DAC-hr = 2.52 mrem (ALI)
 DAC-hr = 2.55 mrem (h)

1		0.00E+0
2		
3		
4		
5		
6		
7		
8		
9		
10		
20		
30		
40		
50		
60		
70		
80		
90		
100		
200		
300		
400		

Misc Data		
T 1/2 =	32.2 m	
β^-	3400	
γ	462.8	30.8%
	546.9	10.8%
	1010	29.8%
	1435.9	76.3%
	2218	15.2%
	2639.6	7.6%
$\Gamma =$	1100	
mR/hr per Ci at 1 meter		

Committed Dose Equivalent per Unit Intake (mrem/ μ Ci)

All Classifications

Nuclide	Class	f	Committed Dose Equivalent per Unit Intake (mrem/ μ Ci)								Recommended		Lung to Eff
			Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem	Eff	ALI	DAC	
H-3	D	1.00	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	78000	1.6E-05	1.0
C-14	Org	1.00	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2400	1.0E-06	1.0
C-14	CO	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1700000	7.1E-04	1.0
C-14	CO2	1.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	210000	8.8E-05	1.0
F-18	D	1.00	0.01	0.01	0.40	0.10	0.10	0.01	0.05	0.08	60000	2.5E-05	4.8
F-18	W	1.00	0.00	0.01	0.48	0.04	0.04	0.01	0.03	0.07	67000	2.8E-05	6.4
F-18	Y	1.00	0.00	0.01	0.52	0.02	0.02	0.01	0.03	0.08	64000	2.7E-05	6.6
Cr-51	D	0.10	0.10	0.07	0.14	0.10	0.10	0.07	0.13	0.11	46000	1.9E-05	1.3
Cr-51	W	0.10	0.08	0.06	1.39	0.07	0.06	0.04	0.18	0.26	19000	7.9E-06	5.3
Cr-51	Y	0.10	0.08	0.06	1.98	0.07	0.05	0.04	0.19	0.33	15000	6.3E-06	5.9
Mn-54	D	0.10	3.27	3.38	4.37	6.14	9.47	2.41	7.73	5.25	950	4.0E-07	0.8
Mn-54	W	0.10	2.60	3.20	24.60	4.10	4.60	2.70	6.40	6.70	750	3.1E-07	3.7
Fe-55	D	0.10	1.94	1.88	1.92	1.91	1.90	2.01	4.48	2.69	1900	7.9E-07	0.7
Fe-55	W	0.10	0.66	0.64	3.92	0.65	0.65	0.68	1.62	1.34	3700	1.5E-06	2.9
Fe-59	D	0.10	12.28	11.14	12.95	11.77	10.77	10.92	21.50	14.81	340	1.4E-07	0.9
Fe-59	W	0.10	5.14	4.66	51.06	4.85	4.11	4.33	10.95	12.23	410	1.7E-07	4.2
Co-57	W	0.05	0.60	0.58	14.99	0.94	0.73	0.42	1.50	2.63	1900	7.9E-07	5.7
Co-57	Y	0.05	0.46	1.39	62.53	2.18	1.67	1.00	3.04	9.08	550	2.3E-07	6.9
Co-58	W	0.05	2.41	2.26	29.38	2.34	1.77	2.04	5.00	6.36	790	3.3E-07	4.6
Co-58	Y	0.05	2.28	3.47	59.20	3.42	2.56	3.23	6.99	10.88	460	1.9E-07	5.4
Co-60	W	0.05	15.0	15.4	132.1	15.7	13.1	13.8	28.3	33.1	150	6.3E-08	4.0
Co-60	Y	0.05	17.6	68.1	1276.5	63.6	50.0	59.9	133.2	218.7	23	9.6E-09	5.8
Cu-64	D	0.50	0.06	0.05	0.75	0.05	0.04	0.04	0.25	0.20	26000	1.1E-05	3.8
Cu-64	W	0.50	0.04	0.03	1.24	0.03	0.02	0.02	0.29	0.26	19000	7.9E-06	4.8
Cu-64	Y	0.50	0.05	0.02	1.30	0.03	0.02	0.02	0.34	0.28	18000	7.5E-06	4.7
Zn-65	Y	0.50	7.5	11.4	77.7	13.4	12.4	11.2	17.2	20.4	250	1.0E-07	3.8
Rb-87	D	1.00	2.65	2.65	3.89	4.70	8.88	2.65	2.66	3.23	1500	6.3E-07	1.2
Rb-88	D	1.00	0.00	0.01	0.54	0.01	0.01	0.01	0.05	0.08	60000	2.5E-05	6.5
Rb-89	D	1.00	0.00	0.01	0.25	0.01	0.01	0.01	0.03	0.04	120000	5.0E-05	5.9
Zr-95	D	0.002	7.0	7.1	8.0	48.1	381.1	5.3	8.4	23.7	130/210	8.8E-08	0.3
Zr-95	W	0.002	3.1	3.4	68.8	12.0	80.3	2.9	7.9	15.9	320	1.3E-07	4.3
Zr-95	Y	0.002	2.1	4.6	150.6	5.0	8.6	4.3	10.2	23.3	210	8.8E-08	6.5
Nb-95	W	0.01	1.79	1.39	20.31	2.49	8.95	1.16	3.65	4.79	1000	4.2E-07	4.2
Nb-95	Y	0.01	1.60	1.51	30.78	1.64	1.90	1.32	3.96	5.80	860	3.6E-07	5.3
Ru-103	D	0.05	2.70	2.25	3.77	2.46	2.29	2.21	3.85	3.05	1600	6.7E-07	1.2
Ru-103	W	0.05	1.46	1.18	36.48	1.25	1.00	1.02	4.44	6.48	770	3.2E-07	5.6
Ru-103	Y	0.05	1.14	1.15	57.72	1.18	0.88	0.95	4.63	8.95	560	2.3E-07	6.4
Ru-106	D	0.05	51.06	50.69	66.60	50.69	50.69	50.69	62.53	56.24	89	3.7E-08	1.2
Ru-106	W	0.05	14.91	14.91	780.70	15.02	14.80	14.84	51.43	117.66	42	1.8E-08	6.6
Ru-106	Y	0.05	4.81	6.59	3848	6.51	5.96	6.36	44.40	477.30	10	4.2E-09	8.1
Sb-122	D	0.10	0.60	0.44	5.81	1.43	1.31	0.41	3.96	2.32	2200	9.2E-07	2.5
Sb-122	W	0.01	0.53	0.19	20.91	0.39	0.30	0.13	8.07	5.15	970	4.0E-07	4.1
Sb-124	D	0.10	3.39	2.41	7.51	5.66	12.62	2.10	7.77	5.56	900	3.8E-07	1.4
Sb-124	W	0.01	3.85	3.31	153.18	4.03	4.59	2.49	15.47	25.18	200	8.3E-08	6.1
I-131	D	1.00	0.09	0.29	2.43	0.23	0.21	1080	0.30	32.89	46/150	6.3E-08	0.1
I-133	D	1.00	0.07	0.11	3.03	0.10	0.09	180	0.19	5.86	280/850	3.5E-07	0.5
Cs-134	D	1.00	48.1	40.0	43.7	43.7	40.7	41.1	51.4	46.4	110	4.6E-08	0.9
Cs-137	D	1.00	32.4	29.0	32.6	30.7	29.4	29.3	33.7	31.9	160	6.7E-08	1.0
Cs-138	D	1.00	0.01	0.01	0.59	0.01	0.01	0.01	0.08	0.10	49000	2.0E-05	5.8
Ba-140	D	0.10	1.59	1.06	6.14	4.77	8.92	0.95	5.22	3.73	1300	5.4E-07	1.6
La-140	D	0.001	1.34	0.76	6.14	1.69	1.49	0.45	6.70	3.46	1400	5.8E-07	1.8
La-140	W	0.001	1.68	0.54	15.58	0.79	0.52	0.25	7.84	4.84	1000	4.2E-07	3.2
Ce-141	W	3E-4	0.31	0.26	41.44	1.55	14.02	0.17	8.73	8.32	600	2.5E-07	5.0
Ce-141	Y	3E-4	0.20	0.17	61.79	0.33	0.94	0.09	4.66	8.96	560	2.3E-07	6.9
Ce-144	W	3E-4	7.1	7.3	677.1	98.8	168.0	7.0	381.1	215.6	23	9.6E-09	3.1
Ce-144	Y	3E-4	0.9	1.3	2926.7	10.7	17.5	1.1	70.7	374.7	13	5.4E-09	7.8

Offsite Dose Calculations Using RG 1.109 and Corrected by EPA 11

This section shows the significant calculation problems associated with the RG 1.109 and the new Effluent Concentrations.

10CFR20 Effluent Conc		RG 1.109 Total Body Dose Factor		Adult Total Body Yearly Dose		RG 1.109 Max Organ Dose Factor		Adult Max Organ Yearly Dose	
Conc	(mrem/μCi)	Dose Factor	(mrem/μCi)	Total Body	(mrem)	Max Organ	(mrem/μCi)	Max Organ	(mrem)
H-3	1.0E-07	0.16	0.2	126.4	126.4		0.2	126.4	126.4
Cr-51	3.0E-08	0.01	1.8	3.0	432.0		1.8	432.0	432.0
Mn-54	1.0E-09	0.79	175.0	6.3	1400.0		175.0	1400.0	1400.0
Fe-59	5.0E-10	1.32	127.0	5.3	508.0		127.0	508.0	508.0
Co-57	9.0E-10								
Co-58	1.0E-09	0.26	116.0	2.1	928.0		116.0	928.0	928.0
Co-60	5.0E-11	1.85	746.0	0.7	298.4		746.0	298.4	298.4
Zn-65	4.0E-10	5.82	108.0	18.6	345.6		108.0	345.6	345.6
Zr-95	4.0E-10	2.91	221.0	9.3	707.2		221.0	707.2	707.2
Nb-95	2.0E-09	0.53	63.1	8.4	1009.6		63.1	1009.6	1009.6
Ru-103	9.0E-10	0.08	63.1	0.6	454.3		63.1	454.3	454.3
Ru-106	2.0E-11	1.09	1170.0	0.2	187.2		1170.0	187.2	187.2
Sb-124	3.0E-10								
I-131	2.0E-10	2.56	149.0	4.1	238.4		149.0	238.4	238.4
I-133	1.0E-09	5.65	269.0	45.2	2152.0		269.0	2152.0	2152.0
Cs-134	2.0E-10	91.00	106.0	145.6	169.6		106.0	169.6	169.6
Cs-137	2.0E-10	53.50	77.6	85.6	124.2		77.6	124.2	124.2
Ce-141	8.0E-10	0.19	45.2	1.2	289.3		45.2	289.3	289.3
Ce-144	2.0E-11	23.00	972.0	3.7	155.5		972.0	155.5	155.5

This section shows the yearly CEDE calculation using EPA 11 and the new Eff Conc.

10CFR20 Effluent Conc		EPA 11 Dose factor		Adult Yearly Dose	
Conc	(mrem/μCi)	Dose factor	(mrem/μCi)	Yearly Dose	(mrem)
H-3	1.0E-07	0.1	0.1	48	48
Cr-51	3.0E-08	0.3	0.3	79	79
Mn-54	1.0E-09	6.7	6.7	54	54
Fe-59	5.0E-10	14.8	14.8	59	59
Co-57	9.0E-10	9.1	9.1	66	66
Co-58	1.0E-09	10.9	10.9	87	87
Co-60	5.0E-11	218.7	218.7	87	87
Zn-65	4.0E-10	20.4	20.4	65	65
Zr-95	4.0E-10	23.7	23.7	76	76
Nb-95	2.0E-09	5.8	5.8	93	93
Ru-103	9.0E-10	9.0	9.0	65	65
Ru-106	2.0E-11	478.4	478.4	77	77
Sb-124	3.0E-10	25.2	25.2	60	60
I-131	2.0E-10	32.9	32.9	53	53
I-133	1.0E-09	5.9	5.9	47	47
Cs-134	2.0E-10	46.4	46.4	74	74
Cs-137	2.0E-10	31.9	31.9	51	51
Ce-141	8.0E-10	9.0	9.0	58	58
Ce-144	2.0E-11	374.7	374.7	60	60

This section shows the yearly CEDE calculation using EPA 11 and my recommended mods to the Eff Conc.

10CFR20 ALLI Effluent Conc		EPA 11 Dose factor		Adult Yearly Dose	
Conc	(mrem/μCi)	Dose factor	(mrem/μCi)	Yearly Dose	(mrem)
H-3	78000	9.7E-08	0.1	47	47
Cr-51	15000	1.9E-08	0.3	49	49
Mn-54	750	9.4E-10	6.7	50	50
Fe-59	340	4.2E-10	14.8	50	50
Co-57	550	6.9E-10	9.1	50	50
Co-58	460	5.7E-10	10.9	50	50
Co-60	23	2.9E-11	218.7	50	50
Zn-65	250	3.1E-10	20.4	51	51
Zr-95	210	2.6E-10	23.7	50	50
Nb-95	860	1.1E-09	5.8	50	50
Ru-103	560	7.0E-10	9.0	50	50
Ru-106	10	1.2E-11	478.4	48	48
Sb-124	200	2.5E-10	25.2	50	50
I-131	150	1.9E-10	32.9	49	49
I-133	850	1.1E-09	5.9	50	50
Cs-134	110	1.4E-10	46.4	51	51
Cs-137	160	2.0E-10	31.9	51	51
Ce-141	560	7.0E-10	9.0	50	50
Ce-144	13	1.6E-11	374.7	49	49

To Determine the current 10CFR20 Effluent Concentrations, use:
 The Stochastic ALI
 Divide by 2.4E9 cc/yr occupational breathing rate
 Divide by 300 for following three factors:
 A factor of 50 for dose limit difference
 A factor of 2 for age groups
 A rounded factor of 3 for difference in hours, breathing rate

To Determine the Recommended Effluent Concentrations, use:
 The recommended Stochastic ALI rounded to two significant figures
 Divide by 8E9 cc/yr Non-occupational breathing rate
 Divide by a factor of 50 for dose limit difference
 Divide by a factor of 2 for age groups
 Round to two significant figures

Nb-95: 2E-9 μCi/cc x 8E9 cc/yr x 0.53 mrem/μCi = 8.48 mrem/yr

Nb-95: 2E-9 μCi/cc x 8E9 cc/yr x 5.8 mrem/μCi = 92.8 mrem/yr

Nb-95: 1.1E-9 μCi/cc x 8E9 cc/yr x 5.8 mrem/μCi = 49.8 mrem/yr

COMMITTED DOSE EQUIVALENT WORKSHEET

INTAKES

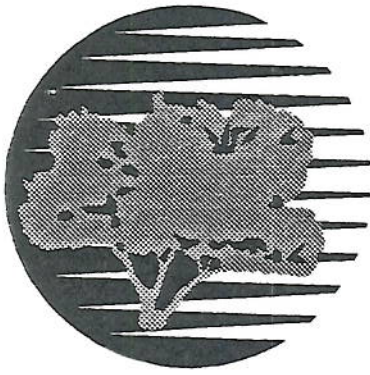
Nuclide	Intakes	1/1/92	Cr-51 Y	Mn-54 W	Fe-59 D	Co-57 Y	Co-58 Y	Co-60 Y	Co-60 W	Zn-65 Y	Zr-95 D	Nb-95 Y	Ru-103 Y	Ru-106 Y	Sb-124 W	I-131 D	I-133 D	Cs-134 D	Cs-137 D	Ce-141 Y	Ce-144 Y	Rb-88 D	Cs-138 D	
	μCi		μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi	μCi
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total =		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

INTERNAL DOSES

Committed Dose Equivalents (mrem)

Nuclide	Class	Intake (μCi)	Gonad mrem	Breast mrem	Lung mrem	R Mar mrem	B Surf mrem	Thy mrem	Rem mrem
H-3	V	1	0	0	0	0	0	0	0
Cr-51	Y	1	0	0	2	0	0	0	0
Mn-54	W	1	3	3	25	4	5	3	6
Fe-59	D	1	12	11	13	12	11	11	22
Co-57	Y	1	0	1	63	2	2	1	3
Co-58	Y	1	2	4	59	3	3	3	7
Co-60	Y	1	18	68	1277	64	50	60	133
Co-60	W	1	15	15	132	16	13	14	28
Zn-65	Y	1	8	11	78	13	12	11	17
Zr-95	D	1	7	7	8	48	381	5	8
Nb-95	Y	1	2	2	31	2	2	1	4
Ru-103	Y	1	1	1	58	1	1	1	5
Ru-106	Y	1	5	7	3848	7	6	6	44
Sb-124	W	1	4	3	153	4	5	3	16
I-131	D	1	0	0	2	0	0	1080	0
I-133	D	1	0	0	3	0	0	180	0
Cs-134	D	1	48	40	44	44	41	41	51
Cs-137	D	1	32	29	33	31	29	29	34
Ce-141	Y	1	0	0	62	0	1	0	5
Ce-144	Y	1	1	1	2927	11	18	1	71
Rb-88	D	1	0	0	1	0	0	0	0
Cs-138	D	1	0	0	1	0	0	0	0
Totals =			158	205	8817	261	579	1451	455

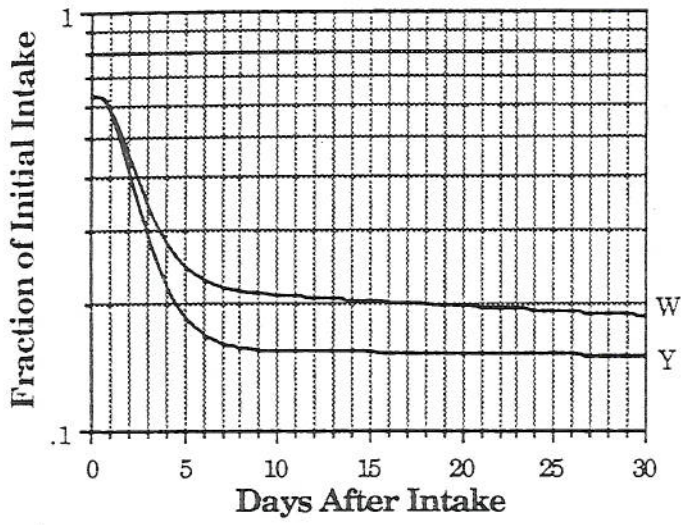
INTAKE TOTALS



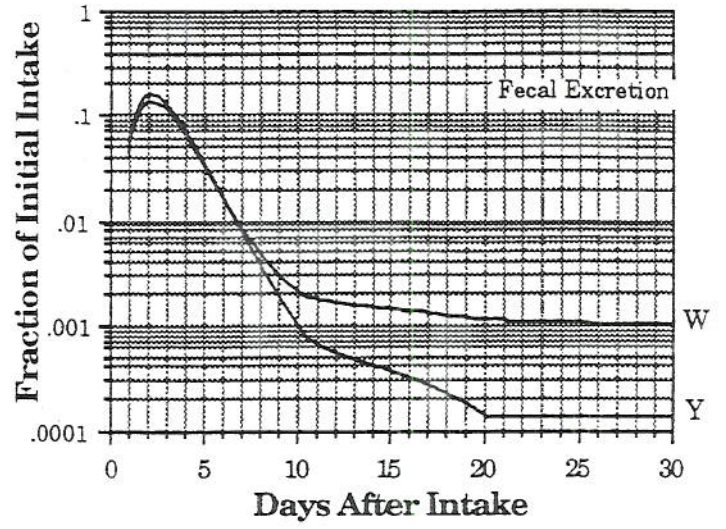
Alpha Emitter Internal Dose Information

Note in Bold: CDE and CEDE based on nCi intakes instead of μCi

Pu-238 Retention Fractions



Pu-238 Excretion Fractions



Notes

Pu-238

(All CDE and CEDE in mrem; ALI's in nCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
W	1.0E-3	2.80E-05	1.00E-09	1.84E-05	1.52E-04	1.90E-03	9.62E-10	7.02E-05
CDE per nCi Inhaled =		104	0	68	562	7030	0	260
CEDE per nCi Inhaled =		26	0	8	67	211	0	78

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per nCi Inhaled =	1.06E-04	390	13	382	13	10	7

Days	Whole Body Retention		Fecal Excretion	
	W	Y	W	Y
0.1	0.639	0.639		
0.2	0.639	0.639		
0.3	0.638	0.638		
0.4	0.636	0.636		
0.5	0.634	0.632		
0.6	0.629	0.627		
0.7	0.623	0.620		
0.8	0.616	0.610		
0.9	0.607	0.599		
1	0.596	0.587	4.24E-2	5.21E-2
2	0.461	0.426	1.36E-1	1.61E-1
3	0.346	0.295	1.14E-1	1.31E-1
4	0.280	0.222	6.65E-2	7.36E-2
5	0.245	0.185	3.42E-2	3.64E-2
6	0.228	0.168	1.71E-2	1.73E-2
7	0.219	0.160	8.81E-3	8.13E-3
8	0.214	0.156	4.86E-3	3.89E-3
9	0.211	0.154	2.99E-3	1.91E-3
10	0.209	0.153	2.09E-3	9.87E-4
20	0.196	0.151	1.10E-3	1.36E-4
30	0.186	0.149	9.59E-4	1.34E-4
40	0.177	0.148	8.35E-4	1.32E-4
50	0.169	0.147	7.27E-4	1.30E-4
60	0.162	0.145	6.34E-4	1.28E-4
70	0.156	0.144	5.52E-4	1.26E-4
80	0.151	0.143	4.82E-4	1.24E-4
90	0.146	0.141	4.20E-4	1.23E-4
100	0.142	0.140	3.66E-4	1.21E-4
200	0.121	0.129	9.57E-5	1.05E-4
300	0.115	0.118	2.72E-5	9.15E-5
400	0.112	0.110	9.34E-6	7.96E-5

DAC (Y) = 3E-12
 DAC-hr = 3.6 pCi
 DAC-hr = 1.8 mrem (ALI)
 DAC-hr = 1.4 mrem (h)

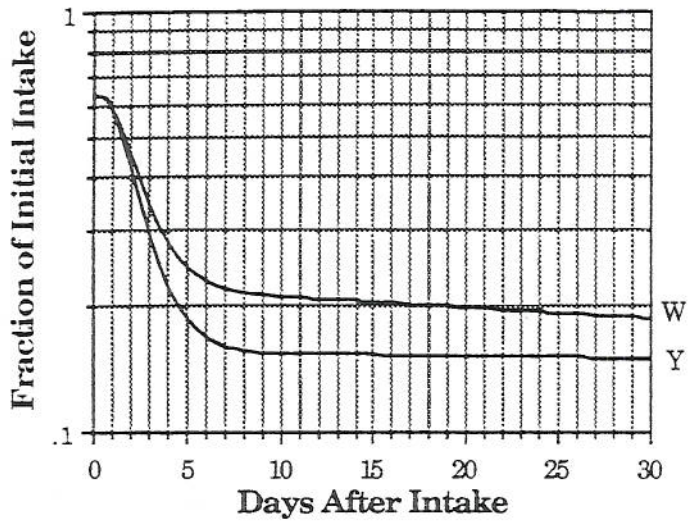
"Recommended ALI/DAC"
 (N)ALI = 7.1 nCi
 (S)ALI = 13 nCi
 DAC (Y) = 5.4E-12 *
 DAC-hr = 6.5 pCi
 DAC-hr = 2.50 mrem (ALI)
 DAC-hr = 2.54 mrem (h)

* Pu-238 limited to 1094 DAC-hrs/yr
 or 1000 DAC-hrs/yr to be conservative

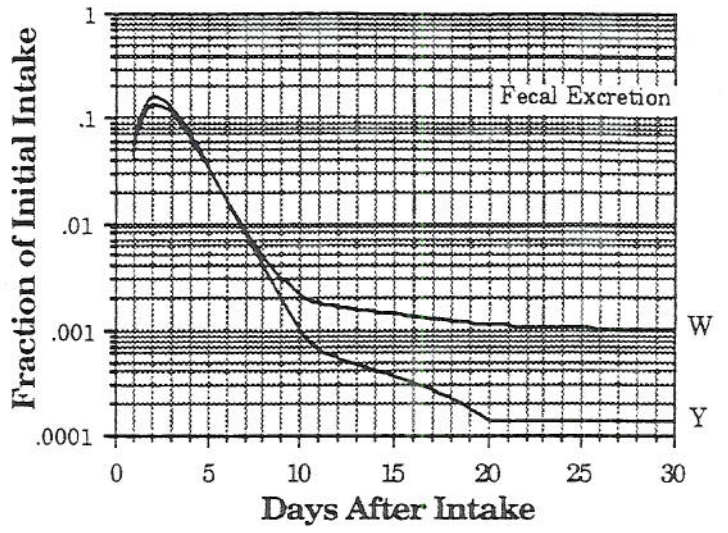
Misc.
 Data
 T 1/2 = 87.75 yrs
 α 5.50 MeV 72%
 5.46 MeV 28%
 γ 0
 Γ = 0
 mR/hr per Ci at 1 meter

Ingestion Model
f1 is 1E-05 for oxides
f1 is 1E-04 for nitrates
f1 is 1E-03 for others
h (1E-5) = 0.05 mrem/nCi
h (1E-4) = 0.34 mrem/nCi
h (1E-3) = 3.2 mrem/nCi
.01%, .1%, 1% of the W Class inhalation dose

Pu-239 Retention Fractions



Pu-239 Excretion Fractions



Notes

Pu-239

(All CDE and CEDE in mrem; ALI's in nCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
W	1.0E-3	3.18E-05	9.22E-10	1.73E-05	1.69E-04	2.11E-03	9.03E-10	7.56E-05
CDE per nCi Inhaled =		118	0	64	625	7807	0	280
CEDE per nCi Inhaled =		29	0	8	75	234	0	84

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per nCi Inhaled =	430	12	6.4 (B Surf)	423	12	10	6

Days	Whole Body Retention		Fecal Excretion	
	W	Y	W	Y
0.1	0.639	0.639		
0.2	0.639	0.639		
0.3	0.638	0.638		
0.4	0.636	0.636		
0.5	0.634	0.632		
0.6	0.629	0.627		
0.7	0.623	0.620		
0.8	0.616	0.610		
0.9	0.607	0.600		
1	0.596	0.587	4.24E-2	5.21E-2
2	0.461	0.426	1.36E-1	1.61E-1
3	0.346	0.295	1.14E-1	1.31E-1
4	0.280	0.222	6.65E-2	7.36E-2
5	0.245	0.185	3.42E-2	3.64E-2
6	0.228	0.168	1.71E-2	1.73E-2
7	0.219	0.160	8.81E-3	8.13E-3
8	0.214	0.156	4.86E-3	3.89E-3
9	0.211	0.154	2.99E-3	1.91E-3
10	0.209	0.153	2.09E-3	9.87E-4
20	0.197	0.151	1.10E-3	1.36E-4
30	0.186	0.149	9.59E-4	1.34E-4
40	0.177	0.148	8.35E-4	1.32E-4
50	0.169	0.147	7.28E-4	1.30E-4
60	0.162	0.146	6.34E-4	1.28E-4
70	0.156	0.144	5.53E-4	1.26E-4
80	0.151	0.143	4.82E-4	1.25E-4
90	0.146	0.142	4.21E-4	1.23E-4
100	0.142	0.141	3.67E-4	1.21E-4
200	0.121	0.129	9.62E-5	1.06E-4
300	0.115	0.119	2.73E-5	9.21E-5
400	0.113	0.110	9.42E-6	8.03E-5

DAC (Y) = 3E-12
 DAC-hr = 3.6 pCi
 DAC-hr = 1.8 mrem (ALI)
 DAC-hr = 1.55 mrem (h)

"Recommended ALI/DAC"

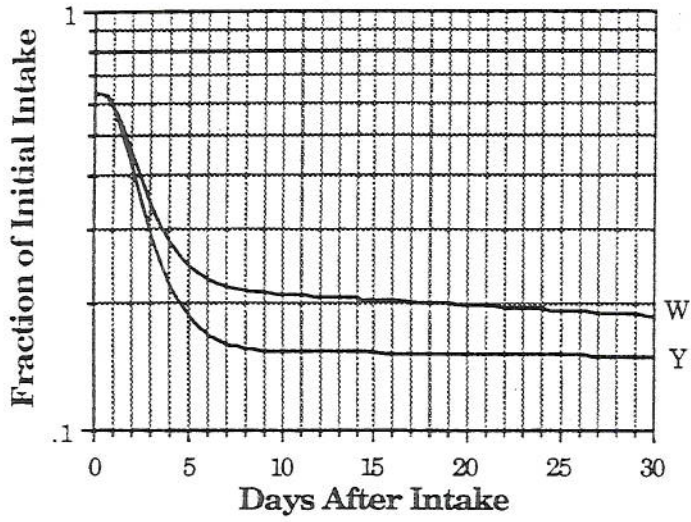
(N)ALI = 6.4 nCi
 (S)ALI = 12 nCi
 DAC (Y) = 5.0E-12 *
 DAC-hr = 6.0 pCi
 DAC-hr = 2.50 mrem (ALI)
 DAC-hr = 2.58 mrem (h)

* Pu-239 limited to 1067 DAC-hrs/yr
 or 1000 DAC-hrs/yr to be conservative

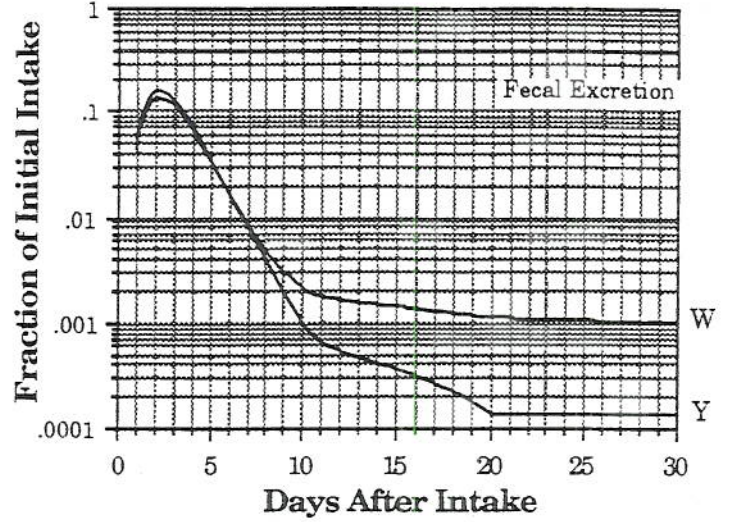
Misc.
 Data
 T 1/2 = 24400 yrs
 α 5.16 MeV 88%
 5.11 MeV 11%
 γ 0
 Γ = 0
 mR/hr per Ci at 1 meter

Ingestion Model
f1 is 1E-05 for oxides
f1 is 1E-04 for nitrates
f1 is 1E-03 for others
h (1E-5) = 0.05 mrem/nCi
h (1E-4) = 0.37 mrem/nCi
h (1E-3) = 3.54 mrem/nCi
.01%, .1%, 1% of the W Class inhalation dose

Pu-240 Retention Fractions



Pu-240 Excretion Fractions



Notes

Pu-240

(All CDE and CEDE in mrem; ALI's in nCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
W	1.0E-3	3.18E-05	9.51E-10	1.73E-05	1.69E-04	2.11E-03	9.03E-10	7.56E-05
CDE per nCi Inhaled =		118	0	64	625	7807	0	280
CEDE per nCi Inhaled =		29	0	8	75	234	0	84

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per nCi Inhaled =	1.16E-04	0.01	0.01	423	12	10	6

Days	Whole Body Retention		Fecal Excretion	
	W	Y	W	Y
0.1	0.639	0.639		
0.2	0.639	0.639		
0.3	0.638	0.638		
0.4	0.636	0.636		
0.5	0.634	0.632		
0.6	0.629	0.627		
0.7	0.623	0.620		
0.8	0.616	0.610		
0.9	0.607	0.600		
1	0.596	0.587	4.24E-2	5.21E-2
2	0.461	0.426	1.36E-1	1.61E-1
3	0.346	0.295	1.14E-1	1.31E-1
4	0.280	0.222	6.65E-2	7.36E-2
5	0.245	0.185	3.42E-2	3.64E-2
6	0.228	0.168	1.71E-2	1.73E-2
7	0.219	0.160	8.81E-3	8.13E-3
8	0.214	0.156	4.86E-3	3.89E-3
9	0.211	0.154	2.99E-3	1.91E-3
10	0.209	0.153	2.09E-3	9.87E-4
20	0.197	0.151	1.10E-3	1.36E-4
30	0.186	0.149	9.59E-4	1.34E-4
40	0.177	0.148	8.35E-4	1.32E-4
50	0.169	0.147	7.28E-4	1.30E-4
60	0.162	0.146	6.34E-4	1.28E-4
70	0.156	0.144	5.53E-4	1.26E-4
80	0.151	0.143	4.82E-4	1.25E-4
90	0.146	0.142	4.21E-4	1.23E-4
100	0.142	0.141	3.67E-4	1.21E-4
200	0.121	0.129	9.62E-5	1.06E-4
300	0.115	0.119	2.73E-5	9.21E-5
400	0.113	0.110	9.42E-6	8.03E-5

DAC (Y) = 3E-12
 DAC-hr = 3.6 pCi
 DAC-hr = 1.8 mrem (ALI)
 DAC-hr = 1.55 mrem (h)

"Recommended ALI/DAC"
 (N)ALI = 6.4 nCi
 (S)ALI = 12 nCi
 DAC (Y) = 5.0E-12 *
 DAC-hr = 6.0 pCi
 DAC-hr = 2.50 mrem (ALI)
 DAC-hr = 2.58 mrem (h)

* Pu-240 limited to 1067 DAC-hrs/yr or 1000 DAC-hrs/yr to be conservative

Misc. Data
 T 1/2 = 6580 yrs
 α 5.17 MeV 76%
 5.12 MeV 24%
 γ 0
 Γ = 0
 mR/hr per Ci at 1 meter

Ingestion Model
f1 is 1E-05 for oxides
f1 is 1E-04 for nitrates
f1 is 1E-03 for others
h (1E-5)= 0.05 mrem/nCi
h (1E-4)= 0.37 mrem/nCi
h (1E-3)= 3.54 mrem/nCi
.01%, .1%, 1% of the W Class inhalation dose

Am-241

(All CDE and CEDE in mrem; ALI's in nCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
W	1.0E-3	3.25E-05	2.67E-09	1.84E-05	1.74E-04	2.17E-03	1.60E-09	7.82E-05
CDE per nCi Inhaled =		120	0	68	644	8029	0	289
CEDE per nCi Inhaled =		30	0	8	77	241	0	87

* Most Restrictive Inhalation Classification

	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per nCi Inhaled =	1.20E-04	0.01	0.01	435	11	10	6

Days	Whole Body Retention	Total Excreta
	W	W
	Fract	Fract
0.1	0.638	
0.2	0.636	
0.3	0.634	
0.4	0.632	
0.5	0.629	
0.6	0.624	
0.7	0.618	
0.8	0.610	
0.9	0.601	
1	0.590	4.88E-2
2	0.455	1.35E-1 f
3	0.340	1.14E-1 f
4	0.274	6.64E-2 f
5	0.239	3.41E-2 f
6	0.222	1.71E-2 f
7	0.214	8.83E-3 f
8	0.209	4.89E-3 f
9	0.206	3.02E-3 f
10	0.203	2.12E-3 f
20	0.191	1.13E-3 f
30	0.180	9.86E-4 f
40	0.171	8.60E-4 f
50	0.163	7.50E-4 f
60	0.156	6.55E-4 f
70	0.150	5.71E-4 f
80	0.145	4.99E-4 f
90	0.140	4.35E-4 f
100	0.136	3.80E-4 f
200	0.115	9.90E-5
300	0.110	2.79E-5
400	0.108	9.71E-6

DAC (Y) = 3E-12
 DAC-hr = 3.6 pCi
 DAC-hr = 1.8 mrem (ALI)
 DAC-hr = 1.60 mrem (h)

"Recommended ALI/DAC"

(N)ALI = 6.2 nCi

(S)ALI = 11 nCi

DAC (Y) = 4.6E-12 *

DAC-hr = 5.5 pCi

DAC-hr = 2.51 mrem (ALI)

DAC-hr = 2.46 mrem (h)

* Am-241 limited to 1128 DAC-hrs/yr
 or 1000 DAC-hrs/yr to be conservative

Misc.

Data

T 1/2 = 458 yrs

α 5.49 MeV 85%

5.44 MeV 15%

γ 60

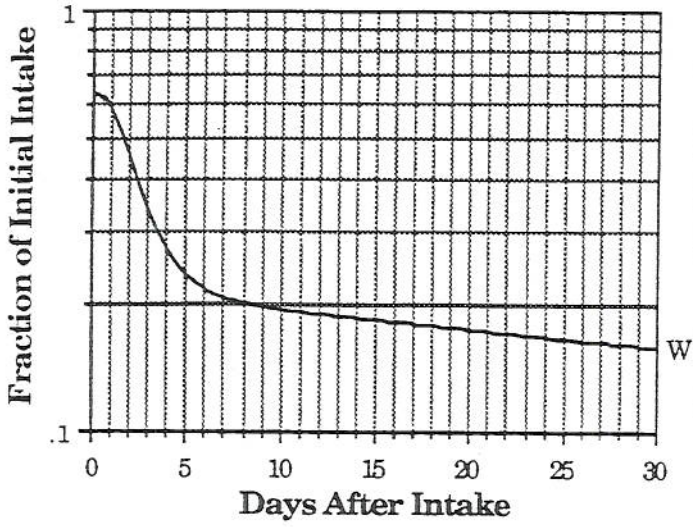
Γ = 32

mR/hr per Ci at 1 meter

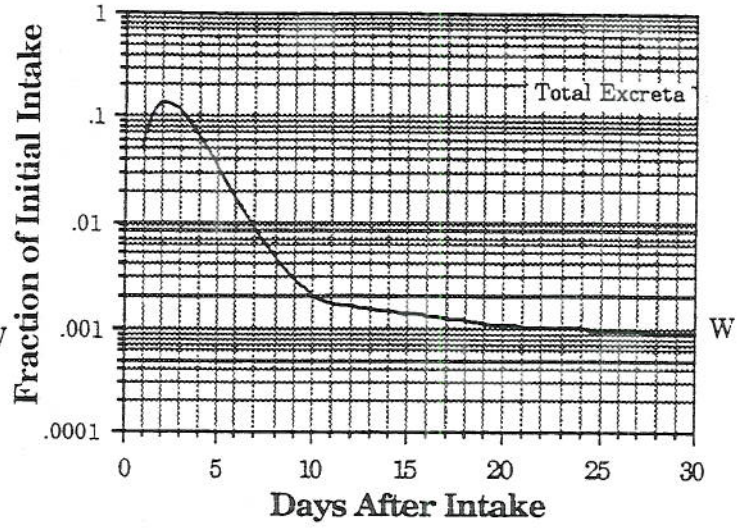
Ingestion Model
f1 is 0.001 for all forms
h eff = 9.84E-7 Sv/Bq 3.64 mrem/nCi
1% of the W Class inhalation dose

Note: f - fecal excretion >90%

Cm-242 Retention Fraction



Cm-242 Excretion Fraction



Notes

Cm-242

(All CDE and CEDE in mrem; ALI's in nCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
W	1.0E-3	5.70E-07	9.44E-10	1.55E-05	3.90E-06	4.87E-05	9.41E-10	2.45E-06
CDE per nCi Inhaled =		2	0	57	14	180	0	9
CEDE per nCi Inhaled =		0.5	0.0	6.9	1.7	5.4	0.0	2.7

* Most Restrictive Inhalation Classification

	h Based h eff	h Based (S)ALI	h Based (N)ALI	10% Rule	10% Rule	(S)ALI	(S)ALI	(N)ALI
CEDE per nCi Inhaled =	4.67E-06	0.29	0.28	h eff	(S)ALI	(S)ALI	(N)ALI	
	17.3	290	277	16.7	300	300	300	

Days	Whole Body Retention	Total Excreta
	W Fract	W Fract
0.1	0.637	
0.2	0.636	
0.3	0.634	
0.4	0.631	
0.5	0.627	
0.6	0.622	
0.7	0.616	
0.8	0.608	
0.9	0.598	
1	0.588	4.86E-2
2	0.451	1.34E-1 f
3	0.336	1.13E-1 f
4	0.269	6.54E-2 f
5	0.234	3.35E-2 f
6	0.217	1.67E-2 f
7	0.207	8.57E-3 f
8	0.202	4.72E-3 f
9	0.198	2.90E-3 f
10	0.195	2.03E-3 f
20	0.175	1.04E-3 f
30	0.159	8.68E-4 f
40	0.144	7.25E-4 f
50	0.132	6.06E-4 f
60	0.121	5.07E-4 f
70	0.111	4.24E-4 f
80	0.103	3.55E-4 f
90	0.096	2.97E-4 f
100	0.089	2.49E-4 f
200	0.049	4.24E-5
300	0.031	7.76E-6
400	0.020	1.77E-6

DAC (Y) = 1E-10
 DAC-hr = 120 pCi
 DAC-hr = 2.00 mrem (ALI)
 DAC-hr = 2.08 mrem (h)

"Recommended ALI/DAC"

(N)ALI = 280 nCi

(S)ALI = 1290 nCi

DAC (Y) = 1.2E-10 *

DAC-hr = 145 pCi

DAC-hr = 2.50 mrem (ALI)

DAC-hr = 2.51 mrem (h)

* Cm-242 limited to 1916 DAC-hrs/yr
 2000 DAC-hrs/yr may be acceptable

Misc.

Data

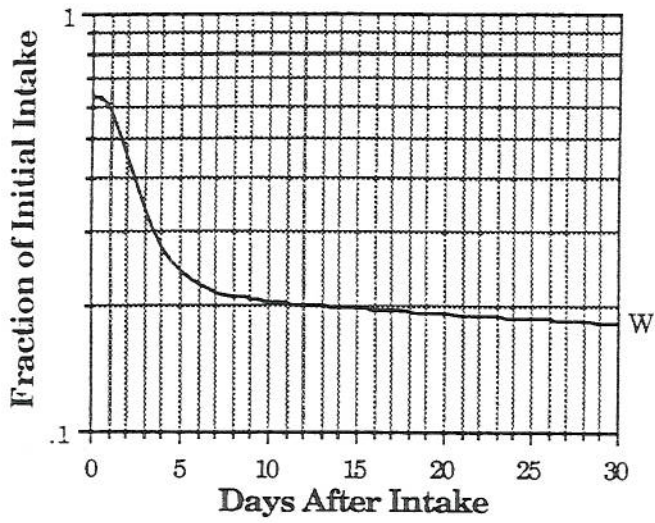
T 1/2 = 163 days
 α 6.12 MeV 74%
 6.07 MeV 26%
 γ 44 0.04%
 Γ = 0

mR/hr per Ci at 1 meter

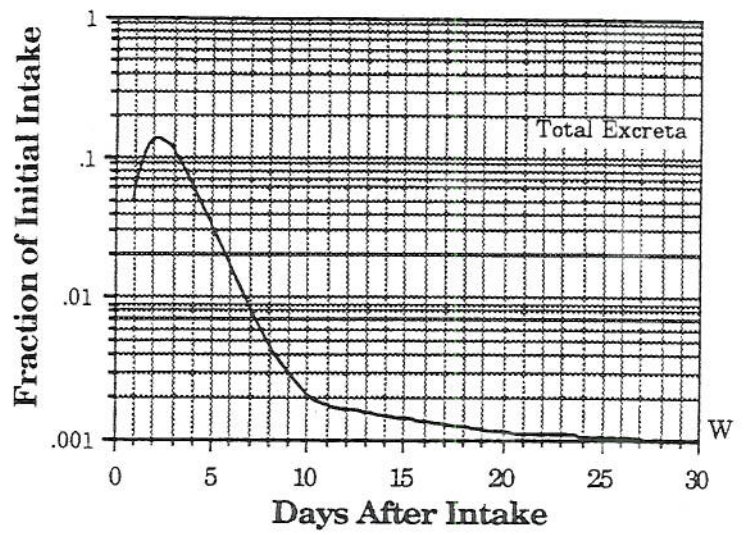
Ingestion Model
f1 is 0.001 for all forms
h eff = 3.10E-8 Sv/Bq 0.115 mrem/nCi
0.6% of the W Class inhalation dose

Note: f - fecal excretion >90%

Cm-243 Retention Fraction



Cm-243 Excretion Fraction



Notes

Cm-243

(All CDE and CEDE in mrem; ALI's in nCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
W	1.0E-3	2.07E-05	6.29E-09	1.94E-05	1.18E-04	1.47E-03	3.83E-09	5.76E-05
CDE per nCi Inhaled =		77	0	72	437	5439	0	213
CEDE per nCi Inhaled =		19.1	0.0	8.6	52.4	163.2	0.0	63.9

* Most Restrictive Inhalation Classification

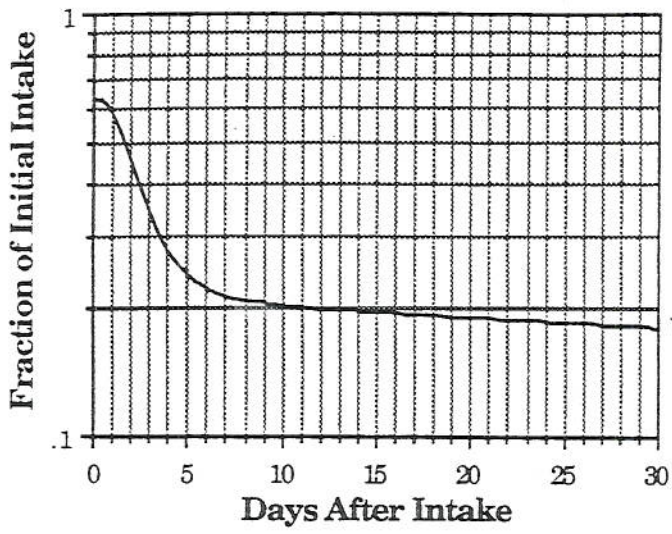
	h eff	h Based (S)ALI	h Based (N)ALI	10% Rule h eff	10% Rule (S)ALI	(S)ALI	(N)ALI
CEDE per nCi Inhaled =	8.30E-05	0.02	0.01	298.6	17	20	9

Days	Whole Body Retention W Fract	Total Excreta W Fract	DAC (Y) = 4E-12
0.1	0.637		DAC-hr = 4.8 pCi
0.2	0.637		DAC-hr = 1.20 mrem (ALI)
0.3	0.635		DAC-hr = 1.47 mrem (h)
0.4	0.632		"Recommended ALI/DAC"
0.5	0.628		(N)ALI = 9.2 nCi
0.6	0.624		(S)ALI = 16 nCi
0.7	0.618		DAC (Y) = 6.7E-12 *
0.8	0.610		DAC-hr = 8.0 pCi
0.9	0.600		DAC-hr = 2.51 mrem (ALI)
1	0.590	4.88E-2	DAC-hr = 2.47 mrem (h)
2	0.455	1.35E-1 f	* Cm-243 limited to 1143 DAC-hrs/yr
3	0.340	1.14E-1 f	or 1000 DAC-hrs/yr to be conservative
4	0.274	6.65E-2 f	Misc.
5	0.239	3.42E-2 f	Data
6	0.223	1.71E-2 f	T 1/2 = 32 yrs
7	0.213	8.83E-3 f	α 6.06 MeV 6%
8	0.209	4.88E-3 f	5.99 MeV 6%
9	0.206	3.01E-3 f	5.79 MeV 73%
10	0.203	2.12E-3 f	5.74 MeV 12%
20	0.190	1.13E-3 f	γ 209 4%
30	0.180	9.84E-4 f	228 12%
40	0.170	8.57E-4 f	278 14%
50	0.163	7.47E-4 f	Γ = 40
60	0.156	6.52E-4 f	mR/hr per Ci at 1 meter
70	0.149	5.69E-4 f	
80	0.144	4.96E-4 f	
90	0.139	4.33E-4 f	
100	0.135	3.79E-4 f	
200	0.114	9.80E-5	
300	0.108	2.73E-5	
400	0.105	9.46E-6	

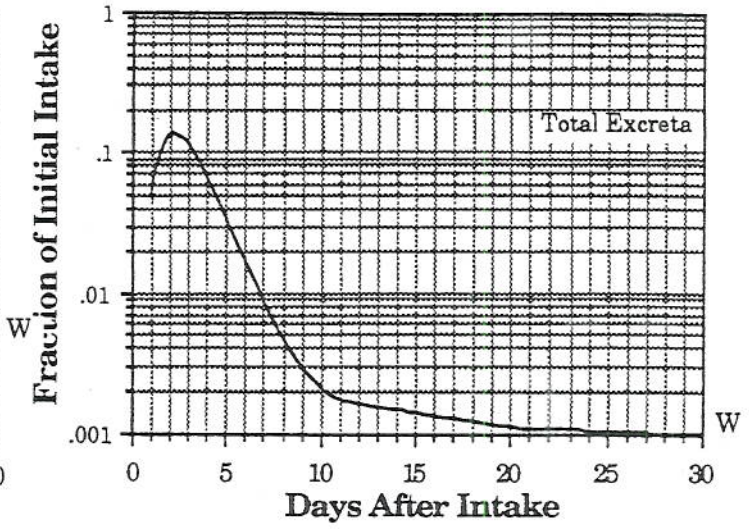
Note: f - fecal excretion >90% 1% of the W Class inhalation dose

Ingestion Model	
f1 is 0.001 for all forms	
h eff = 6.79E-7 Sv/Bq	
2.51 mrem/nCi	

Cm-244 Retention Fraction



Cm-244 Excretion Fraction



Notes

Cm-244

(All CDE and CEDE in mrem; ALI's in nCi)

Class*	f	Gonad	Breast	Lung	R Mar	B Surf	Thy	Rem
W	1.0E-3	1.59E-05	1.04E-09	1.93E-05	9.38E-05	1.17E-03	1.01E-09	4.78E-05
CDE per nCi Inhaled =		59	0	71	347	4329	0	177
CEDE per nCi Inhaled =		14.7	0.0	8.6	41.6	129.9	0.0	53.1

* Most Restrictive Inhalation Classification

	h Based h eff	h Based (S)ALI	h Based (N)ALI	10% Rule	10% Rule	(S)ALI	(S)ALI	(N)ALI
CEDE per nCi Inhaled =	6.70E-05	0.02	0.01	h eff	(S)ALI	(S)ALI	(N)ALI	
	248	20	12	239.3	21	20	10	(B Surf)

Days	Whole Body Retention W Fract	Total Excreta W Fract	DAC (Y) = 5E-12 DAC-hr = 6.0 pCi DAC-hr = 1.50 mrem (ALI) DAC-hr = 1.49 mrem (h)
0.1	0.637		
0.2	0.637		
0.3	0.635		
0.4	0.632		"Recommended ALI/DAC"
0.5	0.628		(N)ALI = 12 nCi
0.6	0.624		(S)ALI = 20 nCi
0.7	0.618		DAC (Y) = 8.3E-12 *
0.8	0.610		DAC-hr = 10 pCi
0.9	0.600		DAC-hr = 2.49 mrem (ALI)
1	0.590	4.88E-2	DAC-hr = 2.47 mrem (h)
2	0.455	1.35E-1 f	* Cm-244 limited to 1160 DAC-hrs/yr or 1000 DAC-hrs/yr to be conservative
3	0.340	1.14E-1 f	
4	0.273	6.65E-2 f	Misc.
5	0.239	3.42E-2 f	Data
6	0.222	1.71E-2 f	T 1/2 = 17.6 yrs
7	0.213	8.82E-3 f	α 5.81 MeV 77%
8	0.209	4.88E-3 f	5.77 MeV 23%
9	0.206	3.01E-3 f	γ 0
10	0.203	2.12E-3 f	Γ = 0
20	0.190	1.13E-3 f	mR/hr per Ci at 1 meter
30	0.180	9.83E-4 f	
40	0.170	8.56E-4 f	
50	0.162	7.45E-4 f	
60	0.155	6.50E-4 f	
70	0.148	5.67E-4 f	
80	0.143	4.94E-4 f	
90	0.139	4.31E-4 f	
100	0.135	3.77E-4 f	
200	0.113	9.71E-5	
300	0.106	2.69E-5	
400	0.103	9.28E-6	

Ingestion Model
f1 is 0.001 for all forms
h eff = 5.45E-7 Sv/Bq 2.02 mrem/nCi
1% of the W Class inhalation dose

Note: f - fecal excretion >90%