

Recommended Modifications to the DAC and ALI Values in 10 CFR 20, Appendix B

Health Physics Society Annual Meeting

July 1993

Michael Lantz

Health Physics Society Annual Meeting

Atlanta, Georgia

July 11-15, 1993

**Recommended Modifications to the DAC and ALI Values in
10CFR20, Appendix B**

Michael Lantz

This work began as a compilation of internal dose data from ICRP 30, EPA 11, NUREG 4884, Rad Health Handbook, and personal experiences. I wanted to create the following situation:

- Important information would be available in my portable computer.
- My understanding of the dose calculational processes would be further developed.
- I would provide assistance to others; i.e., training materials.

Recommendations for Modifications to the ALI's and DAC's of 10CFR20, Appendix B

Recalculate the ALI's using EPA 11 heff values. Round these to two significant figures.

Recalculate the DAC's from these new ALI's using the Appendix B note; i.e., divide by $2.4E9$. Round to two significant figures.

The DAC for the Non-Stochastically Limited radionuclides should be determined from the Stochastic ALI. The DAC used in the field would then provide a DAC-hr equal to 2.5 mrem of CEDE. We would have to limit intakes of these radionuclides to less than 2000 DAC-hrs because of their Non-Stochastic ALI.

Cr-51

Class D

Gonad	Breast	Lung	R Marrow	B Surface	Thyroid	Remainder Organs
2.7E-11	1.9E-11	3.8E-11	2.7E-11	2.7E-11	..	3.0E-11 3.8E-11 5.9E-11 2.5E-11
2.71E-11	1.94E-11	3.81E-11	2.68E-11	2.74E-11	1.82E-11	3.55E-11

Class W

Gonad	Breast	Lung	R Marrow	B Surface	Thyroid	Remainder Organs
2.2E-11	..	3.8E-10	1.1E-10
2.21E-11	1.50E-11	3.77E-10	1.87E-11	1.50E-11	1.10E-11	4.93E-11

Class Y

Gonad	Breast	Lung	R Marrow	B Surface	Thyroid	Remainder Organs
..	..	5.3E-10	1.2E-10
2.03E-11	1.58E-11	5.34E-10	1.87E-11	1.39E-11	1.08E-11	5.26E-11

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

Days	Whole Body Retention		Urinary Excretion		DAC (Y) = 3E-7 DAC-hr = 360 nCi DAC-hr = 2.57 mrem (ALI) DAC-hr = 3.92 mrem (h)
	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	

"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

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 Fract	W Fract	Y Fract	D Fract	W Fract	Y Fract
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
 β = 315
 γ = 320 9.80%
 Γ = 16
 mR/hr per Ci at 1 meter

Note: f - fecal excretion >90%

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 =		0.22	0.19	351.20	1.28	0.52	0.03	21.20

* 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 =	1.01E-07	13	17	h eff	(S)ALI	(S)ALI	(N)ALI	
	374.7	13	17	351.2	14	10	20	(Lung)

Days	Whole Body Retention		Total Excreta		f
	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	0.635			
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	4.20E-2	5.20E-2	f
2	0.459	0.424	1.35E-1	1.60E-1	f
3	0.345	0.293	1.13E-1	1.30E-1	f
4	0.278	0.220	6.58E-2	7.29E-2	f
5	0.244	0.183	3.37E-2	3.60E-2	f
6	0.226	0.166	1.68E-2	1.70E-2	f
7	0.217	0.157	8.64E-3	7.99E-3	f
8	0.212	0.153	4.75E-3	3.81E-3	f
9	0.208	0.151	2.91E-3	1.87E-3	f
10	0.206	0.150	2.03E-3	9.62E-4	f
20	0.189	0.144	1.05E-3	1.29E-4	f
30	0.175	0.139	8.93E-4	1.24E-4	f
40	0.163	0.135	7.61E-4	1.19E-4	f
50	0.152	0.130	6.49E-4	1.14E-4	f
60	0.142	0.126	5.55E-4	1.10E-4	f
70	0.134	0.122	4.73E-4	1.06E-4	f
80	0.126	0.118	4.04E-4	1.02E-4	f
90	0.120	0.114	3.46E-4	9.91E-5	f
100	0.113	0.110	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 (A)
 DAC-hr = 2.7 mrem (h)

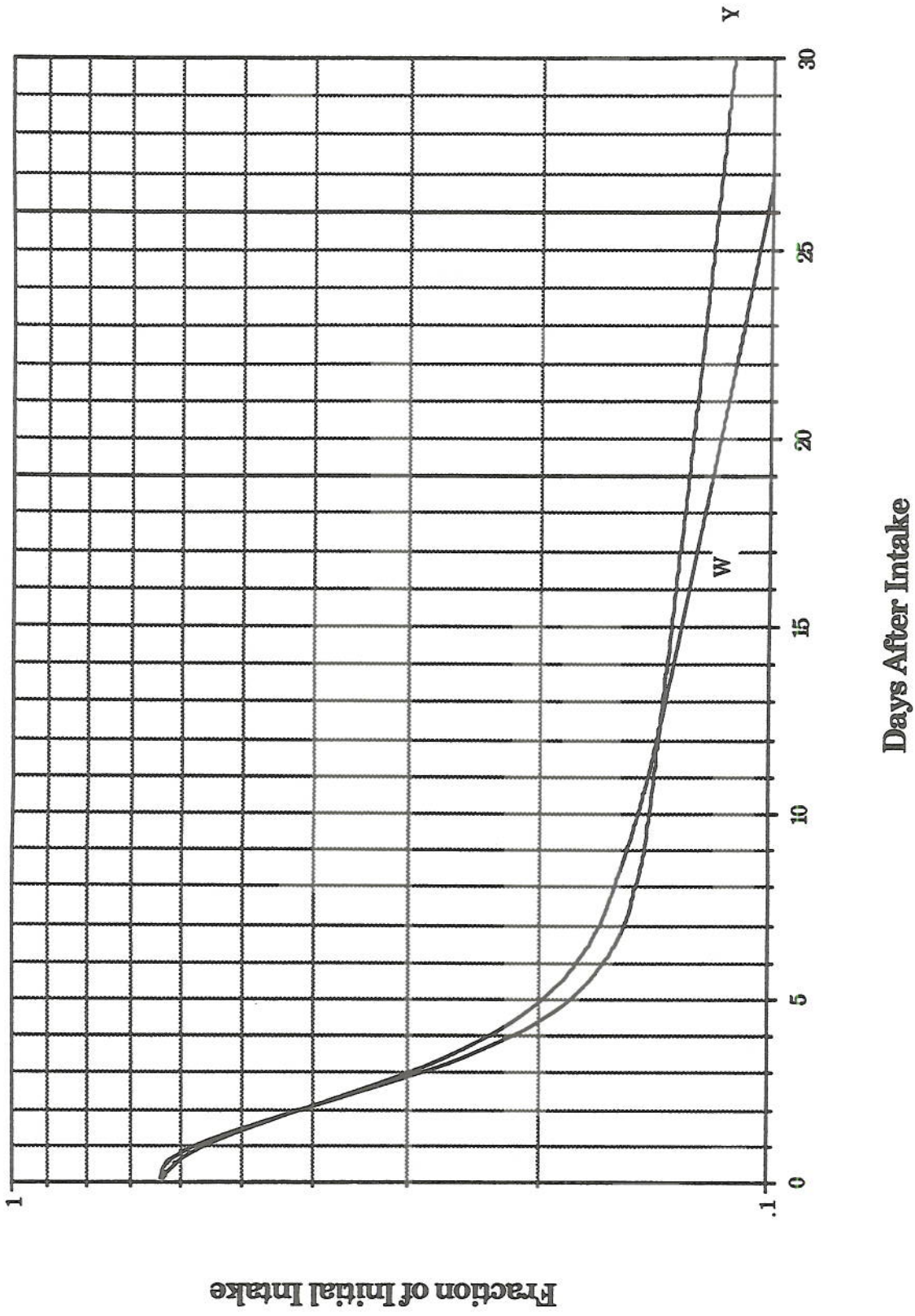
"Properly Based ALI/DAC"

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

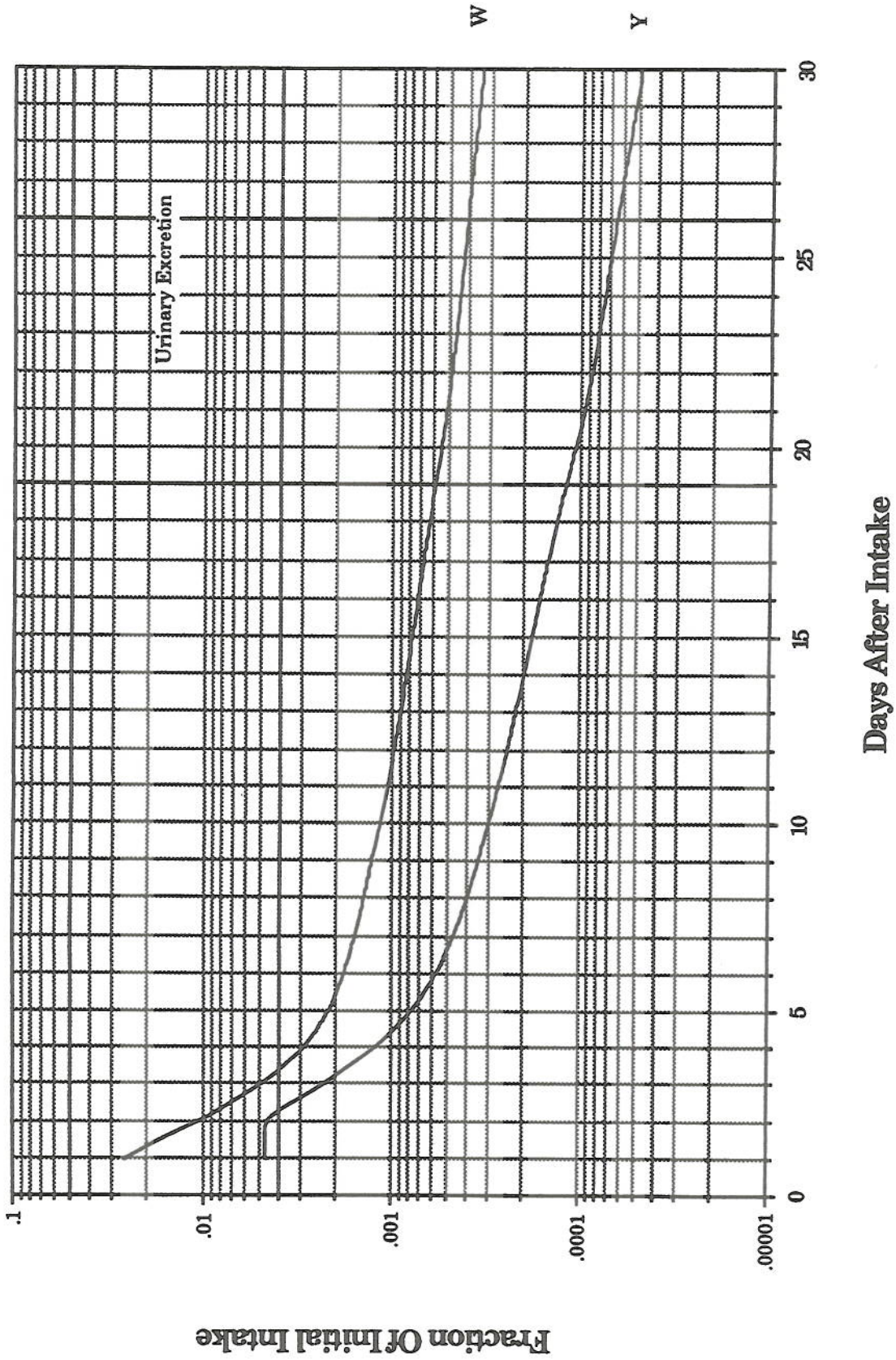
Misc
 Data
 T 1/2 = 284.2 d
 β^- 310
 γ 80.1 1.6%
 133.5 10.8%
 Γ = 40
 mR/hr per Ci at 1 meter

Note: f - fecal excretion >90%

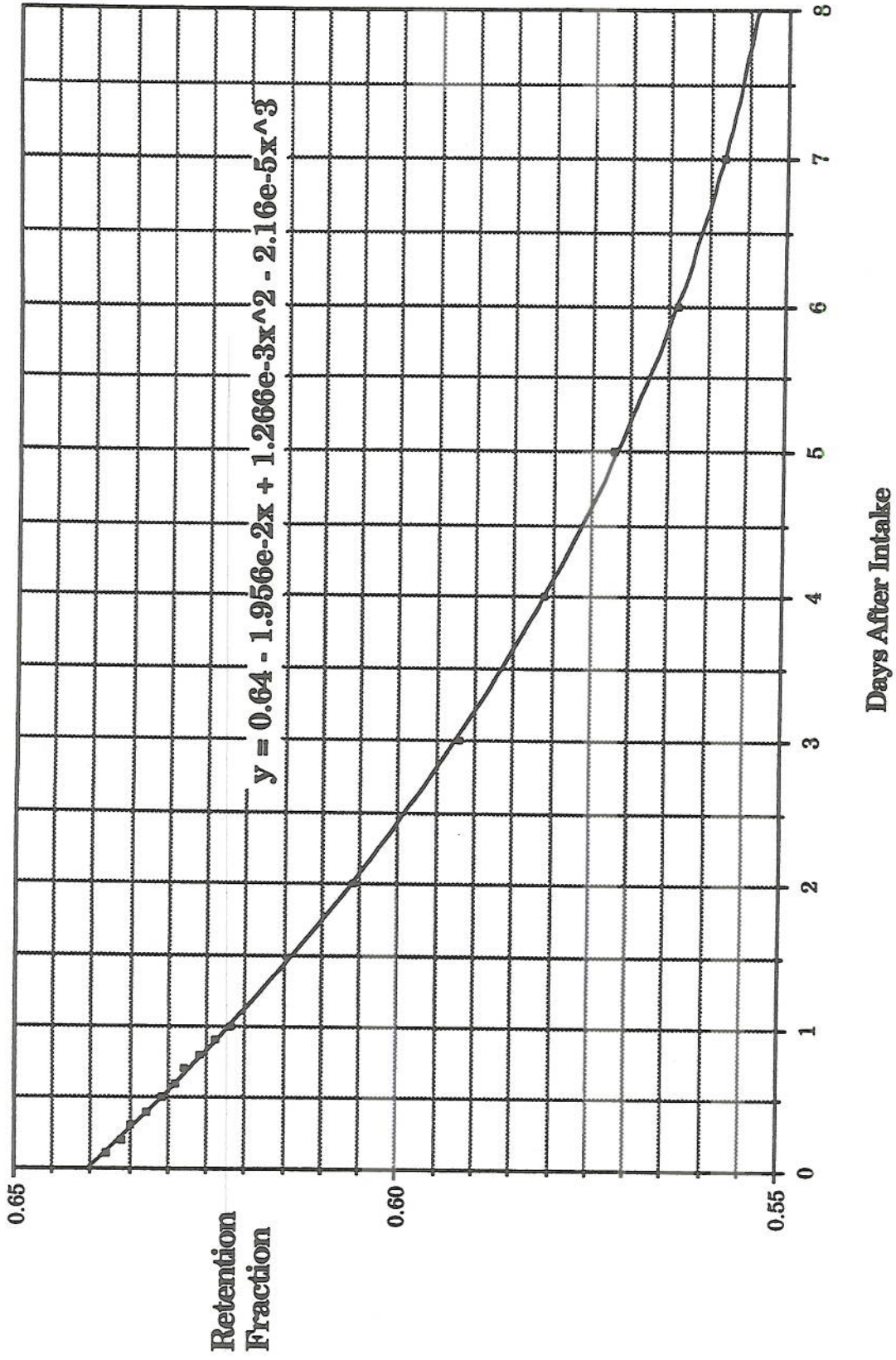
Co-58 Retention Fractions



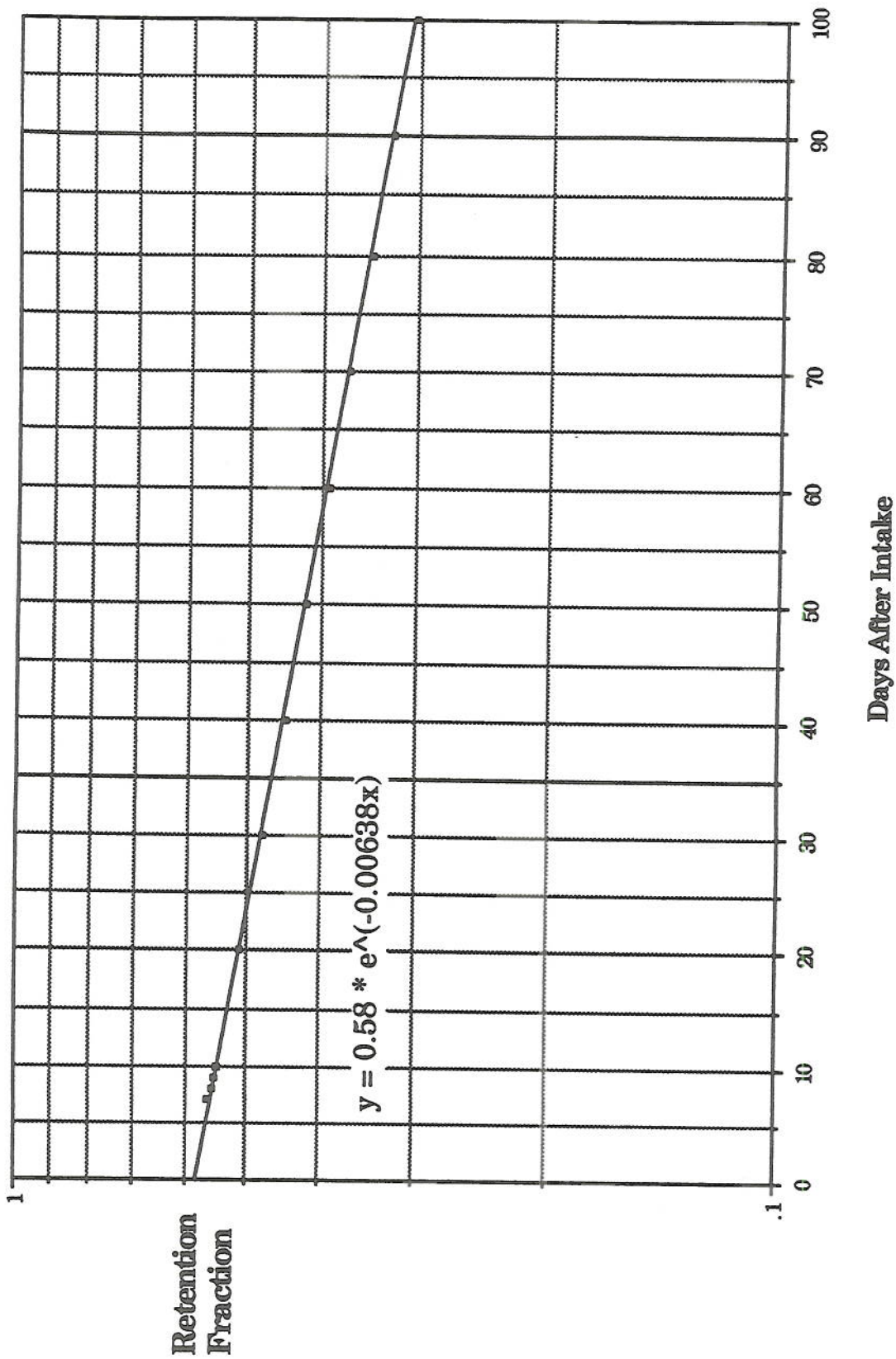
Co-58 Excretion Fractions



Cs-137 Intake Retention Fractions



Cs-137 Intake Retention Fractions



(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

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

Dose Calculational Problems with the 10% Rule and Roundoff

10% Rule: Up to 30% of the dose is ignored in some ALI calculations.

Roundoff: An ALI of 15.2 μCi would round to 20 μCi .
An ALI of 14.7 μCi would round to 10 μCi .

ALI's can be a factor of 2 higher than they should be;
i.e., an intake of 1 ALI would be 10 Rem of CEDE.

Problem Summary

The current ALI's and DAC's were determined from rounded results that ignored dose components that may be numerically significant in additional computations.

The Non-Stochastic calculated DAC's are not appropriate for field use.

The ALI's and DAC's were never meant to be used to calculate internal doses. They were simply to be used as an internal dose limitation system.

However, the new 10CFR20 requires CEDE/CDE calculations from this system.

If they are to be used to calculate dose, they should be correct.

10 CFR 20, Appendix B states "The relationship between the DAC and the ALI is given by:

$$DAC = ALI \div 2.4E09$$

The following examples show this 10CFR20 statement to be invalid:

<u>Radionuclide</u>	<u>(S)ALI</u>	<u>DAC</u>
Cs-137 (D)	200	6E-08
Co-60 (W)	200	7E-08
Co-56 (Y)	200	8E-08
Si-32 (D)	200	1E-07

These differences in DAC determination are not because of any difficulty in rounding the above calculation to one significant figure; i.e.,

$$200 \div 2.4E09 = 8.3E-08 \longrightarrow 8E-08$$

Table of ICRP 30 Unrounded ALI's That Determined The DAC's

<u>Radionuclide</u>	<u>(S)ALI</u>	<u>DAC</u>
Cs-137 (D)	150	6E-08
Co-60 (W)	170	7E-08
Co-56 (Y)	190	8E-08
Si-32 (D)	240	1E-07

Keith Eckerman retrieved these ALI's out of the ICRP/ORNL computer code. They are the unrounded ALI's that were actually used to determine the 10CFR20 DAC's.

Dose Calculations Using Various Reg Guide 8.34 Methods

Calculational Method	Co-58 (Y)	5 μ Ci	13.9 DAC-hrs
----------------------	-----------	------------	--------------

By heff	1)	$5 \mu\text{Ci} \times 10.9 = 55 \text{ mrem}$
By ALI	2)	$5/700 \times 5000 = 36 \text{ mrem}$
By DAC-hr	3)	$13.9/2000 \times 5000 = 35 \text{ mrem}$

Dose Calculations Using Various Reg Guide 8.34 Methods

Calculational Method	Co-58 (Y)	5 μ Ci	13.9 DAC-hrs
----------------------	-----------	------------	--------------

By heff	1)	5 μ Ci X 10.9 =	55 mrem
By ALI	2)	5/700 X 5000 =	36 mrem
By DAC-hr	3)	13.9/2000 X 5000 =	35 mrem

(If Corrected)

Calculational Method	Co-58 (Y)	5 μ Ci	21.7 DAC-hrs
----------------------	-----------	------------	--------------

By heff	1)	5 μ Ci X 10.9 =	55 mrem
By ALI	2)	5/460 X 5000 =	54 mrem
By DAC-hr	3)	21.7/2000 X 5000 =	54 mrem

When corrected, all calculational methods provide the same answer.

Dose Calculations Using Various Reg Guide 8.34 Methods

Calculational Method	Ce-144 (Y)	5 μ Ci	694.4 DAC-hrs
----------------------	------------	------------	---------------

By heff	1)	$5 \mu\text{Ci} \times 374.7 = 1874 \text{ mrem}$
By ALI	2)	$5/10 \times 5000 = 2500 \text{ mrem}$
By DAC-hr	3)	$694.4/2000 \times 5000 = 1736 \text{ mrem}$

Dose Calculations Using Various Reg Guide 8.34 Methods

Calculational Method	I-131 (D) 5 μ Ci	208 DAC-hrs
----------------------	-------------------------	-------------

By heff 1) 5 μ Ci X 32.9 = 165 mrem

By ALI 2) 5/200 X 5000 = 125 mrem

By DAC-hr 3) 208/2000 X 5000 = 521 mrem

Calculational		Co-58 (Y)	
Method		700 μ Ci (1 ALI)	1946 DAC-hrs
By heff	1)	700 μ Ci X 10.9 =	7630 mrem
By ALI	2)	700/700 X 5000 =	5000 mrem
By DAC-hr	3)	1946/2000 X 5000 =	4865 mrem

Radionuclide	Without the 10% Rule		With the 10% Rule		Published
	ALI	(μCi)	ALI	(μCi)	
Ag-105 (Y)	1.1E+03	1.1E+03	1.6E+03	1.6E+03	2.0E+03
Mg-28 (D)	1.5E+03	1.5E+03	1.6E+03	1.6E+03	2.0E+03
Mn-56 (W)	1.3E+04	1.3E+04	1.5E+04	1.5E+04	2.0E+04
Se-73 (W)	1.1E+04	1.1E+04	1.6E+04	1.6E+04	2.0E+04
Sr-87m (Y)	1.2E+05	1.2E+05	1.5E+05	1.5E+05	2.0E+05

DAC-hrs \neq DAC-hrs \neq DAC-hrs

(i.e., not 2.5 mrem of CEDE)

<u>Radionuclide</u>	<u>DAC</u>	<u>DAC-hr</u>	<u>mrem</u>
Co-58(Y)	3E-07	360 nCi	3.92
Ru-103(Y)	3E-07	360 nCi	3.24
Fe-59(D)	1E-07	120 nCi	1.78
I-133(D)	1E-07	120 nCi	0.71

The concentration values given in Columns 1 and 2 of Table 2 are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.05 rem (50 millirem).

10CFR20 Effluent Concentration Offsite Dose Calculations Using RG 1.109

	Eff Conc ($\mu\text{Ci/cc}$)	Total Body D.F. (mrem/ μCi)	Total Body Adult Dose (mrem)	Max Organ D.F. (mrem/ μCi)	Max Organ Adult Dose (mrem)
H-3	1.0E-07	0.16	126	0.2	126
Co-58	1.0E-09	0.26	2.1	116	928
Co-60	5.0E-11	1.85	0.7	746	298
Zr-95	4.0E-10	2.91	9.3	221	707
Nb-95	2.0E-09	0.53	8.4	63	1010
Ru-106	2.0E-11	1.09	0.2	1170	187
I-131	2.0E-10	2.56	4.1	149	238
Cs-134	2.0E-10	91.00	146	106	170
Ce-144	2.0E-11	23.00	3.7	972	156



From Appendix B:
 To Determine the current 10CFR20 Effluent Concentrations, they used:
 The Stochastic ALI
 Divided by 2.4E9 cc/yr occupational breathing rate
 Divided 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

Dose Calculation Example:
 Nb-95: 2E-9 $\mu\text{Ci/cc}$ x 8E9 cc/yr x 0.526 mrem/ μCi = 8.42 mrem/yr

Using EPA 11

	Eff Conc ($\mu\text{Ci/cc}$)	EPA 11 D.F. (mrem/ μCi)	Adult Dose (mrem)
H-3	1.0E-07	0.1	48
Co-58	1.0E-09	10.9	87
Co-60	5.0E-11	218.7	87
Zr-95	4.0E-10	23.7	76
Nb-95	2.0E-09	5.8	93
Ru-106	2.0E-11	478.4	77
I-131	2.0E-10	32.9	53
Cs-134	2.0E-10	46.4	74
Ce-144	2.0E-11	374.7	60

Recommended Effluent Concentration Offsite Dose Calculations Using EPA 11

Recommended

	ALI (μCi)	Eff Conc ($\mu\text{Ci}/\text{cc}$)	EPA 11 D.F. (mrem/ μCi)	Adult Dose (mrem)
H-3	78000	9.8E-08	0.1	47
Co-58	460	5.8E-10	10.9	50
Co-60	23	2.9E-11	218.7	50
Zr-95	210	2.6E-10	23.7	50
Nb-95	860	1.1E-09	5.8	50
Ru-106	10	1.3E-11	478.4	48
I-131	150	1.9E-10	32.9	49
Cs-134	110	1.4E-10	46.4	51
Ce-144	13	1.6E-11	374.7	49



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: $1.1\text{E-}9 \mu\text{Ci}/\text{cc} \times 8\text{E}9 \text{ cc}/\text{yr} \times 5.8 \text{ mrem}/\mu\text{Ci} = 49.8 \text{ mrem}/\text{yr}$

"The ALI's and DAC's were never meant to be used to calculate internal dose."

Keith Eckerman

Dose Calculational Problems with the 10% Rule and Roundoff

10% Rule: Up to 30% of the dose is ignored in some ALI calculations.

Roundoff: An ALI of 15.2 μCi would round to 20 μCi .
An ALI of 14.7 μCi would round to 10 μCi .

ALI's can be a factor of 2 higher than they should be;
i.e., an intake of 1 ALI would be 10 Rem of CEDE.

Impact of the Recommendations

80% of the ALI's and DAC's should be lowered.

I.E. the vast majority of the current ALI's are NON-CONSERVATIVE.

Some of the DAC's, however, would be increased by more than a factor of three; i.e., the non-stochastically limited DAC's.

(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
2.94E-09	460	845	7.1	704	700	(N)ALI
CEDE per μCi Inhaled = 10.9	460	845 (Lung)				800

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)

Nuclide Class	Current		Recommended		Current		Recommended	
	ALI	ALI	ALI	DAC	DAC	DAC	DAC	
Cr-51	Y	20000	15000	8E-06	8E-06	6.3E-06	6.3E-06	
Mn-54	W	800	750	3E-07	3E-07	3.1E-07	3.1E-07	
Co-58	W	1000	790	5E-07	5E-07	3.3E-07	3.3E-07	
Co-58	Y	700	460	3E-07	3E-07	1.9E-07	1.9E-07	
Co-60	W	200	150	7E-08	7E-08	6.3E-08	6.3E-08	
Co-60	Y	30	23	1E-08	1E-08	9.6E-09	9.6E-09	
Nb-95	W	1000	1000	5E-07	5E-07	4.2E-07	4.2E-07	
Nb-95	Y	1000	860	5E-07	5E-07	3.6E-07	3.6E-07	
I-131	D	50/200	46/150	2E-08	2E-08	6.3E-08	6.3E-08	
I-133	D	300/900	280/850	1E-07	1E-07	3.5E-07	3.5E-07	
Cs-134	D	100	110	4E-08	4E-08	4.6E-08	4.6E-08	
Cs-137	D	200	160	6E-08	6E-08	6.7E-08	6.7E-08	
Ce-144	W	30	23	1E-08	1E-08	9.6E-09	9.6E-09	
Ce-144	Y	10	13	6E-09	6E-09	5.4E-09	5.4E-09	

The following respected health physicists have reviewed this work and given their full agreement:

Keith Eckerman
John Poston
Bob Alexander
Ralph Anderson
Dave Miller
Steve Sims

An NRC official has indicated his agreement with the analysis presented here. It was his position that these changes would very likely be a part of expected 10CFR20 resolutions in the next few years; along with any other identified problem resolutions.

NRC officials have agreed that they would allow these modifications in several ways:

- 1) Request for Rulemaking
- 2) Application for an exemption under 20.2301
- 3) Request for the approval of adjusted DAC's and ALI's under 20.1204 (c)