

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

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10CFR20, Appendix B

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

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)		
Days	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%
 β^+ 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 (Lung)	0.26	18983	20000	30000

Whole Body Retention			Total Excreta			
Days	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		
	1.01E-07	13	17	h eff	(S)ALI	(S)ALI	(N)ALI
CEDE per μCi Inhaled =	374.7	13	17	351.2	14	10	20
			(Lung)				

Whole Body Retention			Total Excreta		
Days	W	Y	W	Y	
	Fract	Fract	Fract	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 (A)
 DAC-hr = 2.7 mrem (h)

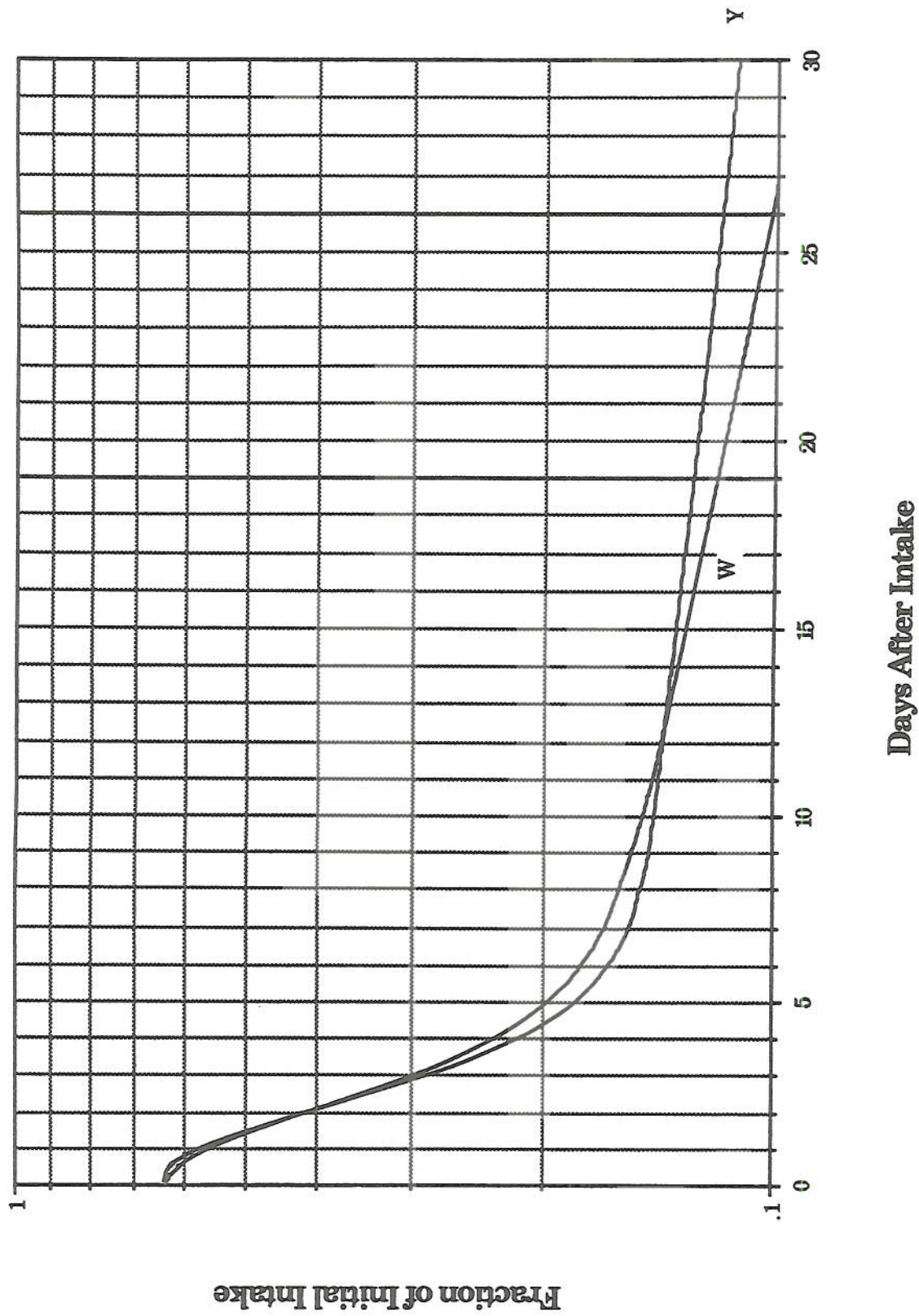
"Properly Based ALI/DAC"

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

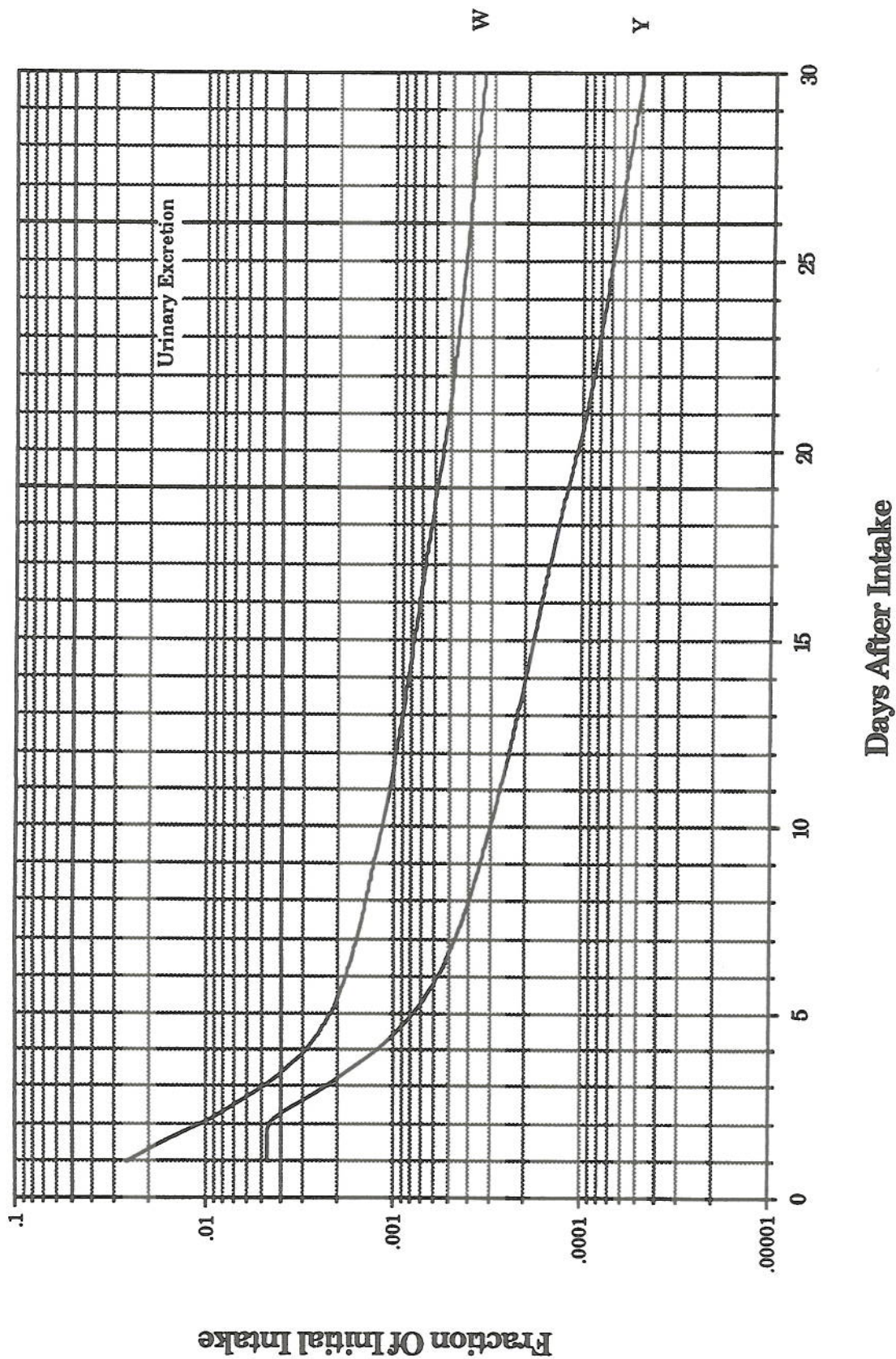
Misc
 Data
 T 1/2 = 284.2 d
 β^- 310
 γ 80.1 1.6%
 133.5 10.8%
 Γ = 40
 mR/hr per Ci at 1 meter

Note: f - fecal excretion >90%

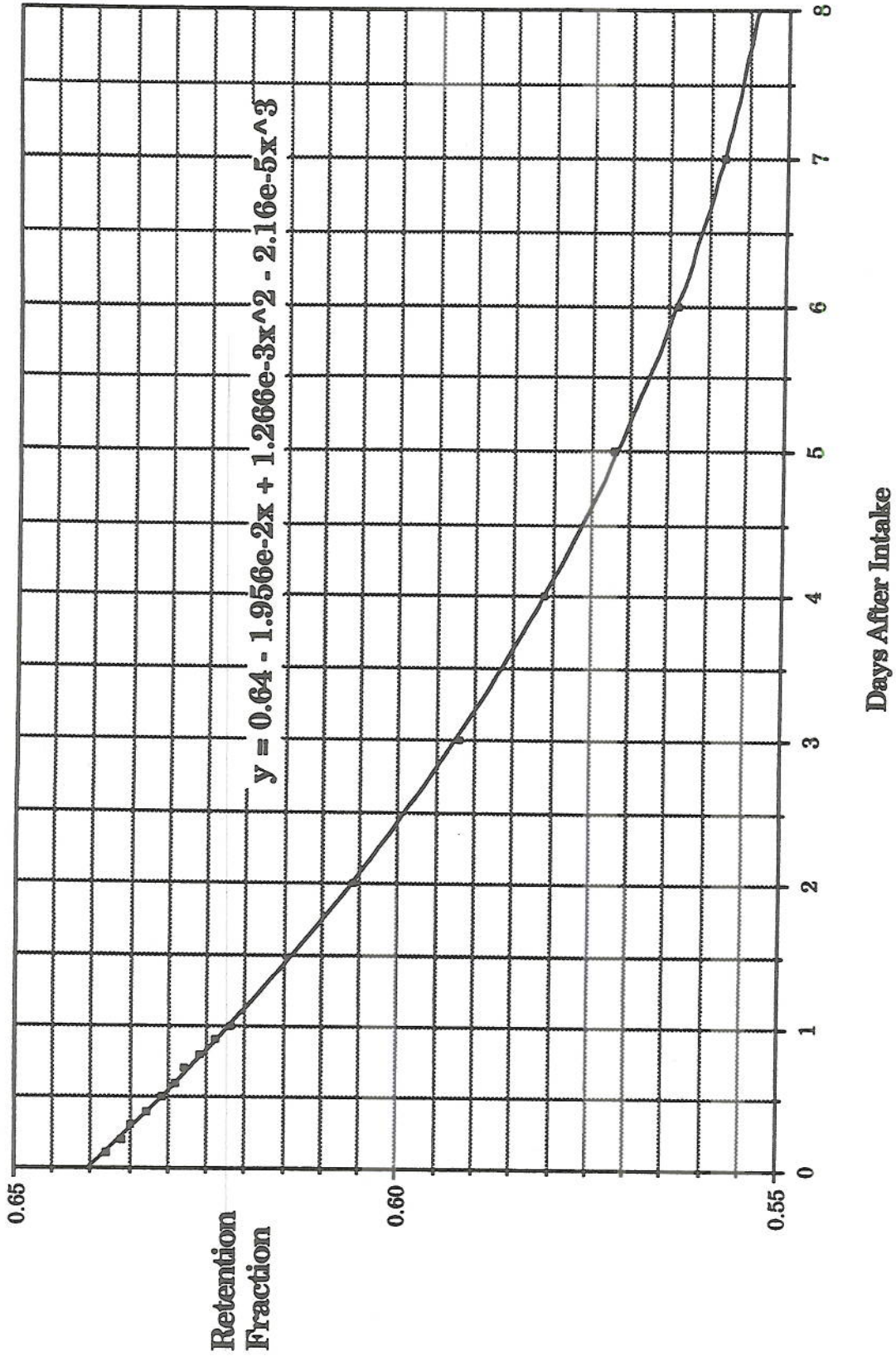
Co-58 Retention Fractions



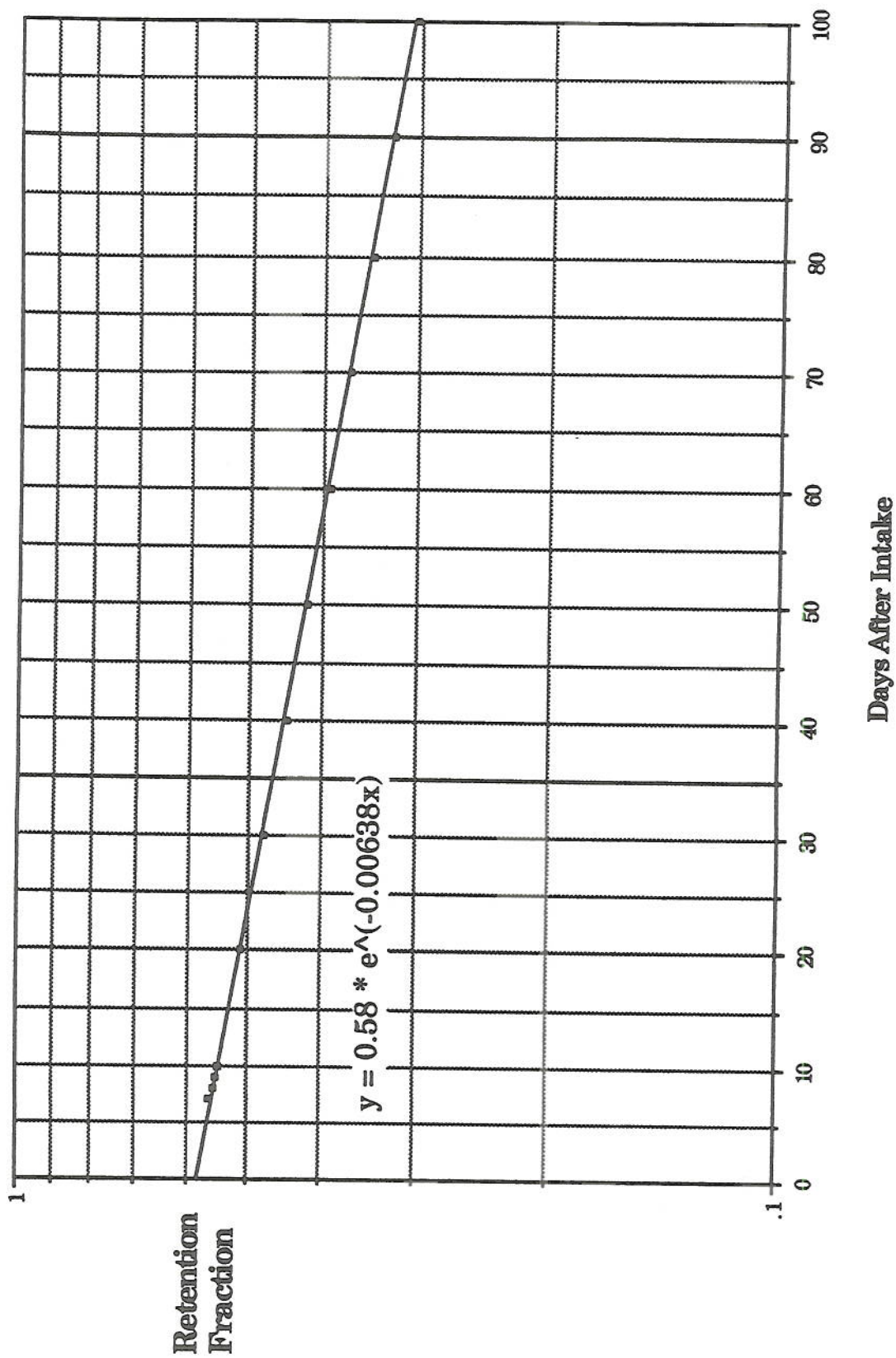
Co-58 Excretion Fractions



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

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

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

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.,

$$200 \div 2.4\text{E}09 = 8.3\text{E}-08 \longrightarrow 8\text{E}-08$$

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

(If Corrected)

▼

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

By heff	1)	$5 \mu\text{Ci} \times 10.9 =$	55 mrem
By ALI	2)	$5/460 \times 5000 =$	54 mrem
By DAC-hr	3)	$21.7/2000 \times 5000 =$	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
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By heff	1)	$5 \mu\text{Ci} \times 374.7 = 1874 \text{ mrem}$
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By ALI	2)	$5/10 \times 5000 = 2500 \text{ mrem}$
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By DAC-hr	3)	$694.4/2000 \times 5000 = 1736 \text{ mrem}$
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Dose Calculations Using Various Reg Guide 8.34 Methods

Calculational Method	I-131 (D) 5 μ Ci	208 DAC-hrs
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By heff	1)	$5 \mu\text{Ci} \times 32.9 = 165 \text{ mrem}$
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By ALI	2)	$5/200 \times 5000 = 125 \text{ mrem}$
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By DAC-hr	3)	$208/2000 \times 5000 = 521 \text{ mrem}$
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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	

the 10% Rule

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

	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: $2\text{E-}9 \mu\text{Ci/cc} \times 8\text{E}9 \text{ cc/yr} \times 0.526 \text{ mrem}/\mu\text{Ci} = 8.42 \text{ mrem/yr}$

WATER EFFLUENT CONCENTRATION VISITE DOSE CALCULATION
Using EPA 11

	Eff Conc (μ Ci/cc)	EPA 11 D.F. (mrem/ μ Ci)	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

Maximum Recommended Effluent Concentration Offsite Dose Calculations Using EPA 11

Recommended				
	ALI (μCi)	Eff Conc ($\mu\text{Ci/cc}$)	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: $1.1\text{E-}9 \mu\text{Ci/cc} \times 8\text{E}9 \text{ cc/yr} \times 5.8 \text{ mrem}/\mu\text{Ci} = 49.8 \text{ mrem/yr}$

"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

CEDE per μCi Inhaled =	h eff 2.94E-09 10.9	h Based (S)ALI 460 460	h Based (N)ALI 845 845 (Lung)	10% Rule h eff 7.1	10% Rule (S)ALI 704	(S)ALI 700	(N)ALI 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	DAC	ALI	DAC	ALI	DAC	ALI	DAC
Cr-51	Y	20000			15000	8E-06		6.3E-06
Mn-54	W	800			750	3E-07		3.1E-07
Co-58	W	1000			790	5E-07		3.3E-07
Co-58	Y	700			460	3E-07		1.9E-07
Co-60	W	200			150	7E-08		6.3E-08
Co-60	Y	30			23	1E-08		9.6E-09
Nb-95	W	1000			1000	5E-07		4.2E-07
Nb-95	Y	1000			860	5E-07		3.6E-07
I-131	D	50/200			46/150	2E-08		6.3E-08
I-133	D	300/900			280/850	1E-07		3.5E-07
Cs-134	D	100			110	4E-08		4.6E-08
Cs-137	D	200			160	6E-08		6.7E-08
Ce-144	W	30			23	1E-08		9.6E-09
Ce-144	Y	10			13	6E-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)