Concerns Regarding Radiation Protection Standards in a Post-Fukushima Era

31 October 2011

Starting Point: Longstanding Fundamental EPA Principles

1. Cancer Risks Should Not Exceed Acceptable Risk Range of 10^{-6} to 10^{-4}

2. Drinking Water Should Not Exceed Safe Drinking Water Levels (MCLs)

THE OVERARCHING CONCERN

During the prior administration, ORIA & OEM proposed markedly weakening radiation standards- to levels far outside the risk range and far above the MCLs, placing longstanding EPA fundamental policies at risk.

These efforts at weakening standards do not appear to have ceased.

Background

Fundamental Concern

The science keeps finding radiation to be more dangerous than previously assumed, while politics keeps pushing to relax rather than strengthen radiation protection standards.

National Academy of Sciences' Biological Effects of Ionizing Radiation Studies

BEIR V found radiation ~3-4 times more dangerous per unit dose than previously assumed

BEIR VII found cancer incidence risks 35% higher than BEIR V

Yet the radiation standards of EPA and other agencies have generally not been tightened accordingly. Indeed, as in the case of the PAGs, there has been pressure to dramatically weaken standards further.

Whereas EPA generally relies on risk for setting standards, NRC, DOE and ORIA use dose, which makes it hard for decisionmakers to readily judge the appropriateness of proposed radiation standards.

Therefore, it is helpful to keep in mind EPA's official risk estimates for radiation.

Key Cancer Incidence Risk Conversion Factor for Radiation

Current EPA Factor: 1.16×10^{-3}/Rem

Source: EPA "Blue Book," EPA Radiogenic Cancer Risk Models and Projections for the U.S. Population (April 2011)

based on exposure spread over a lifetime, or exposure to someone of average age.

Now matches closely to findings of the National Academy of Sciences (BEIR VII) [9] [1.141×10^{-3}/Rem]

Thus, any cumulative dose of 0.1 rem -- 100 millirem (not 100 mrem/yr, but *total accumulated* dose) – or greater to someone of average age would be above the upper edge of EPA's permissible risk range of 10^{-4}.

87 mrem = $1x10^{-4}$ risk per EPA Blue Book. [0.087 rem x 1.16 x 10^{-3} cancers per rem = 1 x 10^{-4}.]

Based on EPA Blue Book data for risk associated with age at exposure, however, the risk is greater for exposures at younger ages.

EPA Blue Book: Lifetime Attributable Risk by Age at Exposure

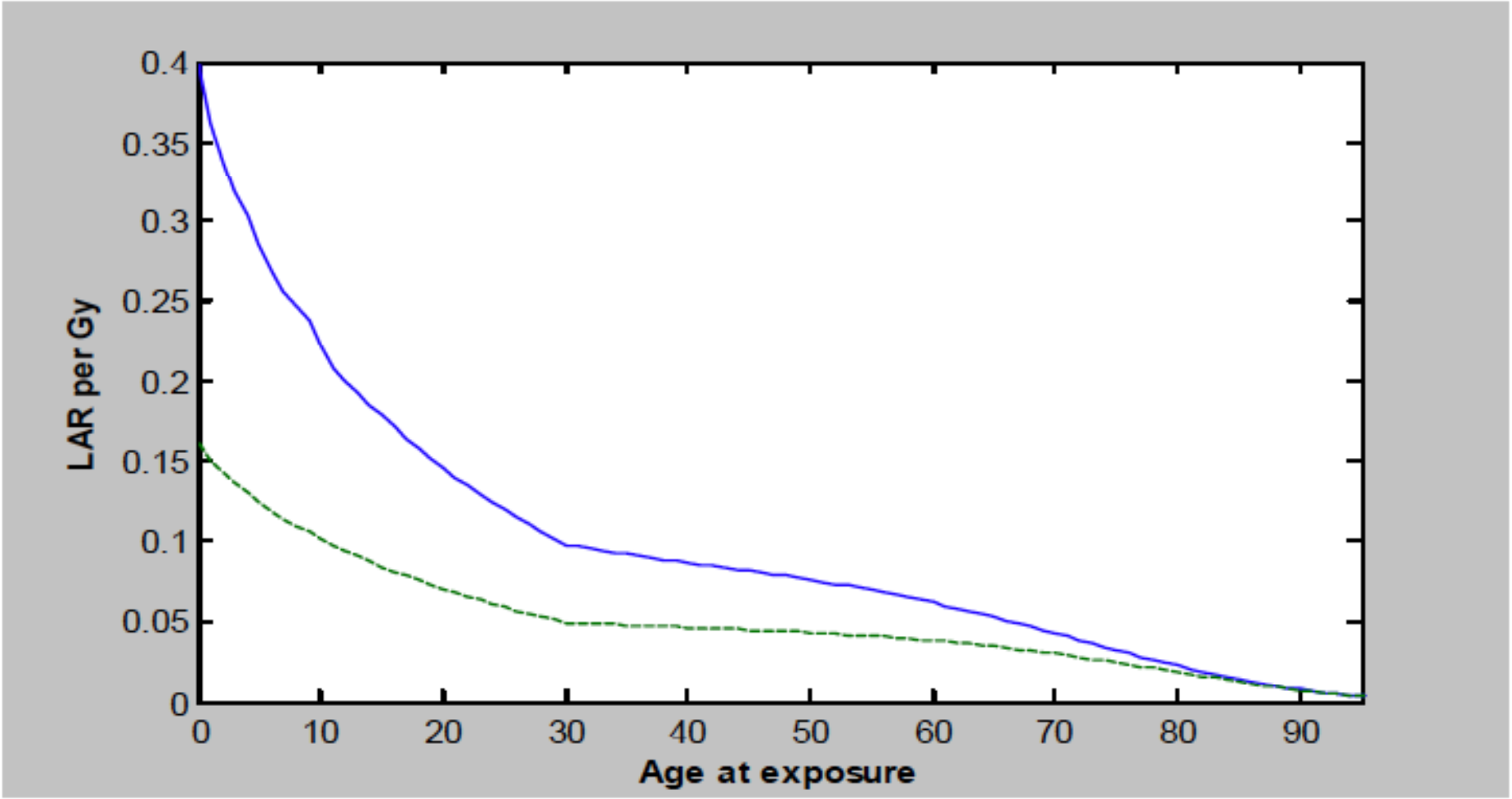


Figure 3-9: LAR for all cancers combined by age at exposure for exposures at low doses and/or dose rates for incidence (solid) and mortality (dashed)

According to the EPA Blue Book data, risk before age 30 is on average ~2000 cancers per 10,000 person-Gy, or ~2 x 10^{-3}/rem, ~1.8 times as high as for exposures spread over a lifetime (1160 cancers per 10,000 person-Gy, or 1.16 x 10^{-3}/rem).

Table 3-14: LAR for cancer incidence[1,2] for lifelong and childhood exposures

	Lifelong exposure			Exposures before age 15		
Cancer site	Males	Females	Sex-averaged	Males	Females	Sex-averaged
Stomach	62	75	68	128	161	144
Colon	146	92	119	272	179	227
Liver	40	21	30	79	43	62
Lung	130	308	220	247	611	425
Breast	—	289	146	—	885	433
Prostate	89	—	44	161	—	82
Uterus	—	23	12	—	51	25
Ovary	—	33	17	—	71	35
Bladder	97	92	95	175	176	175
Thyroid	22	65	44	81	265	171
Residual	251	259	255	616	675	645
Kidney	24	22	23	53	53	53
Bone	2.4	2.3	2.39	7.2	7.2	7.2
Skin	182	96	138	773	436	608
Solid[3]	863	1280	1080	1820	3180	2480
Leukemia	92	69	80	132	108	120
Total[3]	955	1350	1160	1950	3290	2600

[1] Cases per 10,000 person-Gy for a stationary population.
[2] DDREFof 1.5 for sites other than leukemia, bone, and skin
[3] Excludes nonfatal skin cancers

Table 3-12c: Sex-averaged LAR for cancer incidence[1,2] by age at exposure

	Age at exposure										
Cancer site	**0**	**5**	**10**	**15**	**20**	**30**	**40**	**50**	**60**	**70**	**80**
Stomach	190	157	129	106	87	58	55	49	41	29	15
Colon	285	244	207	175	149	107	104	97	81	55	26
Liver	81	67	55	46	38	26	25	23	19	13	7
Lung	547	459	383	320	268	188	187	179	154	110	60
Breast	614	480	372	288	222	130	72	36	16	6	2
Prostate	101	88	75	65	56	42	42	40	30	14	4
Uterus	32	27	22	18	15	10	9	8	6	4	2
Ovary	44	38	31	26	22	15	14	12	9	6	3
Bladder	220	188	160	136	116	84	83	80	69	49	24
Thyroid	252	227	126	68	47	21	8	3	1	0	0
Residual	1290	680	515	408	324	206	179	146	106	64	28
Kidney	117	54	43	36	30	21	19	15	10	6	2
Bone	10.4	8.0	6.1	4.7	3.5	2.0	1.1	0.6	0.3	0.1	0.0
Skin[3]	1360	722	381	201	106	30	8	2	1	0	0
Solid	3780	2720	2130	1700	1380	910	799	690	543	356	173
Leukemia	183	130	101	86	79	69	70	73	77	75	54
Total[3]	3970	2850	2230	1780	1460	979	870	763	620	430	227

[1] Cases per 10,000 person-Gy.
[2] DDREF of 1.5 for sites other than leukemia, bone, and skin
[3] Excludes nonfatal skin cancers

0	3970	6820			
1	3410	2			
2	3410	3410			
3	3410				
4	3410				
5	2850	5080	15 year	30 year	
6	2540	2	40870	61565.5	
7	2540	2540	15	30	
8	2540		2724.666667	**2052.183333**	
9	2540				
10	2230	4010			
11	2005	2			
12	2005	2005			
13	2005				
14	2005				
15	1780	3240			
16	1620	2			
17	1620	1620			
18	1620				
19	1620				
20	1460	2439			
21	1219.5	2			
22	1219.5	1219.5			
23	1219.5				
24	1219.5				
25	1219.5				
26	1219.5				
27	1219.5				
28	1219.5				
29	1219.5				
	979				

<u>Estimating risk for exposure before age 15 and before age 30.</u>

Risks at ages 0, 5, 10, 15, 20, and 30 (2nd column) taken from EPA Blue Book Table 3-12c (prior slide). Risks between those ages are the averages of those intervals. Risk for exposure up to age 30 is ~2052 cancers per 10,000 person-Gy. Blue Book estimates risk for exposure over lifetime at 1160 cancers/10,000 person-Gy. Exposures up to age 30 thus produce ~1.8 times more cancers.

Since EPA's radiation standards (e.g., CERCLA) are generally based on cancer incidence from 30 years of exposure to age 30, this means that any standard higher than *~1.7 millirem per year would exceed a 1 x 10^{-4} risk, and anything above about 5 millirem per year would exceed 3 x 10^{-4}*, based on EPA's Blue Book figures.

0.0017 rem/yr x 30 yrs x
2×10^{-3} cancers/rem =
1×10^{-4} risk

0.005 rem/yr x 30 yrs x 2×10^{-3}
cancers/rem = 3×10^{-4} risk

Thus, no radiation standard should exceed a few millirem/year, as it would result in risks outside EPA's longstanding acceptable risk range, based on EPA's current radiation risk figures.

So, rule of thumb, based on EPA's most recent official radiation risk #s:

~1.7 mrem/year over one's first 30 years

$\approx 10^{-4}$ risk

100mRem/yr for 30 yrs would, according to EPA's own risk figures, result in cancer incidence about two orders of magnitude higher than the upper end of the acceptable risk range. NRC's general limits are, in fact, 100 mrem/yr.

Radiation exposure to a female infant, according to EPA, will result in 4-5 times the cancer risk than the age- and gender-averaged risk. (This doesn't even take into account that the same amount of radioactivity ingested or inhaled can result in a much higher dose in an infant because of the small body size.)

Table 3-12a: LAR for cancer incidence[1,2] by age at exposure for males

	Age at exposure										
Cancer site	**0**	**5**	**10**	**15**	**20**	**30**	**40**	**50**	**60**	**70**	**80**
Stomach	168	139	114	94	77	51	48	43	35	24	12
Colon	342	292	248	210	179	129	126	117	97	65	29
Liver	103	86	71	59	49	34	33	29	24	17	9
Lung	320	268	222	185	154	108	107	104	90	65	35
Prostate	198	172	148	127	110	82	83	80	61	30	9
Bladder	219	188	159	135	116	84	84	81	71	50	24
Thyroid	123	107	58	32	23	11	5	2	1	0	0
Residual	1180	653	498	394	313	199	174	142	101	58	24
Kidney	102	55	44	37	31	22	20	16	11	6	2
Bone	10.4	8.0	6.1	4.6	3.5	2.0	1.1	0.6	0.3	0.1	0.0
Skin	1720	917	484	256	136	38	10	3	1	0	0
Solid[3]	2760	1970	1570	1280	1050	722	682	616	492	314	144
Leukemia	193	142	112	97	89	78	79	83	88	87	64
Total[3]	2950	2110	1680	1370	1140	801	761	699	580	402	208

[1] Cases per 10,000 person-Gy.
[2] DDREF of 1.5 for sites other than leukemia, bone, and skin
[3] Excludes nonfatal skin cancers

Source: EPA Blue Book

Table 3-12b: LAR for cancer incidence by age at exposure[1,2] for females

	Age at exposure										
Cancer site	**0**	**5**	**10**	**15**	**20**	**30**	**40**	**50**	**60**	**70**	**80**
Stomach	212	175	144	118	97	64	61	55	46	33	18
Colon	225	193	164	139	118	84	82	76	65	46	23
Liver	57	47	39	32	26	18	18	16	14	10	6
Lung	785	660	552	462	387	272	269	255	217	150	79
Breast	1260	982	761	588	454	265	146	72	32	12	4
Uterus	66	55	46	38	31	21	19	16	12	8	4
Ovary	91	77	64	53	45	31	28	24	17	11	5
Bladder	221	189	161	137	116	84	83	78	67	48	24
Thyroid	386	352	196	106	73	30	12	4	1	0	0
Residual	1410	707	534	422	336	213	184	151	112	69	31
Kidney	133	53	41	34	28	20	17	14	10	5	2
Bone	10.4	8.0	6.1	4.7	3.6	2.1	1.2	0.6	0.3	0.1	0.0
Skin	972	517	273	144	76	21	6	2	0	0	0
Solid[3]	4850	3500	2710	2130	1720	1100	920	764	594	393	195
Leukemia	173	117	88	75	69	60	61	63	65	63	47
Total[3]	5020	3620	2800	2210	1780	1160	981	827	659	456	242

[1] Cases per 10,000 person-Gy.
[2] DDREF of 1.5 for sites other than leukemia, bone, and skin
[3] Excludes nonfatal skin cancers

Source: EPA Blue Book

So, exposure to 2 rem in a year (the controversial Japanese proposed standard, partially retreated from, and the existing U.S. PAG value for the intermediate period) would result, according to EPA's official risk figures, in a radiation-induced cancer risk of 2.3 x 10^{-3} on an age- and gender-averaged basis, or *about one in five hundred, an order of magnitude outside the acceptable risk range.*

BUT, for a female infant, the risk would be 1 x 10^{-2}--*one in a hundred of them would get cancer from that dose,* based on EPA's own official risk estimates. This simply isn't an acceptable standard.

And any standard that permits exposure to the general public of doses of more than 20 millirem total in a single year, even assuming no radiation thereafter is ever received, would permit female infants to receive a risk above the 10^{-4} upper end of the permissible risk range, even if they never again in their life received any radiation.

EPA has historically opposed any radiation standard above 15 mRem EDE/year. For example, NESHAPs were set at 10 mRem/yr, MCLs at 4 mRem/yr, etc.

Anything higher would exceed the EPA risk range, and EPA has declared would be “non-protective”.

Even some of these older standards would no longer meet the risk range, given the increased cancer risks from radiation determined by EPA in the Blue Book and by NAS in BEIR VII.

Summary

According to EPA's own official most recent risk figures:

Any standard greater than a few millirem/year exceeds EPA's acceptable risk range.

Any standard for a single year that allows doses greater than ~100 millirem to an adult or ~20 millirem to a child exceeds the risk range for an entire lifetime from just that one year's dose.

ISSUE 1

THE BUSH ADMINISTRATION PROPOSEDPROTECTIVE ACTION GUIDE (PAG)

In the last full day before the Obama Inauguration, outgoing Acting Administrator Marcus Peabody transmitted to the Federal Register ORIA's rewrite of EPA's PAGs for dealing with a wide range of radiological releases.

As drafted by ORIA, the revised PAGs would have astronomically increased permissible exposures to radioactivity.

We had written the outgoing Administration urging that it not engage in such “midnight mischief.”

The Obama Administration, a day or two after taking office, and before the PAG could be published in the Federal Register, pulled it back, pending review by its new team.

More than 2 ½ years have passed and yet the issue is not resolved.

The revised Protective Action Guidance would be applicable to any "event or a series of events, deliberate or accidental, leading to the release or potential release into the environment of radioactive materials in sufficient quantity to warrant consideration of protective actions."

PAG August 2007 draft, p. 1-1

PAGs are to apply to a “wide range of incidents,” including transportation events, releases from a radiopharmaceutical facility, contamination at a scrap metal or recycling facility, incidents at research reactors, and incidents and releases at Department of Energy facilities or civil power reactors.

PAG draft p. ES-2, PAG website http://www.epa.gov/radiation/rert/pags.html

“A PAG is defined as ‘the projected dose to reference man, or other defined individual, from a release of radioactive material
at which a specific protective action to reduce or avoid that dose is recommended.’ PAG Draft p. ES-2

The Proposed PAG established for long-term cleanup a process called “optimization,” by which there would be no health-based cleanup standard but rather one could choose any cleanup level one wished from various “benchmarks.”

Those benchmarks included

- 0.1 Rem/year
- 1 Rem/year
- 10 Rem/year

Below the benchmark, no cleanup would occur.

Over the standard 30 year occupancy period EPA normally assumes, doses to the public under those benchmarks would result in cancer risks, according to EPA's official risk figures (Blue Book), of approximately:

- ~7×10^{-3}
- ~7×10^{-2} and
- ~7×10^{-1} respectively

<u>These benchmarks are nearly 2-4 orders of magnitude outside EPA's acceptable risk range, and as high as a **7 in 10 risk**</u>

CANCER RISKS* FROM EPA/ORIA PROPOSED PROTECTIVE ACTION GUIDE "OPTIMIZATION" PROCESS FOR LONG TERM CLEANUP

Cleanup Benchmark	≈ equivalent # of Chest X-rays		Risk of Cancer (exponential)	=1 Cancer Per X People Exposed	Factor by Which EPA Acceptable Risk Range Is Exceeded
	Per Year	Over 30 Years			
100 mrem/year	17	500	3.4×10^{-3}	1 in 300	34-3,400
500 mrem/year	83	2,500	1.7×10^{-2}	1 in 60	170-17,000
1,000 mrem/year	170	5,000	3.4×10^{-2}	1 in 30	340-34,000
10,000 mrem/year	1,700	50,000	3.4×10^{-1}	1 in 3	3,400-340,000

*** Based on thirty-year exposure and most recent cancer risk estimates for ionizing radiation from the National Academy of Sciences** This does not include a correction for increased risk for exposures prior to age 30. Correcting for age at exposure would roughly double the above risk estimates.

In 2001, EPA's position was that any revised general PAGs should be based on Safe Drinking Water MCLs for intermediate phase water consumption and the CERCLA risk range for long-term cleanup standards. Subsequently, ORIA effectively abandoned this position and put forward proposals to extraordinarily relax these standards.

Intermediate Phase Water PAGs

The intermediate phase lasts for one to several years after the initial release.

Buried deep in the proposed PAGs was the following table—with no explanation that the water contamination limits in the table are different than longstanding EPA water standards, nor any substantive explanation of how they were derived. (The right-hand two columns, marked DRL, or Derived Response Levels, are the proposed water contaminant limits in the draft PAGs.)

Table 4-1. DRLs Associated with a Total Effective Dose Equivalent of 0.5 rem Resulting from 1 Year of Ingestion

			Recruitment DRLs in rem per pCi/L (TEDE)		DRLs (pCi/L)	
Radionuclide	Radioactive Decay Constant 1/d	DCF rem/uCi	Without Radioactive Decay	With Radioactive Decay Only	Without Radioactive Decay	With Radioactive Decay Only
H-3	1.54E-04	1.35E-01	1.13E-04	1.16E-04	4.42E+06	4.34E+06
C-14	3.31E-07	2.12E+00	1.57E-03	1.57E-03	3.18E+05	3.18E+05
Na-22	7.38E-04	1.76E+01	8.81E-05	7.58E-03	5.68E+04	6.61E+04
P-32	4.84E-02	6.66E+00	6.49E-05	3.08E-04	7.71E+04	1.62E+06
P-33	2.73E-02	8.10E-01	6.84E-04	6.87E-03	7.32E+05	7.30E+05
S-35	7.93E-03	2.67E+00	2.10E-03	6.84E-04	2.38E+05	7.31E+05
Cl-36	8.29E-09	3.44E+00	2.57E-03	2.51E-03	1.95E+05	1.99E+05
K-40	1.49E-12	2.22E+01	1.66E-02	1.66E-02	3.00E+04	3.00E+04
Ca-45	4.35E-03	2.63E+00	1.82E-03	9.73E-04	2.06E+05	5.13E+05
Sc-46	8.27E-03	5.48E+00	4.00E-05	1.26E-03	1.25E+05	3.97E+05
Ti-44	3.19E-05	2.16E+01	1.57E-02	1.58E-02	3.18E+04	3.20E+04
V-49	4.37E-02	7.35E+00	5.35E-05	3.41E-04	9.34E+04	1.46E+06
Cr-51	2.59E-02	1.43E-01	1.04E-04	1.14E-03	4.78E+06	4.37E+07
Mn-54	2.23E-03	2.87E+00	1.95E-03	1.34E-03	2.57E+05	3.74E+05
Fe-55	7.03E-04	1.23E+00	8.95E-04	7.06E-04	5.57E+05	6.37E+05
Fe-59	1.58E-02	5.62E+00	4.09E-05	5.46E-04	1.53E+05	9.97E+05
Co-58	9.76E-03	2.77E+00	2.02E-03	5.93E-04	2.47E+05	8.43E+05
Co-60	3.63E-04	1.37E+01	9.97E-05	9.98E-03	5.36E+04	5.75E+04
Ni-63	1.94E-05	6.63E-01	4.11E-04	4.11E-04	1.22E+06	1.22E+06
Zn-65	2.84E-03	1.46E+01	1.07E-03	9.84E-03	4.68E+04	7.64E+04
Ge-68	2.41E-03	4.77E+00	3.48E-05	2.32E-03	1.44E+05	2.16E+05
Se-75	5.78E-03	9.66E+00	7.04E-05	2.90E-03	7.09E+04	1.72E+05
Rb-86	3.71E-02	1.84E+01	7.69E-05	5.81E-04	6.50E+04	8.62E+05
Sr-89	1.37E-02	9.91E+00	6.94E-05	1.39E-03	7.20E+04	3.63E+05
Sr-90	6.62E-05	1.03E+02	7.53E-03	7.43E-03	6.63E+03	6.73E+03
Y-90	2.80E-01	9.98E+00	7.27E-05	7.30E-03	6.90E+04	6.83E+05
Y-91	1.19E-02	6.77E+00	6.40E-05	1.47E-03	7.81E+04	3.41E+05
Zr-93	1.34E-09	4.11E+00	3.00E-05	3.06E-03	1.67E+05	1.67E+05
Zr-95	1.04E-02	3.59E+00	2.62E-05	8.49E-04	1.92E+04	7.73E+05
Nb-94	9.33E-09	8.44E+00	4.70E-05	4.70E-03	1.06E+05	1.06E+05
Nb-95	1.07E-02	2.17E+00	1.58E-05	2.27E-04	3.14E+05	2.20E+05
Nb-99	2.52E-01	2.24E+00	1.64E-05	1.79E-03	3.04E+05	2.81E+07
Tc-99	6.91E-09	2.32E+00	1.70E-05	1.70E-03	2.94E+05	2.94E+05
Ru-103	1.76E-02	2.72E+00	1.99E-05	3.05E-04	2.52E+05	1.62E+05
Ru/Rh-106	1.88E-03	2.56E+01	1.88E-02	1.97E-02	2.04E+04	3.80E+04
Ag-110m	2.77E-03	1.63E+01	7.52E-05	4.72E-03	6.66E+04	1.06E+05
Cd-109	1.48E-03	7.40E+00	5.40E-05	4.17E-03	9.26E+04	1.20E+05
Cd-113m	1.49E-04	8.91E+01	6.21E-03	8.09E-03	8.05E+03	6.26E+03
In-114m	1.49E-02	1.97E+01	1.10E-02	2.14E-02	4.54E+04	2.33E+05
Sn-113	8.03E-03	2.73E+00	1.99E-05	9.06E-04	2.51E+05	5.20E+05
Sn-123	5.36E-03	7.77E+00	5.67E-05	2.49E-03	8.82E+04	2.01E+05
Sn-126	7.99E-02	1.14E+01	8.32E-05	3.17E-04	6.01E+04	1.58E+06
Sb-124	8.25E-03	1.77E+01	1.29E-03	1.28E-03	3.87E+04	3.87E+04
Sb-125	1.15E-02	9.40E+00	6.86E-05	1.81E-03	7.28E+04	3.11E+05
Te-125	5.09E-02	9.10E+00	6.64E-05	3.26E-04	7.53E+04	1.54E+06

Table 4-1. DRLs Associated with a Total Effective Dose Equivalent of 0.5 rem Resulting from 1 Year of Ingestion

			Normalized DRLs mrem per pCi/L (TEDE)		DRLs (pCi/L)	
Radionuclide	Radioactive Decay Constant 1/d	DCF mrem/uCi	Without Radioactive Decay	With Radioactive Decay Only	Without Radioactive Decay	With Radioactive Decay Only
Sb-127	1.90E-01	8.18E+00	4.51E-03	6.87E-05	1.11E+05	7.28E+06
Te-127	1.75E+00	8.35E-01	4.58E-04	7.02E-07	1.10E+06	7.12E+08
Te-129	1.43E+01	2.33E-01	1.70E-04	3.28E-06	2.94E+06	1.52E+10
Te-129m	2.08E-02	1.10E+01	8.03E-03	1.67E-03	8.35E+04	4.48E+05
Te-131m	5.65E-01	7.22E+00	5.27E-03	2.80E-05	9.49E+04	1.92E+07
Te-132	2.13E-01	1.41E+01	1.03E-02	1.32E-04	4.86E+04	3.79E+06
I-129	1.13E-02	5.70E+01	4.16E-02	9.76E-03	1.20E+04	5.12E+04
I-129	1.21E-10	3.92E+02	2.86E-01	2.86E-01	1.75E+03	1.75E+03
I-131	8.62E-02	9.07E+01	5.66E-02	1.40E-03	8.49E+03	2.67E+05
Cs-134	9.20E-04	7.11E+01	5.19E-02	4.41E-02	9.63E+03	1.13E+04
Cs-136	5.28E-02	1.14E+01	8.32E-03	4.31E-04	6.01E+04	1.16E+06
Cs/Ba-137	8.33E-06	8.03E+01	3.67E-02	3.65E-02	1.36E+04	1.36E+04
Ba-133	1.77E-04	3.88E+00	4.13E-03	4.00E-03	1.21E+05	1.25E+05
Ba-140	5.44E-02	9.62E+00	7.03E-03	3.54E-04	7.12E+04	1.41E+06
La-140	4.13E-01	7.48E+00	5.46E-03	3.62E-05	9.16E+04	1.38E+07
Ce-141	2.13E-02	2.63E+00	1.92E-03	2.47E-04	2.60E+05	2.03E+06
Ce-143	5.04E-01	4.16E+00	3.03E-03	1.65E-05	1.65E+05	3.04E+07
Ce/Pr-144	2.44E-03	1.94E+01	1.42E-02	9.36E-03	3.53E+04	5.35E+04
Nd-147	6.31E-02	4.05E+00	2.92E-03	1.27E-04	1.71E+05	3.94E+06
Pm-145	1.07E-04	4.29E-01	3.13E-04	3.07E-04	1.60E+06	1.63E+06
Pm-147	7.23E-04	9.95E-01	7.26E-04	6.32E-04	7.58E+05	8.07E+05
Pm-149	3.13E-01	3.69E+00	2.69E-03	2.35E-05	1.86E+05	2.13E+07
Pm-151	5.69E-01	2.71E+00	1.98E-03	9.23E-06	2.52E+05	5.41E+07
Sm-151	2.11E-05	3.63E-01	2.65E-04	2.64E-04	1.88E+06	1.89E+06
Eu-152	1.43E-04	5.07E+00	3.70E-03	3.61E-03	1.35E+05	1.39E+05
Eu-154	2.16E-04	7.88E+00	5.97E-03	5.30E-03	8.37E+04	9.43E+04
Eu-155	3.03E-04	1.21E+00	8.83E-04	8.24E-04	5.66E+05	6.07E+05
Gd-153	2.98E-03	1.03E+00	7.52E-04	4.67E-04	6.65E+05	1.07E+06
Tb-160	9.63E-03	8.96E+00	4.38E-03	1.21E-03	1.16E+06	4.15E+06
Ho-166m	1.58E-08	7.33E+00	5.35E-03	5.35E-03	9.34E+04	9.35E+04
Tm-170	5.36E-03	4.69E+00	3.67E-03	1.88E-03	1.40E+06	3.20E+06
Yb-169	2.17E-02	2.63E+00	1.92E-03	2.42E-04	2.60E+05	2.06E+06
Hf-181	1.49E-02	4.16E+00	3.03E-03	6.08E-04	1.65E+06	8.24E+06
Ta-182	6.03E-03	8.70E+00	4.16E-03	1.88E-03	1.20E+06	2.67E+06
W-187	8.81E-01	2.33E+00	1.70E-03	6.70E-06	2.94E+05	7.47E+07
Ir-192	9.36E-03	5.07E+00	3.70E-03	1.03E-03	1.35E+05	4.77E+05
Au-198	2.57E-01	3.81E+00	2.78E-03	2.68E-05	1.80E+05	1.86E+07
Hg-203	1.49E-02	7.07E+00	5.16E-03	9.45E-04	9.68E+04	5.29E+05
Tl-204	5.03E-04	4.40E+00	3.21E-03	2.98E-03	1.56E+05	1.70E+05
Pb-210	6.67E-05	2.58E+03	1.88E+00	1.85E+00	2.66E+02	2.70E+02
Bi-207	4.98E-05	4.70E+00	3.43E-03	3.40E-03	1.46E+05	1.47E+05
Bi-210	1.38E-01	4.85E+00	3.54E-03	7.03E-05	1.41E+05	7.11E+06
Po-210	5.01E-03	4.48E+03	3.27E+00	1.50E+00	1.53E+02	3.33E+02
Ra-226	1.18E-08	1.94E+03	7.56E-01	7.56E-01	6.59E+02	6.59E+02
Ac-227	9.72E-09	1.16E+03	8.69E-01	8.69E-01	5.75E+02	5.86E+02
Th-227	3.70E-02	3.34E+01	2.44E-02	1.81E-03	2.05E+04	2.77E+05
U-235	2.70E-12	1.73E+02	1.26E-01	1.26E-01	3.96E+03	3.96E+03

Table 4-1. DRLs Associated with a Total Effective Dose Equivalent of 0.5 rem Resulting from 1 Year of Ingestion

			Normalized DRLs mrem per pCi/L (TEDE)		DRLs (pCi/L)	
Radionuclide	Radioactive Decay Constant 1/d	DCF mrem/uCi	Without Radioactive Decay	With Radioactive Decay Only	Without Radioactive Decay	With Radioactive Decay Only
U-238	4.25E-13	1.65E+02	1.20E-01	1.20E-01	4.15E+03	4.15E+03
Np-237	8.87E-10	3.96E+02	2.89E-01	2.89E-01	1.73E+03	1.73E+03
Np-239	2.94E-01	2.95E+00	2.15E-03	2.01E-05	2.32E+05	2.49E+07
Pu-236	6.66E-04	3.22E+02	2.35E-01	2.09E-01	2.13E+03	2.40E+03
Pu-238	2.16E-05	8.44E+02	6.16E-01	6.14E-01	8.12E+02	8.15E+02
Pu-239	7.89E-08	9.29E+02	6.78E-01	6.78E-01	7.37E+02	7.37E+02
Pu-240	2.90E-07	9.29E+02	6.78E-01	6.78E-01	7.37E+02	7.37E+02
Pu-241	1.32E-04	1.76E+01	1.28E-02	1.25E-02	3.89E+04	3.99E+04
Pu-242	5.04E-09	8.81E+02	6.43E-01	6.43E-01	7.77E+02	7.77E+02
Am-241	4.39E-06	7.55E+02	5.51E-01	5.51E-01	9.07E+02	9.08E+02
Am-242m	1.25E-05	7.07E+02	5.16E-01	5.15E-01	9.69E+02	9.71E+02
Am-243	2.57E-07	7.51E+02	5.48E-01	5.48E-01	9.12E+02	9.12E+02
Cm-242	4.26E-03	4.33E+01	3.16E-02	1.60E-02	1.58E+04	3.12E+04
Cm-243	6.66E-05	5.51E+02	4.02E-01	3.97E-01	1.24E+03	1.26E+03
Cm-244	1.05E-04	4.55E+02	3.32E-01	3.26E-01	1.51E+03	1.53E+03
Cm-245	2.23E-07	7.70E+02	5.62E-01	5.62E-01	8.90E+02	8.90E+02
Cm-246	4.01E-07	7.66E+02	5.59E-01	5.59E-01	8.94E+02	8.94E+02
Cf-252	7.19E-04	3.52E+02	2.57E-01	2.26E-01	1.95E+03	2.21E+03

Co-60	3.60E-04	1.27E+01	9.27E-03	8.69E-03	5.39E+04	5.76E+04
Ni-63	1.98E-05	5.63E-01	4.11E-04	4.10E-04	1.22E+06	1.22E+06
Zn-65	2.84E-03	1.46E+01	1.07E-02	6.64E-03	4.69E+04	7.54E+04
Ge-68	2.41E-03	4.77E+00	3.48E-03	2.32E-03	1.44E+05	2.16E+05
Se-75	5.79E-03	9.66E+00	7.05E-03	2.93E-03	7.09E+04	1.70E+05
Rb-86	3.71E-02	1.04E+01	7.59E-03	5.61E-04	6.59E+04	8.92E+05
[illegible]	1.37E-02	9.51E+00	6.94E-03	1.38E-03	[illegible]	[illegible]
Sr-90	6.52E-05	1.03E+02	7.52E-02	7.43E-02	6.65E+03	6.73E+03
[illegible]	2.60E-01	9.96E+00	7.27E-03	7.66E-05	6.88E+04	6.53E+06
Y-91	1.18E-02	8.77E+00	6.40E-03	1.47E-03	7.81E+04	3.41E+05
Zr-93	1.24E-09	4.11E+00	3.00E-03	3.00E-03	1.67E+05	1.67E+05
Zr-95	1.08E-02	3.56E+00	2.60E-03	6.46E-04	1.92E+05	7.73E+05
Nb-94	9.35E-08	6.44E+00	4.70E-03	4.70E-03	1.06E+05	1.06E+05
Nb-95	1.97E-02	2.18E+00	1.59E-03	2.21E-04	3.14E+05	2.26E+06
Mo-99	2.52E-01	2.24E+00	1.64E-03	1.78E-05	3.06E+05	2.81E+07
Tc-99	8.91E-09	2.38E+00	1.74E-03	1.74E-03	2.88E+05	2.88E+05
Ru-103	1.76E-02	2.72E+00	1.99E-03	3.09E-04	2.52E+05	1.62E+06
Ru/Rh-106	1.88E-03	2.59E+01	1.89E-02	1.37E-02	2.64E+04	3.65E+04
Ag-110m	2.77E-03	1.03E+01	7.52E-03	4.73E-03	6.65E+04	1.06E+05
Cd-109	1.49E-03	7.40E+00	5.40E-03	4.17E-03	9.26E+04	1.20E+05
Cd-113m	1.40E-04	8.51E+01	6.21E-02	6.06E-02	8.05E+03	8.26E+03
In-114m	1.40E-02	1.51E+01	1.10E-02	2.14E-03	4.54E+04	2.33E+05
Sn-[illegible]3	6.02E-03	2.73E+00	1.99E-03	8.06E-04	2.51E+05	6.20E+05
Sn-123	5.36E-03	7.77E+00	5.67E-03	2.49E-03	8.82E+04	2.01E+05

EPA's existing emergency response levels – the CERCLA Program's Removal Action Levels (RALs) – are the MCLs.

See, e.g., OSWER, Revised Superfund Removal Action Levels," 17 September 2008, from Deborah Dietrich, Director of Emergency Management, to Regional Superfund Division Directors and Regional Removal Managers

(Note: CBG 2008 study, "Proposed Relaxation of EPA Drinking Water Standards for Radioactivity," compared the proposed PAGs to the RALs that were in effect prior to the above directive.)

EPA Maximum Concentration Limits (MCLs)/ Response Action Levels (RALs) for Beta and Photon Emitters in Drinking Water

Source: EPA Directive 9283.1-14,Use of Uranium Drinking Water Standards under 40 CFR 141 and 40 CFR 192 as Remediation Goals for Groundwater at CERLCA Sites, 6 November 2001

Attachment B: List of Radionuclides addressed by 4 mrem/yr man-made beta particles and photon emitters MCL standard[5]

Nuclide	pCi/l	Nuclide	pCi/l	Nuclide	pCi/l	Nuclide	
H-3	20,000	Sr-85 m	20,000	Sb-124	60	Er-169	300
Be-7	6,000	Sr-85	900	Sb-125	300	Er-171	300
C-14	2,000	Sr-89	20	Te-125m	600	Tm-170	100
F-18	2,000	Sr-90	8	Te-127	900	Tm-171	1,000
Na-22	400	Sr-91	200	Te-127m	200	Yb-175	300
Na-24	600	Sr-92	200	Te-129	2,000	Lu-177	300
Si-31	3,000	Y-90	60	Te-129m	90	Hf-181	200
P-32	30	Y-91	90	Te-131m	200	Ta-182	100
S-35 inorg	500	Y-91m	9,000	Te-132	90	W-181	1,000
Cl-36	700	Y-92	200	I-126	3	W-185	300
Cl-38	1,000	Y-93	90	I-129	1	W-187	200
K-42	900	Zr-93	2,000	I-131	3	Re-186	300
Ca-45	10	Zr-95	200	I-132	90	Re-187	9,000
Ca-47	80	Zr-97	60	I-133	10	Re-188	200
Sc-46	100	Nb-93m	1,000	I-134	100	Os-185	200
Sc-47	300	Nb-95	300	I-135	30	Os-191	600
Sc-48	80	Nb-97	3,000	Cs-131	20,000	Os-191m	9,000
V-48	90	Mo-99	600	Cs-134	80	Os-193	200
Cr-51	6,000	Tc-96	300	Cs-134m	20,000	Ir-190	600
Mn-52	90	Tc-96m	30,000	Cs-135	900	Ir-192	100
Mn-54	300	Tc-97	6,000	Cs-136	800	Ir-194	90
Mn-56	300	Tc-97m	1,000	Cs-137	200	Pt-191	300
Fe-55	2,000	Tc-99	900	Ba-131	600	Pt-193	3,000
Fe-59	200	Tc-99m	20,000	Ba-140	90	Pt-193m	3,000
Co-57	1,000	Ru-97	1,000	La-140	60	Pt-197	300
Co-58	300	Ru-103	200	Ce-141	300	Pt-197m	3,000
Co-58m	9000	Ru-105	200	Ce-143	100	Au-196	600
Co-60	100	Ru-106	30	Ce-144	30	Au-198	100
Ni-59	300	Rh-103m	30,000	Pr-142	90	Au-199	600
Ni-63	50	Rh-105	300	Pr-143	100	Hg-197	900
Ni-65	300	Pd-103	900	Nd-147	200	Hg-197m	600
Cu-64	900	Pd-109	300	Nd-149	900	Hg-203	60
Zn-65	300	Ag-105	300	Pm-147	600	Tl-200	1,000
Zn-69	6,000	Ag-110m	90	Pm-149	100	Tl-201	900
Zn-69m	200	Ag-111	100	Sm-151	1,000	Tl-202	300
Ga-72	100	Cd-109	600	Sm-153	200	Tl-204	300

[5]For those isotopes where an MCL is calculated, concentration values were rounded using the same format as EPA guidance for the 1976 MCL rulemaking.

Attachment B: List of Radionuclides addressed by 4 mrem/yr man-made beta particles and photon emitters MCL standard[5]

le	pCi/l	Nuclide	pCi/l	Nuclide	pCi/l	Nuclide
	20,000	Sr-85 m	20,000	Sb-124	60	Er-169
	6,000	Sr-85	900	Sb-125	300	Er-171
	2,000	Sr-89	20	Te-125m	600	Tm-170
	2,000	Sr-90	8	Te-127	900	Tm-171
	400	Sr-91	200	Te-127m	200	Yb-175
	600	Sr-92	200	Te-129	2,000	Lu-177
	3,000	Y-90	60	Te-129m	90	Hf-181
	30	Y-91	90	Te-131m	200	Ta-182
	500	Y-91m	9,000	Te-132	90	W-181
	700	Y-92	200	I-126	3	W-185
	1,000	Y-93	90	I-129	1	W-187
	900	Zr-93	2,000	I-131	3	Re-186
	10	Zr-95	200	I-132	90	Re-187

A Comparison of the Proposed Water PAGs and Longstanding MCLs

PROPOSED RELAXATION OF EPA DRINKING WATER STANDARDS

Proposed Protective Action Guide [PAG] vs. Current Maximum Concentration Level [MCL]

Radionuclide	PROPOSED PAG (w/o Decay)*	CURRENT Maximum Concentration Level (MCL)*	RATIO (Factor by which permissible concentration of radioactivity in drinking water is proposed to increase)
H-3	4,420,000	20,000	221
C-14	319,000	2,000	160
Na-22	58,000	400	145
P-32	77,100	30	2,570
S-35	239,000	500	478
Cl-36	199,000	700	284
Ca-45	260,000	10	26,000
Sc-46	125,000	100	1,250
V-48	93,400	90	1,040
Cr-51	4,790,000	6,000	798
Mn-54	257,000	300	857
Fe-55	557,000	2,000	279
Fe-59	103,000	200	515
Co-58	247,000	300	823
Co-60	53,900	100	539
Ni-63	1,220,000	50	24,400
Zn-65	46,900	300	156
Se-75	70,900	900	78
Rb-86	65,900	600	110
Sr-89	72,000	20	3,600
Sr-90	6,650	8	831
Y-90	68,800	60	1,150
Y-91	78,100	90	868
Zr-93	167,000	2,000	84
Zr-95	192,000	200	960
Nb-95	314,000	300	1,050
Mo-99	306,000	600	510
Tc-99	288,000	900	320
Ru-103	252,000	200	1,260
Ag-110m	66,500	90	739
Cd-109	92,600	600	154
In-114m	45,400	60	757
Sn-113	251,000	300	837
Sn-125	60,100	60	1,000
Sb-124	72,900	60	1,220
Te-127	1,100,000	900	1,220

*Units = picoCuries per Liter (pCi/L)

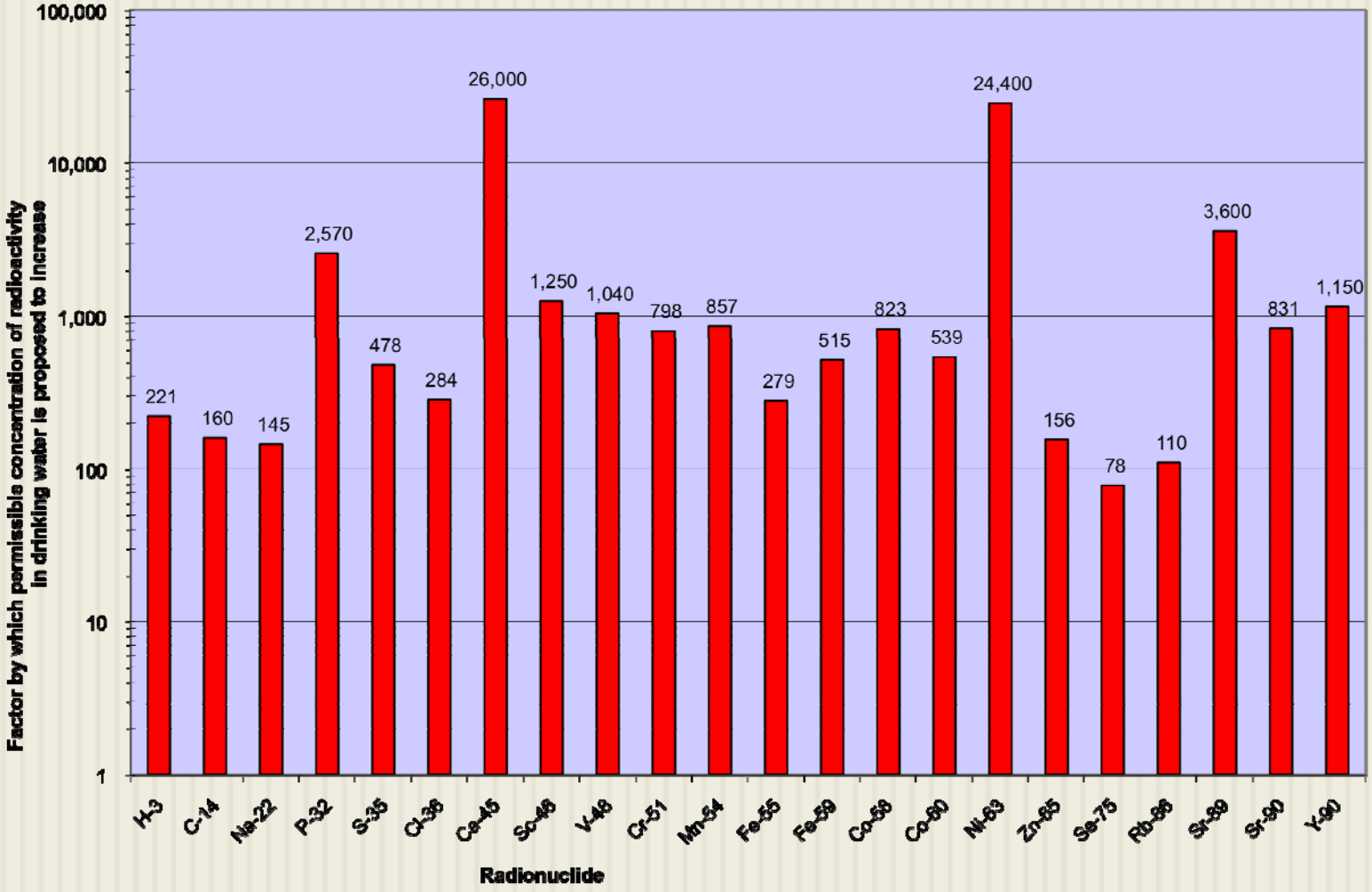
PROPOSED RELAXATION OF EPA DRINKING WATER STANDARDS

Proposed Protective Action Guide [PAG] vs. Current Maximum Concentration Level [MCL]

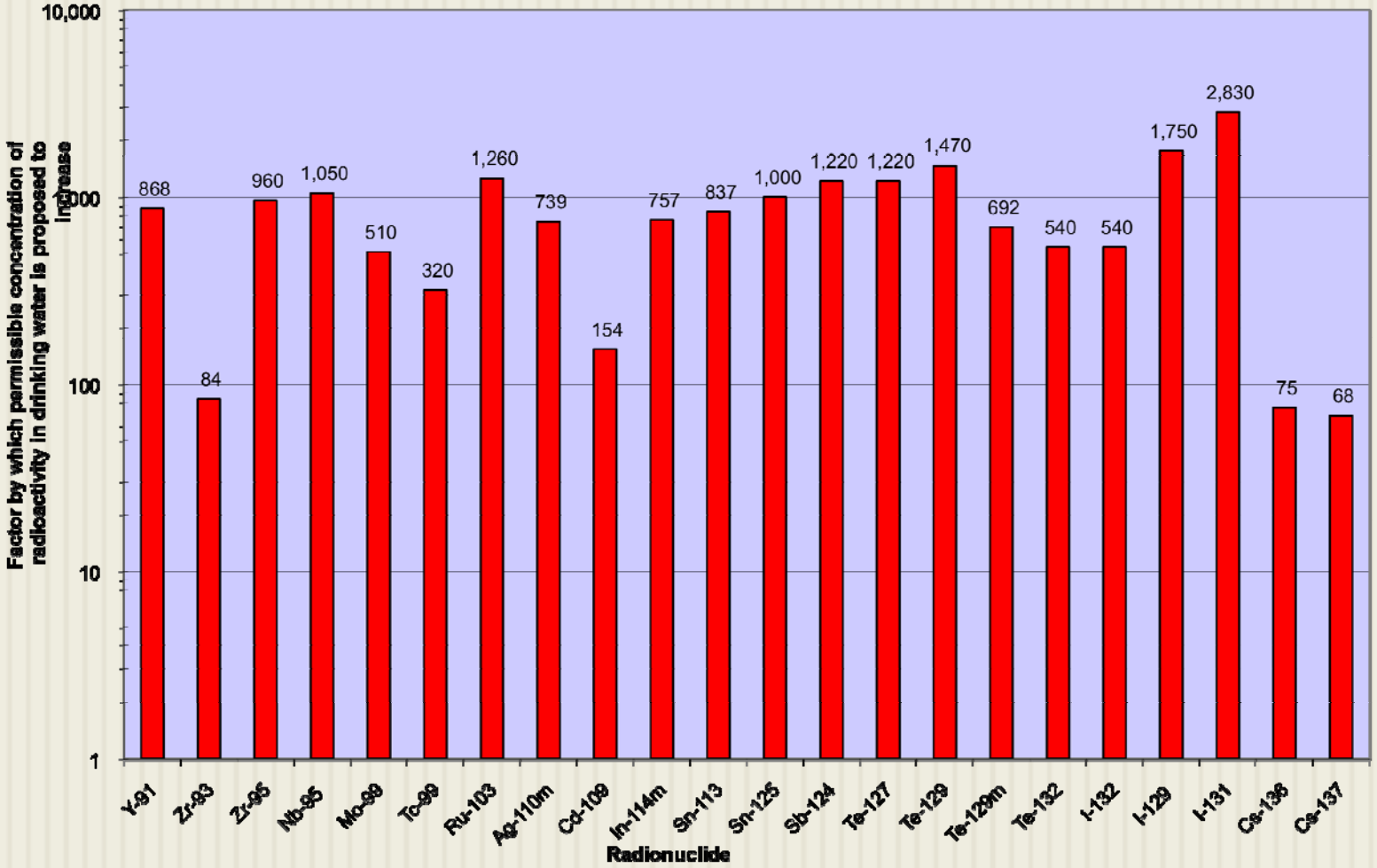
Radionuclide	PROPOSED PAG (w/o Decay)*	CURRENT Maximum Concentration Level (MCL)*	RATIO (Factor by which permissible concentration of radioactivity in drinking water is proposed to increase)
Te-129	2,940,000	2,000	1,470
Te-129m	62,300	90	692
Te-132	48,600	90	540
I-132	48,600	90	540
I-129	1,750	1	1,750
I-131	8,490	3	2,830
Cs-136	60,100	800	75
Cs-137	13,600	200	68
Ba-140	71,200	90	791
La-140	91,600	60	1,530
Ce-141	260,000	300	867
Ce-143	165,000	100	1,650
Ce-144	35,300	30	1,180
Nd-147	171,000	200	855
Pm-149	186,000	100	1,860
Sm-151	1,890,000	1,000	1,890
Eu-152	135,000	200	675
Eu-154	90,700	60	1,510
Eu-155	566,000	600	943
Gd-153	665,000	600	1,110
Tb-160	115,000	100	1,150
Tm-170	140,000	100	1,400
Hf-181	165,000	200	825
Ta-182	120,000	100	1,200
W-187	294,000	200	1,470
Ir-192	135,000	100	1,350
Au-198	116,900,000	100	1,170,000
Hg-203	96,900	60	1,620
Tl-204	156,000	300	520
Bi-207	146,000	200	730

*Units = picoCuries per Liter (pCi/L)

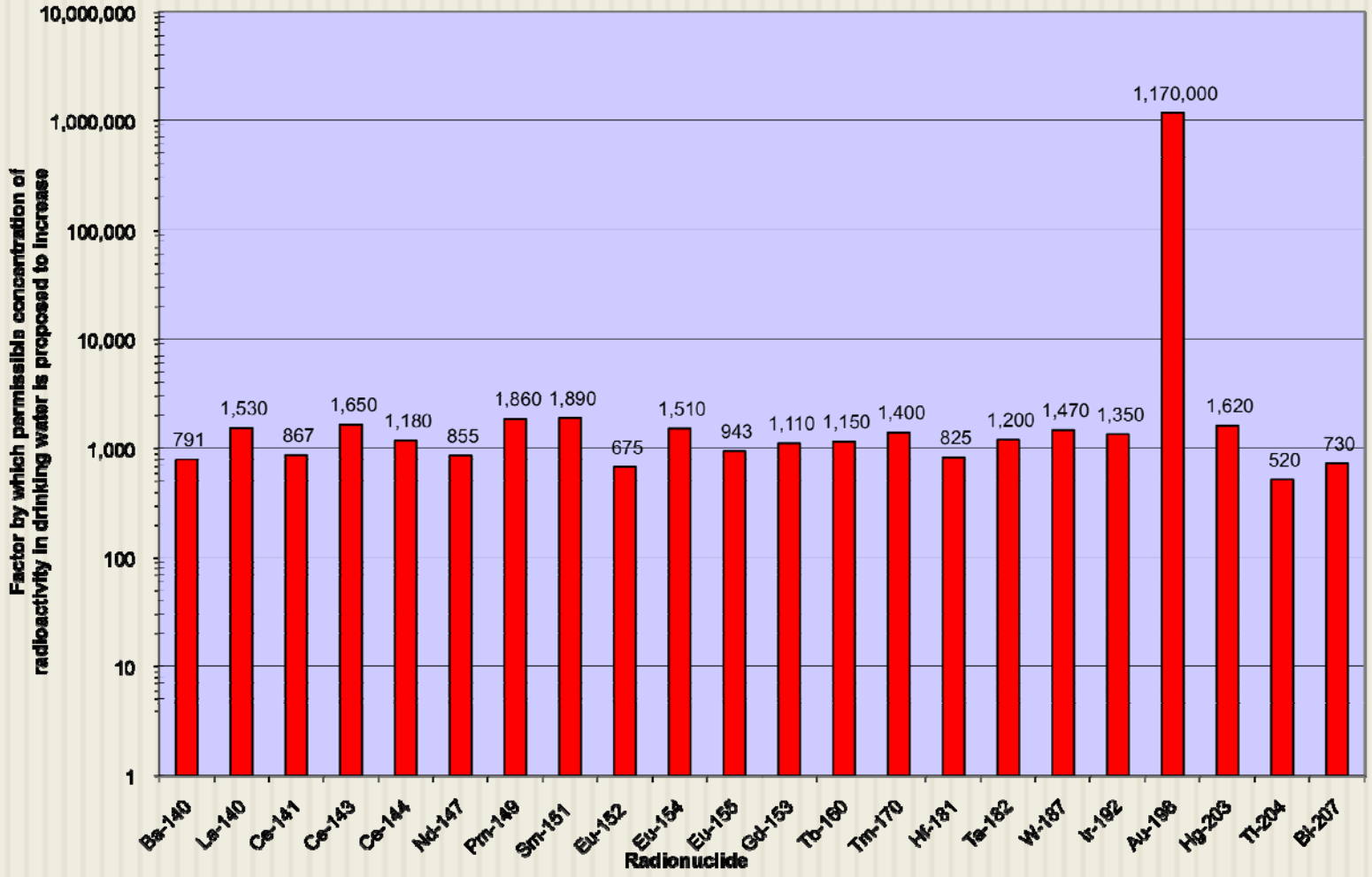
Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase
Proposed PAG (w/o Decay) vs. Current Maximum Concentration Level (MCL)



Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase
Proposed PAG (w/o Decay) vs. Current Maximum Concentration Level (MCL)



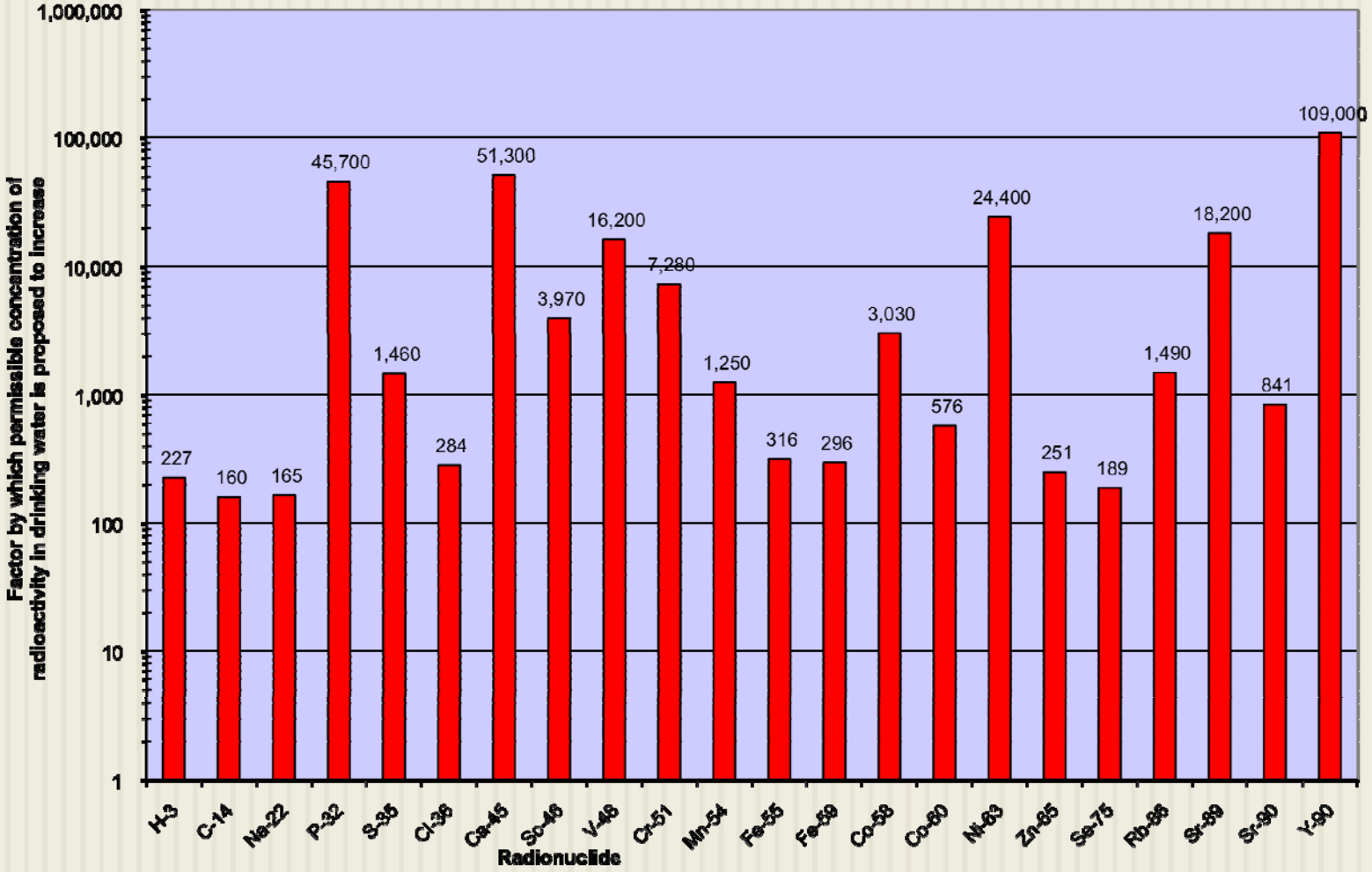
Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase
Proposed PAG (w/o Decay) vs. Current Maximum Concentration Level (MCL)



PAGs w/ decay compared to MCLs/RALs

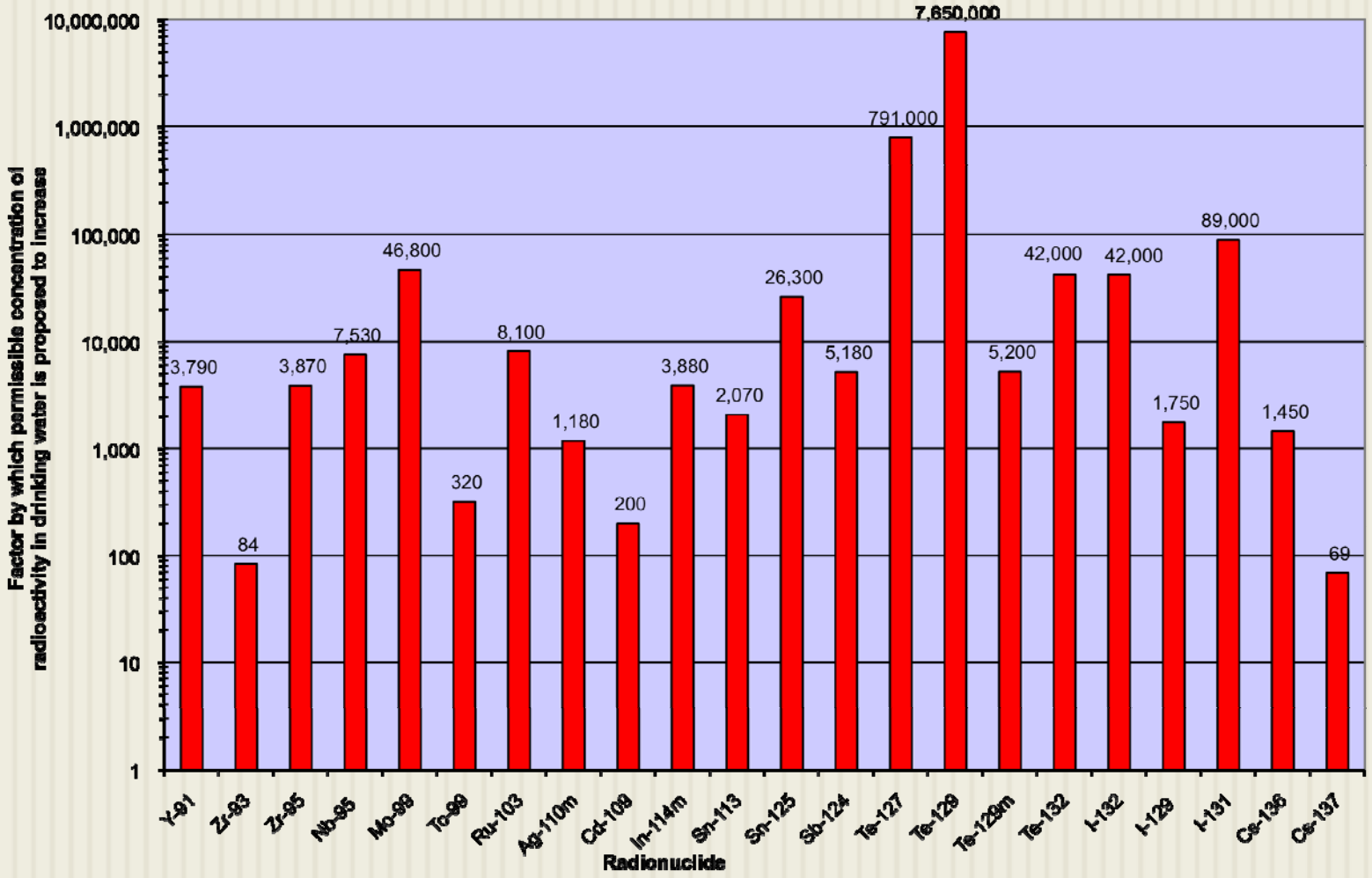
Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase

FIGURE 2: Proposed DRL (with Decay) vs. Current Maximum Concentration Level (MCL)



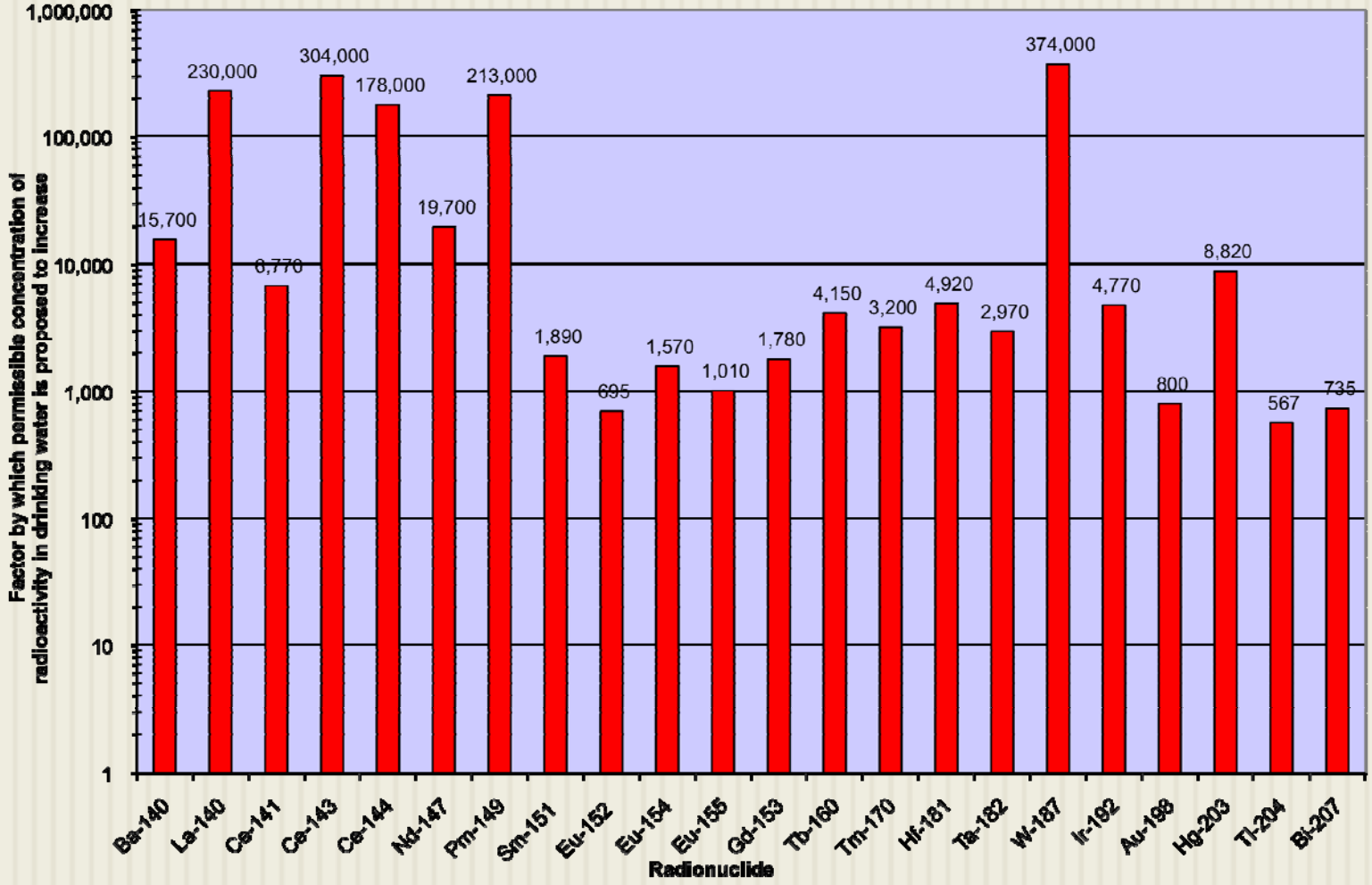
Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase

FIGURE 2: Proposed DRL (with Decay) vs. Current Maximum Concentration Level (MCL)



Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase

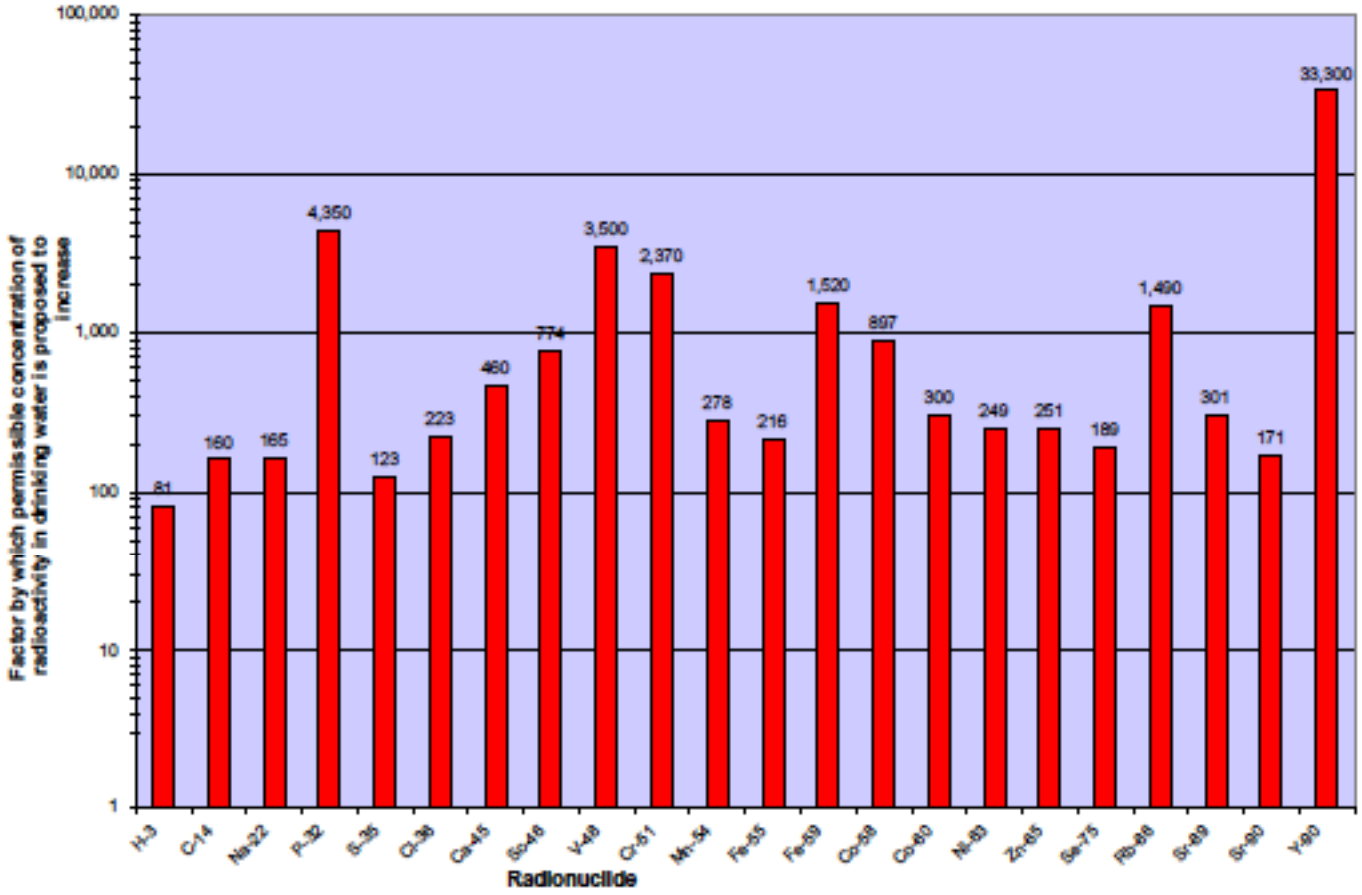
FIGURE 2: Proposed DRL (with Decay) vs. Current Maximum Concentration Level (MCL)



EPA's previous method for determining RALs was to take the greater of the MCL or the concentration associated with a 10^{-4} risk. Using this method, we calculated RALs and compared them with the proposed PAG values. The PAGs were many orders of magnitude higher.

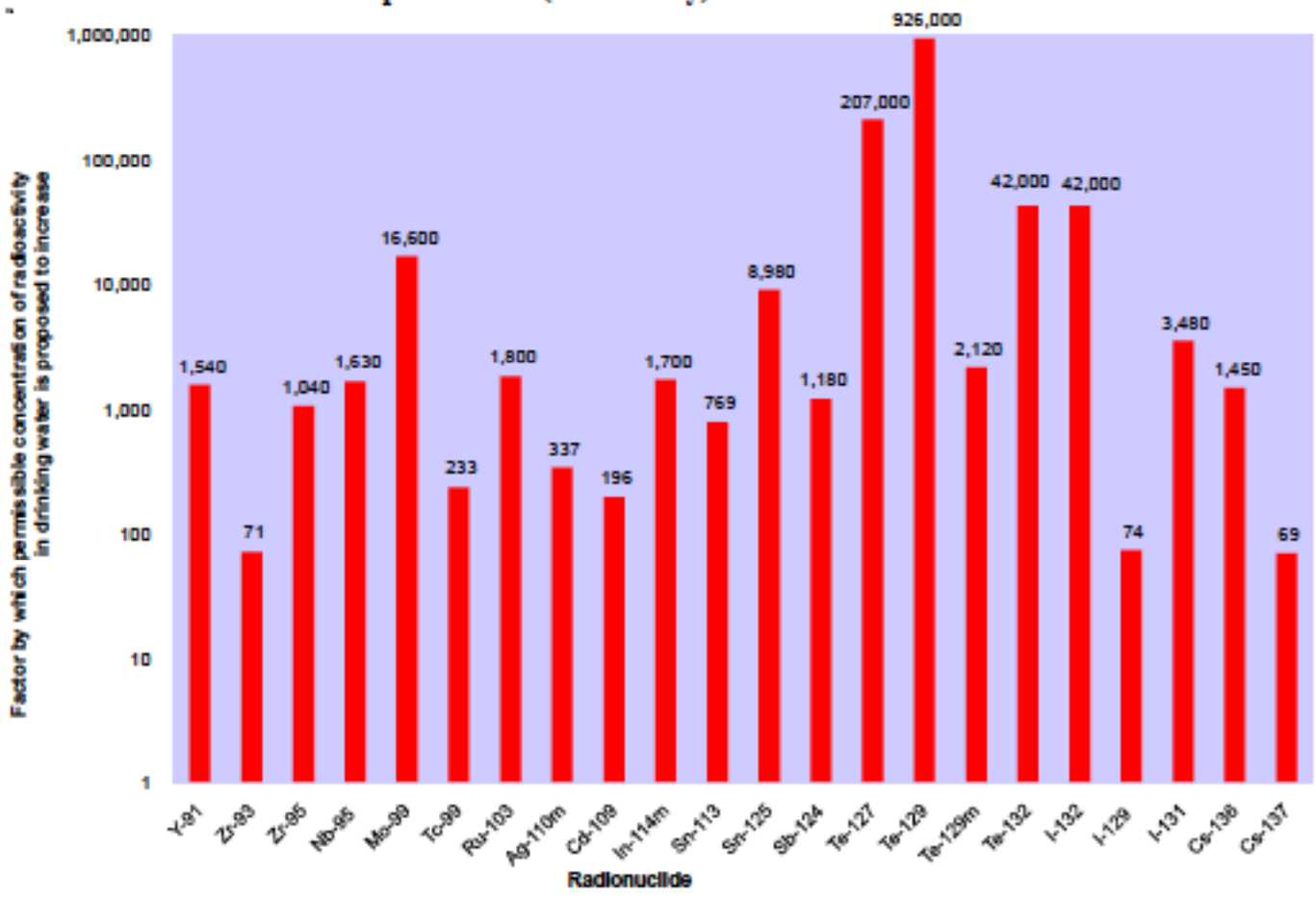
Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase

FIGURE 4: Proposed DRL (with Decay) vs. Current Removal Action Level (RAL)



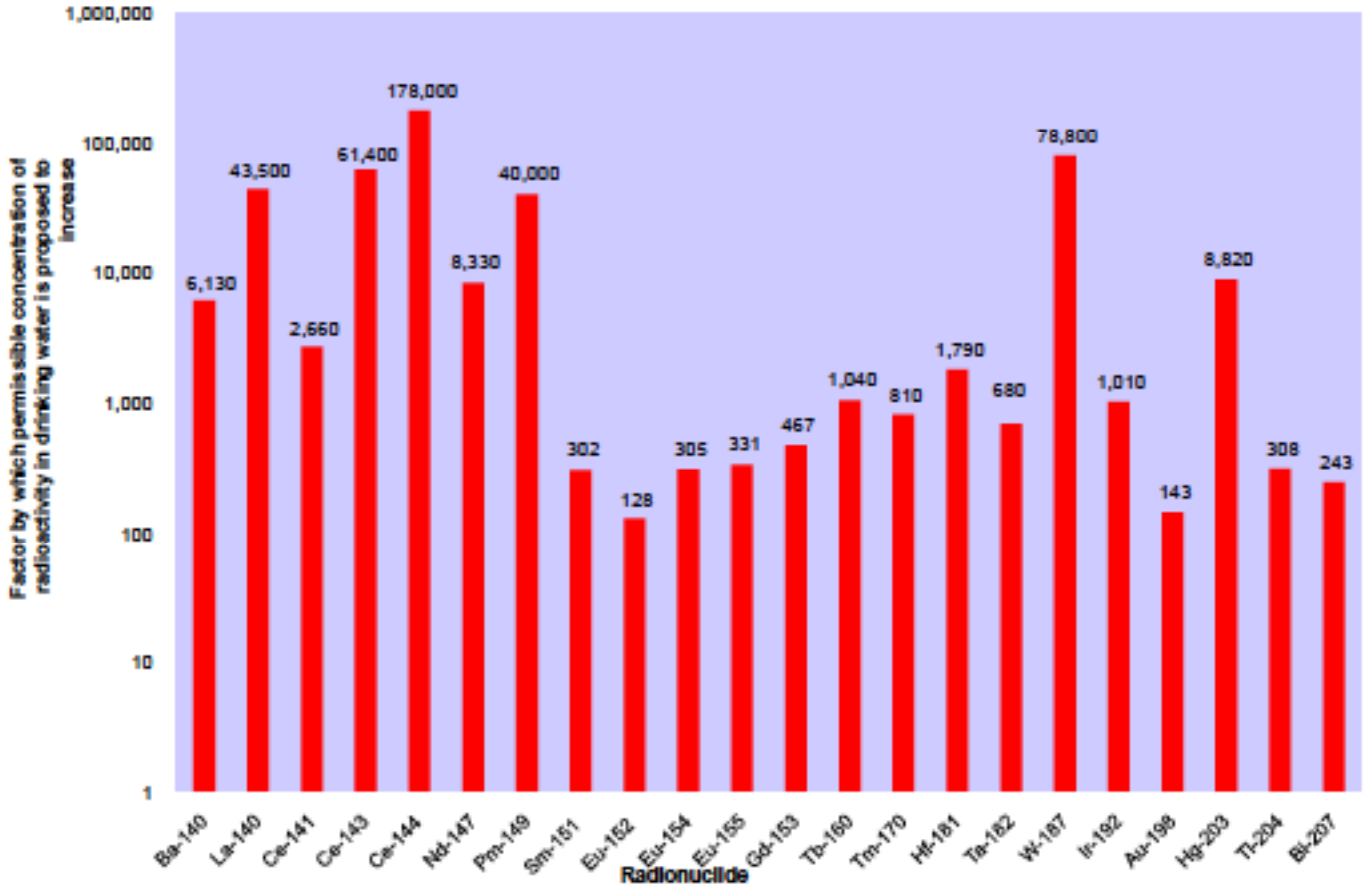
Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase

FIGURE 4: Proposed DRL (with Decay) vs. Current Removal Action Level



Factor by which Allowable Radioactivity in Drinking Water is Proposed to Increase

FIGURE 4: Proposed DRL (with Decay) vs. Current Removal Action Level



Forcing the public to drink water contaminated at orders of magnitude above Safe Drinking Water Levels or RALs, for a year or more after an event, is contrary to longstanding EPA practice, which is to provide alternative drinking water supplies or require treatment of contaminated supplies.

Current Concerns

Press reports indicate that EPA is moving forward with optimization for long-term cleanup but without use of the term. It is reported that no firm standard for long term cleanup will be specified, leaving it to be determined at the time and permitting it to be picked from various benchmarks. That is optimization without calling it such. EPA should set guidance now, rather than allowing confusion in the wake of an emergency, and that guidance should be consistent with CERCLA's 10^{-6} to 10^{-4} risk range.

EPA conduct during U.S. monitoring of Fukushima radiation appeared to in fact follow the withdrawn PAGs, with EPA attacking its own Safe Drinking Water Act MCLs and instead making inappropriate comparisons to levels orders of magnitude more lax.

Two years after we raised our original concerns, no one at EPA has talked to us. It appears clear NRC and DOE are in the loop, pushing for weakening the PAGs, but those of us with an interest in protecting public health and the environment have been frozen out. This needs to change.

Issue 2:
EPA Radnet Monitoring of Fukushima Radiation in the U.S.

PAGs are Guidance for Protective Actions to be Taken When Specified Radiation Levels are Exceeded. For PAGs to be effective, the PAG levels must be protective, and there must be a workable system for determining when those radiation levels are exceeded.

The EPA RADnet U.S. monitoring system's performance during the Fukushima accident was a good, real-world test of preparedness for a radiological release affecting this country.

The RADnet system performed poorly. Substantial improvements need to be made to assure that were there a major radiological event in the U.S., protective actions could be taken.

The Fukushima Daiichi accident began on Friday, March 11. The event resulted in meltdowns in three reactors and damage to up to four irradiated fuel pools. Very large amounts of radioactivity was being released directly into the environment. The accident continues to this day.

U.S. policy is that "EPA is theCoordinating Federal Agency for the U.S. government's response to foreign nuclear accidents."

See http://www.epa.gov/rpdweb00/rert/internationalplans.html#nuclearaccident

However, at least in the early period of the accident, EPA was apparently relegated to a secondary position in coordinating the U.S. response to this nuclear accident.

On Monday, March 14, a press conference was held at the White House with NRC and DOE. NRC stated that no “harmful” radiation could reach the United States. EPA promptly posted on its website an affirmation of this statement.

This was disturbing, and has created substantial trouble ever since. The longstanding position of both NRC and DOE has been that there is no safe level of radiation, all radiation increases risk of cancer, and that there is no threshold below which there is no risk.

All agencies, including EPA, accept the Linear No-Threshold (LNT) Model, and the National Academy of Sciences has recently re-affirmed it.

LNT means there is no threshold of radiation exposure below which the risk is zero; risk increases with dose.

These misstatements have caused great confusion in the press and public, leading both to believe that the EPA's position is that only very high doses of radiation are harmful and that below those doses there is no risk.

As the accident went on, EPA particularly pointed to its RADnet system of stationary air monitors for its claim that all data indicated levels "thousands of times below any level of concern."

However, the stationary air monitor system had major problems.

Less than half the monitors were fully functional at the time of the accident.

Many were broken, and had been broken for months.

Source: EPA website, 20 March 2011

Legend for color scheme

- Dark Blue - RadNet monitor is running
- White - RadNet monitor is temporarily out of service
- Light Blue - RadNet data is undergoing quality review

For the fixed monitors, the following icons are used:

For the deployable monitors, the following icons are used:

Source: EPA website, 20 March 2011

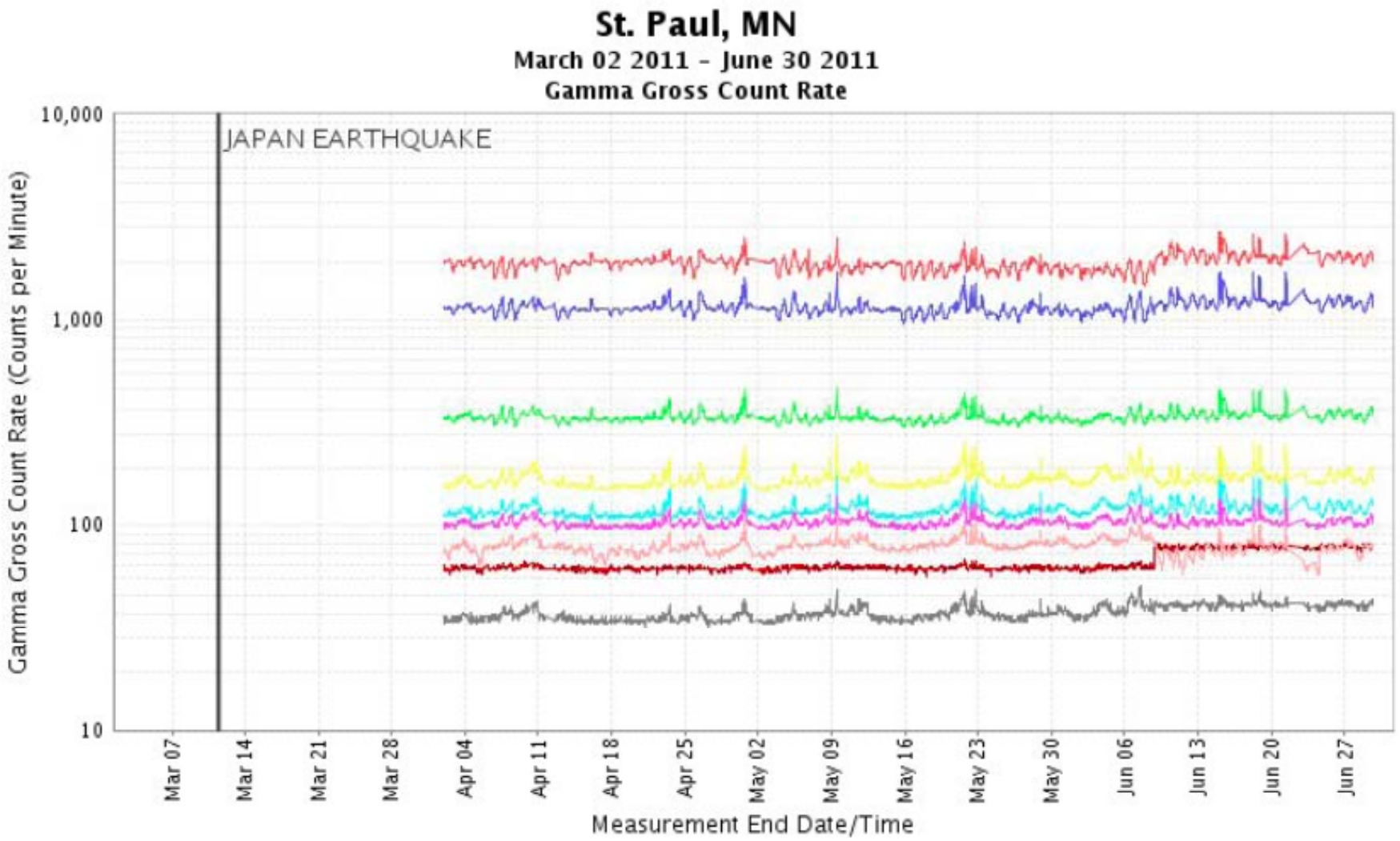
So, according to EPA's own compilation, less than half of the monitors were "running."

Indeed, they had apparently been broken for many months, without anyone noticing or taking steps to fix them.

For example, the San Diego Union discovered that San Diego's RADnet monitor had been broken since November.

EPA's response was that it got the broken ones fixed after the accident. But how can one have an emergency system where many of the monitors had been broken for months and weren't functioning when the accident occurred?

Those that did get fixed weren't fixed until a couple of weeks into the accident. In most accidents, the event would be long over before the monitors even started operating.

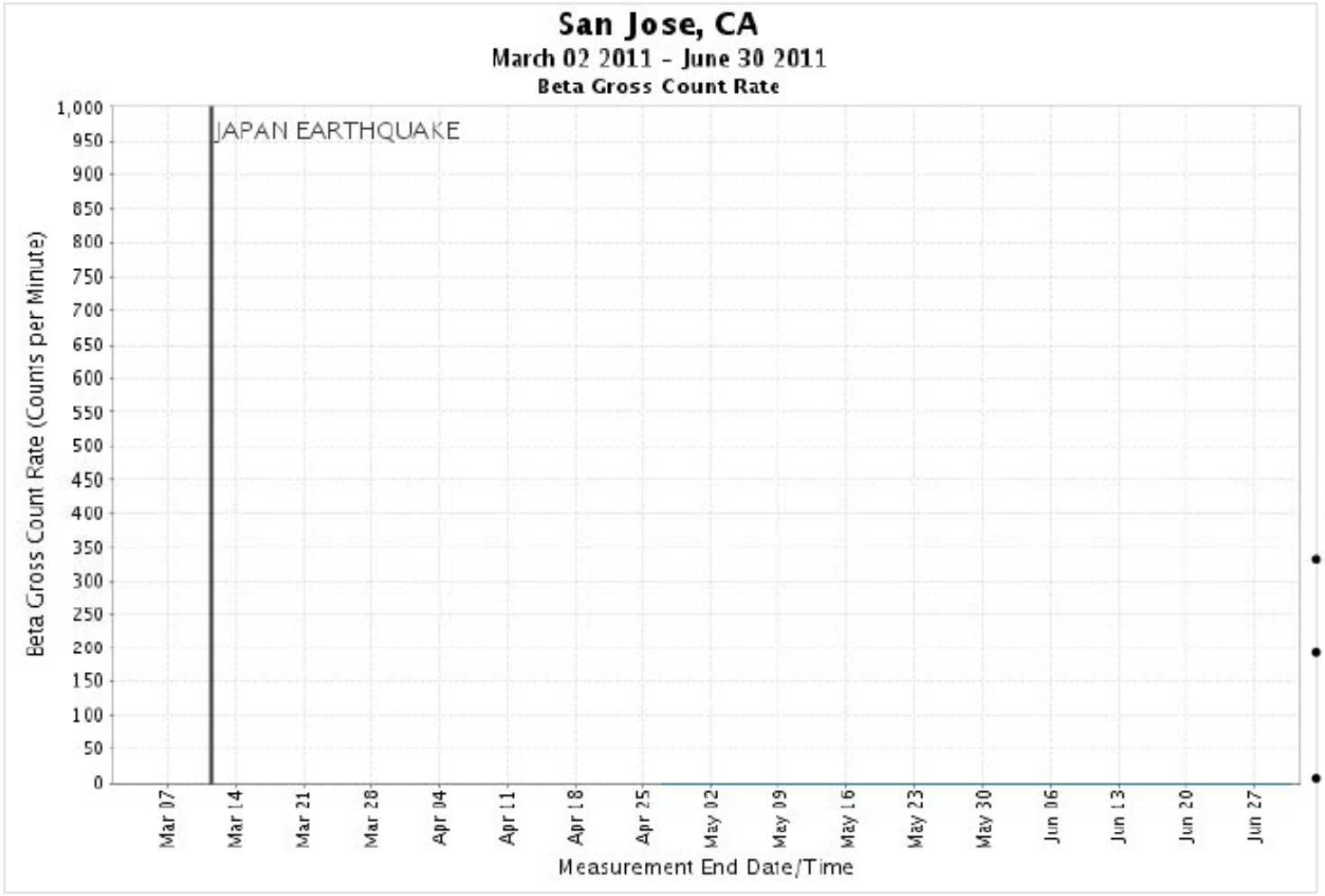

St. Paul, MN
March 02 2011 - June 30 2011
Gamma Gross Count Rate
JAPAN EARTHQUAKE
Gamma Gross Count Rate (Counts per Minute)
10,000
1,000
100
10
Mar 07
Mar 14
Mar 21
Mar 28
Apr 04
Apr 11
Apr 18
Apr 25
May 02
May 09
May 16
May 23
May 30
Jun 06
Jun 13
Jun 20
Jun 27
Measurement End Date/Time

EPA officials told the press that the stations marked light blue in the EPA map weren't really broken, just "undergoing data review" that takes an hour or so before posting the data.

However, that doesn't seem to be accurate. Many of the light blue stations had broken monitors that stayed broken throughout the accident.

To-date, levels recorded at this monitor have been thousands of times below any conservative level of concern.

Gross beta counts are temporarily unavailable due to mechanical issues. See gamma counts above.



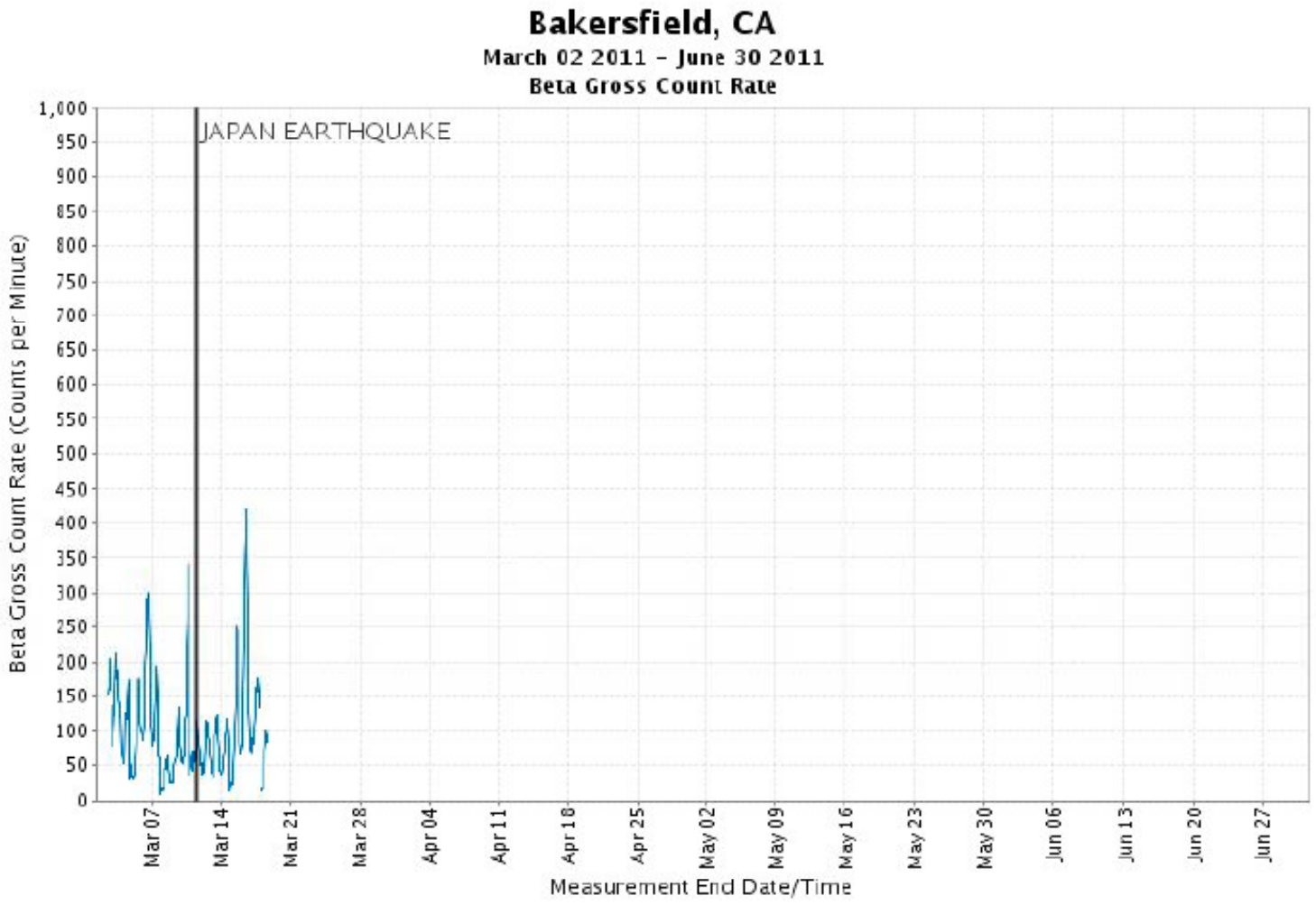
The beta gross count rate measures the radiation from all radionuclides that emit beta particles, which is indicated by the term *gross* or *total*. The term *count rate* tells us how quickly beta particles are being detected, which indicates how much radioactivity the monitor is seeing. (Learn more about beta radiation.)

Notes on the Data

- Brief gaps in RadNet data represent instrument error.
- Larger gaps (>1 day) occasionally appear when RadNet monitors are taken offline for servicing.
- A notice is posted when monitors are off-line for servicing. A blank graph indicates that one part of a meter on the monitor is not working.

And others seems to have been working when the accident began, and broke a few days later and never got fixed.

To-date, levels recorded at this monitor have been thousands of times below any conservative level of concern.



The beta gross count rate measures the radiation from all radionuclides that emit beta particles, which is indicated by the term *gross* or *total*. The term *count rate* tells us how quickly beta particles are being detected, which indicates how much radioactivity the monitor is seeing. (Learn more about beta radiation.)

Notes on the Data

- Brief gaps in RadNet data represent instrument error.
- Larger gaps (>1 day) occasionally appear when RadNet monitors are taken offline for servicing.
- A notice is posted when monitors are off-line for servicing. A blank graph

indicates that one part of a meter on the monitor is not working.

But even had the near-real-time parts of the monitors been working, they couldn't see much that would be important. They are very insensitive, producing only gross counts that require very high increases to be visible.

Their primary way of working is by letting the air filter collect particulates for 3-4 days, then mailing them to Montgomery, Alabama for measurement, which takes additional time. Any measurement would thus occur a week or so after the actual radiation exposure.

Yet even so, virtually none of the filters had data reported for particular radionuclides. It turns out EPA's practice is to ship the filters back to Montgomery, but not actually measure them for particular radionuclides unless the gross beta count is 100 or 200 times normal.

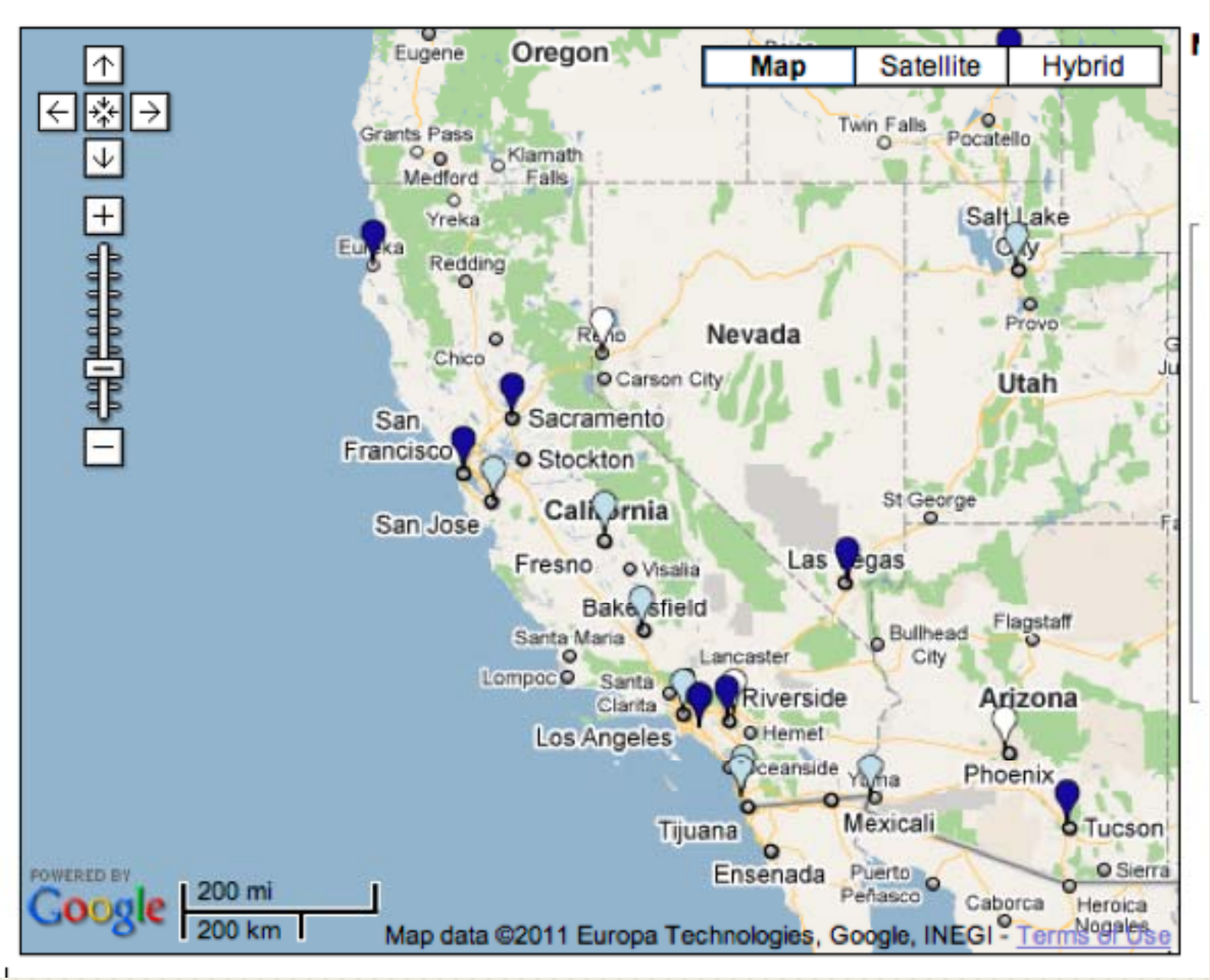
This means that, for example, if you had a RADnet device in Washington, and if it was working, radioactivity levels in Washington air would have to rise two orders of magnitude before EPA would even measure to see what radionuclides were in the air.

But even had the system been fully functional, it was incapable, as operated, of seeing most radioactivity. The stationary air samplers rely only on air filters, and most radioiodine, a key isotope of concern, would pass right through the filter because it is generally in elemental (vapor) form. The RADnet systems is blind to most radioiodine.

Radioiodine is a critical radionuclide in nuclear accidents. It is produced in copious quantities; is very volatile and thus released at a high rate from damaged reactor fuel; and concentrates in the thyroid gland and readily produces thyroid cancer. As we shall see, radioiodine was a dominant finding in other media, e.g. rainwater and milk.

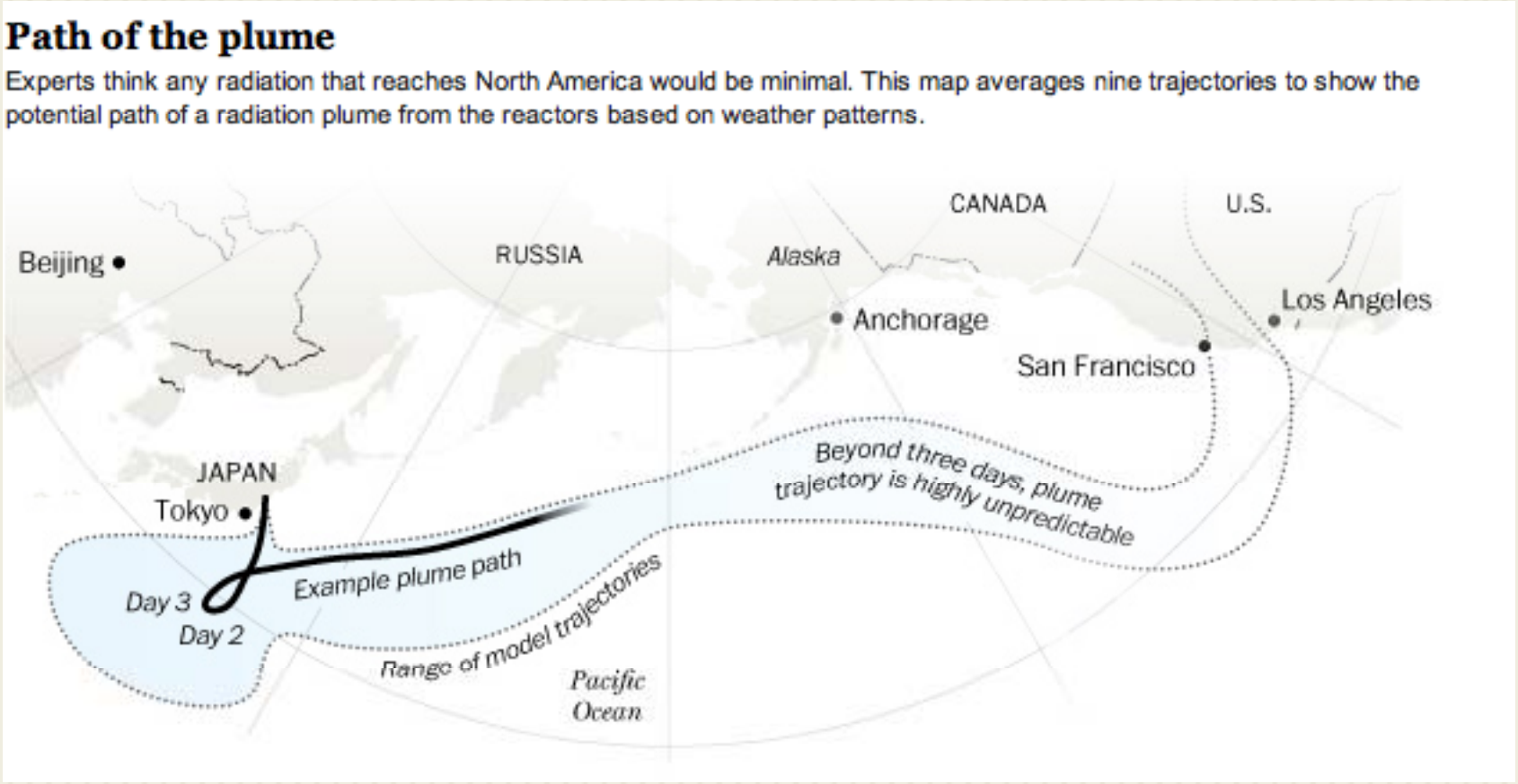
EPA does have devices that can measure all forms of radioiodine—deployable monitors. These deployables use both filters and charcoal cartridges; the former pick up particulates, the latter the gaseous forms. They also have more efficient filters, and were to be sending filters and cartridges for measurement more frequently, reducing delays in data.

There were large gaps in the RADnet system, even if all devices were working. For example, there were no monitors on the coast between LA and San Francisco.



Source: EPA website, 20 March 2011

Some plume projections indicated the plume would in fact arrive between LA and San Francisco.



Source: Washington Post

So, EPA commenced steps to place deployables up and down the West Coast, filling in gaps in the system. The deployables were “stages”—sent out to several locations from which they would then be deployed in the field. Cooperation from state air pollution officers was arranged. And then something strange happened.

APCOs and Monitoring Managers at SCAQMD, SBAPCD, SLOAPCD, MBUAPCD, MCAPCD, NCUAQMD:

Thank you for your patience. I had hoped to get this out sooner to give you an update. EPA HQ has decided at this time not to deploy the deployable RadNet monitors to CA, OR, and WA. We have deployed only to AK, HI, Guam, and Saipan as the western US forward deployed RadNet monitoring network. Should the situation in Japan remain stable or improve, EPA may not deploy monitors to the 3 states. Should the situation deteriorate, the Administrator's office may decide otherwise. I will keep you informed as the situation evolves.

I personally want to thank you and your staff for the excellent cooperation we received from you this week. Truly a pleasure working with each of you. Please contact me if you have any questions or concerns. If I addressed anyone incorrectly, please forward this message to them.

John

John Kennedy

Emergency Response Program

USEPA Region 9

Co Chair CA Air Emergency Response Alliance

Despite a FOIA request, we have been unable to get any information as to why EPA HQ decided to stop the plans for deploying the deployable monitors.

In the end, they sat, with a couple of exceptions, in the offices and warehouses to which they had been staged, without getting placed in the field where they could provide useful data.

Precipitation

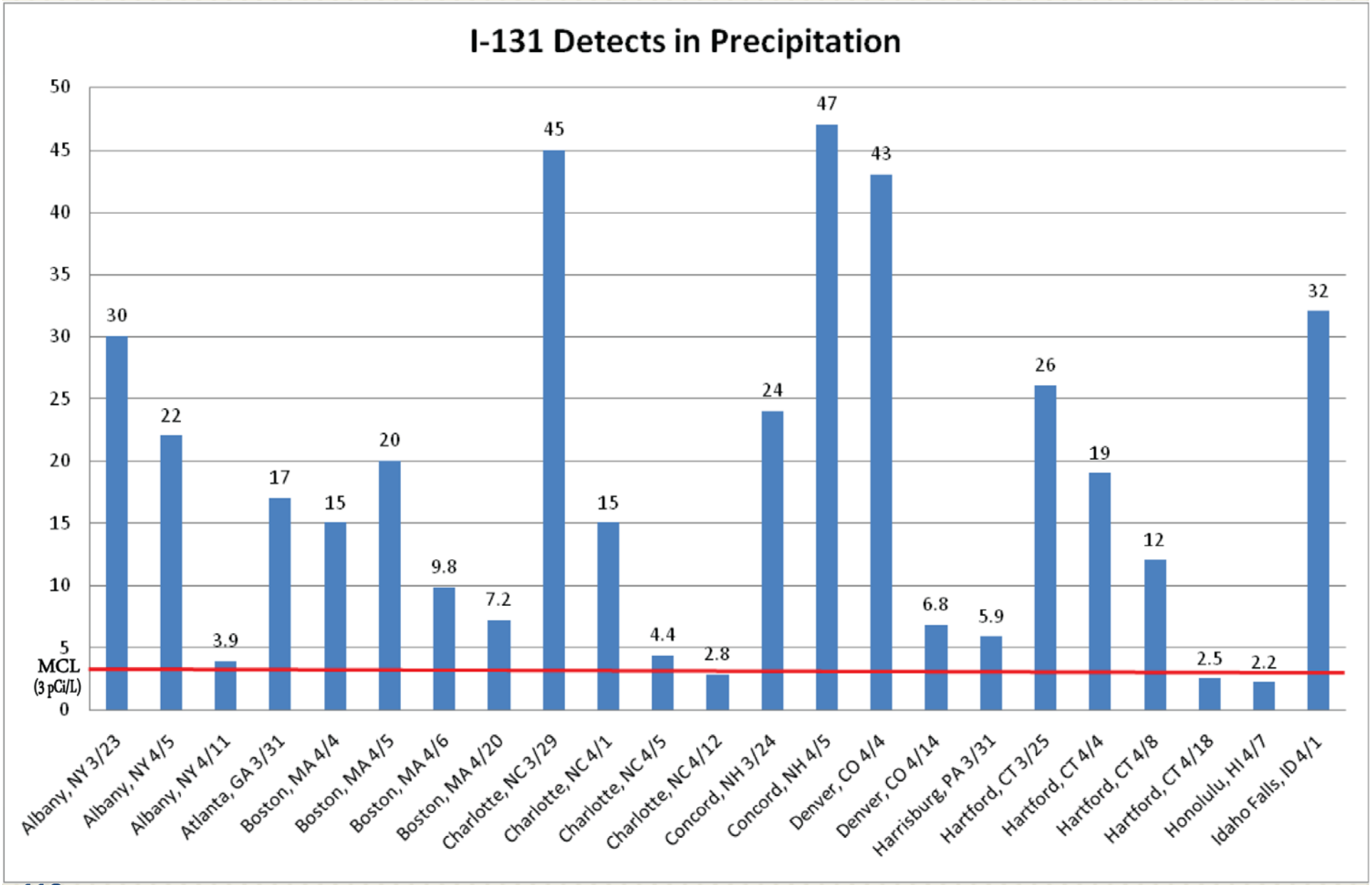
Perhaps more important than air monitoring was precipitation. Radionuclides come back to earth in rain, snow, and sleet.

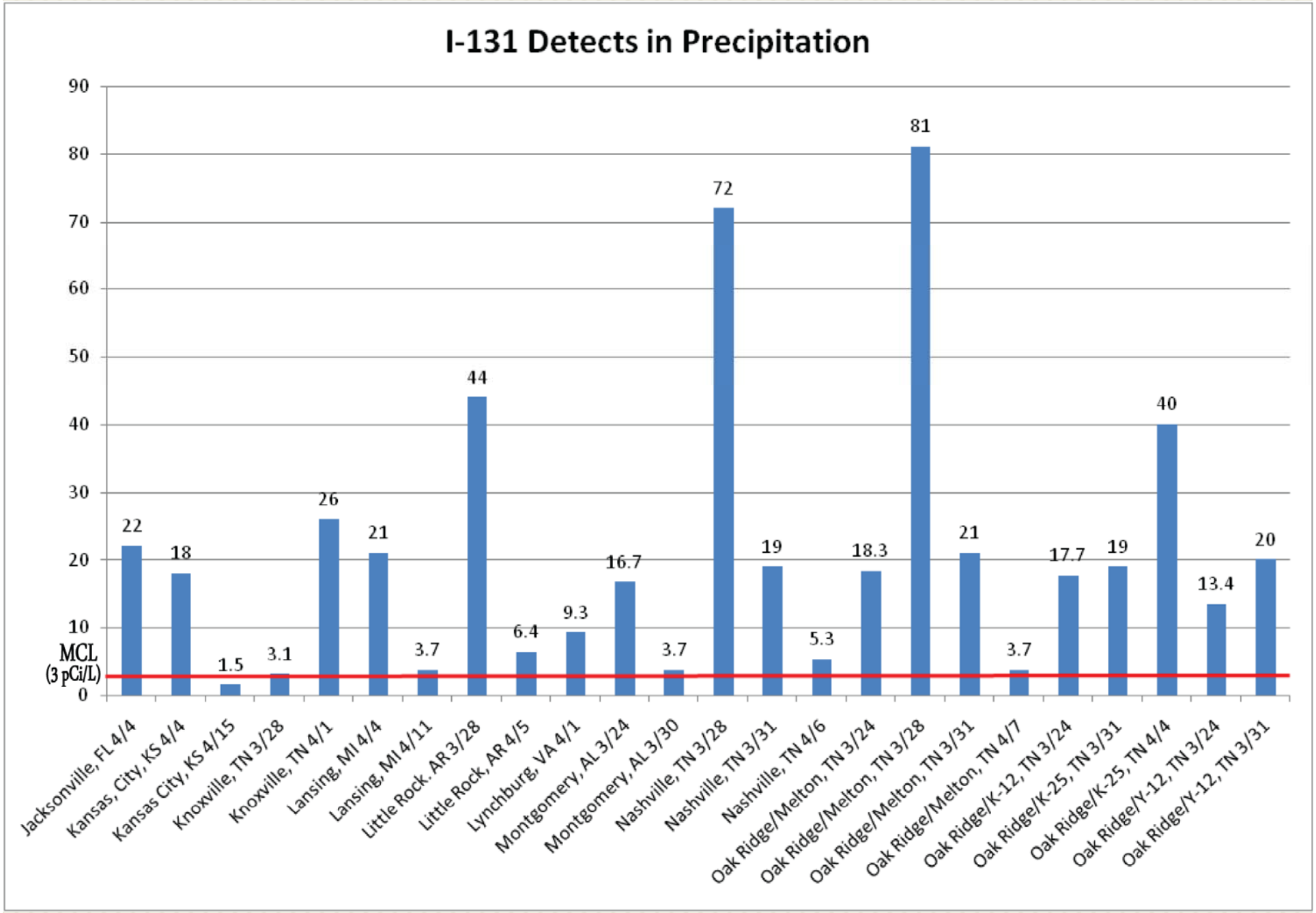
They can thus work their way into drinking water and, even more critically, food, since many radionuclides bioaccumulate, i.e., increase in concentration as they move their way up the food chain. Strontium-90, for example, concentrates in grass, in the cow that eats the grass, in the milk, and then in human bone, where it can cause bone cancer and leukemia. Radioiodine has similar concentrating properties.

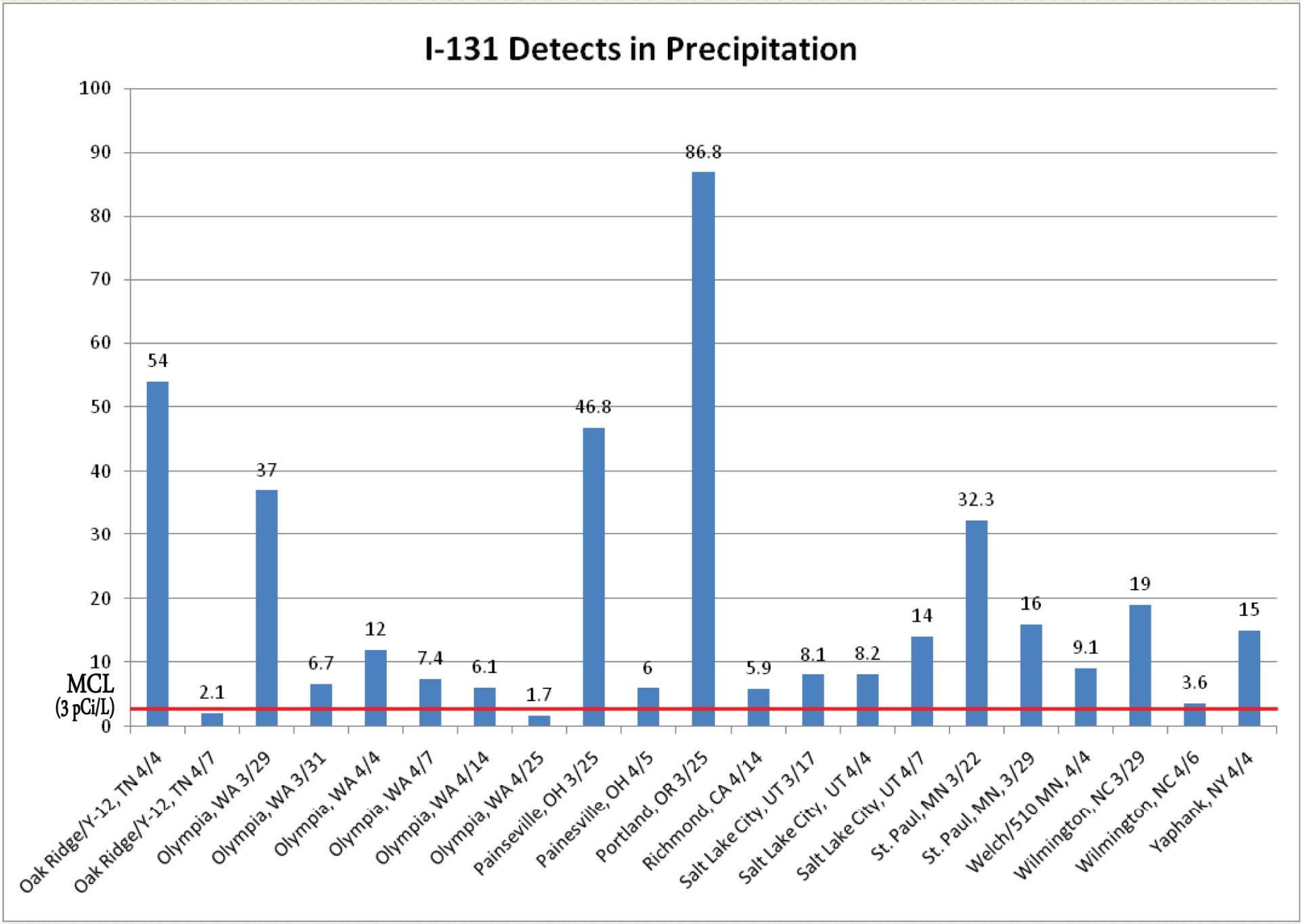
Yet EPA did not address precipitation until Pennsylvania and Massachussetts state authorities released measurements they had made finding quite elevated levels of radioiodine in precipitation.

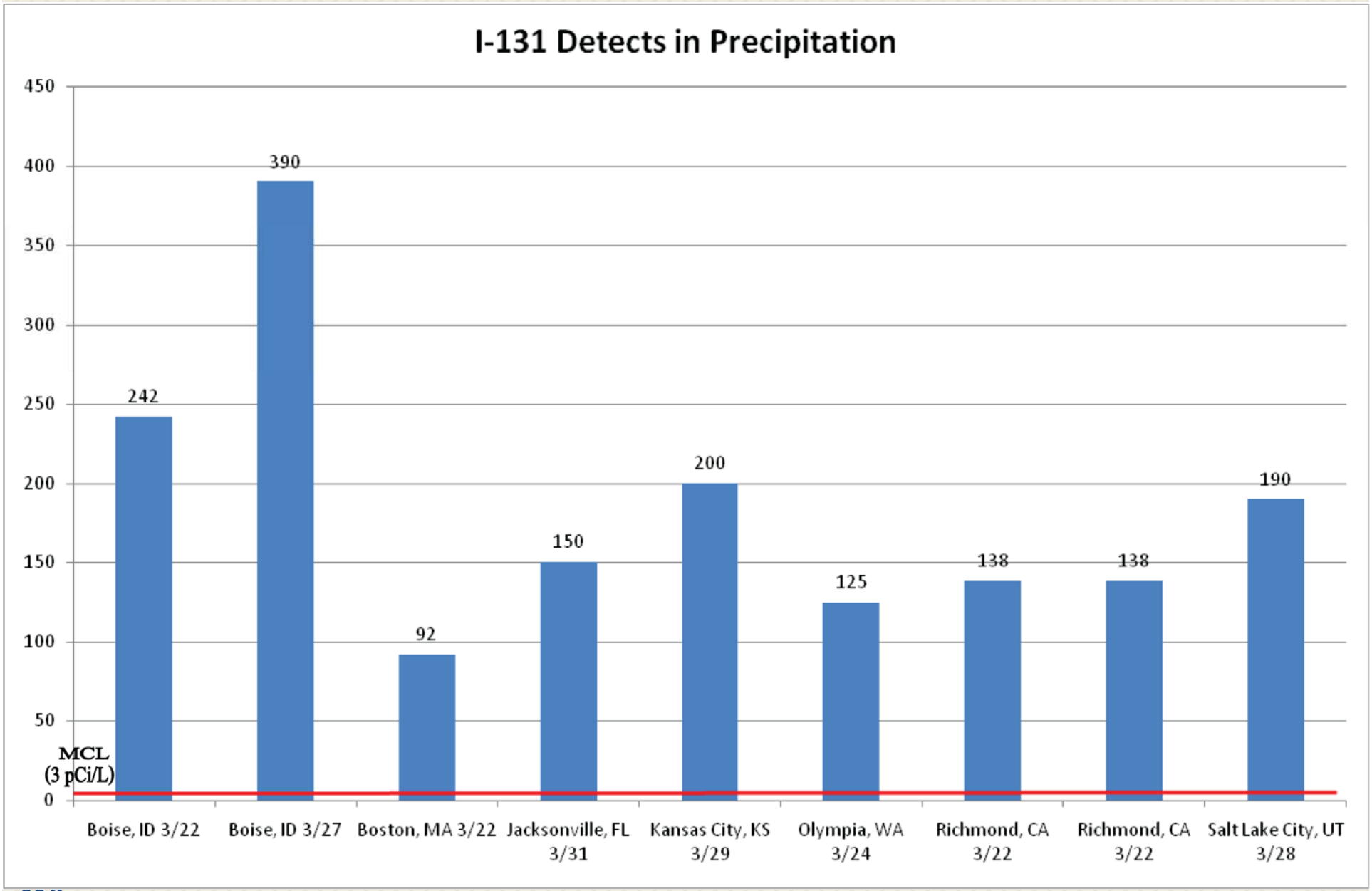
Then EPA's measurements also showed elevated radioiodine all across the country, which far exceeded its own Safe Drinking Water levels (MCLs). But EPA downplayed the significance, and seemed to attack its own MCLs.

We have in the slides that follow compiled the precipitation detects for I-131 and compared them with EPA's Maximum Contaminant Levels for drinking water.


I-131 Detects in Precipitation
50
45
40
35
30
25
20
15
10
5
0
MCL
(3 pCi/L)
30
22
3.9
17
15
20
9.8
7.2
45
15
4.4
2.8
24
47
43
6.8
5.9
26
19
12
2.5
2.2
32
Albany, NY 3/23
Albany, NY 4/5
Albany, NY 4/11
Atlanta, GA 3/31
Boston, MA 4/4
Boston, MA 4/5
Boston, MA 4/6
Boston, MA 4/20
Charlotte, NC 3/29
Charlotte, NC 4/1
Charlotte, NC 4/5
Charlotte, NC 4/12
Concord, NH 3/24
Concord, NH 4/5
Denver, CO 4/4
Denver, CO 4/14
Harrisburg, PA 3/31
Hartford, CT 3/25
Hartford, CT 4/4
Hartford, CT 4/8
Hartford, CT 4/18
Honolulu, HI 4/7
Idaho Falls, ID 4/1

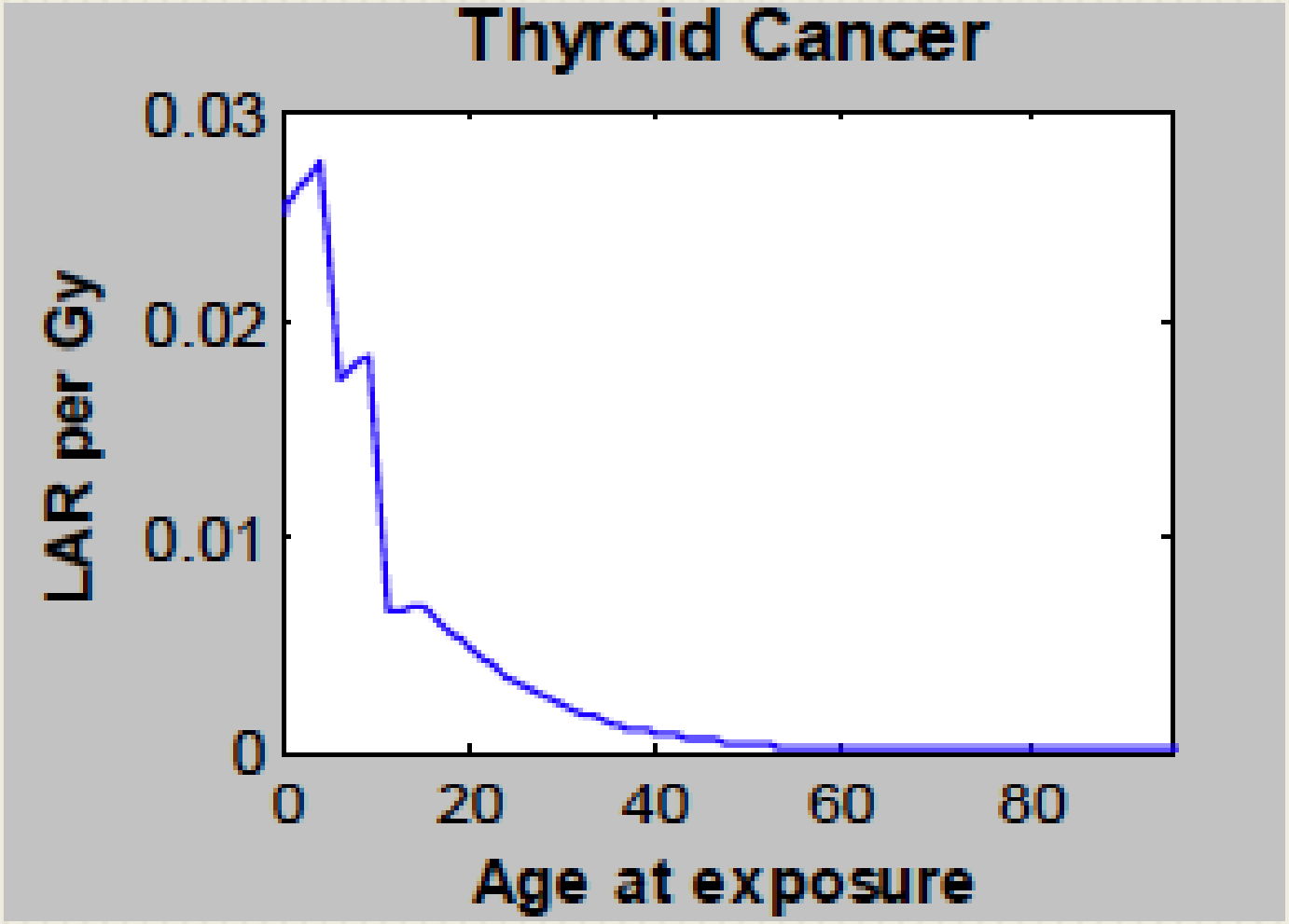

I-131 Detects in Precipitation
90
80
70
60
50
40
30
20
10
0
MCL
(3 pCi/L)
22
18
1.5
3.1
26
21
3.7
44
6.4
9.3
16.7
3.7
72
19
5.3
18.3
81
21
3.7
17.7
19
40
13.4
20
Jacksonville, FL 4/4
Kansas, City, KS 4/4
Kansas City, KS 4/15
Knoxville, TN 3/28
Knoxville, TN 4/1
Lansing, MI 4/4
Lansing, MI 4/11
Little Rock. AR 3/28
Little Rock, AR 4/5
Lynchburg, VA 4/1
Montgomery, AL 3/24
Montgomery, AL 3/30
Nashville, TN 3/28
Nashville, TN 3/31
Nashville, TN 4/6
Oak Ridge/Melton, TN 3/24
Oak Ridge/Melton, TN 3/28
Oak Ridge/Melton, TN 3/31
Oak Ridge/Melton, TN 4/7
Oak Ridge/K-12, TN 3/24
Oak Ridge/K-25, TN 3/31
Oak Ridge/K-25, TN 4/4
Oak Ridge/Y-12, TN 3/24
Oak Ridge/Y-12, TN 3/31


I-131 Detects in Precipitation
100
90
80
70
60
50
40
30
20
10
0
MCL
(3 pCi/L)
54
2.1
37
6.7
12
7.4
6.1
1.7
46.8
6
86.8
5.9
8.1
8.2
14
32.3
16
9.1
19
3.6
15
Oak Ridge/Y-12, TN 4/4
Oak Ridge/Y-12, TN 4/7
Olympia, WA 3/29
Olympia, WA 3/31
Olympia, WA 4/4
Olympia, WA 4/7
Olympia, WA 4/14
Olympia, WA 4/25
Painseville, OH 3/25
Painesville, OH 4/5
Portland, OR 3/25
Richmond, CA 4/14
Salt Lake City, UT 3/17
Salt Lake City, UT 4/4
Salt Lake City, UT 4/7
St. Paul, MN 3/22
St. Paul, MN, 3/29
Welch/510 MN, 4/4
Wilmington, NC 3/29
Wilmington, NC 4/6
Yaphank, NY 4/4


I-131 Detects in Precipitation
450
400
350
300
250
200
150
100
50
0
MCL
(3 pCi/L)
242
390
92
150
200
125
138
138
190
Boise, ID 3/22
Boise, ID 3/27
Boston, MA 3/22
Jacksonville, FL 3/31
Kansas City, KS 3/29
Olympia, WA 3/24
Richmond, CA 3/22
Richmond, CA 3/22
Salt Lake City, UT 3/28

EPA appeared to attack its own MCLs, arguing misleadingly that they are based on 70-year exposure. In fact, EPA's Safe Drinking Water standards bar exposure above the MCL for more than a year. Even averaged over a year, these readings would exceed the MCL.

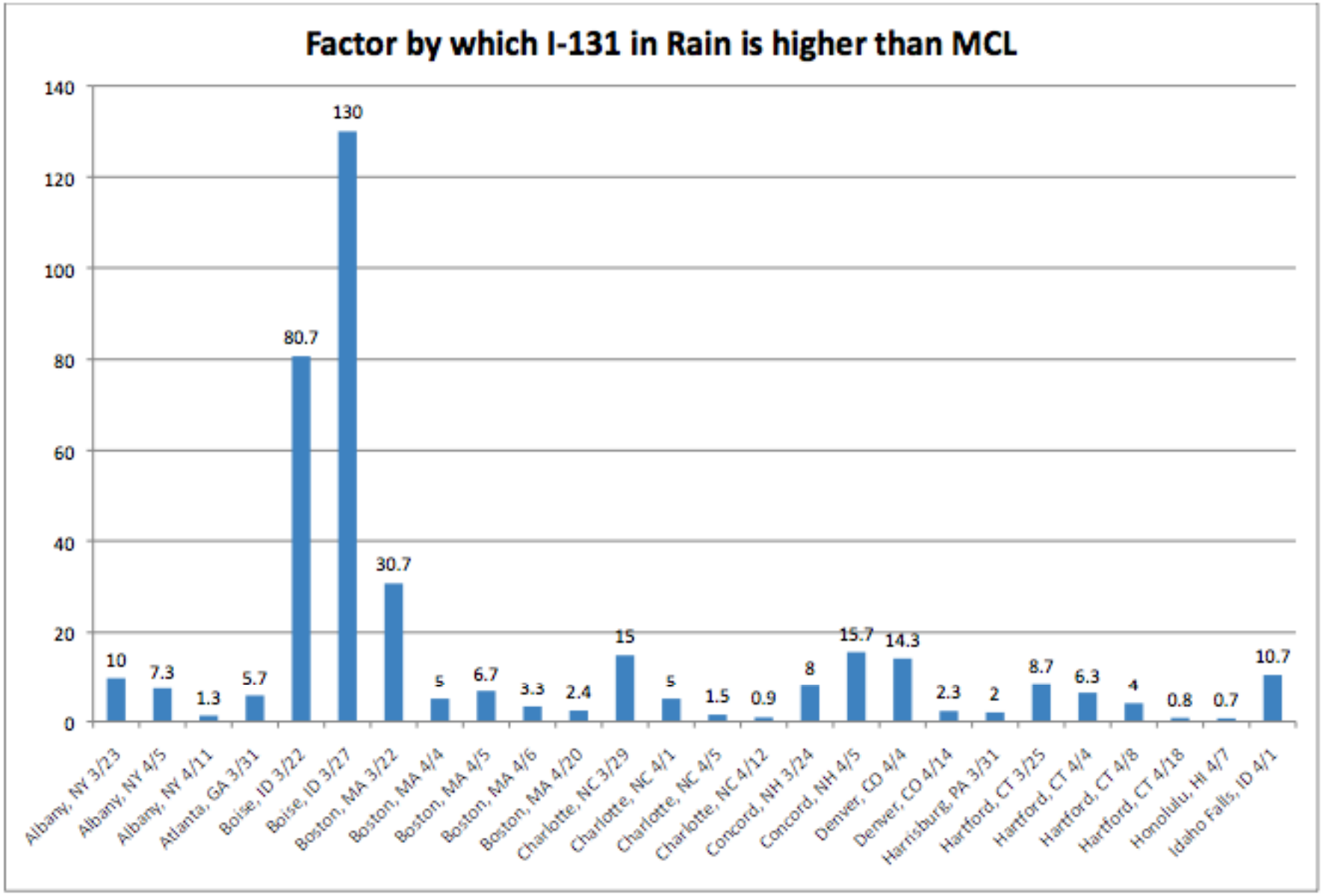
Furthermore, note that the bulk of the cancer risk from ingesting I-131 occurs in the first few years. The risk is heavily “front-loaded” in terms of age.

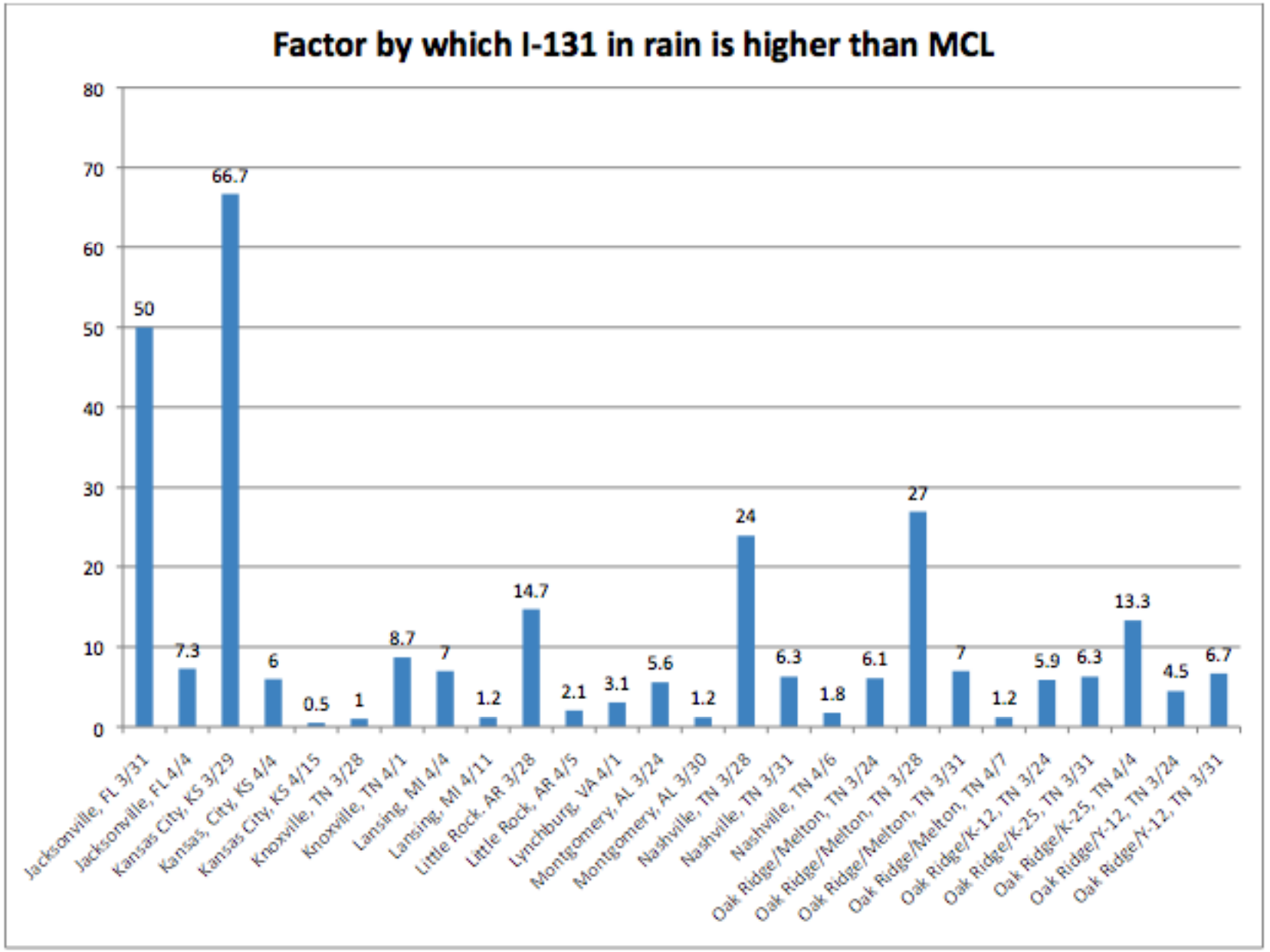


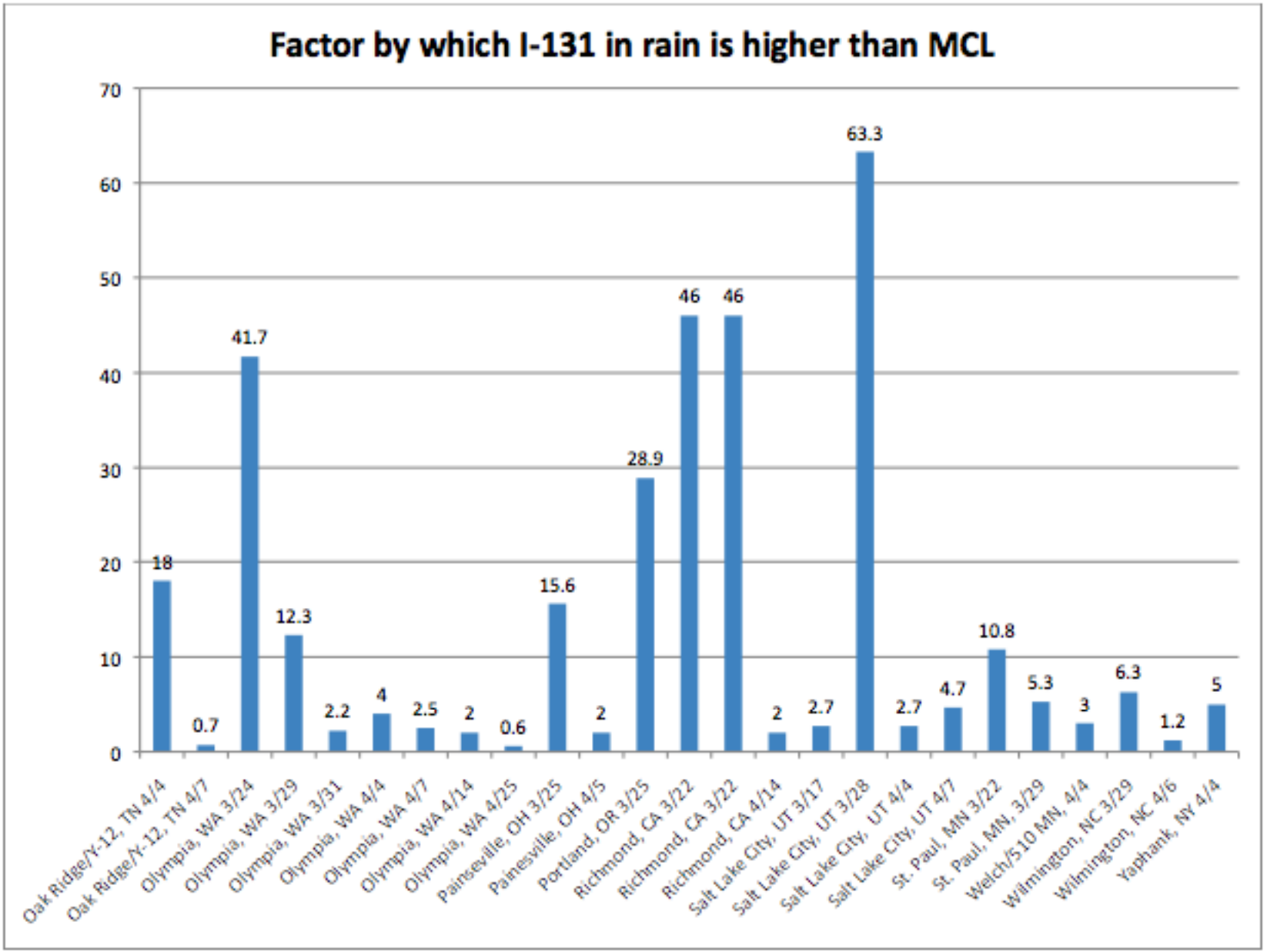
Source: EPA “Blue Book”

Lastly, as indicated earlier, EPA's MCLs are in fact the basis for EPA's existing emergency levels for providing replacement water supplies or requiring treatment– the RALs of your Superfund program. It is also worth remembering that we are talking not about PAG standards for the immediate emergency, but for the year or two after the emergency is presumed to have ended.

EPA kept saying that all measurements were orders of magnitude below “any level of concern.” But, of course, the Safe Drinking Water MCLs are EPA levels of concern, and they were far exceeded, as shown in the next slides.

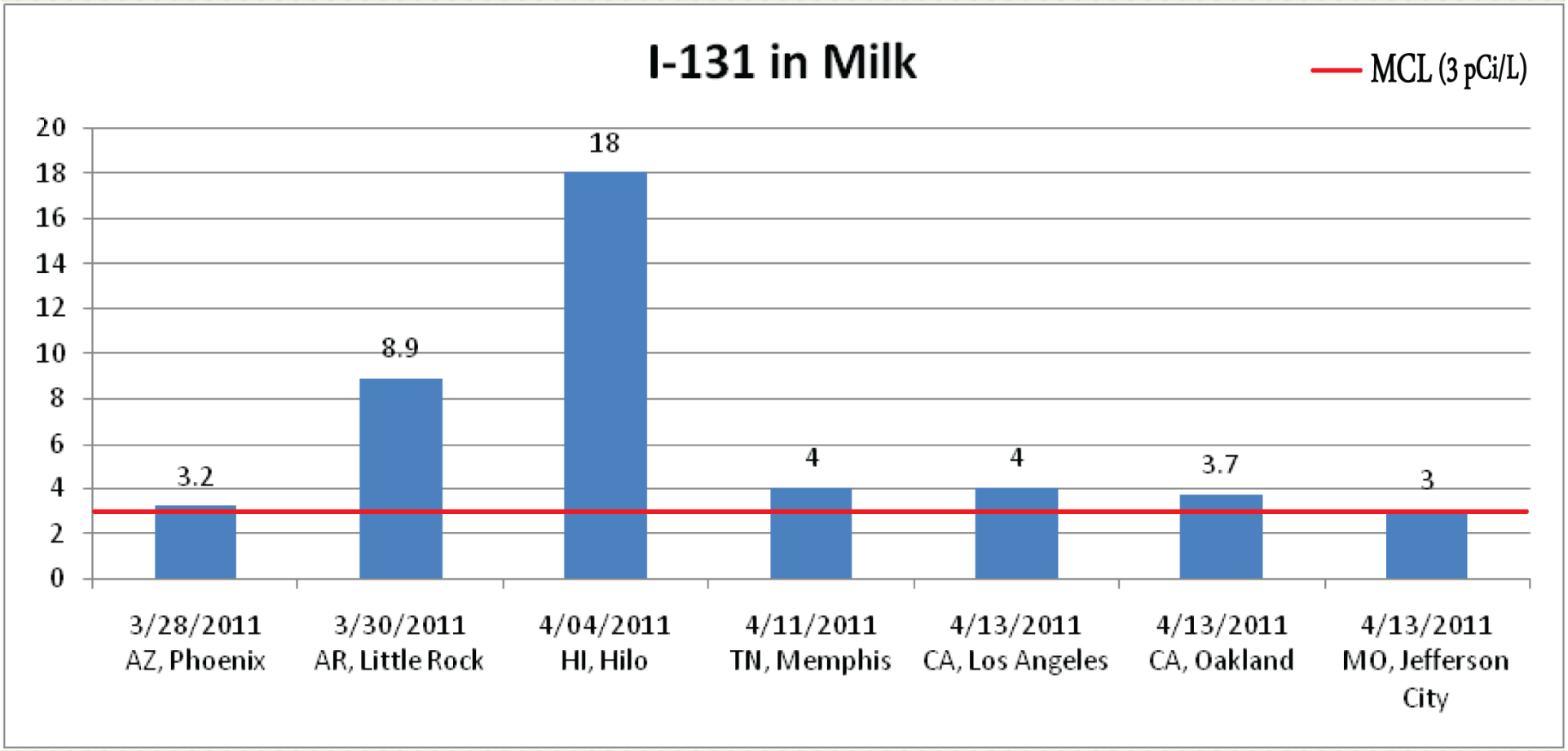

Factor by which I-131 in Rain is higher than MCL
140
120
100
80
60
40
20
0
10
7.3
1.3
5.7
80.7
130
30.7
5
6.7
3.3
2.4
15
5
1.5
0.9
8
15.7
14.3
2.3
2
8.7
6.3
4
0.8
0.7
10.7
Albany, NY 3/23
Albany, NY 4/5
Albany, NY 4/11
Atlanta, GA 3/31
Boise, ID 3/22
Boise, ID 3/27
Boston, MA 3/22
Boston, MA 4/4
Boston, MA 4/5
Boston, MA 4/6
Boston, MA 4/20
Charlotte, NC 3/29
Charlotte, NC 4/1
Charlotte, NC 4/5
Charlotte, NC 4/12
Concord, NH 3/24
Concord, NH 4/5
Denver, CO 4/4
Denver, CO 4/14
Harrisburg, PA 3/31
Hartford, CT 3/25
Hartford, CT 4/4
Hartford, CT 4/8
Hartford, CT 4/18
Honolulu, HI 4/7
Idaho Falls, ID 4/1


Factor by which I-131 in rain is higher than MCL
80
70
60
50
40
30
20
10
0
50
7.3
66.7
6
0.5
1
8.7
7
1.2
14.7
2.1
3.1
5.6
1.2
24
6.3
1.8
6.1
27
7
1.2
5.9
6.3
13.3
4.5
6.7
Jacksonville, FL 3/31
Jacksonville, FL 4/4
Kansas City, KS 3/29
Kansas, City, KS 4/4
Kansas City, KS 4/15
Knoxville, TN 3/28
Knoxville, TN 4/1
Lansing, MI 4/4
Lansing, MI 4/11
Little Rock, AR 3/28
Little Rock, AR 4/5
Lynchburg, VA 4/1
Montgomery, AL 3/24
Montgomery, AL 3/30
Nashville, TN 3/28
Nashville, TN 3/31
Nashville, TN 4/6
Oak Ridge/Melton, TN 3/24
Oak Ridge/Melton, TN 3/28
Oak Ridge/Melton, TN 3/31
Oak Ridge/Melton, TN 4/7
Oak Ridge/K-12, TN 3/24
Oak Ridge/K-25, TN 3/31
Oak Ridge/K-25, TN 4/4
Oak Ridge/Y-12, TN 3/24
Oak Ridge/Y-12, TN 3/31


Factor by which I-131 in rain is higher than MCL
70
60
50
40
30
20
10
0
18
0.7
41.7
12.3
2.2
4
2.5
2
0.6
15.6
2
28.9
46
46
2
2.7
63.3
2.7
4.7
10.8
5.3
3
6.3
1.2
5
Oak Ridge/Y-12, TN 4/4
Oak Ridge/Y-12, TN 4/7
Olympia, WA 3/24
Olympia, WA 3/29
Olympia, WA 3/31
Olympia, WA 4/4
Olympia, WA 4/7
Olympia, WA 4/14
Olympia, WA 4/25
Painesville, OH 3/25
Painesville, OH 4/5
Portland, OR 3/25
Richmond, CA 3/22
Richmond, CA 3/22
Richmond, CA 4/14
Salt Lake City, UT 3/17
Salt Lake City, UT 3/28
Salt Lake City, UT 4/4
Salt Lake City, UT 4/7
St. Paul, MN 3/22
St. Paul, MN, 3/29
Welch/510 MN, 4/4
Wilmington, NC 3/29
Wilmington, NC 4/6
Yaphank, NY 4/4

Food

One of the main pathways of concern is food. However, there were no measurements of foodstuffs except for some milk measurements, and those were spotty. Virtually no strontium-90 measurements were made, despite its critical importance in the milk pathway. And radiodine was detected above the drinking water MCL.


I-131 in Milk
MCL (3 pCi/L)
20
18
16
14
12
10
8
6
4
2
0
3.2
8.9
18
4
4
3.7
3
3/28/2011 AZ, Phoenix
3/30/2011 AR, Little Rock
4/04/2011 HI, Hilo
4/11/2011 TN, Memphis
4/13/2011 CA, Los Angeles
4/13/2011 CA, Oakland
4/13/2011 MO, Jefferson City

But EPA continued to assert that measurements were far below any level of concern." It appeared to do so by comparing readings not with its Safe Drinking MCLs but with levels which are thousands of times higher.

In essence, ORIA acted during Fukushima as though the Bush-era proposed PAGs were in fact in effect. Rather than relying on MCLs, it used comparisons to de facto PAGs orders of magnitude higher.

The normal milk monitoring procedures are troubling. Only a relatively few milk samples are taken, they are only taken quarterly, they are generally composited (so elevated values from a dairy would be diluted and you wouldn't be able to locate which dairy was the cause of elevated composited readings), and strontium measurements are taken only every 4th year from sample locations.

Normal procedure is to not get around to measuring milk samples for gross gamma radiation (e.g. I-131) for several weeks and for strontium-90 for half a year to a year. Obviously, if one found a problem, any protective action would be impossible, as the milk would long since have been consumed.

The Fukushima tragedy provided an important test of the adequacy of EPA's planning and capability of responding to a radiological release affecting the U.S. The problems identified need to be promptly remedied so that were there an event in the U.S., the system would in fact be capable of leading to protective actions that were truly protective.

Conclusions

1. The science keeps showing radiation to be more dangerous than presumed before, but standards keep getting weakened rather than strengthened.

2. The Bush-era proposed PAGs have not been fixed. Reports indicate that the essence of the problem with them – optimization for long-term cleanup and suggesting far higher permissible concentrations in drinking water than the Safe Drinking Water levels or emergency RALS—continue to be considered, albeit without use of the explicit language from the Bush draft.

3. The EPA RADnet system—essential for protective actions to actually be initiated—largely failed to function appropriately during the Fukushima disaster. This should be a wake-up call to fix the system before it may be needed in a domestic nuclear event.

4. More than 2 years have passed since we expressed our original concerns, and yet there has been no engagement with the environmental and public health communities on these issues. Yet DOE and NRC, among others, are clearly interacting with EPA pushing for weakening of protections. EPA should be transparent, and bring us into the loop.

Fundamental closing thought: As EPA said many years ago in opposing NRC radiation standards as non-protective:

“To put it bluntly, radiation should not be treated as a privileged pollutant.”

Contact: Daniel Hirsch
Committee to Bridge the Gap
(831) 336-8003