Greek, prefix & abbreviation	Value	Shorthand exponential notation	Description
mill—m	1/1,000	10^{-3}	One part per thousand.
micro—Greek m	1/1,000,000	10^{-6}	One part per million.
nano—n	1,1,000,000,000	10^{-9}	One part per billion.
pico—p	1/1,000,000,000,000	10^{-12}	
femto—f	1/1,000,000,000,000,000	10^{-15}	
atto—a	1/1,000,000,000,000,000,000	10^{-18}	

Thus 1 picocurie is a millionth millionth of a curie and is abbreviated 1 pCi. Also 1 millirad (1 mrad) is one thousandth of a rad.

Because of the particle mass and charge, 1 rad deposited in tissue by alpha particles creates a more concentrated biological damage than 1 rad of gamma rays. To compensate for this difference in damage and subsequent effect, a new unit was created—the rem. This is called the dose equivalent. The absorbed dose is measured in rads and the dose equivalent is measured in rems.

The rad and rem are related by a quality factor as follows:

Number of rems = Q times the number of rads

Where Q is the quality factor which has been assigned the following value:

Q=1 for beta particles and all electromagnetic radiations (gamma rays and x-rays)

Q=10 for neutrons from spontaneous fission and for protons

Q=20 for alpha particles and fission fragments

The quality factor is meant to approximately account for the relative harm caused by various types of radiation. The International System (SI) unit corresponding to the rem is the Sievert (Sv). One Sievert equals 100 rem.

Appendix B—Beta Particle and Photon Emitters

Nuclide	Ch (pCi/liter)
H-3	6.09E+04
BE-7	4.35E+04
N-13	1.52E+05
C-11	9.92E+04
C-14	3.20E+03
C-15	6.69E+06
O-15	4.95E+05
F-18	3.95E+04
NA-22	4.66E+02
NA-24	3.35E+03
SI-31	1.02E+04
P-32	6.41E+02
P-33	1.87E+03
S-35	1.29E+04
CL-36	1.85E+03
CL-38	2.12E+04
K-42	3.90E+03
CA-45	1.73E+03
CA-47	8.46E+02
SC-46	8.63E+02
SC-47	2.44E+03
SC-48	7.66E+02
V-48	6.44E+02
CR-51	3.80E+04
MN-52	7.33E+02
MN-54	2.01E+03
MN-56	5.64E+03
FE-55	9.25E+03

Appendix B—Beta Particle and Photon Emitters—Continued

Nuclide	Ch (pCi/liter)
FE-59	8.44E+02
CO-57	4.87E+03
CO-58	1.59E+03
CO-58M	6.49E+04
CO-60	2.18E+02
NI-59	2.70E+04
NI-63	9.91E+03
NI-65	8.81E+03
CU-64	1.19E+04
ZN-65	3.96E+02
ZN-69	6.31E+04
ZN-69M	4.22E+03
GA-67	7.02E+03
GA-72	1.19E+03
GE-71	4.36E+05
AS-73	7.85E+03
AS-74	1.41E+03
AS-76	1.06E+03
AS-77	4.33E+03
SE-75	5.74E+02
BR-82	3.15E+03
RB-82	4.36E+05
RB-86	4.85E+02
RB-87	5.01E+02
RB-88	2.91E+04
RB-89	5.27E+04
SR-82	2.41E+02
SR-85	2.83E+03
SR-85M	2.37E+05
SR-89	5.99E+02
SR-90	4.20E+01
SR-91	2.16E+03
SR-92	3.10E+03
Y-90	5.10E+02
Y-91	5.76E+02
Y-91M	1.32E+05
Y-92	2.87E+03
Y-93	1.20E+03
ZR-93	5.09E+03
ZR-95	1.46E+03
ZR-97	6.50E+02
NB-93M	1.05E+04
NB-94	7.07E+02
NB-95	2.15E+03
NB-95M	2.39E+03
NB-97	2.35E+04
NB-97M	1.37E+06
MO-99	1.83E+03
TC-95	6.97E+04
TC-95M	3.12E+03
TC-96	2.05E+03
TC-96M	1.76E+05
TC-97	3.25E+04
TC-97M	4.45E+03
TC-99	3.79E+03
TC-99M	8.96E+04
RU-97	7.96E+03
RU-103	1.81E+03
RU-105	4.99E+03
RU-106	2.03E+02
RH-103M	4.71E+05
RH-105	3.72E+03
RH-105M	5.51E+06

Appendix B—Beta Particle and Photon Emitters—Continued

Nuclide	Ch (pCi/liter)
RH-106	1.24E+06
PD-100	1.30E+03
PD-101	1.34E+04
PD-103	6.94E+03
PD-107	3.66E+04
PD-109	2.12E+03
AG-105	2.70E+03
AG-108	6.26E+05
AG-108M	7.23E+02
AG-109M	1.67E+07
AG-110	1.84E+06
AG-110M	5.12E+02
AG-111	1.08E+03
CD-109	2.27E+02
CD-115	9.58E+02
CD-115M	3.39E+02
IN-113M	5.24E+04
IN-114	9.76E+05
IN-114M	3.23E+02
IN-115	3.51E+01
IN-115M	1.64E+04
SN-113	1.74E+03
SN-121	6.06E+03
SN-121M	2.26E+03
SN-125	4.46E+02
SN-126	2.93E+02
SB-122	8.10E+02
SB-124	5.63E+02
SB-125	1.94E+03
SB-126	5.44E+02
SB-126M	5.85E+04
SB-127	8.18E+02
SB-129	3.09E+03
TE-125M	1.49E+03
TE-127	7.92E+03
TE-127M	6.63E+02
TE-129	2.72E+04
TE-129M	5.24E+02
TE-131	2.68E+04
TE-131M	9.71E+02
TE-132	5.80E+02
I-122	2.11E+05
I-123	1.07E+04
I-125	1.51E+02
I-126	8.10E+01
I-129	2.10E+01
I-130	1.19E+03
I-131	1.08E+02
I-132	8.19E+03
I-133	5.49E+02
I-134	2.14E+04
I-135	2.34E+03
CS-131	2.28E+04
CS-134	8.13E+01
CS-134M	1.01E+05
CS-135	7.94E+02
CS-136	5.18E+02
CS-137	1.19E+02
CS-138	2.56E+04
BA-131	2.95E+03
BA-133	1.52E+03
BA-133M	2.62E+03
BA-137M	2.15E+06

APPENDIX B—BETA PARTICLE AND PHOTON EMITTERS—Continued

Nuclide	Ch (pCi/liter)
BA-139	1.38E+04
BA-140	5.82E+02
LA-140	6.52E+02
CE-141	1.89E+03
CE-143	1.21E+03
CE-144	2.61E+02
PR-142	1.04E+03
PR-143	1.17E+03
PR-144	4.70E+04
PR-144M	1.12E+05
ND-147	1.25E+03
ND-149	1.17E+04
PM-147	5.24E+03
PM-148	5.05E+02
PM-148M	5.75E+02
PM-149	1.38E+03
SM-151	1.41E+04
SM-153	1.83E+03
EU-152	8.41E+02
EU-154	5.73E+02
EU-155	3.59E+03
EU-156	6.00E+02
GD-153	4.68E+03
GD-159	2.76E+03
TB-158	1.25E+03
TB-160	8.15E+02
DY-165	1.51E+04
DY-166	8.30E+02
HO-166	9.81E+02
ER-169	3.64E+03
ER-171	3.80E+03
TM-170	1.03E+03
TM-171	1.27E+04
YB-169	1.83E+03
YB-175	3.11E+03
LU-177	2.55E+03
HF-181	1.17E+03
TA-182	8.42E+02
W-181	1.90E+04
W-185	3.44E+03
W-187	2.66E+03
RE-183	5.40E+03
RE-186	1.88E+03
RE-187	5.82E+05
RE-188	1.79E+03
OS-185	2.46E+03
OS-191	2.38E+03
OS-191M	1.43E+04
OS-193	1.69E+03
IR-190	1.01E+03
IR-192	9.57E+02
IR-194	1.04E+03
PT-191	3.81E+03
PT-193	4.61E+04
PT-193M	3.02E+03
PT-197	3.40E+03
PT-197M	1.75E+04
AU-196	3.66E+03
AU-198	1.31E+03
HG-197	5.76E+03
HG-203	2.39E+03
TL-202	3.84E+03
TL-204	1.68E+03
TL-207	4.00E+05
TL-208	2.83E+05
TL-209	3.58E+05
PB-203	5.06E+03
PB-209	2.53E+04
PB-210	1.01E+00
PB-211	1.28E+04
PB-212	1.23E+02
PB-214	1.18E+04
BI-206	6.56E+02
BI-207	1.01E+03
BI-212	5.20E+03
BI-213	1.50E+04
BI-214	1.89E+04
FR-223	3.41E+03
RA-225	9.14E+00
RA-228	7.85E+00
AC-227	1.27E+00
AC-228	3.27E+03
TH-231	4.07E+03
TH-234	4.01E+02
PA-233	1.51E+03
PA-234	2.56E+03
PA-234M	9.30E+05
U-237	1.78E+03
U-240	1.54E+03
NP-236	5.96E+03
NP-238	1.39E+03
NP-239	1.68E+03
NP-240	2.31E+04
NP-240M	1.74E+05
PU-241	6.26E+01
PU-243	1.64E+04
AM-242M	1.27E+00

Ch=Concentration in water for 4 mrem ede/y, assuming 2 liters daily intake.

APPENDIX C—ALPHA EMITTERS

NUCLIDE	Cm (pCi/liter)	Ci (pCi/liter)
SM-147	1.06E+02	1.04E+02
BI-210	1.94E+03	1.01E+03
BI-211	2.05E+05	1.56E+05
PO-210	1.40E+01	7.46E+00
PO-212	1.15E+14	8.78E+13
PO-213	8.03E+12	6.06E+12
PO-214	2.43E+11	1.86E+11
PO-215	9.17E+09	6.84E+09
PO-216	7.38E+07	5.30E+07
PO-218	9.50E+04	6.91E+04
AT-217	5.74E+08	4.27E+08
FR-221	4.50E+04	3.26E+04
RA-223	3.21E+01	2.41E+01
RA-224	5.46E+01	4.06E+01
RA-226	2.07E+01	1.57E+01
AC-225	1.85E+02	1.13E+02
TH-227	6.62E+02	4.03E+02
TH-228	1.53E+02	1.25E+02
TH-229	5.15E+01	4.93E+01
TH-230	8.27E+01	7.92E+01
TH-232	9.18E+01	8.80E+01
PA-231	1.02E+01	1.02E+01
U-232	1.02E+01	5.72E+00
U-233	2.56E+01	1.38E+01
U-234	2.59E+01	1.39E+01
U-235	2.65E+01	1.45E+01
U-236	2.74E+01	1.47E+01
U-238	2.62E+01	1.46E+01
NP-237	7.19E+00	7.06E+00
PU-236	3.33E+01	3.23E+01
PU-238	7.15E+00	7.02E+00
PU-239	6.49E+01	6.21E+01
PU-240	6.49E+01	6.22E+01
PU-242	6.83E+01	6.54E+01
PU-244	7.02E+00	6.87E+00
AM-241	6.45E+00	6.34E+00
AM-242	8.66E+03	5.34E+03
AM-243	6.49E+00	6.37E+00
CM-242	1.45E+02	1.33E+02
CM-243	8.47E+00	8.30E+00
CM-244	1.00E+01	9.84E+00
CM-245	6.35E+00	6.23E+00
CM-246	6.38E+00	6.27E+00
CM-247	6.93E+00	6.79E+00
CM-248	1.71E+00	1.67E+00
CF-252	1.70E+01	1.62E+01

Cm=Concentration in water for lifetime mortality risk=1×10^{-4}

Ci=Concentration in water for lifetime incidence risk=1×10^{-4}

Both assume 2 liters daily intake of water.

List of Subjects in 40 CFR Parts 141 and 142

Chemicals, Reporting and record keeping requirements, Water supply, Administrative practice and procedure.

Dated: June 17, 1991.

William K. Reilly,

Administrator, Environmental Protection Agency.

For the reasons set forth in the preamble, title 40 of the Code of Federal Regulations is proposed to be amended as follows:

PART 141—NATIONAL PRIMARY DRINKING WATER REGULATIONS

1. The authority citation for part 141 continues to read as follows:

Authority: 42 U.S.C. 300f, 300g–1, 300g–2, 300g–3, 300g–4, 300g–5, 300g–6, 300j–4 and 300j–9.

2. Section 141.2 is amended by adding, in alphabetical order, a definition for "adjusted gross alpha" as follows:

§ 141.2 Definitions

* * * * *

Adjusted gross alpha: Adjusted gross alpha is defined as the result of a gross alpha measurement, less radium-226 and less uranium. Radon is not included in adjusted gross alpha.

* * * * *

3. Section 141.15 is amended by revising the introductory text to read as follows:

§ 141.15 Maximum contaminant levels for radium-226, radium-228, and gross alpha particle radioactivity in community water systems.

The following are the maximum contaminant levels for radium-226, radium-228, and gross alpha particle radioactivity, which shall remain effective until [insert date 18 months after publication of the final rule in the **Federal Register**];

* * * * *

4. Section 141.16 is proposed to be amended by adding introductory text to read as follows:

§ 141.16 Maximum contaminant levels for beta particle and photon radioactivity from man-made radionuclides in community water systems.

The following maximum contaminant levels shall remain effective until [insert date 18 months after publication of the final rule in the **Federal Register**];

* * * * *

5. Section 141.25 is amended by revising the section to read as follows: