UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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Directive no. 9283.1-14

MEMORANDUM

SUBJECT: Use of Uranium Drinking Water Standards under 40 CFR 141 and 40 CFR 192 as Remediation Goals for Groundwater at CERCLA sites

FROM: Elaine F. Davies, Acting Director
Office of Emergency and Remedial Response (OERR)
Office of Solid Waste and Emergency Response

Stephen D. Page, Director
Office of Radiation and Indoor Air (ORIA)
Office of Air and Radiation

TO: Addressees

PURPOSE

This memorandum addresses the use of uranium standards in 40 CFR Part 141 and 40 CFR Part 192 when setting remediation goals for ground waters that are current or potential sources of drinking water at Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) sites. Today's memorandum will be of interest to site decisionmakers that have uranium as a contaminant of concern in groundwater at their CERCLA site.

This document provides guidance to Regional staff, in dealing with the public and the regulated community, regarding how EPA intends to implement the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). It describes national policy. This document is not a substitute for EPA's statutes or regulations, nor is it a regulation itself. Thus, it cannot impose legally-binding requirements on EPA, States, or the regulated community, and may not apply to a particular situation based upon the circumstances.

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BACKGROUND

All remedial actions at CERCLA sites must be protective of human health and the environment and comply with applicable or relevant and appropriate requirements (ARARs) unless a waiver is justified. Cleanup levels for response actions under CERCLA are developed based on site-specific risk assessments, ARARs, and/or to-be-considered material[1] (TBCs). The determination of whether a requirement is applicable, or relevant and appropriate, must be made on a site-specific basis (see 40 CFR §300.400(g)).

CERCLA GROUNDWATER PROTECTION

"EPA expects to return usable ground waters to their beneficial uses whenever practicable." (see 40 CFR §300.430(a)(1)(iii)(F)). In general, drinking water standards provide relevant and appropriate cleanup levels for ground waters that are a current or potential source of drinking water. However, drinking water standards generally are not relevant and appropriate for ground waters that are not a current or potential source of drinking water (see 55 FR 8732, March 8, 1990). Drinking water standards include federal maximum contaminant levels (MCLs) and/or non-zero maximum contaminant level goals (MCLGs) established under the Safe Drinking Water Act (SDWA), or more stringent state drinking water standards. Other regulations may also be ARARs as provided in CERCLA §121(d)(2)(B).

The Agency issued guidance concerning ground water use determinations in a memo from Office of Solid Waste and Emergency Response Assistant Administrator to the Regions entitled "The Role of CSGWPPs in EPA Remediation Programs" (OSWER Directive 9283.1-09), April 4, 1997. This guidance states that EPA generally defers to State determination of current and future groundwater uses, when the State has a Comprehensive State Ground Water Protection Program (CSGWPP) that has been endorsed by EPA and has provisions for site-specific decisions. For States that do not have an EPA-endorsed CSGWPP (or whose CSGWPPs do not have provisions for making site-specific determinations of groundwater use, resource value, priority or vulnerability), EPA uses either "EPA Guidelines for Ground-Water Classification" (Final Draft, December 1986), or State groundwater classifications or similar State designations, whichever classification scheme leads to more stringent remediation goals.

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[1]To-be-considered material, TBCs include non-promulgated advisories or guidance issued by Federal or State governments that are not legally binding and do not have the status of potential ARARs. However, TBCs should be considered along with ARARs as part of the site risk assessment and may be used in determining the necessary level of cleanup for protection of health and the environment.

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MASS AND ACTIVITY (pCi/L and µg/L)

Concentrations of radionuclides in water are typically expressed in terms of "activity" of the radionuclide per unit of volume in the water (e.g., picocuries per liter or pCi/L). Activity measures the rate of disintegration of a radionuclide per unit mass (for soil, sediment, and foodstuffs) or volume (for air and water). Because the carcinogenic effect of a radionuclide is due to its disintegration rate, which occurs during its decay process, concentrations of radionuclides are generally measured in terms of activity for health evaluation purposes.

Uranium is the only radionuclide for which the chemical toxicity has been identified to be comparable to or greater than the radiotoxicity, and for which a reference dose (RfD) has been established to evaluate chemical toxicity. The RfD is an estimate of a daily ingestion exposure to the population, including sensitive subgroups, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Uranium in soluble form is a kidney toxin. The relative risk of uranium kidney toxin effects correspond to the level of exposure to the uranium mass concentrations; the oral RfD of uranium is expressed in terms of mass (0.6 µg/kg/day).

RADIONUCLIDE MCLs

On July 9, 1976, EPA promulgated 40 CFR Part 141 *Drinking Water Regulations: Radionuclides* (1976 MCL rule). This 1976 MCL rule included the following MCLs: 5 pCi/L for radium-226 and radium-228 combined; 15 pCi/L for gross alpha particle activity (including radium 226, but excluding uranium and radon); and a concentration that produces a dose equivalent of 4 mrem/yr or less to the total body or any internal organ for the sum of the doses from man-made beta particles and photon emitters. A list of radionuclides that are addressed by the gross alpha MCL are provided in Attachment A to today's memorandum. Also, provided in Attachment B to today's memorandum is a list of radionuclide concentrations calculated using the 4 mrem/yr beta particles and photon emitters MCL standard.

On December 7, 2000, EPA amended 40 CFR Part 141 (65 FR 76708 December 7, 2000) *National Primary Drinking Water Regulations; Radionuclides* (2000 MCL rule). This 2000 MCL rule established requirements for uranium, and retained the existing requirements for combined radium-226 and radium-228, gross alpha particle radioactivity, and beta particle and photon radioactivity. The 2000 MCL rule did include MCLGs of zero for the last four contaminants (see 40 CFR § 141.55).

The 2000 MCL rule established an MCL for uranium of 30 micrograms per liter (µg/L). For the MCL rulemaking, EPA assumed a typical conversion factor of 0.9 pCi/µg for the mix of uranium isotopes found at public water systems, which means that an MCL of 30 µg/L will typically correspond to 27 pCi/L. EPA considered the 30 µg/L level (which corresponds to a

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27 pCi/L level) to be appropriate since it is protective for both kidney toxicity and cancer. However, the relationship between mass concentration (μg/L) and activity (pCi/L) is dependent upon the relative mix of the radioactive isotopes (e.g., uranium-234, uranium-235, uranium-238) that comprise the uranium at a particular drinking water source.[2] In circumstances with more extreme conversion factors (> 1.5 pCi/μg), uranium activity levels may exceed 40 pCi/L. In these circumstances, EPA recommends in the 2000 MCL rule that drinking water systems mitigate uranium levels to 30 pCi/L or less, to provide greater assurance that adequate protection from cancer health effects is being afforded (see 65 FR at page 76715).

UMTRCA GROUNDWATER STANDARDS

On January 11, 1995, EPA promulgated 40 CFR Part 192 (60 FR 2854 January 11, 1995) *Groundwater Standards for Remedial Actions at Inactive Uranium Processing Sites* (UMTRCA rule).[3] Included in these standards is a constituent concentration limit for the combined level of uranium-234 and uranium-238 in groundwater. These standards were developed specifically for the cleanup of uranium mill tailings at 24 sites designated under Section 102(a)(1) of UMTRCA (Title I sites). The list of 24 Title I sites is a closed set chosen in 1979 that cannot be expanded without congressional action. The standards were developed to ensure that all currently used and reasonably expected drinking water supplies near these 24 sites, both public and private, are adequately protected for use by present and future generations. The concentration limit for the combined level of uranium-234 and uranium-238 is 30 pCi/L.

IMPLEMENTATION

The following subsections will clarify the use of standards under 40 CFR Part 141 and 40 CFR Part 192 as ARARs when setting remediation levels for uranium in groundwater at CERCLA sites.

MCLs AND UMTRCA AS APPLICABLE REQUIREMENTS

The uranium drinking water standards contained within 40 CFR Part 141 are potentially applicable requirements only for community water systems designated under § 141.26 (see 65 FR 76708, 76748 (December 7, 2000)). The uranium groundwater standards contained within

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[2]For further discussion of mass and activity, including the formula to convert between the two measurement units, see U.S. EPA "Radiation Risk Assessment At CERCLA Sites: Q & A" EPA 540/R/99/006, December 1999, pp. 5-6.

[3]These standards were developed pursuant to Section 275 of the Atomic Energy Act (42 U.S.C. 2022), as amended by Section 206 of the Uranium Mill Tailings Radiation Control Act of 1978 (42 U.S.C. 7918) (UMTRCA).

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40 CFR Part 192 are potentially applicable requirements only for the 24 Title I sites designated under Section 206 of UMTRCA.

MCLs AND UMTRCA AS RELEVANT AND APPROPRIATE REQUIREMENTS

In general, because the MCLG is zero for the radionuclides included in 40 CFR Part 141, the MCLs for these radionuclides are potentially relevant and appropriate requirements at sites with radioactive contamination in groundwaters that are current or potential sources of drinking water. In particular, **the uranium MCL of 30 µg/L is a potentially relevant and appropriate requirement for groundwaters that are current or potential sources of drinking water that have any of the uranium isotopes as a contaminant of concern**. Thus, for these radionuclides, the MCL concentration of 30 µg/L is generally used as the cleanup level for groundwater that is a current or potential source of drinking water, and is to be attained throughout the plume at the completion of the response action.

If either uranium-234 or uranium-238 is a contaminant of concern in ground waters that are current or potential sources of drinking water, and the site is not a Title I UMTRCA site, then the uranium UMTRCA standard under 40 CFR Part 192 of 30 pCi/L is a potentially relevant and appropriate requirement. Please note that this means both the uranium MCL (40 CFR Part 141) and the uranium UMTRCA (40 CFR Part 192) standards may be selected as relevant and appropriate requirements for addressing uranium contamination in ground water at the same CERCLA site. Since both standards establish levels of uranium in groundwater that are acceptable for drinking, EPA would expect that whenever the uranium UMTRCA ground water standard is a relevant and appropriate requirement, the uranium MCL will also be a relevant and appropriate standard. Selecting both the MCL and UMTRCA standards will ensure that the kidney toxicity and carcinogenic health effects posed by uranium are adequately addressed.

MCL PREAMBLE AS A TO-BE-CONSIDERED

In addition, the preamble recommendation to public water systems concerning extreme pCi/µg conversion factors in the uranium 2000 MCL rulemaking may be a TBC. **In situations where the mix of uranium isotopes means that attaining the uranium MCL of 30 µg/L may result in residual activity levels of uranium of greater than 40 pCi/L for total uranium, and a site-specific risk assessment demonstrates that 30 pCi/L is protective, then we recommend 30 pCi/L as a suitable cleanup level in addition to 30 µg/L.** This recommendation is made to ensure an equivalent level of protection from the carcinogenic effects of uranium at CERCLA sites and public water systems, and is therefore consistent with the recommendation made in the preamble to the 2000 MCL rule.

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CONDUCTING GROUNDWATER RESPONSES FOR 40 CFR PART 141 AND/OR 40 CFR PART 192 ARAR COMPLIANCE

When either the uranium MCL and/or the 30 pCi/L uranium UMTRCA standard is considered a relevant and appropriate requirement, or the preamble to the uranium 2000 MCL rulemaking is a TBC, then CERCLA response actions should be conducted using the approach found in the NCP and Superfund guidance (e.g., determining groundwater use, point of compliance, areas of flexibility). Because the CERCLA approach for attaining the uranium MCL is more stringent than the UMTRCA approach 40 CFR Part 192, using the CERCLA approach automatically insures compliance with the UMTRCA groundwater standard as an ARAR. For example, the CERCLA approach for complying with the MCL throughout the plume is more stringent than the UMTRCA approach of complying with the groundwater standard only in the uppermost aquifer. Thus if an MCL is attained throughout the plume, the groundwater standard will also be attained in the uppermost aquifer. Key documents that include guidance on the Superfund approach to evaluating and remediating groundwater include: "Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites" (OSWER Directive No. 9283.1-12), October 1996; "The Role of CSGWPPs in EPA Remediation Programs" (OSWER Directive No. 9283.1-09), April 4, 1997, and; the "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites" (OSWER Directive No. 9200.4-17P), April 21, 1999). These and other Superfund groundwater guidance documents may be found on the Internet at: http://www.epa.gov/superfund/resources/gwdocs/index.htm.

Guidance documents that address establishing contaminant levels in soil to protect groundwater include: "Soil Screening Guidance for Radionuclides: User's Guide" (OSWER Directive No. 9355.4-16A), October 2000, and "Soil Screening Guidance for Radionuclides: Technical Background Document" (OSWER Directive No. 9355.4-16), October 2000. These Superfund guidance documents may be found on the Internet at: http://www.epa.gov/superfund/resources/radiation/radssg.htm.

FURTHER INFORMATION

The subject matter specialist for this directive is Stuart Walker of OERR 703-603-8748. General questions about this directive, should be directed to 1-800-424-9346.

Addressees:
National Superfund Policy Managers, Regions 1-10
Superfund Branch Chiefs, Regions 1-10
Superfund Branch Chiefs, Office of Regional Counsel, Regions 1-10
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Attachment A: List of Man-made and Naturally-Occurring Radionuclides addressed by 15 pCi/L gross alpha particle activity MCL standard[4]

Nd-144	Ra-219	U-235
Sm-147	Ra-223	U-236
Sm-148	Ra-224	U-238
Po-208	Ra-226	Pa-231
Bi-210	Rn-220	Pu-236
Bi-211	Fr-221	Pu-238
Bi-212	Fr-223	Pu 239
Bi-213	Ac-225	Pu-240
Bi-214	Ac-227	Pu-241
Po-210	Th-227	Pu-242
Po-212	Th-228	Np-237
Po-213	Th-229	Am-241
Po-214	Th-230	Cm-242
Po-215	Th-232	Cm-244
Po-216	U-230	Cm-245
Po-218	U-232	Cm-248
At-217	U-233	Bk-248
At-218	U-234	Cf-250
Tl-217		

[4]This list includes only those radionuclides with half lives exceeding 4 days.

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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.

Nuclide	pCi/l	Nuclide	pCi/l	Nuclide	pCi/l	Nuclide	
Ge-71	6,000	Cd-115	90	Eu-152	200	Pb-203	1,000
As-73	1,000	Cd-115m	90	Eu-154	60	Bi-206	100
As-74	100	In-113m	3,000	Eu-155	600	Bi-207	200
As-76	60	In-114m	60	Gd-153	600	Pa-230	600
As-77	200	In-115	300	Gd-159	200	Pa-233	300
Se-75	900	In-115m	1,000	Tb-160	100	Np-239	300
Br-82	100	Sn-113	300	Dy-165	1,000	Pu-241	300
Rb-86	600	Sn-125	60	Dy-166	100	Bk-249	2,000
Rb-87	300	Sb-122	90	Ho-166	90		