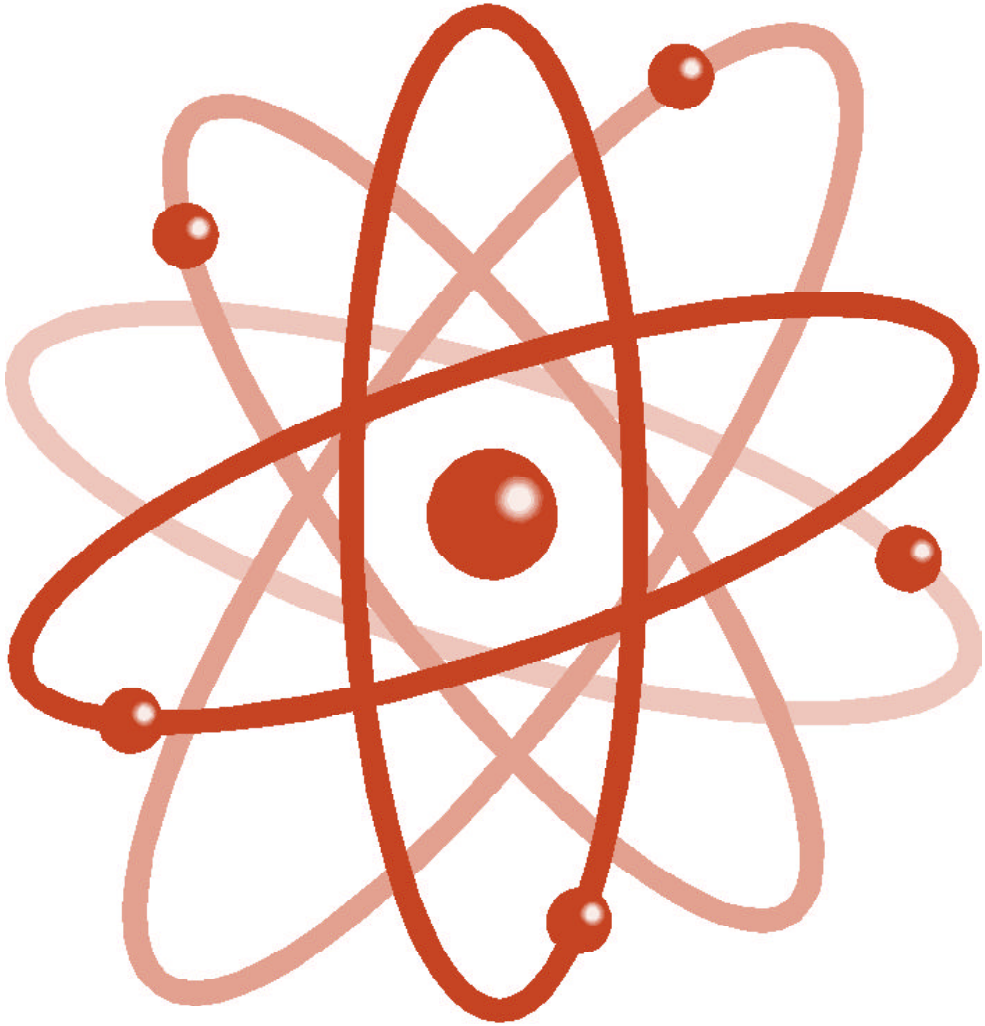
United States
Environmental Protection
Agency

Radionuclides in Drinking Water: A Small Entity Compliance Guide



Office of Ground Water and Drinking Water

(4606M)

EPA 815-R-02-001

www.epa.gov/safewater

February 2002

Printed on recycled paper

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NOTICE

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Introduction

If you own or operate a community water system (CWS), this Guide will help you understand a rule that applies to you.

This Guide was prepared pursuant to section 212 of the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. 104-121. It is intended to aid you in complying with the Radionuclides Rule issued on December 7, 2000 under the Safe Drinking Water Act (SDWA). The SDWA provisions, the Radionuclides Rule, and other EPA regulations described in this Guide contain legally binding requirements. This document does not substitute for those provisions or regulations, nor is it a regulation itself. It does not impose legally binding requirements on EPA, States, or the regulated community, and may not apply to a particular situation based on the circumstances. EPA and State decisionmakers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate. Any decisions regarding a particular CWS will be made based on the applicable statutes and regulations. Therefore, interested parties are free to raise questions and objections about the appropriateness of the application of this guide to a particular situation, and EPA will consider whether or not the recommendations or interpretations in this Guide are appropriate in that situation based on the law and regulations. EPA may change this guidance in the future. To determine whether EPA has revised this Guide and/or to obtain copies, contact the Safe Drinking Water Hotline at 1-800-426-4791.

EPA first began to regulate radionuclides in 1976. Unless your system is new, you have been monitoring for these contaminants. Since 1976, we have learned a great deal more about radionuclides, including effects they can have on peoples' health, where they are likely to occur, and how to detect and remove them from drinking water. With this improved understanding, EPA published a new rule in the **Federal Register** on December 7, 2000 (65 FR 76708-76753). While many of the current requirements remain unchanged, there are some new requirements, including the following:

- **Uranium.** EPA established a Maximum Contaminant Level (MCL) of 30 micrograms per liter (µg/L) for uranium.
- **Radium-228.** Systems must monitor separately for radium-228.
- **Entry Point Monitoring.** Systems must monitor at **EACH** active Entry Point to the Distribution System (EPTDS).

Additional copies of this Guide may be obtained by calling the Safe Drinking Water Hotline at 1-800-426-4791. Copies also may be downloaded from EPA's Safe Drinking Water Web site at www.epa.gov/safewater.

This Guide describes the minimum Federal requirements under the Radionuclides Rule. Your State may have more specific or additional requirements. Be sure to check with your State Drinking Water Program regarding their specific requirements. (Systems on Tribal lands or in Wyoming should check with the EPA Regional Office.) Contact information for State Programs is at the end of this Guide.

Please note that the term "State" is used in this guide to refer to your Primacy Agency. The Primacy Agency for most systems is your State Drinking Water Agency. However, the Primacy Agency for systems located in the Navajo Nation is your tribal office, and the Primacy Agency for systems located on other tribal lands, in Wyoming, or in the District of Columbia is your EPA Regional office.

1. Who Should Read this Guide?

This Guide is designed to help CWSs serving 3,330 or fewer persons. A CWS includes any drinking water system, regardless of ownership, that has at least 15 service connections or regularly serves at least 25 of the same people year round. Systems that may find this Guide useful include water systems serving:

- Mobile Home Parks
- Home Owners Associations
- Small Towns
- Rural Water Districts
- Small Private Systems
- Tribal Systems

This handbook is divided into 16 sections designed to help you:

- Determine if you will be able to comply with the Radionuclides Rule.
- Understand why it is important to remove radionuclides from drinking water.
- Explain when and how often you need to monitor for radionuclides.
- Determine what you will need to report to the State and to your customers.
- Understand your compliance options if you cannot meet an MCL for one or more of the regulated radionuclides.
- Choose a treatment technology if you selected treatment as your compliance option.
- Find help if you need it.

There is also a section at the end of the Guide on beta particle and photon activity. While the regulations for the beta particle and photon emitters are similar to the regulations for the other radionuclides, most systems will never need to monitor for beta particle and photon emitters. Your State will determine a monitoring schedule if your system is vulnerable to this type of contamination.

Photo by Dan Fraser, The Cadmus Group, Inc.

2. Which Radionuclides Does EPA Regulate in Drinking Water?

Some elements, either found in nature or man-made, are unstable and emit particles or waves of high energy from the nucleus or other parts of the atom.

There are three basic kinds of high-energy radiation: alpha, beta, and gamma (included in a broader group called photons). Many radioactive elements called "radionuclides" (pronounced "radio-noo-clydes") emit more than one kind of radiation, but are classified by their most important kind.

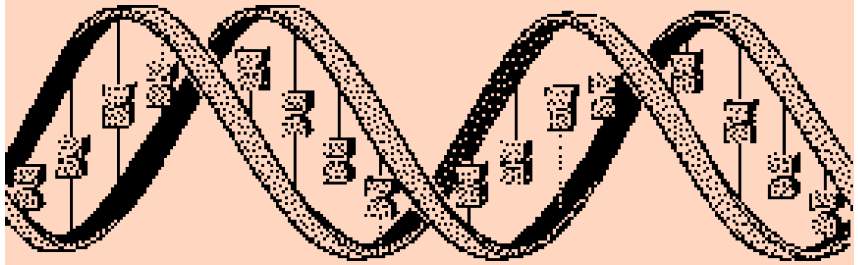
EPA has limits in drinking water called maximum contaminant levels (MCLs) for four groupings of radionuclides:

- One MCL is a limitation on two kinds (or "isotopes") of radium: radium-226 (Ra-226), which mostly emits alpha radiation, Ra-228, which mostly emits beta radiation.
- Another MCL limits radiation from a group of 179 man-made beta and photon emitters. Only systems which have been designated by your State as vulnerable or contaminated by this class of radionuclides must monitor. See section 7.
- The third MCL is for "gross alpha" which includes all alpha emitters except uranium and radon.
- Fourth is a new MCL for uranium isotopes U-234, U-235 and U-238, which mostly emit alpha radation. This last MCL is actually concerned primarily about limiting the toxic effects of uranium as a heavy metal as much as its effect as a radionuclide.

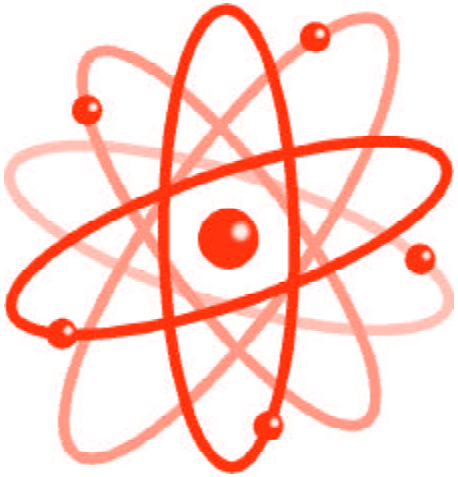
The MCLs are concerned with the health effects from radiation inside the body after drinking the radionuclides. However, many

How Radionuclides Affect Peoples' Health

Exposure to radioactivity may be harmful to chemical reactions important to living cells in your body. Radiation pulls electrons off atoms in the cells (ionizes them) and may prevent the cell from functioning properly. It may lead to the cell's death, to the cell's inability to repair itself, or to the cell's uncontrolled growth (cancer). For example, ionizing radiation can damage DNA, which carries the genetic information in a cell. Damage to DNA may change the cell's genetic code, resulting in the mutation of one or more genes contained in the DNA. These mutations can cause cells to malfunction or lead to cancer. These mutations may also be passed on to children.



radionuclides classified as “alpha emitters’ or “beta emitters” also emit gamma radiation, which can penetrate the body from outside, affecting workers during storage or disposal of wastes.



Radionuclide Maximum Contaminant Levels	
Beta/photon emitters*	4 mrem/year
Gross alpha particle	15 pCi/L
Radium-226 and Radium-228	5 pCi/L
Uranium	30 µg/L
*A total of 179 individual beta particle and photon emitters may be used to calculate compliance with the MCL.	

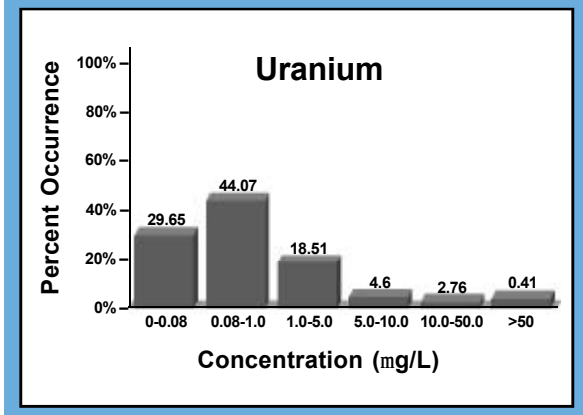
3. Why Is it Important to Monitor for Radionuclides?

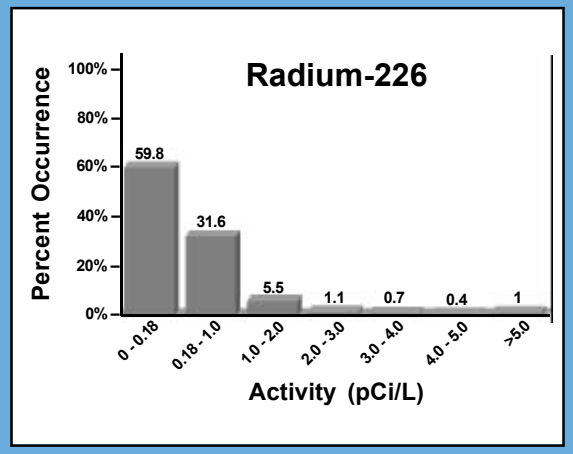
Completely avoiding radioactivity is impossible. Radionuclides are found in air, water, soil, and even living things. People are exposed to background levels of radiation all the time. Sources of these exposures to radiation include building materials such as granite, airborne radon, and cosmic radiation from outer space. Even food can contain low levels of radiation.

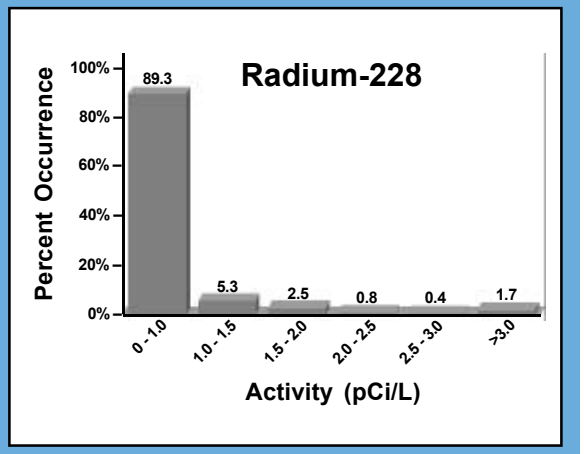
Radionuclides generally enter drinking water through the erosion or chemical weathering of naturally occurring mineral deposits, although human activity (such as mining, industrial activities, or military activities that use or produce man-made radioactive materials) can also contribute to their presence in water. Evidence suggests that long-term exposure to radionuclides in drinking water may cause cancer. In addition, exposure to uranium may have toxic effects on a person's kidneys.

The graphs below show the results of a nationwide occurrence study of naturally occurring radionuclides in public water supplies. The survey included a random sample of 990 collection sites. Each graph shows the percent of systems above a given concentration or activity. For example, 44.07 percent of the 990 systems sampled had uranium concentrations between 0.08 and 1.0 µg/L.

Radionuclide Occurrence in Drinking Water







Source: Longtin, J.P. "Occurrence of Radon, Radium, and Uranium in Groundwater," *J. Am. Water Works Assoc.* 80(7):84 (1988).

4. When Do I Have to Comply?

The revised Radionuclides Rule takes effect on December 8, 2003. The current Rule remains in effect until then, and you must continue monitoring and complying with current standards. For most systems, this means continuing to monitor in accordance with the schedule set by your State.

Systems must continue to comply with the 1976 Rule until December 7, 2003. The initial monitoring period for the revised Rule begins December 8, 2003 and ends December 31, 2007. Your State will determine your initial monitoring requirements for all the entry points into the distribution system during this 4-year initial monitoring period. The table on this page shows some of the Rule's milestones. Further information on monitoring requirements appears in the next two sections.

Radionuclides Requirements Dates	
July 9, 1976	1976 Radionuclides Drinking Water Regulation.
June 2000	Under certain circumstances, data collected between June 2000 and December 8, 2003 may be eligible for use as grandfathered data to satisfy the initial monitoring requirements for gross alpha, radium-226/228, and uranium. Information on grandfathering data appears in future sections.
December 7, 2000	The Radionuclides Final Rule.
December 8, 2003	Rule effective date. Systems must begin initial monitoring under a State-specified monitoring plan, unless the State permits the grandfathering of data collected between June 2000 and December 8, 2003.
December 31, 2007	All systems must complete initial monitoring.
2008	Future monitoring frequency and compliance requirements will be determined by the State by this time.

5. Are My Monitoring Requirements Changing?

Yes. One key change in the new Radionuclides Rule is that, rather than monitor at a "representative" point in your distribution system, you must now monitor at ***EACH*** entry point to the distribution system (EPTDS). This change prevents situations in which the "average" water meets the standard, even though some people are drinking poor-quality water from a contaminated source. It also makes the Radionuclides Rule consistent with other regulations covering chemical contaminants in drinking water.

Unless told otherwise by the State, a system which uses an intermittent source of supply (i.e., a source that is used seasonally) or that uses more than one source and that blends water from more than one source before distribution, must sample at an EPTDS during periods of normal operating conditions. Normal operating conditions include when water is representative of all the sources being used.

EPA has provided States with the flexibility to decide on a case-by-case basis whether data collected between June 2000 and December 8, 2003 can be grandfathered (i.e., substituted for the initial quarterly monitoring required by the Revised Radionuclides Rule). States must decide if the data collected by a system during the grandfathering period—in conjunction with historical data, information on geology, and any other criteria the State chooses to use—will provide enough information to ensure that radionuclide activity will remain below the MCLs.

The annotated time line on the next page shows the schedule for radionuclides monitoring through the year 2016. The time line also shows how the radionuclide monitoring schedule fits within the Standardized Monitoring Framework already in place for other chemical contaminants. Note that EPA extended the initial compliance monitoring period for radionuclides until 2007 so that the first compliance cycle is consistent with the Standardized Monitoring Framework.

I've been collecting samples for years. Can I get a waiver?

No. All systems must conduct initial monitoring at each EPTDS to determine that entry point's water quality between December 8, 2003 and December 31, 2007, or have data that the State allows to be grandfathered. However, your State may allow you to waive the final two quarters of monitoring for a radionuclide at an EPTDS if your results for the first two quarters of initial monitoring are less than the detection limit defined by EPA for that particular radionuclide.

Radionuclide Detection Limits

Contaminant	Detection Limit
Gross Alpha Particle Activity	3 pCi/L
Radium-226	1 pCi/L
Radium-228	1 pCi/L
Uranium	To be determined before the compliance date of the rule.

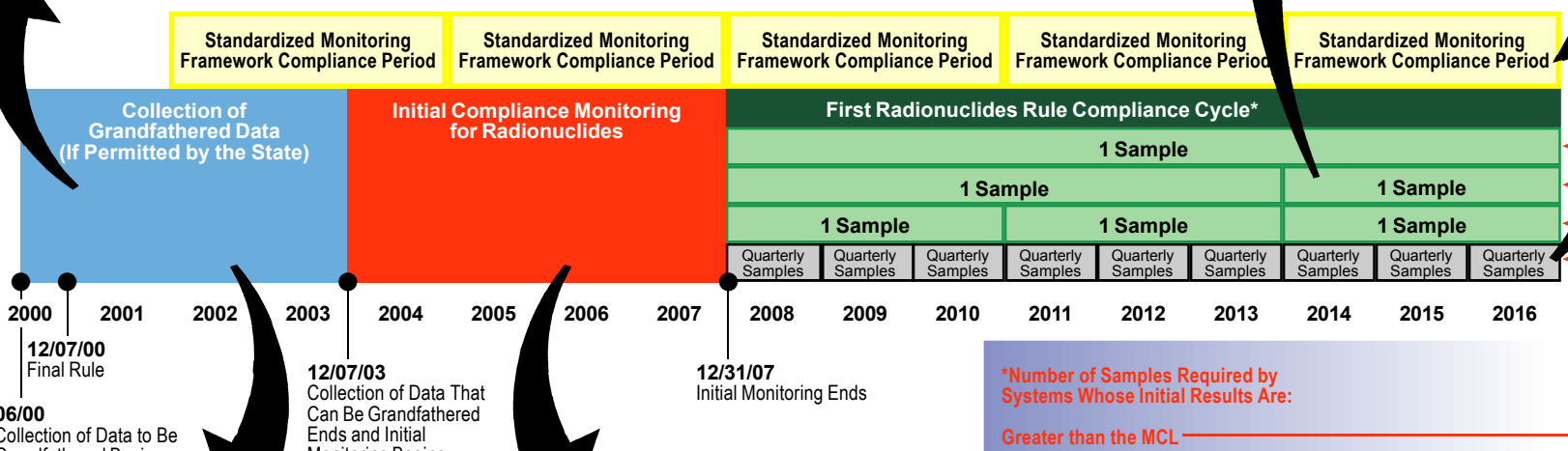
Annotated Radionuclide Montoring Timeline (2000 - 2016)

Grandfathered Data. Your State may allow you to use grandfathered data to comply with the initial monitoring requirements for gross alpha or radium-226/228 if you collect monitoring data from each EPTDS between June 2000 and December 8, 2003.

You may also be allowed to use data collected from a representative point in the distribution system if it is collected between June 2000 and December 8, 2003 and the State makes a written finding that the data is representative of each entry point based on the variability of historical contaminant monitoring results and other factors.

Reduced Monitoring. If your monitoring results range from below the defined detection level to the MCL, you may qualify for reduced monitoring.

Increased Monitoring. If you have an entry point result above the MCL, you will have to take quarterly samples until 4 consecutive quarterly samples are below the MCL.



*Number of Samples Required by Systems Whose Initial Results Are:

Greater than the MCL

Greater than 1/2 the MCL, but less than or equal to the MCL

Greater than or equal to the defined detection limit, but less than or equal to 1/2 the MCL

Below the defined detection limit

You are encouraged to monitor for uranium before December 8, 2003, although the standard does not go into effect until then. If the sampling result is less than 30 µg/L, you may be able to grandfather the data. If the result of your uranium sampling prior to December 8, 2003 is greater than 30 µg/L, you will be required to take four consecutive quarterly samples during the initial monitoring period.

Initial Monitoring. Systems are required to conduct initial monitoring for gross alpha, radium-226, radium-228, and uranium at each EPTDS by December 31, 2007. You must collect four consecutive quarterly samples at each EPTDS during this initial round of monitoring in order to provide contaminant information during each of the four seasons.

6. What Are My Monitoring Requirements under the New Radionuclides Rule?

This section presents additional information on the initial, reduced, and increased monitoring requirements for gross alpha, radium-226, radium-228, and uranium. The Radionuclides Rule makes the monitoring requirements for radionuclides consistent with the monitoring requirements for other inorganic contaminants (IOCs).

Initial Monitoring Requirement for Gross Alpha, Radium-226/228, and Uranium

Systems are required to conduct initial monitoring for gross alpha, radium-226, radium-228, and uranium at each EPTDS by December 31, 2007. You must collect four consecutive quarterly samples at each EPTDS during this initial round of monitoring in order to provide contaminant information during each of the four seasons.

What if I am developing a new system, or I develop a new water source?

New systems, and systems using new sources of supply, must conduct initial monitoring for gross alpha, radium-226, radium-228, and uranium starting in the first quarter after beginning operation or beginning to use a new source of supply. Your initial results, called an "occurrence profile," will determine the frequency of future monitoring.

Reduced Monitoring for Gross Alpha, Combined Radium-226/228, and Uranium

You may be able to reduce the frequency of monitoring at each EPTDS based on the initial sample results. The table which follows shows the reduced monitoring frequencies.

Reduced Monitoring for Radionuclides

If the initial monitoring results are:		Monitoring frequency is reduced to:
< Defined Detection limit	→	1 sample every 9 years
$ Defined Detection limit, but # 1/2 the MCL	→	1 sample every 6 years
> 1/2 the MCL, but # the MCL	→	1 sample every 3 years
> MCL	→	Quarterly samples

In addition to allowing a reduction in the number of times samples must be taken, the Radionculides Rule also provides some flexibility in reducing the cost of monitoring through the compositing of samples. Some States may allow you to collect up to four samples from the same EPTDS and have them analyzed together. Compositing of quarterly samples can be performed only during the initial monitoring period. Afterwards, monitoring is one sample every 3, 6, or 9 years. Quarterly sampling is necessary only if one quarter is above the MCL for an EPTDs.

Increased Monitoring for Gross Alpha, Radium-226/228, and Uranium

Systems whose EPTDSs are on a reduced monitoring schedule (i.e., collecting 1 sample every 3, 6, or 9 years) can remain on that reduced schedule as long as the most recent sample results support that monitoring schedule. An increase in a radionuclide level at an EPTDS may increase the frequency of monitoring for that radionuclide at that sampling point. If you get an entry point result above the MCL while on reduced monitoring, you must begin to take quarterly samples in the

next quarter. Quarterly sampling must continue until four consecutive quarterly samples are below the MCL.

Substituting Gross Alpha for Radium-226 or Uranium

In some cases, the gross alpha particle activity measurement may be substituted for the required radium-226 or uranium measurements. These rules are complex, but generally, gross alpha is allowed as a substitute for radium-226 if previous gross alpha results including the analytical error are less than or equal to 5pCi/L. It is allowed as a substitute for uranium if the gross alpha result is less than or equal to 15 pCi/L. If a uranium determination is made by a method measuring radioactivity, a conversion can be made to mass (the units of the MCL) without paying for another analysis. Simply divide the result in picoCuries by 0.67. That will give you a conservatively high mass number in micrograms. If you are below the MCL, you do not need further analysis. If you find you exceed 30 µg/L you should have the laboratory analyze the mass by a direct method for mass. The result will be lower. Contact your State drinking water program for more information, or see ***The Radionuclides Implementation Guidance* on EPA's Web site (www.epa.gov/safewater/rads/implement.html).**

Grandfathered Data

The Radionuclides Rule balances the need to ensure that the levels of regulated radionuclides are at or below the MCL at each EPTDS with the recognition that some systems have monitored for certain radionuclides for years. The Rule gives States the flexibility to decide, on a case-by-case basis, whether to approve the use of grandfathered data and on the number of samples a system has to take to prove that radionuclide activity will remain below the MCLs.

You may be allowed to grandfather data instead of taking four consecutive quarterly samples during the initial monitoring period. Your State may allow you to grandfather data for gross alpha, radium-226/228, and uranium if any of three conditions are met:

- A system with one EPTDS collects monitoring data at that EPTDS between June 2000 and December 8, 2003.
- A system with more than one EPTDS collects samples at each EPTDS between June 2000 and December 8, 2003.
- A system collects data from a representative point in the distribution system between June 2000 and December 8, 2003 and the State makes a written finding that the data are representative of each entry point.

EPA is encouraging systems to monitor for uranium before December 8, 2003 even though the standard does not go into effect until then. If the sampling results are less than 30 µg/L, the State may allow these data to be grandfathered, potentially saving the system from conducting additional monitoring.

If the levels of uranium exceed 30 µg/L, the system will be required to take four consecutive quarterly samples during the initial monitoring period. However, knowing early that your system has high levels of uranium gives you time to review your compliance options and choose the one that's best for your system. Your options may include developing a new source of drinking water, blending two or more sources of water, purchasing water from another public water supply, or installing a treatment plant. These options are discussed in more detail in the following sections.

7. What Are the Requirements for Man-Made Beta Particle and Photon Emitters?

Most systems will never need to monitor for beta particle and photon radioactivity. These emitters generally come from nuclear facilities; commercial nuclear power plants; institutional sources such as research facilities, hospitals, and universities; and from industrial sources such as laboratories and pharmaceutical companies. Unless your system is vulnerable to this type of contamination, or is already contaminated by beta and photon emitters, you do not have to monitor for these contaminants. Your State will determine whether your system is vulnerable to contamination or already contaminated.

In general, the regulations for beta particle and photon radioactivity are similar to those for other radionuclides, with some important exceptions, which are outlined below. Contact your State drinking water program if you are unsure if you need to monitor for beta particle and photon radioactivity.

What Is the MCL?

The MCL for beta particle and photon radioactivity did not change in the revised rule from the current level of 4 millirem per year (mrem/year). A millirem is a ***dose of energy*** to the body. EPA regulates 179 man-made nuclides, and each of them has a *concentration* of radiation (measured in picoCuries per liter [pCi/L]) which produces the 4 millirem (mrem) dose. These concentrations are listed on a conversion table that the State will use to determine if you are in compliance.

Each nuclide has a different concentration that produces a 4 mrem dose because different radionuclides have different energy levels. Some nuclides need to be in a higher concentration to give the same 4 mrem dose.

The laboratory will measure the nuclide concentration in the water, and the State will compare this result to the concentration allowed for that particular nuclide (see table on page 13). The comparison results in a *fraction*. This is shown in the calculation below.

$$\frac{\text{pCi/L found in sample (from laboratory results)}}{\text{pCi/L equivalent from 4 mrem of exposure (from conversion table)}} = \text{fraction of the maximum 4 mrem/yr exposure limit}$$

If your water contains several man-made radionuclides, the State will add all the fractions together. If the result is >1, your system exceeds the 4 mrem MCL. Your system must monitor monthly until a rolling average of 3 months is below the MCL.

What Are the Monitoring Requirements?

There are three types of systems when it comes to monitoring for beta particle and photon emitters:

- Those that are not vulnerable to man-made radionuclides (these systems are not required to monitor for beta and photon emitters).

- Those that are vulnerable.
- Those that already are contaminated.

If your State says you are ***vulnerable*** to contamination from man-made radionuclides, you must take quarterly samples for gross beta emitters and annual samples for tritium and strontium-90 at each entry point to the distribution system.. If the running annual average (minus potassium-40) is less than or equal to 50 pCi/L, the State may reduce your monitoring to once every 3 years. Systems in the vicinity of a nuclear facility may be allowed to use the facility's own surveillance data.

Systems determined to be using waters that ***are contaminated*** by effluents from nuclear facilities must analyze monthly samples or composite three monthly samples each quarter for gross beta activity, analyze a composite of five consecutive daily samples each quarter for iodine-131, and analyze four quarterly samples or composite four consecutive quarterly samples for strontium-90 and tritium.

If your State determines that you are vulnerable to contamination, or already contaminated, the initial monitoring period takes place between 2004 and 2007. Your monitoring requirements after this time will vary depending on your results.

How Can I Tell If My System Is in Violation?

Determining if your system is in violation requires two steps. First, if your system is vulnerable to contamination and the results of testing for all beta and photon emitters is less than or equal to 50 pCi/L, you are in compliance. If your results are greater than 50 pCi/L, you must have the samples further analyzed for the *individual* nuclides. The results of the more specialized analysis are compared to the concentration limits as explained above.

If you are using waters that are contaminated, the State calculates compliance as described above. If the sum of the fractions is less than 1, your system is in compliance.

Can I get a waiver?

States cannot issue waivers to those systems that are vulnerable to contamination or already contaminated with beta particle and photon radioactivity.

What if I have a new system or source?

State requirements differ on sampling for beta particle and photon radioactivity. Contact your State drinking water program for more information.

Derived Concentrations (pCi/l) of Beta and Photon Emitters in Drinking Water

Yielding a Dose of 4 mrem/yr to the Total Body or to any Critical Organ as defined in NBS Handbook 69

Nuclide	pCi/l	Nuclide	pCi/l	Nuclide	pCi/l	Nuclide	pCi/l	Nuclide	pCi/l	Nuclide	pCi/l
H-3	20,000	Ni-65	300	Nb-95	300	Sb-124	60	Nd-147	200	Os-191	600
Be-7	6,000	Cu-64	900	Nb-97	3,000	Sb-125	300	Nd-149	900	Os-191m	9,000
C-14	2,000	Zn-65	300	Mo-99	600	Te-125m	600	Pm-147	600	Os-193	200
F-18	2,000	Zn-69	6,000	Tc-96	300	Te-127	900	Pm-149	100	Ir-190	600
Na-22	400	Zn-69m	200	Tc-96m	30,000	Te-127m	200	Sm-151	1,000	Ir-192	100
Na-24	600	Ga-72	100	Tc-97	6,000	Te-129	2,000	Sm-153	200	Ir-194	90
Si-31	3,000	Ge-71	6,000	Tc-97m	1,000	Te-129m	90	Eu-152	200	Pt-191	300
P-32	30	As-73	1,000	Tc-99	900	Te-131m	200	Eu-154	60	Pt-193	3,000
S-35 inorg	500	As-74	100	Tc-99m	20,000	Te-132	90	Eu-155	600	Pt-193m	3,000
Cl-36	700	As-76	60	Ru-97	1,000	I-126	3	Gd-153	600	Pt-197	300
Cl-38	1,000	As-77	200	Ru-103	200	I-129	1	Gd-159	200	Pt-197m	3,000
K-42	900	Se-75	900	Ru-105	200	I-131	3	Tb-160	100	Au-196	600
Ca-45	10	Br-82	100	Ru-106	30	I-132	90	Dy-165	1,000	Au-198	100
Ca-47	80	Rb-86	600	Rh-103m	30,000	I-133	10	Dy-166	100	Au-199	600
Sc-46	100	Rb-87	300	Rh-105	300	I-134	100	Ho-166	90	Hg-197	900
Sc-47	300	Sr-85 m	20,000	Pd-103	900	I-135	30	Er-169	300	Hg-197m	600
Sc-48	80	Sr-85	900	Pd-109	300	Cs-131	20,000	Er-171	300	Hg-203	60
V-48	90	Sr-89	20	Ag-105	300	Cs-134	80	Tm-170	100	Tl-200	1,000
Cr-51	6,000	Sr-90	8	Ag-110m	90	Cs-134m	20,000	Tm-171	1,000	Tl-201	900
Mn-52	90	Sr-91	200	Ag-111	100	Cs-135	900	Yb-175	300	Tl-202	300
Mn-54	300	Sr-92	200	Cd-109	600	Cs-136	800	Lu-177	300	Tl-204	300
Mn-56	300	Y-90	60	Cd-115	90	Cs-137	200	Hf-181	200	Pb-203	1,000
Fe-55	2,000	Y-91	90	Cd-115m	90	Ba-131	600	Ta-182	100	Bi-206	100
Fe-59	200	Y-91m	9,000	In-113m	3,000	Ba-140	90	W-181	1,000	Bi-207	200
Co-57	1,000	Y-92	200	In-114m	60	La-140	60	W-185	300	Pa-230	600
Co-58	300	Y-93	90	In-115	300	Ce-141	300	W-187	200	Pa-233	300
Co-58m	9000	Zr-93	2,000	In-115m	1,000	Ce-143	100	Re-186	300	Np-239	300
Co-60	100	Zr-95	200	Sn-113	300	Ce-144	30	Re-187	9,000	Pu-241	300
Ni-59	300	Zr-97	60	Sn-125	60	Pr-142	90	Re-188	200	Bk-249	2,000
Ni-63	50	Nb-93m	1,000	Sb-122	90	Pr-143	100	Os-185	200		

8. How Can I Tell If I Am in Violation of the Radionuclides MCL?

- If the running annual average of one year of quarterly samples at an EPTDS is greater than a radionuclides MCL, then your system is in violation.
  - If the running annual average of one year of quarterly samples is less than a radionuclides MCL, then your system is NOT in violation.
- If any single sampling result is four times the MCL, then your system is in violation.
- If any sampling result causes the running annual average at an EPTDS to be above an MCL, then your system is in violation.
  - Remember that if you sample once every 3, 6,or 9 years and an EPTDS has a result above an MCL, this may not be an MCL violation. Having a result greater than a radionuclide MCL will put you on an increased monitoring schedule where you will have to collect quarterly samples. If the running annual average of one year of quarterly samples is greater than a radionuclides MCL, then you are in violation.

How Many Samples Will Be Used to Determine If I Am in Compliance?

The State will use the results from ALL of the samples, even if you have taken more. If your State allows you to take more than the required number of samples, all of them will be averaged to determine compliance.

If you don't collect all of the required samples, you have committed a monitoring and reporting violation. The State will take the average of the samples you collected to determine if you have also committed an MCL violation.

9. What Do I Have to Tell My Customers?

Letting your customers know what is happening with their water is one of your responsibilities. Informed customers are more likely to understand the need for new treatment, infrastructure changes, and rate increases. While you should try to communicate with your customers regularly, there are three occasions when you must provide information:

1. If you have an MCL violation.
   - You must let your customers know within 30 days.
   - You can send a mailing to all people served by the system (includes all billed and non-billed customers), publish the information in a local newspaper, post the notice in public places or on the Internet, or deliver it through community organizations.
2. If you fail to take a required sample or the State finds you in violation of other monitoring or testing requirements.
   - You can send out one notice every year for all of these violations.
   - If you can coordinate the timing, the notice may be included in your annual Consumer Confidence Report (CCR) (see explanation below).
3. On July 1 of every year, when you must deliver a CCR to your customers.
   - The CCR is a “snapshot” of the quality of the water over the past year.
   - The CCR Rule requires you to tell your customers about any violations, the actions you took to fix the violations, and any potential health effects from the violations.
   - If you violate a radionuclides MCL you must include in your CCR the specific health-effects language in the table on the next page.

Contaminant	Source	Health Effects
Alpha Emitters	Erosion of natural deposits	Certain minerals are radioactive and may emit a form of radiation known as alpha radiation. Some people who drink water containing alpha emitters in excess of the MCL over many years may have an increased risk of getting cancer.
Combined radium-226 and radium-228	Erosion of natural deposits	Some people who drink water containing radium-226 or 228 in excess of the MCL over many years may have an increased risk of getting cancer.
Uranium	Erosion of natural deposits	Some people who drink water containing uranium in excess of the MCL over many years may have an increased risk of getting cancer and kidney toxicity.
Beta and Photon Emitters*	Erosion of natural deposits*	Certain minerals are radioactive any may emit forms of radiation known as photons and beta radiation. Some people who drink water containing beta particle and photon radioactivity in excess of the MCL over many years may have an increased risk of getting cancer.*

*EPA recognizes that there is an error in the Rule's language as relates to the beta and photon emitters CCR language, which appears verbatim in the table above. The beta and photon emitters that EPA regulates are all man made, and the sources of these regulated contaminants are their improper use, storage, discharge, and disposal from commercial, industrial, and military activities. The health effects language refers to minerals that are radioactive. The Rule, however, applies only to man-made substances that do not occur in mineral form.

10. What Do I Have to Report to the State?

The Radionuclides Rule follows the same reporting requirements as other drinking water regulations in terms of what you must report to your State.

- **Analytical Results.** You have to report the entire analytical result, including the standard deviation. Remember that you can't round your results. Though the requirements may differ slightly from one State to another, generally you need to report your results no more than 10 days after you get the results from the lab, or no more than 10 days following the end of a monitoring period, whichever is shorter. You do not have to report results or MCL violations to your State if your laboratory already does this for you. Contact your laboratory if you are unsure of its practices.

- **Violations.** Anytime you exceed an MCL or fail to fulfill a monitoring requirement, you have to report the violation **to the State within 48 hours**. This notification is in addition to any public notices you are required to send to your customers.

- **Public Notice.** Anytime you send out a public notice, you also need to send a copy to the State. You also have to send a letter certifying that you have met all the public notification requirements. Both a copy of the notice and the certification letter are due **to the State within 10 days** of sending out the public notice.

11. What Compliance Options Do I Have?

There are several ways that small systems with high levels of radionuclides can protect their customers, including:

- Source Water Changes
- Water Blending
- Consolidation
- Treatment

Source Water Changes

Water systems located in areas with high levels of man-made or naturally occurring radionuclides need to be very careful about what water sources they choose to use. If you find that the radionuclide levels in an existing water source are too high, you may wish to abandon this source and develop a new one. While developing a new source can prove quite expensive, in the long run, a source change may be the most cost-effective way to produce water that has low levels of radionuclides. Yet, new sources come with their own challenges, and systems must remember that new sources, while lower in radionuclide levels, may contain higher levels of other contaminants that require treatment.

Water Blending

Systems may also consider blending water from a source that has high levels of radionuclides with water from a source with low levels of radionuclides. Adding additional source water may help reduce the level of contamination below the MCL and help you meet the requirements of the Radionuclides Rule.

Consolidation

Small water systems face the technical problems of larger systems but often lack larger systems' financial reserves. Treatment technologies and strategies that are effective on a large scale may be much too expensive for a small water system. Working with other water systems may allow you to lower costs and simplify management while continuing to provide your customers with safe water. You may consolidate with another established water system that has a history of safe water and then purchase water from the system or interconnect and function as a single, larger system. Another option may include consolidating management, which involves sharing operators and technical staff. Sharing management could also include bulk purchasing agreements and the joint use of materials, supplies, or non-essential equipment.

Treatment

Treatment to lower levels of radionuclides in your drinking water will be necessary if your source water contains radionuclides in excess of an MCL and developing an alternative source, blending, or consolidation are not feasible. Small systems can use several types of treatment technologies to reduce the amount of radionuclides in their water. Section 11 has more information on treatment.

12. How Can I Treat My System's Water to Meet the MCL?

Treatment to lower the levels of radionuclides in your drinking water will be necessary if your source water contains high levels of radionuclides and an alternative source is not available or switching sources would be cost prohibitive. Small systems can use several types of treatment technologies to lower the amount of radionuclides in their water.

EPA has approved the following best available technologies (BATs) and small system compliance technologies (SSCTs) for removing radionuclides from water:

- Ion Exchange (BAT, SSCT)
- Reverse Osmosis (BAT, SSCT)
- Lime Softening (BAT, SSCT)
- Enhanced Coagulation/Filtration (BAT, SSCT)
- Green Sand Filtration (SSCT)
- Co-precipitation with Barium Sulfate (SSCT)
- Electrodialysis/Electrodialysis Reversal (SSCT)
- Pre-formed Hydrous Manganese Oxide Filtration (SSCT)
- Activated Alumina (SSCT)

EPA has also approved the use of two point-of-use (POU) devices: POU ion exchange and POU reverse osmosis. POU units treat water only at a particular tap or faucet. For some small systems, POU treatment strategies may be cheaper than central treatment technologies. Because the treatment units will be located at many different locations, however, there may be higher administrative and monitoring costs. (For example, you may have to take samples from each unit, rather than from a single, central location.) Also, regeneration solution from POU ion exchange contains high contaminant concentrations, which may cause waste disposal problems. If you choose to install POU devices in your community, you should work with your State to develop a program for long-term operation, maintenance, and monitoring to make sure the units are operating correctly.

The list on the next page provides more information on the SSCTs, including required operator skill level, raw water quality considerations, and which technologies are appropriate for different sizes of systems.

Technology Considerations

When choosing a technology, remember:

- ✔ The Radionuclides Rule is but one regulation among many. Select a technology that can remove whatever contaminants your system has, at the most affordable cost.
- ✔ Your operator may need additional training.
- ✔ The chosen technology may have waste disposal issues. See Section 13 for more information on handling waste.

List of Small System Compliance Technologies for Radionuclides and Limitations of Use

Unit Technologies	Limitations*	Operator Skill Level Required	Raw Water Quality and Range Considerations	Compliance Technologies Appropriate for System Size**		
				25-500	501 - 3,300	3,301 - 10,000
Ion Exchange (IE)	a	Intermediate	All ground waters	C, B, U	C, B, U	C, B, U
Point of Use (POU) IE	b	Basic	All ground waters	C, B, U	C, B, U	C, B, U
Reverse Osmosis (RO)	c	Advanced	Surface waters that usually require pre-filtration	C, G, B	C, G, B, U	C, G, B, U
POU RO	b	Basic	Surface waters that usually require pre-filtration	C, G, B, U	C, G, B, U	C, G, B, U
Lime Softening	d	Advanced	All waters	C	C, U	C, U
Green Sand Filtration	e	Basic		C	C	C
Co-precipitation with Barium Sulfate	f	Intermediate to Advanced	Ground waters with suitable water quality	C	C	C
Electrodialysis/Electrodialysis Reversal	N/A	Basic to Intermediate	All ground waters	C	C	C
Re-formed Hydrous Manganese Oxide Filtration	g	Intermediate	All ground waters	C	C	C
Activated Alumina	a, h	Advanced	All ground waters; competing anion concentrations may affect regeneration frequency	U	U	U
Enhanced Coagulation/filtration	i	Advanced	Can treat a wide range of water qualities	U	U	U

***Footnotes**:

a. Disposal options should be carefully considered before choosing this technology.
b. Requires careful long-term operations, maintenance, and monitoring plans to ensure proper performance.
c. Reject water disposal options should be carefully considered before choosing this technology.
d. Variable source water quality and complex water chemistry make this technology too complex for small water systems.
e. Removal efficiencies can vary depending on water quality.
f. This technology is most applicable to systems that have sufficiently high sulfate levels and that already have filtration in place.
g. This technology is most applicable to small systems that already have filtration in place.
h. Handling of chemicals required during regeneration and pH adjustment requires an adequately trained operator.
i. Assumes modication to a coagulation/filtration process already in place.

****Key:**

B = Beta partical activity and photon activity

C = Combined radium-226 and radium-228

G = Gross alpha particle activity

U = Uranium

13. What Do I Do with Water Treatment Waste?

EPA is updating its guidelines that describe the safe handling and disposal of liquid wastes, sludges, and spent resins from treatment technologies such as those presented in Section 12. However, most of the requirements for dealing with technically enhanced naturally occurring radioactive material (TNORM) are not included within federal regulations. There may be State and local requirements, or requirements of the landfill or sewage treatment plant.

The EPA guidelines will provide you with:

- Background information on water treatment technologies and the kinds of wastes they generate.
- Reasons why it is important to protect people from radiation, including information about federal programs and other regulations dealing with radioactive waste.
- Guidelines for several ways to dispose of solid and liquid wastes that contain radionuclides.
- Ways to protect workers who may be exposed to water-treatment wastes that contain radiation.

When complete, the guidelines will be posted on EPA's Web site.

14. How Can I Get More Time to Finance, Plan, Build, or Consolidate?

The Radionuclides Rule provides States with the flexibility to alter certain requirements on a case-by-case basis, in response to extraordinary local circumstances. Granting variances and exemptions are two ways States can exercise their flexibility. Since a system with a variance or exemption will be supplying water with levels of radionuclides above the MCLs, variances and exemptions are difficult to obtain.

Variances

If you install a Best Available Technology (BAT) or a Small System Compliance Technology (SSCT) and still cannot meet the MCL requirements because of the quality of your raw water, you may be eligible for a variance. A variance gives you more time to come into compliance, but requires you to:

- Enter into a compliance schedule with your State's regulatory agency.
- Deliver water that does not result in an unreasonable risk to health.

Exemptions

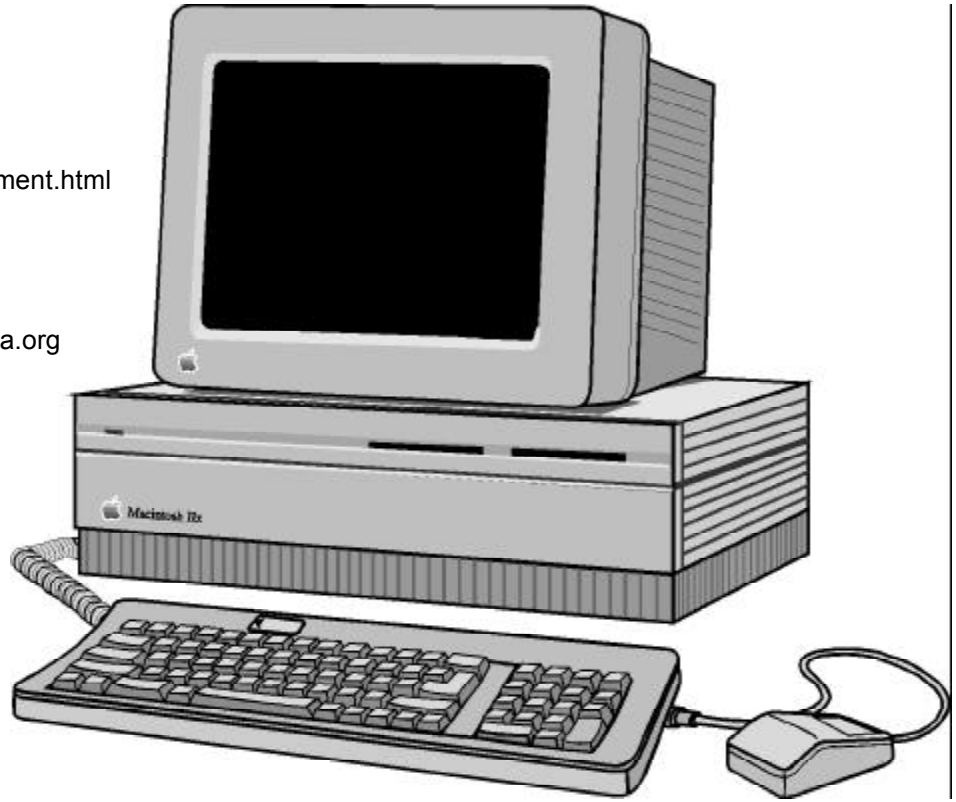
An exemption means you don't have to comply with an MCL for 3 to 9 years. The Safe Drinking Water Act prohibits States from issuing exemptions for rules in effect before 1986. Because the MCLs for gross alpha, radium 226/228, and total beta particle and photon emitters were put into effect by the 1976 Rule, you cannot get an exemption for these contaminants.

If you are operating before the effective date of the rule (December 8, 2003) and are unable to comply with the MCL, you may be eligible for an exemption. Your State may issue an exemption after determining that there are no alternative sources of supply, that changing the structure of your system won't lead to compliance, and the exemption will not result in an unreasonable risk to public health. If you begin operating after December 8, 2003, you are not eligible for an exemption.

15. Where Can I Get More Information?

Additional information is available from:

- EPA Safe Drinking Water Hotline: (800) 426-4791
- EPA Safewater Web site:
  - EPA has posted the text of the Radionuclides Rule, the Radionuclides Implementation Guidance, a fact sheet, quick reference guide, and other information about the Radionuclides Rule
    - Text: www.epa.gov/safewater/rads/radfr.html.
    - Guidance, etc.: http://www.epa.gov/safewater/rads/implement.html
- American Water Works Association: www.awwa.org
- Association of State Drinking Water Administrators: www.asdwa.org
- National Ground Water Association: www.ngwa.org
- National Rural Water Association: www.nrwa.org



16. Who Can I Contact for More Information?

EPA REGION 1	www.epa.gov/region1/	(617) 565-3543
Connecticut		
Department of PublIc Health: Water Supplies Section	www.state.ct.us/dph/	(860) 509-7333
Maine		
Maine Department of Human Services: Division of Health Engineering	http://janus.state.me.us/dhs/eng/water/index.htm	(207) 287-2070
Massachusetts		
Department of Environmental Protection: Drinking Water Program	www.state.ma.us/dep/brp/dws/dwshome.htm	(617) 292-5770
New Hampshire		
Department of Environmental Services: Water Supply Engineering Bureau	www.des.state.nh.us/wseb/	(603) 271-3139
Rhode Island		
Department of Health: Office of Drinking Water Quality	www.health.state.ri.us/environment/dwq.htm	(401) 222-6867
Vermont		
Department of Environmental Conservation: Water Supply Division	www.anr.state.vt.us/dec/watersup/wsd.htm	(802) 241-3400

EPA REGION 2	www.epa.gov/region02/water/	(212) 637-3846
New Jersey		
Department of Environmental Protection: Bureau of Safe Drinking Water	www.state.nj.us/dep/watersupply/	(609) 292-5550
New York		
Department of Health: Bureau of Public Water Supply Protection	www.health.state.ny.us/nysdoh/water/main.htm	(518) 402-7650

Puerto Rico		
Department of Health: Public Water Supply Supervision Program	www.epa.gov/region02/cepd/compnum.htm#JCA	(787) 754-6010
Virgin Islands		
Department of Planning & Natural Resources: Division of Environmental Protection		(340) 774-3320

EPA REGION 3	www.epa.gov/region03/	(215) 814-3201
Delaware		
Delaware Health & Social Services: Division of Public Health	www.state.de.us/dhss/dph/hsp.htm	(302) 739-5410
District of Columbia		
Environmental Health Administration: Water Resources Management Division	www.dchealth.com/eha/welcome.htm	(202) 645-6601
Maryland		
Department of the Environment: Public Drinking Water Program	www.mde.state.md.us/	(410) 631-3702
Pennsylvania		
Department of Environmental Protection: Bureau of Water Supply Management	www.dep.state.pa.us/dep/deputate/watermgt/wsm/wsm.htm	(717) 787-9037
Virginia		
Department of Health: Division of Water Supply Engineering	www.vdh.state.va.us/dwse/index.htm	(804) 786-1767
West Virginia		
Bureau for Public Health: Environmental Engineering Division	www.wvdhhr.org/bph/enviro.htm	(304) 558-2981

EPA REGION 4	www.epa.gov/region4/	(404) 562-9442
Alabama		
Department of Environmental Management: Water Supply Branch	www.adem.state.al.us/EnviroProtect/Water/water.htm	(334) 271-7773
Florida		
Department of Environmental Protection: Drinking Water Section	www8.myflorida.com/environment/learn/waterprograms/drinkingwater/index.html	(850) 487-1762
Georgia		
Department of Natural Resources: Water Resources Branch	www.ganet.org/dnr/environ/	(404) 656-5660
Kentucky		
Department for Environmental Protection: Drinking Water Branch	http://water.nr.state.ky.us/dw/	(502) 564-3410
Mississippi		
Department of Health: Division of Water Supply	www.msdh.state.ms.us/watersupply/index.htm	(601) 576-7518
North Carolina		
Department of Environment and Natural Resources: Public Water Supply Section	www.deh.enr.state.nc.us/pws/index.htm	(919) 733-2321
South Carolina		
Department of Health & Environmental Control: Bureau of Water	www.scdhec.net/water/html/dwater.html	(803) 734-5300
Tennessee		
Department of Environment & Conservation: Division of Water Supply	www.state.tn.us/environment/dws/index.html	(615) 532-0191

EPA REGION 5	www.epa.gov/region5/	(312) 886-4239
Illinois		
Environmental Protection Agency: Division of Public Water Supplies	www.epa.state.il.us/water/	(217) 785-8653
Indiana		
Department of Environmental Management: Drinking Water Branch	www.state.in.us/idem/owm/dwb/index.html	(317) 308-3281
Michigan		
Department of Environmental Quality: Drinking Water & Radiological Protection Division	www.deq.state.mi.us/dwr/	(517) 335-9216
Minnesota		
Department of Health: Drinking Water Protection Section	www.health.state.mn.us/divs/eh/eh.html	(612) 215-0770
Ohio		
Environmental Protection Agency: Division of Drinking & Ground Water	www.epa.state.oh.us/ddagw/	(614) 644-2769
Wisconsin		
Department of Natural Resources: Bureau of Water Supply	www.dnr.state.wi.us/org/water/dwg/	(608) 266-2299

EPA REGION 6	www.epa.gov/region6/	(214) 665-2757
Arkansas		
Department of Health: Division of Engineering	www.healthyarkansas.com/eng/index.html	(501) 661-2623
Louisiana		
Office of Public Health: Division of Environmental & Health Services	www.dhh.state.la.us/OPH/safewtr.htm	(225) 568-5100
New Mexico		
Environment Department: Drinking Water Bureau	www.nmenv.state.nm.us/field_op.html	(505) 827-7536

Oklahoma		
Department of Environmental Quality: Water Quality Division	www.deq.state.ok.us/water.html	(405) 702-5100
Texas		
Natural Resource Conservation Commission: Water Utilities Division	www.tnrcc.state.tx.us/water/wu/mon/	(512) 239-6096

EPA REGION 7	www.epa.gov/region7/	(913) 551-7903
Iowa		
Department of Natural Resources: Water Supply Section	www.state.ia.us/government/dnr/organiza/epd/wtrsuply/wtrsup.htm	(515) 281-8998
Kansas		
Department of Health & Environment: Public Water Supply Section	www.kdhe.state.ks.us/water/pwss.html	(785) 296-5514
Missouri		
Department of Natural Resources: Public Drinking Water Program	www.dnr.state.mo.us/deq/pdwp/homepdwp.htm	(573) 751-5331
Nebraska		
Department of HHS Regulation & Licensure	e-mail: anne.pamperl@hhss.ne.state.us	(402) 471-1009

EPA REGION 8	www.epa.gov/region8/	(303) 312-7021
Colorado		
Department of Public Health & Environment: Drinking Water Program	www.cdphe.state.co.us/wq/wqhom.asp	(303) 692-3500
Montana		
Department of Environmental Quality: Public Water Supply Section	www.deq.state.mt.us/pcd/csb/index.htm	(406) 444-4323
North Dakota		
Department of Health	www.ehs.health.state.nd.us/ndhd/environ/mf/index.htm	(701) 328-5211

South Dakota		
Department of Environment & Natural Resources: Drinking Water Program	www.state.sd.us/denr/des/drinking/dwprg.htm	(605) 773-3754
Utah		
Department of Environmental Quality: Division of Drinking Water	www.deq.state.ut.us/eqdw/	(801) 536-4200
Wyoming		
EPA Region 8: Wyoming Drinking Water Program	www.epa.gov/region08/water/	(303) 312-6312

EPA REGION 9	**www.epa.gov/region9/**	**(415) 744-1884**
Arizona		
Department of Environmental Quality: Drinking Water Monitoring & Assessment Section	www.adeq.state.az.us/environ/water/dw/index.html	(602) 207-4644
California		
Department of Health Services: Division of Drinking Water & Environmental Management	www.dhs.cahwnet.gov/org/ps/ddwem/	(916) 323-6111
Hawaii		
Department of Health: Environmental Management Division	www.hawaii.gov/health/eh/eiemdw00.htm	(808) 586-4258
Nevada		
Department of Human Resources: Bureau of Health Protection Services	www.state.nv.us/health/bhps/sdwp.htm	(775) 687-4750
American Samoa		
EPA Region 9: American Samoa		(684) 633-2304

Guam		
Guam Environmental Protection Agency: Safe Drinking Water Program	www.gepa.gov.gu/	(671) 475-1637
Northern Mariana Islands		
Northern Mariana Islands Division of Environmental Quality: Safe Drinking Water Branch		(670) 664-8500

EPA REGION 10	ww.epa.gov/region10/	(206) 553-1389
Alaska		
Department of Environmental Conservation: Drinking Water & Wastewater Program	www.state.ak.us/dec/deh/safewater.htm	(907) 269-7500
Idaho		
Department of Health and Welfare: Division of Environmental Quality	www2.state.id.us/deq/water/water1.htm	(208) 373-0502
Oregon		
Department of Human Resources: Drinking Water Program	www.ohd.hr.state.or.us/dwp/welcome.htm	(503) 731-4317
Washington		
Department of Health: Drinking Water Division	http://198.187.0.42/ehp/dw/	(800) 521-0323