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Basic Information about Radionuclides in Drinking Water | Basic Informat... <http://water.epa.gov/drink/contaminants/basicinformation/radionuclides.cfm>

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Basic Information about Radionuclides in Drinking Water

The United States Environmental Protection Agency (EPA) regulates radionuclides in drinking water to protect public health. Radionuclides may cause health problems if present in public or private water supplies in amounts greater than the drinking water standard set by EPA.

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What are radionuclides?

A radionuclide is an atom with an unstable nucleus which, to become more stable, emits energy in the form of rays or high speed particles. This is called ionizing radiation because it can create "ions" by displacing electrons in the body e.g. in the DNA, disrupting its function. The three major types of ionizing radiation are: alpha particles, beta particles and gamma rays.

Approximately 80% of our exposure to radioactivity is natural and another 20% is from man made sources, although more frequent use of diagnostic imaging involving radiation (x-rays, CT scans) is increasing exposure from this source. We are exposed to naturally occurring radiation for example from radon gas emanating from rocks and soil, and cosmic radiation from space. We also carry small amounts of potassium-40 in our bodies from the foods containing potassium. Depending on the type of rocks where you live, 55 to 70% of natural exposure comes from radon gas, while cosmic radiation (which is greater at higher altitude) represents about 11%, and potassium-40 about 5%. Radiation may exist in drinking water from nuclides dissolved in the water from natural sources in the earth or occasionally from releases from laboratories or nuclear power plants.¹

EPA regulates the following radionuclides in drinking water: (Adjusted) Gross Alpha Emitters, Beta Particle and Photon (gamma) Radioactivity, Radium 226 and Radium 228 (Combined) and Uranium.

Uses for radionuclides.

Radionuclides have properties which can be valuable in a number of applications. Some radioactive elements have uses in nuclear medicine for diagnosis treatment or research. Tracers such as iodine-131 (I-131) follow the uptake of an element such as iodine into the thyroid. Other radioisotopes such as bismuth-212 (an alpha particle emitter) are used to kill cancer cells. Others like technetium-99 highlight an area of the body so it can be seen more clearly during imaging. Nuclear reactors utilize the heat of radioactive decay of uranium (U-235) to produce steam which turns turbines to generate electric power. Americium-241 is used in smoke detectors, and cobalt-60 and cesium-137 are gamma (photon) sources used to kill pathogens and insects in food.

What are radionuclides' health effects?

Contaminant	Health Effect
Combined radium-226/-228	Some people who drink water containing radium 226 or radium 228 in excess of the MCL over many years may have an increased risk of getting cancer.
(Adjusted) Gross Alpha	Some people who drink water containing alpha emitters in excess of the MCL over many years may have an increased risk of getting cancer.
Beta Particle and Photon Radioactivity	Some people who drink water containing beta particles and photon emitters in excess of the MCL over many years may have an increased risk of getting cancer.
Uranium	Exposure to uranium in drinking water may result in toxic effects to the kidney. Some people who drink water containing alpha emitters, such as uranium, in excess of the MCL over many years may have an increased risk of getting cancer.

This health effects language is not intended to catalog all possible health effects for radionuclides. Rather, it is intended to inform consumers of the most significant and probable health effects, associated with radionuclides in drinking water.

What are EPA's drinking water regulations for radionuclides?

In 1974, Congress passed the Safe Drinking Water Act. This law requires EPA to determine the level of contaminants in drinking water at which no adverse health effects are likely to occur. These non-enforceable health goals, based solely on possible health risks and exposure over a lifetime with an adequate margin of safety, are called maximum contaminant level goals (MCLG). Contaminants are any physical, chemical, biological or radiological substances or matter in water.

EPA sets the enforceable regulation, called a maximum contaminant level (MCL), as close to the health goals (the MCLG) as possible, considering cost, benefits and the ability of public water systems to detect and remove contaminants using suitable treatment technologies.

The regulations for radionuclides are in the table below.

Radionuclides	MCLG	MCL
(Adjusted) Gross Alpha Emitters	Zero	15 picoCuries per liter

Radionuclides	MCLG	MCL
Beta Particle and Photon Radioactivity	Zero	4 millirems per year
Radium 226 and Radium 228 (Combined)	Zero	5 picoCuries per liter
Uranium	Zero	30 micrograms per liter

The National Primary Drinking Water Regulations for radionuclides became effective in 1977 and were last revised in 2000 to include uranium. The Safe Drinking Water Act requires EPA to periodically review the regulation for each contaminant and revise it, if appropriate. EPA will review the radionuclides regulation again in 2015 or sooner if important information becomes available.

- [More information on the Six Year Review of Drinking Water Standards.](#)

States may set more stringent drinking water MCLGs and MCLs for radionuclides than EPA.

How do radionuclides get into my drinking water?

Certain rock types have naturally occurring trace amounts of "mildly radioactive" elements (radioactive elements with very long half-lives) that serve as the "parent" of other radioactive contaminants ("daughter products"). These radioactive contaminants, depending on their chemical properties, may accumulate in drinking water sources at levels of concern. The "parent radionuclide" often behaves very differently from the new element, the "daughter radionuclide" in the environment.

A federal law called the Emergency Planning and Community Right to Know Act (EPCRA) requires facilities in certain industries, which manufacture, process, or use significant amounts of toxic chemicals, to report annually on their releases of these chemicals. For more information on the uses and releases of chemicals in your state, contact the: Community Right-to-Know Hotline: (800) 424-9346.

- [EPA's Toxics Release Inventory \(TRI\) Web site provides information about the types and amounts of toxic chemicals that are released each year to the air, water, and land.](#)

How will I know if radionuclides are in my drinking water?

When routine monitoring indicates that radionuclides levels are above the MCL, your water supplier must take steps to reduce the amount of radionuclides so that it is below that level. Water suppliers must notify their customers as soon as practical or within 30 days after a violation occurs. Additional actions, such as providing alternative drinking water supplies, may be required to decrease risks to public health.

- [See EPA's public notification requirements for public water systems.](#)

If your water comes from a household well, check with your health department or local water systems that use ground water for information on contaminants of concern in your area.

- [For more information on wells, go to EPA's Web site on private wells.](#)

How will radionuclides be removed from my drinking water?

The following treatment method(s) have proven to be effective in removing radionuclides at levels below their MCLs:

- Beta particle and Photon Radiation: ion exchange and reverse osmosis;
- (Gross) Alpha Emitters: reverse osmosis;
- Radium 226 and Radium 228 (Combined): ion exchange, reverse osmosis, lime softening;
- Uranium: Ion exchange, reverse osmosis, lime softening, coagulation/filtration.

How do I learn more about my drinking water?

EPA strongly encourages people to learn more about their drinking water, and to support local efforts to protect and upgrade the supply of safe drinking water. Your water bill or telephone book's government listings are a good starting point for local information.

Contact your water utility. EPA requires all community water systems to prepare and deliver an annual consumer confidence report (CCR) (sometimes called a water quality report) for their customers by July 1 of each year. If your water provider is not a community water system, or if you have a private water supply, request a copy from a nearby community water system.

- [The CCR summarizes information regarding sources used \(i.e., rivers, lakes, reservoirs, or aquifers\), detected contaminants, compliance and educational information.](#)
- [Some water suppliers have posted their annual reports on EPA's Web site.](#)

Other EPA Web sites

- Find an answer or ask a question about drinking water contaminants on [EPA's Question and Answer Web site](#) or call EPA's Safe Drinking Water Hotline at (800) 426-47911
- [Understanding Radiation](#)
- [Radionuclides in drinking water](#)
- [Technology Transfer Network, Radionuclides \(Including Radon, Radium and Radionuclides\)](#)
- [Radiation Protection: Uranium](#)

Other Federal Departments and Agencies

- [Agency for Toxic substances and Disease Registry, Radium ToxFAQs](#)

¹ [Radiation: Risks and Realities. Understanding Radiation in Your Life. Your World PDE](#) (16pp, 1M)

Last updated on Tuesday, March 06, 2012