Technical Fact Sheet: Final Rule for (Non-Radon) Radionuclides in Drinking Water

EPA 815-F-00-013 November 2000

1. What are we announcing?
EPA is promulgating the final drinking water standards for (non-radon) radionuclides in drinking water: combined radium-226/-228, (adjusted) gross alpha, beta particle and photon radioactivity, and uranium. This promulgation consists of revisions to the 1976 rule, as proposed in 1991.

2. What are the requirements of this final rule?
Community water systems (CWSs), which are water systems that serve at least 15 service connections or 25 residents regularly year round, are required to meet the final MCLs and to meet the requirements for monitoring and reporting.

Non-transient, non-community water systems (NTNCWSs) will not be regulated at this time. EPA will further consider this matter and may propose to regulate radionuclides at these systems in the future. NTNCWSs are public water systems that are not a CWS and serve at least 25 of the same people more than 6 months per year (e.g., schools and nursing homes).

The final rule requires that all new monitoring be conducted at each entry point to the distribution system under a schedule designed to be consistent with the Standardized Monitoring Framework.

3. How soon after publishing the final rule will the changes take effect?
The rule will become effective on December 8, 2003, three years after the publication date (December 7, 2000). New monitoring requirements will be phased-in between that date and the beginning of the next Standardized Monitoring Framework period, December 31, 2007. "Phased-in monitoring" refers to the fact that States will require some fraction of water systems to complete their initial monitoring requirements each year of the period between the effective date (December 8, 2003) and the beginning of the new cycle (December 31, 2007). Water systems will determine initial compliance under the new monitoring requirements using the average of four quarterly samples or, at state discretion, using appropriate grandfathered data. Compliance will be determined immediately based on the annual average of the quarterly samples for that fraction of systems required by the state to monitor in any given year or based on the results from the grandfathered data. Water systems with existing radionuclides monitoring data demonstrating that the system is out of compliance with new provisions will be out of compliance on the effective date of December 8, 2003. Water systems with existing data that demonstrates non-compliance with the current (1976) rule are currently in violation of the radionuclides National Primary Drinking Water Regulations.

4. Why is this rule significant?
This rule promulgates new monitoring provisions that will ensure that all customers of community water systems will receive water that meets the Maximum Contaminant Levels for

radionuclides in drinking water. Under the 1976 rule, water systems with multiple entry points to the distribution system were not required to test at every entry point, but rather to test at a "representative point to the distribution system." While the 1976 requirement did ensure that the "average customer" was protected, it did not ensure that all customers were protected. Under the new rule, all entry points will be tested and all CWS customers will be ensured of receiving water that meets the MCLs for radionuclides in drinking water. In addition, this requirement is more consistent with the monitoring requirements for other comparable drinking water contaminants.

This rule promulgates a new standard for uranium in drinking water, which will result in reduced uranium exposures for 620,000 persons. The uranium standard, which is required by the Safe Drinking Water Act, will protect drinking water customers from uranium levels that may cause toxic effects to the kidney and will reduce cancer risk. In addition, the new rule promulgates separate monitoring requirements for radium-228, which is expected to result in reduced exposure to 420,000 persons. This monitoring correction is based on sound science and is necessary for ensuring compliance with the combined radium-226/-228 standard.

5. What health effects are associated with exposure to radionuclides from drinking water?
Exposure to radionuclides from drinking water results in the increased risk of cancer. The radioactive particles (alpha, beta and gamma particles) emitted by radionuclides are called "ionizing radiation" because they ionize ("destabilize") nearby atoms as they travel through a cell or other material. In living tissue, this ionization process can damage chromosomes or other parts of the cell. This cellular damage can lead to the death of the cell or to unnatural reproduction of the cell. When a cell reproduces uncontrollably, it becomes a cancer. Certain elements accumulate in specific organs: radium (like calcium) accumulates in the bones and iodine accumulates in the thyroid.

For uranium, we must consider not only the carcinogenic health effects from its radioactive decay and the decay of its daughter products ("radiotoxicity"), but also damage to the kidneys from exposure to the uranium itself ("chemical toxicity"). Exposure to elevated uranium levels in drinking water has been shown to lead to changes in kidney function that are indicators of potential future kidney failure.

6. What are the sources of radionuclides in water?
Most drinking water sources have very low levels of radioactive contaminants "radionuclides"), levels low enough not to be considered a public health concern. Of the radionuclides that have been observed to occur in drinking water sources, most are naturally occurring. However, contamination of drinking water sources by anthropogenic ("human-made") nuclear materials also occurs. Naturally occurring radionuclides are found in the Earth's crust and are created in the upper atmosphere. For example, trace amounts of long-lived isotopes (e.g., uranium-238, which has a half-life of almost five billion years) have been present in earth's crust since the crust first formed. As these long-lived trace radionuclides decay, shorter-lived ("more radioactive") daughter products are formed. Of particular concern are naturally occurring uranium and the naturally occurring radium isotopes, radium-226 and radium-228, which have been observed to accumulate to levels of concern in drinking water sources.

Most of the naturally occurring radionuclides are alpha particle emitters (e.g., the uranium isotopes and radium-226), but naturally occurring beta particle emitters do occur (e.g., radium-228 and potassium-40). Certain rock types contain trace amounts of the radioactive isotopes of uranium, thorium, and/or actinium. As these parent rocks weather, the resulting clays and other aquifer-forming materials may become a source of naturally-occurring radionuclides to drinking water sources. Other naturally occurring radionuclides include tritium, a beta particle emitter, which forms in the upper atmosphere through interactions between cosmic rays (nuclear particles coming from outer space) and the gases comprising the atmosphere. Tritium can be deposited from the atmosphere onto surface waters via rain or snow and can accumulate in ground water via seepage. Tritium is also formed from human activities, as described below. Natural tritium tends not to occur at levels of concern, but contamination from human activities can result in relatively high levels.

The man-made radionuclides, which are primarily beta and photon emitters, are produced by any of a number activities that involve the use of concentrated radioactive materials. These radioactive materials are used in various ways in the production of electricity, nuclear weapons, nuclear medicines used in therapy and diagnosis, and various commercial products (such as televisions or smoke detectors), as well as in various academic and government research activities. Release of man-made radionuclides to the environment, which may include drinking water sources, are primarily the result of improper waste storage, leaks, or transportation accidents.

7. How many people and how many systems will be affected by this rule?

Higher levels of radionuclides tend to be found more in ground water sources than in surface water sources, like rivers and lakes. While most water systems do not have detectable radionuclide activities, there are some areas of the country that have levels significantly higher than the national average levels. For example, some areas of the midwest have elevated radium-226 levels and some western states have elevated uranium levels compared to the rest of the United States. Separate monitoring for radium is expected to result in roughly half of one percent of the nation's 54,000 CWSs needing to take measures to lower radium in their drinking water. The uranium standard is expected to result in slightly less than one percent of CWSs needing to take measures to reduce uranium in their drinking water. Table 1 below shows the estimated number of CWSs that would be affected by this rule and the estimated population served by these water systems.

Table 1. Estimates of the Community Water Systems That Would Need to Mitigate Contaminant Levels and the Population Served by These CWSs

Regulatory Action	Number of CWSs Affected	Total Population Served
Radium-228 Monitoring Correction	~ 300	~ 420 thousand
Uranium MCL of 30 µg/L	~ 500	~ 620 thousand

8. How much will this rule cost?

Over 96% of the cost of this final rule is expected to come from the mitigation of radionuclide levels through treatment, purchasing water, developing alternate water sources, and other

compliance measures. Table 2 below shows the total annualized costs of mitigation, monitoring, reporting, recordkeeping, and administration for this rule.

Table 2. Total National Annualized Costs of the Radionuclides Rule (Mitigation, monitoring, reporting, recordkeeping, and administration)

Regulatory Action	Annual Costs
Radium-228 Monitoring Correction, Mitigation Costs	~ $ 26 million
Uranium MCL of 30 µg/L, Mitigation Costs	~ $ 50 million
New Monitoring, Reporting, Recordingkeeping, and Administration Costs for all Radionuclides	~ $ 5 million

- For systems that need to take corrective action to comply with the new rule, the annual costs per system will range from $9,000 annually for the smallest community water systems to over $150,000 annually for systems serving 3,300 to 10,000, and over $500,000 annually for larger systems.
- For the small percentage of households that are served by water systems that will be required to take corrective actions because of this rule, it is estimated that households served by typical large water systems will experience increased water bills of less than $30 per year and that households served by typical small water systems (those serving 10,000 persons or fewer) will experience increased water bills of $50 - $100 per year. Costs will vary depending on the system size.

9. What are the benefits of this rule?

- The requirement for separate radium-228 monitoring is expected to result in the avoidance of 0.4 cancer cases per year, with estimated monetized health effects benefits of $ 2 million annually. Water mitigation for radium also tends to reduce iron and manganese levels and hardness, which also has significant associated benefits.
- The kidney toxicity benefits for the uranium standard can not be quantified because limitations in existing health effects models at levels near the MCL. In addition to these non-quantified kidney toxicity benefits, 0.8 cancer cases per year are expected to be avoided, with estimated monetized cancer health effects benefits of $ 3 million annually. Water mitigation for uranium also removes other contaminants, which has associated benefits.

10. Is there funding associated with this rule?

Since 1996, the Drinking Water State Revolving Loan Fund has made over $3.6 billion available for loans to help water systems improve their infrastructure. This program has now made over 1000 loans. EPA also provides funding to states that have primary enforcement responsibility for their drinking water programs through the Public Water Systems Supervision (PWSS) grants program. Other federal funds are available through Housing and Urban Development's

Community Development Block Grant Program, and the Rural Utilities Service of the U.S. Department of Agriculture.

11. How did EPA consult with stakeholders?
In 1997, EPA conducted a public meeting regarding the finalization of portions of the 1991 radionuclides proposal. This meeting was advertised in the *Federal Register*. During the meeting, we discussed a range of regulation development issues with the stakeholders, including the statutory requirements, court stipulated agreement, MCLs for each of the radionuclides, the current and proposed monitoring frameworks, and new scientific information regarding health effects, occurrence, analytical methods, and treatment technologies. The presentations generated useful discussion and provided us feedback regarding technical issues, stakeholder concerns and possible regulatory options. Participants in the stakeholder meeting included representatives from water utilities, environmental and citizens groups, State drinking water programs and health departments, other federal agencies, and other groups.

In addition, during the regulation development process, we gave presentations on the radionuclides regulation at various professional conferences, meetings between State programs and EPA Regions, the American Water Works Association's Technical Advisory Workgroup (TAW), and at Tribal meetings in Nevada, Alaska, and California. Finally, we held a one-day meeting with associations that represent State, county, and local government elected officials on May 30, 2000 and discussed five upcoming drinking water regulations, including radionuclides.

Stakeholders were also asked to comment on a variety of issues in the April 21, 2000 Notice of Data Availability. We utilized the feedback received from the stakeholders during all these meetings and comments from the NODA in developing the final radionuclides rule.

12. Where can the public get more information about the final radionuclides rule?
For general information on radionuclides in drinking water, contact the Safe Drinking Water Hotline, at (800) 426-4791, or visit the EPA Safewater web site at or the radionuclides web site.