United States Environmental Protection Agency

Steps to Selecting a Compliance Option for the Radionuclides Rule

Step 1 How Do I Get Started?

Your system has determined that it is out of compliance with a maximum contaminant level (MCL) for one or more radionuclides (e.g., radium 226/228, gross alpha, uranium, and beta particles and photon emitters). To identify a long-term compliance solution, you must understand the extent of the problem, including how much you need to reduce the level of radionuclides in treated water, which contaminants are of the greatest concern, and whether there are any seasonal fluctuations in radionuclide levels. You will need to review past sampling results, and possibly collect new water samples to get this information. You may also want to contact other water systems in your area that have successfully complied with the Radionuclides Rule[1] to learn from their experience. Your state drinking water program will be a good source of contacts. Many states will require that a professional engineer be involved if treatment changes are made or new treatment is installed. A professional engineer may be helpful in completing the compliance steps outlined in this brochure.

Key considerations include:

- In addition to working with your state drinking water program, you may need to coordinate with other state and local entities (e.g., radiation control program) and a professional engineer.
- If existing or new treatment is used to reduce levels of radionuclides, waste disposal and worker safety issues will need to be addressed.
- Permitting may be required for non-treatment solutions, treatment changes, and disposal of treatment residuals.
- The above issues will increase the amount of time that it takes to implement a compliance solution and achieve compliance.

Once you have assessed your compliance problem, the next steps are to evaluate your options and develop a plan.

Steps to Compliance

1. Conduct quarterly sampling for initial monitoring[2] or after routine result exceeds MCL
2. If running annual average of quarterly samples exceeds MCL, or one sample result causes MCL violation
3. Contact state to review options for compliance
4. Evaluate non-treatment and treatment options
5. Consider compliance costs and financing options

[1] The Radionuclides Rule applies to all community water systems. Go to http://www.epa.gov/safewater/radionuclides for more detailed information.
[2] Or use historical quarterly sampling data where allowed by the state.

Step 2 What Are My Non-Treatment Options?

While installing new treatment is an important option to consider, the following non-treatment approaches may be simpler, more economical compliance solutions in the long-term.

Find a Better Source of Water

You may be able to find (or create) another, higher quality water source to replace the existing source. However, some systems may find it difficult to locate a nearby source that is not influenced by naturally occurring radionuclides. Be sure to contact your state drinking water program since new source approval and/or permits are typically required.

Key considerations include:

- The contaminated source could be abandoned or other sources (e.g., standby or emergency sources) could be used for blending or as permanent replacement sources.
- Water-bearing fractures with high radionuclide levels in the existing well could be selectively sealed off, but this may be expensive.
- There are alternate sources that comply with all regulations, or that could be treated to remove any other existing contaminants at a lower cost than radionuclide treatment (state approval may be necessary before choosing this option).
- The new source will provide enough water to meet system demand and is located within a reasonable distance from the current system.

Blend Source Waters

Blending involves mixing waters from two or more different sources prior to distribution. At its simplest, a source with high radionuclide levels is blended with a source with radionuclide levels below the MCL to produce water that is within the limits of the MCL or a safe margin below the MCL. Check with your state's drinking water program before investigating this option, as blending is not permitted in all states.

Key considerations include:

- The availability of other sources with radionuclide levels below the MCLs that can be blended with existing sources. This could include obtaining water from a nearby water system.
- The cost of blending sources.
- Whether it is possible to blend the sources so that the MCLs are met at every entry point to the distribution system (EPTDS) while maintaining all required plant flow rates.
- Whether it will be necessary to replace pumps or take other measures to ensure that the blended water is in compliance.
- The impact of combining sources on water quality in the distribution system (e.g., changes in finished water quality parameters [such as pH and corrosivity] may affect piping and create compliance problems with other regulated contaminants [such as lead]).

—Step 2 *continued*

Interconnect or Consolidate

Another option is interconnecting with and/or purchasing water from another water system or consolidating all aspects of system operation to become a single, larger system.

Key considerations include:

- Whether there is a nearby system meeting the requirements of the Radionuclides Rule that is willing to interconnect or consolidate (check with your state's drinking water program).
- The costs of interconnection or consolidation.
- The nearby system's ability to handle increased demand from additional customers.
- The impact of the combined sources on water quality and the distribution system.

For more information:

- Volumes I and II of EPA's *System Partnership Solutions to Improve Public Health Protection* guide, available on-line at *http://www.epa.gov/safewater/smallsystems/managementhelp.html*.
- EPA's *Restructuring and Consolidation of Small Drinking Water Systems: A Compendium of State Authorities, Statutes, and Regulations*, available on-line at *http://www.epa.gov/safewater/smallsystems/compliancehelp.html*.

Your state may also be able to provide additional assistance by coordinating with other organizations:

- Local American Water Works Association (AWWA) section (*http://www.awwa.org/awwa/sections/seccont.cfm*).
- State Rural Water Association (RWA) affiliate (*http://www.nrwa.org/sa.htm*).
- Local Technical Assistance Center (*http://www.tacnet.info/*).

Step 3 Can I Use Existing Treatment to Remove Radionuclides?

If non-treatment options are not available or practical, the next step is to consider whether you can modify existing treatment (if available) to remove radionuclides while continuing to meet the original goal of treatment. For example, if your system is currently using lime softening, it may be possible to modify the treatment to remove radium. Some treatment technologies for iron and manganese removal and arsenic removal may also achieve some radium and uranium removal, respectively. Point-of-entry (POE) water softener systems will remove radium and could be modified to remove uranium by adding a small amount of anion resin (see the case study on page 4 for more information on using POE devices to treat for radionuclides). You should consult with your state drinking water program to determine whether or not the use of POE devices to comply with an MCL is allowed.

—Step 3 *continued (Existing Treatment to Remove Radionuclides)*

Evaluating existing treatment should involve raw water monitoring and a careful consideration of how the presence of other contaminants will impact treatment effectiveness, contaminant levels (including radionuclides) in treated water, potential impacts of concentrating radionuclides in filters and residuals, and disposal options including possible regulatory concerns (see Step 4 for more information). EPA has also developed an informational poster and various guides that can help you better understand these issues *http://www.epa.gov/safewater/radionuclides/compliancehelp.html*.

Step 4 How Do I Choose the Most Appropriate Treatment?

If you have ruled out non-treatment options or treatment modification, the next step is to begin evaluating treatment technologies. The type of treatment to consider will be based upon the compliance problem (i.e., radium, uranium, or the combination of both). Possible treatment options include ion exchange, reverse osmosis, activated alumina, coagulation/filtration, lime softening, and pre-formed hydrous manganese oxide (HMO) filtration. Ion exchange is one technology used most frequently by small water systems for radionuclide removal; however, there are trade-offs that must be considered in using this technology including higher radiation levels in the filters, and the potential need and associated costs of disposing of the filters in special regulated landfills. Throw-away media that can be removed by the treatment vendor or a licensed waste broker, or disposed of in an approved landfill may also be an option for small systems.

A CASE STUDY

Illinois' POE Treatment Program for Radium

Three small water systems in Illinois successfully installed POE water softener devices to treat for radium. Working with the U.S. EPA, the Illinois Environmental Protection Agency (IEPA) developed guidelines and criteria for testing the devices to ensure their effectiveness. The water systems are responsible for all aspects of treatment operation, and the POE units are equipped with sensors that alert customers to the need to change the media or any other operational problems. For one of the systems, the total 10-year cost of the POE program ($475,000) was nearly half that of the next-cheapest option (centralized ion exchange treatment, at $920,000), and less than one-third the cost of installing centralized reverse osmosis treatment ($1.6 million).

Some technologies may be more or less appropriate considering system size and location, average demand, the levels and types of radionuclides in the source water, disposal options, capital and operation and maintenance costs, and operator expertise. A number of these considerations are presented in this step. You should work closely with your state's drinking water program to evaluate your treatment options, as they may have restrictions on using certain treatment technologies (e.g., POE devices) or disposal options for drinking water treatment residuals. Your local landfill and wastewater treatment plant (WWTP) should be contacted regarding disposal options.

—Step 4 *continued*

More detailed information on the various treatment technologies is available on-line at *http://www.epa.gov/safewater/radionuclides/compliancehelp.html*.

Step 4a – Residual Disposal Options

The availability and cost of residual disposal options are critical factors in determining which treatment options are realistic and how the treatment will be operated once it is installed.

Some water systems, such as small rural systems, may have very limited residual disposal options due to location, size, and resource limitations.

Liquid Residuals

Liquid residuals include wastes such as brine, backwash water, and rinse water. The most common methods for liquid residual disposal include direct discharge to a water body or discharge to a WWTP which is regulated by National Pollutant Discharge Elimination System (NPDES) permits at the state level. For more information see *http://cfpub.epa.gov/npdes/*. Some water systems may also be able to dispose of liquid residuals in underground injection wells. If liquid residual disposal options are limited, there are treatment technologies that do not generate significant quantities of liquid waste. Key considerations include:

- Whether residuals can be discharged to a WWTP or directly into a water body.
- Restrictions on discharge, including local (e.g., county) and state limits on contaminant concentrations. The U. S. Nuclear Regulatory Commission (NRC) may have additional restrictions for uranium. For more information see *http://www.nrc.gov*.
- Whether underground injection is an option, and if so, whether the residuals will be classified as radioactive or hazardous. Contact your UIC program staff for assistance at *http://www.epa.gov/safewater/uic/primacy.html*.
- Whether intermediate processing (e.g., dewatering) could be used to create other (solid residual) disposal options.

Solid Residuals

Solid residuals include wastes such as spent media from a throw-away process and sludge from processes like lime softening, coagulation/filtration, and HMO filtration. Occasionally, aged filtration media and ion exchange resins must be replaced and these residuals may also contain some level of radiounuclides.

While some states may allow sludges from lime softening to be applied on agricultural land, most solid residuals are generally disposed of in landfills or special Low Level Radioactive Waste (LLRW) facilities, if the concentrations of radionuclides are too high. The amount and concentration of contaminants in solid residuals, as well as your system's location, transportation options, and cost, will influence where and how the wastes can be disposed. For a list of municipal landfills and LLRW facilities, see EPA's Web site at *http://www.epa.gov/safewater/radionuclides/compliancehelp.html*.

Key considerations include:

- Aged filtration media and resins can be cleaned or regenerated, respectively, on site to minimize the level of contamination of the media or resin. In these cases, analysis of the solids should be considered to determine the classification of the solids for disposal.
- The estimated levels of contaminants in the waste. (Your state or a professional engineer may be able to assist you with developing these estimates.)
- Whether these levels will cause the waste to be classified as a low-level radioactive waste, hazardous waste, source material, or mixed waste. If the treatment process residuals generated exceed regulatory concentration limits, it may result in the need for a state radiation control agency or NRC license (for uranium) of the system.

—Step 4 *continued (Solid Residuals)*

- The option of hiring a waste broker, or arranging with the treatment vendor to collect and dispose of the wastes. For more information on waste brokers operating nationwide, see the National Directory of Brokers and Processors at *http://bpdirectory.com/*.

For more information:

- EPA's *A System's Guide to the Management of Radioactive Residuals from Drinking Water Treatment Technologies*, available on-line at *http://www.epa.gov/safewater/radionuclides/compliancehelp.html*.
- *The American Water Works Association Research Foundation's (AwwaRF's) Management of the Disposal of Radioactive Residuals in Drinking Water Treatment*, AwwaRF (Final report for Project #2695, 2005).

Step 4b - Raw Water Monitoring

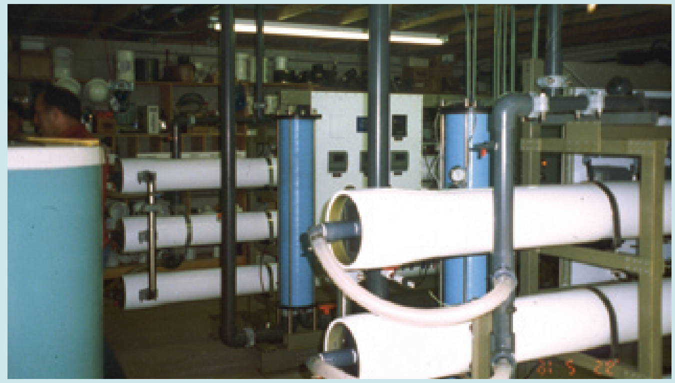
A review of raw water monitoring results will provide a comprehensive understanding of water quality characteristics.

This is important for several reasons:

- To identify any competing ions that could limit treatment effectiveness or cause taste or odor problems in treated water.
- To identify other contaminants that could be removed along with radionuclides (e.g., nitrate, arsenic, hardness, or iron), thus improving the quality of treated water and avoiding other compliance problems.
- To estimate the potential concentration of contaminants in the liquid and solid wastes (or residuals) that treatment may produce.

Step 4c - Treatment Evaluation Criteria

The next step is to work with your state or professional engineer to determine the criteria that you will use to evaluate treatment options. These may vary from system to system based on your system's characteristics and priorities.



Key considerations include:

- The level of radionuclides you would like to achieve in finished water.
- The quantity and characteristics of the residuals and on site disposal options.
- The availability of land for building and installing treatment.
- The levels of water loss that will be tolerable given water quantity issues.
- The capacity (flow rate) for which the treatment will be designed.
- Your system operator's level of experience and the operator skill level and certification required to operate the treatment technologies that you are considering.
- Whether the state has any additional requirements that will impact treatment options (e.g., increase costs, impact targeted finished water radionuclide concentrations, or limit residual disposal options), or require the facility to be licensed by the state radiation control agency or NRC.

For more information on selecting treatment and treatment technologies, see EPA's Web site at *http://www.epa.gov/safewater/radionuclides/compliancehelp.html*.

The costs for finding, designing, installing, and operating treatment can be significant. Estimating costs before investing in treatment can help you avoid unexpected expenses and develop a plan for covering all costs. When estimating capital and operations and maintenance (O&M) costs, you should consider several key expenses associated with treatment installation (or modification) and operation.

Some are one-time expenses:

- Pilot testing, if required by the state.
- Professional engineering fees.
- Permitting.
- Training costs including radiation protection training (i.e., operators).
- Engineering design and construction costs (including any costs for purchasing additional land and building(s) to house the treatment sysem).
- Equipment and installation costs.
- Monitoring instrumentation costs.
- Regulatory licensing costs.

Other expenses will be recurring:

- Chemical and chemical storage costs.
- Energy costs for operating the treatment unit and any associated facilities.
- Labor costs (i.e., if additional operators or an operator with more experience is required).
- Costs of compliance monitoring and any additional routine monitoring done to ensure that the treatment is operating properly, based on the monitoring schedule established by your state drinking water program.
- If applicable, the cost and frequency of media replacement and media disposal.
- Residual handling, transporting, and disposal costs.
- Regulatory licensing costs.
- Recordkeeping costs.

Keep in mind that some treatment options which require a significant up-front investment, may turn out to be more affordable in the long-term, especially when compared to the cost of not installing treatment and responding to a more serious compliance problem in the future.

While systems may seek to incorporate the longer-term costs of operating and maintaining treatment into water system rates, there are also many sources of low-cost or no-cost financing that may be available to help systems with all aspects of treatment selection, installation, and operation, including EPA's Drinking Water State Revolving Fund (DWSRF).

For more information:

- EPA's fact sheet on "Using the DWSRF to Comply with the Radionuclides Rule," available on-line at *http://www.epa.gov/safewater/dwsrf/#facts*.
- EPA's "Sources of Technical and Financial Assistance for Small Drinking Water Systems" guide, available on-line at *http://www.epa.gov/safewater/smallsystems/financialhelp.html#resources*.
- EPA's "Setting Small Drinking Water System Rates for a Sustainable Future" guide, available on-line at *http://www.epa.gov/safewater/smallsystems/financialhelp.html#resources*.

Conclusion

There are numerous non-treatment and treatment compliance options that water systems can consider for compliance with EPA's December 2000 Radionuclides Rule. The best option for your system will depend on your system's unique characteristics. Close communication and cooperation with your state drinking water program throughout the decision-making process will ensure that you are fully informed of your compliance options, regulatory requirements, and opportunities for funding.

Checklist of Recommended Considerations

Have you:

- ☑ Considered using a professional engineer?
- ☑ Coordinated with the appropriate state and local agencies?
- ☑ Reviewed or collected water quality data?
- ☑ Considered non-treatment options?
- ☑ Considered the use of existing treatment?
- ☑ Studied options for new treatment?
- ☑ Identified a method for waste disposal?
- ☑ Obtained necessary permits?

For More Information

EPA's Safe Drinking Water Hotline 1-800-426-4791 (M-F, 10am – 4pm)

http://www.epa.gov/safewater/radionuclides/index.html.