Considerations for Drinking Water System Treatment for Radiological Contaminant Removal

External Guidance for Public Water Systems

Adopted from Internal Guidance Document revision 5 (012216)

The following information is provided by the New Mexico Environment Department Drinking Water Bureau (DWB) as a general guide to Public Water Systems considering drinking water treatment for radiological contamination removal.

Please note that the DWB has no jurisdiction with the New Mexico Environment Department Radiation Control Bureau (RCB) regulations; it is the system's responsibility to apply for and receive the appropriate license from the RCB before start-up operation of any treatment system designed to remove radiological contamination from their drinking water.

Further, it is the system's responsibility to contact the RCB to determine the status of any potential provider of radiological contaminant treatment systems or waste broker services.

The mention of any company in this guidance is strictly for informational purposes only and does not constitute a recommendation, endorsement or approval of any kind.

Drinking Water Regulations for Radiological Treatment Technologies

Public water systems (PWSs) with Safe Drinking Water Act (SDWA) maximum contaminant level (MCL) violations of radiological drinking water standards have several options to achieve compliance:

- blend non-compliant source with a compliant source (other well(s) with suitable quality and quantity characteristics)
- install BAT/NSF-61 treatment technology, such as
  - ✓ ion exchange or reverse osmosis for Beta particle and Photon Radiation
  - ✓ reverse osmosis for (Gross) Alpha Emitters
  - ✓ ion exchange, reverse osmosis or lime softening for Radium 226 and Radium 228 (Combined)
  - ✓ ion exchange, reverse osmosis, lime softening or coagulation/filtration for Uranium
- skid-mounted package treatment processes
- engineered BAT/NSF-61 technology
- challenge testing of non-BAT technology by an approved field testing organization

Treatment Waste Disposal Requirements and Regulations

Disposal of radiological-contaminated treatment works (such as resins, membranes and treatment vessels) remains an issue for small systems. Given any system's design, source water quality and daily flow rates, years may elapse before a system would need to replace its exhausted ion exchange resin component. The NMED-RCB imposes the following thresholds for the accumulation of spent media or other radiologically-contaminated material (RCM) at drinking water facilities:

- A general license is required for those systems that accumulate less than 15 pounds of Uranium and/or Thorium in the spent media or other RCM before off-site removal and disposal as long as they do not transport more than 150 pounds during any given calendar year
- A specific license is required if the amount of Uranium and/or Thorium in the spent media or other RCM on-site at any given time is ≥ 15 pounds and the facility transports 150 pounds or more during any given calendar year

The NMED-RCB imposes additional regulatory requirements as follows:

- Facilities are required to have either a general or specific license and will be required to have a RCB-approved decommissioning plan and financial assurance for site closure
    - Licensee can be the water system’s governing body (responsibilities may be beyond the scope of small system boards) or designee such as the company that provides the treatment process
- Licensee will be responsible for decommissioning plan and assigning financial assurance funds to remove the facility or site from service, terminate the license and reduce residual radioactivity to a level that allows the property to have unrestricted future use
    - RCB regulations establish the requirements for decommissioning plans and the funding for those plans
    - General licensees can be exempted from the decommissioning plan and financial assurance requirement if licensee requests in writing from the RCB the inclusion of a license condition that stipulates that the licensee will not store any Uranium and/or Thorium or other RCM regardless of amount and will immediately remove from their site for transportation and disposal any spent treatment media
        - Under this condition the only financial assurance the licensee has to provide is that amount required for off-site removal, transportation and disposal of the spent media from the Uranium/Thorium treatment process
        - This financial obligation can be obtained by the system or its engineer from a waste broker licensed by the RCB
        - In most cases the RCB will want a copy of the contract between the licensee and broker to verify the relationship and cost of services
- Drinking water systems that are required to have a specific license will also be required to designate a Radiation Safety Officer (RSO) and comply with record keeping requirements, NMAC 20.3.4 Standards for Protection Against Radiation and NMAC 20.3.10 Notices, Instructions and Reports to Workers: Inspections
- Drinking water systems with general licenses are NOT required to have a RSO or comply with record keeping requirements, NMAC 20.3.4 Standards for Protection Against Radiation or NMAC 20.3.10 Notices, Instructions and Reports to Workers: Inspections
- Transporters are required to have a specific license

Even though general licensees are not required to comply with record keeping requirements, it is the systems responsibility to ensure that they do not accumulate 15 or more pounds of Uranium and/or Thorium in the spent media or other RCM before off-site removal and disposal. If the waste broker determines that the spent media or other RCM contains 15 or more pounds of Uranium and/or Thorium, then the RCB will issue a Notice of Violation. The licensee will be required to provide recordkeeping and a RSO for future exchange processes. In addition, the RCB can impose monthly reporting and other requirements (NMAC 20.3.4 and 20.3.10) associated with specific licenses until satisfied that the system can meet general license requirements.

Note that all drinking water systems that remove Radium-226/228 are required to have a specific license for the maximum activity (mrem or Curie/L) expected on the spent media and other RCM; no general licenses are issued for Radium-226/228.

Licensed Options in New Mexico

The NMED-RCB permits/licenses companies that can provide waste handling, packaging and transportation services of spent media and related material from drinking water systems to final disposition facilities. There are also companies licensed to handle naturally-occurring radioactive material (NORM) who service the oil and gas industry (under oil & gas regulations); however, their licenses would need to be amended by application to include radioactive material from drinking water treatment facilities. Out-of-state companies in this category have reciprocity. The NMED-RCB maintains two (2) separate databases that list the in-state and out-of-state licensees. These databases can only be accessed by NMED-RCB staff, but upon request staff can indicate if a company of interest has an appropriate license for a system’s needs.

Drinking Water Treatment Considerations

Package Treatment Options

A package treatment plant refers to a treatment system that is predesigned, pre-constructed and delivered on site for treatment as opposed to a treatment system that is custom designed and constructed to meet a system's individual needs. Package treatment plants are often much more affordable than a custom designed plant. Drinking water systems need to be aware of the different treatment and operational options available to them for radiological contamination removal.

Some companies such as Water Remediation Technology (WRT) can provide package treatment systems and licensed operational services; Tonka Water or AdEdge Water Technologies can only provide package treatment systems. Licensed operational services can include a long-term agreement or as-needed services. Under a long-term agreement the company monitors system operation and provides exhausted media exchanges based on monitoring data. As-needed services include media exchange, transportation and final disposition based on operational data provided by the drinking water system.

Operational Concerns

One of NMED's chief concerns is how drinking water systems operate their treatment system for public health protection, SDWA compliance and economic efficiency. It is important for the community to understand the potentially significant cost difference between treatment to comply with standards and treatment to non-detectable radiological levels.

For example, a system can decide to trigger a treatment media exchange at breakthrough; once effluent samples show detectable amounts of radiological contamination even though a detectable amount could fall well below an MCL. It is understandable that a system would not want to continue operating far past a breakthrough point; however, this technique implies that the system may change out treatment components which still have significant treatment capacity. Therefore, this option may entail significantly higher operation and maintenance costs than may be required to maintain compliance.

For efficient operation, system operators and managers need to know conservatively how long after breakthrough before the media will become exhausted. System managers will need to consult with their engineering experts and treatment/media suppliers to determine where the most efficient operational decision point is for their system based on a timeline cost analysis, life cycle calculations and costs for media removal, transportation, disposal and replacement to meet both NMED DWB MCLs for drinking water treatment protection of public health and NMED-RCB thresholds for storage and disposal of spent media.

Media exhaustion can occur within days, weeks or months of initial breakthrough. There are many influential factors, including the quantity and specific capacity of media in a reaction vessel, the number of treatment units and their respective configurations (such as lead-lag series or parallel), flow, raw water radionuclide concentration(s) and raw water quality/competing ions.

Typically, the longer the same media is used (i.e., past breakthrough but below MCL) the higher its disposal cost but media replacement cost will be lower over the life of the system. Conversely, media replacement at breakthrough would have the lowest disposal cost and highest media replacement cost over the life of the system. System representatives also need to inform customers that the longer the same media is used the higher the concentration of radiological material in the drinking water (though the SDWA requires the system to remain in compliance with the regulatory MCL).

Systems need to be designed with appropriately located flow meters and sample taps. This is especially relevant for ion exchange processes so system operators can estimate/calculate the mass of material adsorbed on the media based on flow through the media and the raw water radiological concentration(s) using the "pounds" formula:

#/day = Q, MGD x C, mg/L x 8.34 #/gal, where
Q, flow must be expressed in million gallons per day (may be a very small number), and
C is raw water radiological(s) concentration expressed as mg/L (even though uranium is frequently reported in ug/L and radium in pCu/L)

Knowing the pounds per day adsorption rate and initial mass of fresh media the operator can calculate the percent by weight of RCM in the treatment system at any time to compare to regulatory triggers and the operational decision points outlined above. Performing periodic assays of the media over an operational timeline enables the operator to verify the percent by weight calculations.

System managers and operators need to be aware that addition of these radiological removal treatment processes to an existing drinking water system may require higher levels of operator certification to operate an entire system. New certification requirements may entail new and additional testing to maintain certification; and, likely this may entail higher overhead costs to operate a system. Customers will need to understand that increased operation and maintenance costs may likely entail a rate increase.

<u>Additional resources</u>

1. NMED-RCB regulations; NMAC Title 20, Chapter 3 http://164.64.110.239/nmac/_title20/T20C003.htm
2. Federal NRC regulations addressing small quantities of source material in 10 CFR 40.22: http://www.nrc.gov/reading-rm/doc-collections/cfr/part040/part040-0022.html.
3. Identification of Best Available Technologies (BATs) for uranium: 20.7.10.100 NMAC incorporating 40 CFR 141.66(g) http://www.gpo.gov/fdsys/pkg/CFR-2014-title40-vol23/pdf/CFR-2014-title40-vol23-part141.pdf
4. Management of the Disposal of Residuals in Drinking Water; Narasimhan, Lowry, Culley, Young-Pong, Chapter 8 on worker safety; http://www.waterrf.org/ExecutiveSummaryLibrary/91077F_2695_profile.pdf