ENVIRONMENTAL Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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DWGB-22-21 2020

Methods to Reduce the Concentration of Radionuclides in Drinking Water and Radionuclide Waste Disposal Criteria

Mitigating a drinking water quality standard exceedance for a naturally occurring radionuclide is complicated since traditional water treatment processes and disposal methods cannot be routinely implemented. This is because residuals and wastewater derived from the treatment process for radionuclides could create a hazard.

Water systems with sources of water that exceed drinking water standards for radionuclides can consider implementing the measures summarized below to comply with drinking water quality regulatory requirements.

1) **Interconnect with Existing Compliant Community Water Systems in the Area:** A water system may interconnect with nearby water systems that have an adequate quality and quantity of water to serve your water system. This option often may be the most cost-effective approach to resolving water quality problems for the long term.

2) **Assess Water Quality of Water Derived from Each Well to Determine whether a Specific Blend Can Meet Water Quality Standards:** Historical water quality data can be reviewed for each water source in a given water system. Depending on the water quality and yield of each source, water from different sources may be blended at different flow rates to meet drinking water standards.

3) **Geologic Solution**: An evaluation of a well can be completed by a qualified hydrogeologist and licensed pump installer to determine whether certain water bearing zones within the well can be isolated to improve water quality and comply with radionuclide or arsenic drinking water standards while still maintaining water quantity requirements for the water system. Contact Stephen Roy at (603) 271-3918 or stephen.roy@des.nh.gov for more information about this option.

4) **Develop New or Supplemental Sources of Water:** It may be possible to develop new sources of water that provide an adequate quantity and quality of water that can either be

used to replace your existing water sources or be used as another source of water to blend with existing sources of water.

5) **Treat and Dispose of Wastewater in a Centralized Subsurface Wastewater Disposal System:** Although state law will not allow the discharge of concentrated radionuclides to the ground surface or groundwater, NHDES believes a waiver from this requirement may be possible under certain conditions. If a given water system disposes of all wastewater to **one** centralized water system and the water system does not have a significant amount of consumptive water uses, then NHDES will consider allowing a controlled discharge of water treatment backwash water to the centralized subsurface disposal system. Any substances used to regenerate treatment media must not contain a regulated contaminant or cause damage to the biological processes that occur in the subsurface disposal system. NHDES can justify such an approach to dispose of the backwash wastewater because although the backwash water is being diluted with other incoming wastewater, the process is essentially re-establishing the concentration of radionuclides in the untreated groundwater.

   Any backwash from a water treatment system to a centralized subsurface wastewater disposal facility must be registered in accordance with Env-Wq 402.

6) **Treat and Dispose of Wastewater, Filter Media and Residuals Off-site at Approved Disposal Facilities:** After the above options have been assessed and determined not to be applicable or feasible for a water system to use to address radionuclide water quality issues, more complex and costly measures to remove radionuclides from drinking water and manage residuals must be utilized. Additional options for managing radionuclides removed from drinking water include: **a**) treating water with filter media until the media is expended and then disposing the filter media at an approved out-of-state facility (New Hampshire state law prohibits the disposal of low-level radioactive material in the state); **b**) regenerating filter media and disposing of the backwash water at a publicly owned wastewater treatment facility; and **c**) regenerating filter media on-site and disposing the backwash liquid containing radionuclides at an out-of-state disposal facility.

   Among options “a” through “c,” above, it is NHDES' experience that only option “a” (treating water with filter media until the media is expended) has been demonstrated to be financially and/or administratively feasible. Option “b,” disposal of backwash water to a sewer system or a publicly owned wastewater treatment system, although allowed by state regulations, has generally not been supported by managers of wastewater treatment plants. Disposal of liquids to an out-of-state facility (option “c”) has not been demonstrated to be financially feasible. Additional information pertaining to these three options is provided below.

a) Treating water with filter media until the media is expended and then dispose of the filter media at an approved out-of-state facility.

Based on limited experience, it appears that where a water system cannot mitigate radionuclide water quality issues utilizing the approaches described in items 1-5, then removing radionuclides with filter media until it is expended is the most cost-effective water treatment option. Once the filter media is expended, it then must be managed by a licensed waste management firm and disposed or recycled at an approved out-of-state facility. Limited experience in New Hampshire indicates that managing radionuclides in this manner will add $1-$2 per 1,000 gallons to the price of providing water.

b) Wastewater Radioactive Content for Discharges to Sewers or Disposal at Wastewater Treatment Facilities.

Water treatment systems may be installed to remove radionuclides from drinking water. Regeneration and backwash wastewater associated water treatment processes that remove radionuclides from drinking water may be discharged to a metal or concrete holding tank and periodically hauled to a municipal wastewater treatment plant facility following the guidelines listed in this section. However, it is NHDES' experience that most municipal wastewater treatment plant facilities are not interested accepting backwash water from water treatment processes that remove radionuclides. The regulatory requirements for discharging backwash water to sewer systems are provided below:

Unity Equation: Acceptable levels of radium and uranium for discharge to a sanitary sewer is based upon the sewer effluent concentrations found in He-P 4090.

In accordance with He-P 4090, Unity Equation calculations need to be performed for wells with combined radium-226 and radium-228 and/or uranium exceeding the drinking water standards. The water system owners or their consultant must submit the Unity Equation assumptions and calculations to NHDES for review and approval before or along with the submission of plans and specifications to the NHDES for the radionuclide removal equipment. The average radium-226, radium-228, and total uranium (all as applicable) assumed to be present in the wastewater will need to be calculated and inserted into the equation. Where the resultant number is less than or equal to one the proposed discharge to the sanitary sewer or wastewater treatment facility will be acceptable as far as the radionuclide content is concerned. **However, the water system must obtain approval from the operator of the wastewater treatment plant and the NHDES Industrial Wastewater Pretreatment Program to ensure that the proposed discharge can be accepted by a given wastewater treatment facility.**

Although most of the radionuclides will be released from cation and anion resins during the brining period of regeneration, the total amount of radium and/or uranium calculated to be removed between each regeneration can be averaged over the total volume of wastewater collected for each regeneration. In the same way, the amount of radium and/or uranium removed by other water treatment processes can be averaged into the total volume of filter backwash wastewater, etc. The frequency that regeneration and backwashing occur can directly control the concentration of uranium and radium in the backwash water.

If the unity equation cannot be successfully met, NHDES staff will consult with the water system owners, their consultant, and with staff of the Radiologic Health Program at the Department of Health and Human Services before proceeding further.

Unity Equation – Discharges to a Sanitary Sewer:

(Avg. Ra-226 in pCi/l ÷ 600) + (Avg. Ra-228 in pCi/l ÷ 600) + (Avg. Total Uranium in pCi/l ÷ 3,000) < 1

Determining average radionuclide concentrations for insertion into the equation: All radium and uranium can be assumed to be contained in the total volume of regeneration/backwashing wastewater (total volume of backwash + brining + rinse wastewater). Also, the process radium removal efficiency for a cation exchange water softener can be assumed to be 99 percent (0.99).

Avg. Ra-226 (pCi/l) = [Vol. of well water treated between regeneration/backwashing (gal.) x raw water Ra-226 (pCi/l) x % process radium removal efficiency] ÷ [Total volume of regeneration/ backwashing wastewater (gal.)]

Avg. Ra-228 (pCi/l) = [Vol. of well water treated between regeneration/backwashing (gal.) x raw water Ra-228 (pCi/l) x % process radium removal efficiency] ÷ [Total volume of regeneration/ backwashing wastewater (gal.)]

Average Total Uranium (pCi/l) = [Vol. of water treated between regeneration/backwashing (gal.) x raw water total uranium (pCi/l) x % process uranium removal efficiency] ÷ [Total volume of regeneration/backwashing wastewater (gal.)]

c) Regenerating filter media on-site and disposing the backwash liquid containing radionuclides at an out-of-state disposal facility.

Water systems can backwash filter media and store backwash liquid in holding tanks on-site. These tanks could be pumped out by appropriately licensed waste management firms and the liquid incinerated at a facility in Oak Ridge, Tennessee. It is estimated that it will cost at least $18/gallon to dispose of the liquid not including costs for transportation, permitting, or licensing.

Radiation Safety

The New Hampshire Department of Health and Human Services (NHDHHS) has the administrative authority to regulate radiation. This agency has not developed any regulations, policies or guidance materials for how water systems should manage and dispose of residuals containing concentrated radionuclides from water treatment processes. National studies by the American Water Works Association Research Foundation and findings by the Nuclear Regulatory Commission have found that the health risk associated with operating water treatment equipment that remove radionuclides from drinking water is low. However, because some risk or perception of risk is associated with radiation where water systems are removing radionuclides from drinking water, it is required that water systems allow NHDES to collect and record radiation measurements before and periodically after treatment to remove radionuclides from drinking water is initiated. The purpose of the radiation surveys is to verify that unsafe levels of radiation do not exist where water treatment is occurring.

There may be worker safety concerns regarding radiation and radon gas when treatment vessels removing radionuclides are installed in buildings. Concerns include gamma radiation being given off from radionuclides building up on the treatment media and high levels of radon gas given off when vessel hatches are opened or regeneration/backwash wastewater is discharged with a free air break into a wastewater collection sump. Metal vessels should be used for radionuclide removal treatment units, as they will provide better shielding from radioactivity than plastic. Precautions that can be implemented to minimize exposures to water treatment operators, especially from resins that continuously concentrate radionuclides and are then removed for disposal include:

- Limit time spent near radiation to reduce exposure and inhalation of contaminated dust.
- Ventilate all treatment buildings.
- Use protective gloves, wash hands, and do not eat and drink in the vicinity of the treatment area.
- Avoid direct contact with potentially radioactive material.
- Locate treatment units and waste storage areas as far away from common areas as possible.
- Shower and launder work clothing.
- Use survey instruments periodically to confirm radiation levels are near to background/ambient level.

Department of Health and Human Services – Radiation Regulations

NHDHHS regulates radiation in New Hampshire. Currently, NHDHHS has not developed policies for regulating radiation associated with water treatment processes. If NHDHHS does develop such policies, then water systems may be subject to additional regulations or requirements. The policies summarized in this document reflect the practices NHDES has found to be used in other states, consistent with licensing measures proposed by the Nuclear Regulatory Commission, and based on research and opinions of qualified professionals as protective of human health and the environment. NHDES intends to periodically work with water systems utilizing water treatment processes for radionuclides to conduct monitoring for radiation to verify that human health and the environment are protected.

For More Information

Please contact the Drinking Water and Groundwater Bureau at (603) 271-2513 or dwgbinfo@des.nh.gov or visit our website at www.des.nh.gov.

Note: This fact sheet is accurate as of August 2019. Statutory or regulatory changes or the availability of additional information after this date may render this information inaccurate or incomplete.