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POINT-OF-USE GUIDANCE FOR SMALL PUBLIC WATER SYSTEMS WITH RADIONUCLIDE MCL VIOLATIONS

Colorado Department
of Public Health
and Environment

This document provides public water systems with the Colorado Department of Public Health and Environment's current policy on point-of-use devices used for compliance with the radionuclide rule. The statutory provisions and regulations presented in this document contain legally binding requirements. This document is not a regulation itself, nor does it change or substitute for the statutory provisions and regulations. This document does not impose legally binding requirements on the Department, or on public water systems. This guidance does not confer legal rights or impose legal obligations upon any member of the public. In the event of a conflict between the discussion in this document and any statute or regulation, this document would not be controlling. This document is subject to modification.

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A. INTRODUCTION

Small public water systems faced with challenges associated with removing naturally occurring contaminants from potable water supplies often find the path to compliance challenging. Prior to 1996, all water systems were required to use centralized treatment systems for the removal of naturally occurring contaminants, such as radionuclide particles. The 1996 Amendments to the Safe Drinking Water Act (SDWA) removed the prohibition on using point-of-use (POU) and point-of-entry (POE) treatment devices for small public water systems to achieve compliance with some of the maximum contaminant levels (MCLs) established in the *National Primary Drinking Water Regulations* and adopted in the *Colorado Primary Drinking Water Regulations* (CPDWR). These amendments have expanded the options small water system can use to meet treated water standards for naturally occurring radiological contaminants.

The CPDWR identify Small Systems Compliance Technologies (SSCTs) for Radionuclides, including POU ion-exchange and POU reverse osmosis. This guidance document is intended to provide public water systems with information on the basics of POU treatment and an overview of how to comply with the (CPDWR) when proposing a POU treatment program for compliance with the radionuclide MCLs. This document also explains the plan approval process that will be implemented by the Water Quality Control Division (Division) for review of POU treatment programs and POU devices.

B. POU DEFINITIONS, REQUIREMENTS, LIMITATIONS AND RESTRICTIONS

Definition

A POU device is a treatment system applied to a single fixture unit or other point of use for the purpose of reducing contaminants in potable water. POU treatment devices rely on many of the same treatment technologies that are commonly used in centralized treatment plants, but offer many different managerial financial and operational characteristics. For example, centralized treatment plants treat all water distributed to consumers to the same level while POU treatment devices are designed to treat only a portion of the total flow delivered to a single user. That is, POU devices treat only the water intended for direct consumption (drinking and cooking), typically at a single tap (faucet). POU devices may be installed under the kitchen sink linked to a single faucet. When POU devices are installed for the purposes of compliance with contaminant regulations, faucets without the POU devices can be used for cleaning or washing, but cannot be used to provide drinking and cooking water.

Point of Entry (POE) treatment devices are often confused with POU treatment devices. A POE treatment device, as defined in the CPDWR, is a treatment device applied to the drinking water entering a house or building for the purpose of reducing contaminants in the drinking water distributed throughout the house or building. As a matter of clarity, this document does not address POE devices. POE devices are not identified as SSCTs; public water systems desiring to use POEs should contact the Division for more information on requirements. Although many of the basic ideas and requirements for POE devices are very similar or the same to POU devices,

additional factors and details may need to be considered and may complicate using a POE device such as waste permitting issues or power requirements.

Types of POU Treatment Techniques

There are several types of POU drinking water technologies available, but only two POU types are identified as SSCTs for radionuclide removal, ion exchange and reverse osmosis. While both systems provide reliable treatment of naturally occurring contaminants in water, each SSCT treatment technology is better suited for different and specific raw water contaminants and characteristics. The water system is responsible for selecting a POU device that will provide the most effective treatment for their source water characteristics.

Key POU Requirements

The Safe Drinking Water Act (SDWA), National Primary Drinking Water Regulations (40 CFR 142) and the CPDWR (5 CCR 1003-1) regulate the design, management, and operation of POU treatment units used to achieve compliance with an MCL. Colorado implements the use of POU devices consistently with all federal and state laws and regulations. As such, the Division requires the water system to provide sufficient information prior to approving a long-term POU Operations, Maintenance and Monitoring Program (OMMP) in order to ensure that each regulatory provision is achieved.

The key provisions of the laws and regulations related to POU devices for radionuclide treatment, with specific regulatory references given in parentheses, are:

1. POU units must be owned, controlled and maintained by the public water system. (SDWA)
2. POU units must have mechanical warnings to notify customers automatically of operational problems. (SDWA)
3. The POU devices must be certified through an accredited ANSI certification body to meet applicable ANSI/NSF standards. (SDWA)
4. A program for long-term operation, maintenance and monitoring must be provided by the water utility to ensure proper performance. (5 CCR 1003-1, § 6.3.6)
5. Prior to installing the POU devices or implementing a POU OMMP, a community public water system must submit, and the Division must approve, plans and specifications. (5 CCR 1003-1, §1.11)
6. Before the devices are installed, the water system must obtain Division approval of a monitoring plan which ensures that the devices provide health protection equivalent to that provided by central water treatment. {40 CFR 142.62(h)(2)}
7. Effective technology must be applied consistently with the monitoring plan approved by the State and the microbiological safety of the water must be maintained. {40 CFR 142.62(h)(3)}
8. Certification of performance, field-testing, and a rigorous engineering design review of the POU device, if not included in the certification process, is required. {40 CFR 142.62(h)(4)}
9. The Division must be assured that buildings connected to the water system have sufficient POU devices that are properly installed, maintained and monitored such that all consumers are protected. {40 CFR 142.62(h)(6)}

POU OMMP Caveats

To protect the integrity of the POU treatment strategy and maintain compliance, the following items must be incorporated into all treatment programs:

- Water systems may not delegate ownership, maintenance, or control to the customers or homeowners.
- POU devices are not approved for treatment of radon because POUs do not provide adequate protection against exposure through inhalation or contact with skin at untreated taps.

C. PLANNING FOR A POU TREATMENT SYSTEM

Implementing any major treatment process requires considerable planning. POU treatment strategies include some unique considerations that are critical to the success of the program. As such, water systems should not consider POUs without careful consideration of all requirements and potential liabilities. Steps needed for a water system to successfully implement a POU program include the following:

- Cost Evaluations
- Addressing Previous Non-compliance or Deficiencies
- Public Outreach, Coordination And Negotiation
- Division Approval

Cost Evaluations

Financing a POU OMMP can be a significant obligation; therefore, the water system should begin the evaluation process by analyzing the life cycle costs of centralized and POU treatment options. Since the life cycle costs will be dominated by capital and operations and maintenance (O&M) components, the water system can have some general expectations. A POU OMMP is expected to have a lower capital cost, a larger O&M cost per customer served, and more extensive management requirements than a centralized treatment system. While the low capital costs of a POU treatment system may be appealing, a water system should not make a conclusion based on the preliminary cost estimates alone. The Division suggests a 20-year life cycle cost analysis which may consist of capital, operational, management, and maintenance expenditures.

For small water systems, implementing a POU OMMP may be less expensive than building, expanding, or upgrading a centralized treatment plant since only a portion of water used in the household is treated to drinking water standards. In fact, the implementation of a POU OMMP for arsenic was found to be less expensive than centralized treatment for communities of fewer than 40 households.[1] Since this threshold of 40 households is not steadfast for POUs, water systems should thoroughly investigate all treatment options prior to selecting a path toward compliance. Dedicated funding is necessary to ensure long-term O&M and management for either a POU OMMP or centralized treatment.

[1] U. S. EPA, *Cost Evaluation of Small System Compliance Options: Point-of-Use and Point-of-Entry Treatment Units.* September, 1998.

For preliminary estimates on POU costs, the water system can download a cost estimating Excel spreadsheet tool from the EPA's website under the section "Treatment Options – Install Point-of-Use (POU) or Point-of-Entry (POE) Treatment" at the following link: http://www.epa.gov/ogwdw/smallsystems/compliancehelp.html (For more accurate estimates of a long term, sustainable and compliant POU program, assumptions in the spreadsheet should be changed to reflect expected conditions and operations of a POU program for a water system such as compliance monitoring frequency of at least one third of all devices each year in accordance with the Division's minimum expectations.)

Capital Costs

Capital costs are the expenditures associated with purchasing equipment and/or building infrastructure. Capital costs may include constructing or modifying a central treatment plant, purchasing individual POU devices, and constructing pre-treatment or pre-filtration.

POU systems tend to have lower capital costs than central treatment plants. The American Water Works Association Research Foundation (AWWARF, 2005)[2] estimated that POU reverse osmosis units serving 20 households may have capital costs ranging from $4,000 to $23,900. As incentive to promote products and help offset capital costs, many vendors offer POU treatment unit rentals, eliminating up-front capital costs for the utility and the associated financing issues. However, this approach may increase operations and maintenance costs since the water system typically enters into a long-term third-party service contract.

Operations and Maintenance Costs

Operation and maintenance (O&M) costs are the expenses associated with ongoing management and service of a working water system such as sampling, labor, service contracts, recordkeeping, liability insurance, treatment chemicals, waste disposal, and other administrative functions. These O&M costs account for a significant portion of the ongoing treatment expenditures and must be carefully considered and re-evaluated often during the planning phases.

In general, centralized treatment O&M costs per customer tap are inversely related to the number of customer taps served, while POU treatment system O&M costs per customer tap are directly proportional to the number of customer taps served. AWWARF (2005) estimated that annual O&M costs for a water system with 20 connections or households using POU technology averaged $6,113 whereas central treatment O&M for 20 connections averaged $9,400. The difference in O&M costs between POU and central treatment rapidly decreases as the number of connections increase. POU O&M costs typically become more expensive as the number of connections increase and exceed O&M for central treatment at between 50 and 60 connections. Two critical O&M costs which may be overlooked or underestimated are compliance monitoring and waste disposal. The cost for analyzing the full suite of regulated radionuclides for compliance from each POU device in 2009 is $200.

In addition to monitoring requirements, the water system must carefully consider the long term costs associated with waste disposal. Spent POU cartridges, media, membranes, and filters must all be properly disposed of at the end of their useful life. In addition, waste brines

[2] AWWA Research Foundation, *POU/POE Implementation Feasibility Study for Arsenic Treatment*, 2005

from POU reverse osmosis systems must also be properly disposed on a regular basis. Therefore, prior to selecting a treatment technology, the water system should consider the cost and potential difficulties associated with the disposal of these wastes (including local regulations, transportation, handling, logistics, etc.). The EPA guidance document entitled, *Waste Disposal Costs for Point-of-Use and Point-of-Entry Treatment Strategies*[3] may assist in the characterization of the waste streams generated as a result of the use of different technologies to treat for radionuclides.

If considering a service contract, the water system should compare the cost of hiring a third party service contractor to that of hiring operating staff. The water system may have to consider other unquantifiable details such as time availability, response time, insurance and liabilities, etc.

Addressing Previous Non-compliance or Deficiencies

Implementing POU devices as a treatment strategy presents challenges different from, and in addition to, those of operating centralized treatment, including:

- The increased operations and maintenance associated with POUs may limit the time dedicated to normal operations and to correcting other existing, unresolved problems.
- Managing POU devices may complicate existing operational problems for the water system.
- Existing operational problems may prevent the water system from implementing a POU OMMP successfully.

For example, a water system that currently experiences high leakage rates in their distribution system that plans to use reverse osmosis POU treatment units in conjunction with centralized pressure booster stations may experience increased losses or more frequent distribution system line breaks following the installation and implementation of the POU OMMP.

To overcome these challenges, the water system must have the managerial capacity to handle present water system operations, monitoring, and treatment issues prior to successfully managing the new challenges of a POU treatment program. To help facilitate the transition to a POU OMMP, the Division requires that all outstanding monitoring/reporting violations and significant deficiencies identified through sanitary surveys be resolved prior to approving and/or implementing a POU OMMP.

Meeting the monitoring requirements for POU operation is crucial to ensuring public health protection. The waster systems should carefully consider strategies that will be implemented to ensure compliance with all monitoring requirements. Water systems should contact the Compliance Assurance Section to discuss concerns about their compliance history.

[3] U. S. EPA, *Waste Disposal Costs for Point-of-Use and Point-of-Entry Treatment Strategies.* October 2000. An updated description of waste disposal strategies and costs will be provided in the revised 1998 report, *Cost Evaluation of Small System Treatment Options: Point-of-Use and Point-of Entry Treatment Units,* scheduled for release in March 2002.

Water systems must review previous sanitary survey reports, identify unresolved significant and minor deficiencies and work to correct them. Recommendations should also be considered since these may complicate implementation and operation of a POU program. Other communicated issues noted by the Division should be reviewed to ensure the water system is in compliance. The water system is encouraged to communicate and work with the Engineering Section on resolving outstanding deficiencies, violations and other unresolved issues.

Water systems which have difficulty operating their existing centralized treatment and/or distribution systems, or have a history of not complying with monitoring/reporting requirements may not be candidates for implementing a POU OMMP unless the devices themselves will correct the violations or deficiencies. Any exceptions will be made on a case by case basis.

Public Outreach, Coordination, and Negotiation

To successfully implement a POU program, the water system will need to open a dialog with customers in order to explain the POU program, water system responsibilities and customer responsibilities. Customer support is critical especially if a service agreement or ordinance change is required to support POU. The water system may have to regularly communicate with their customers in an open forum type discussion and negotiate with customers individually. Public education will help a water system to achieve the customer support needed. Legal consultation may be needed throughout this process to clearly answer questions or facilitate program implementation.

Customer Participation and Access Agreements

Customer participation is a critical component for implementing a POU OMMP successfully. The water system must have 100% customer participation prior to installation of the POU treatment system. Granting access to POU devices through access agreements with each customer is necessary. Access agreements are legal documents and should be prepared and/or reviewed by the water system's attorney.

The Division recommends considering the following key issues when drafting the agreement:

A. Third-party Service Contracts

A water system using a third party service provider for maintenance and operations of the POU devices must submit a copy of the service contract with clearly delineated responsibilities, liabilities, indemnities and explicitly stated duties concerning O&M of the devices between the water system and service provider. However, the water system will ultimately be held responsible for meeting all regulatory requirements.

B. Insurance

The water system must have warranties on all of the POU devices and must be insured against incidental damages, failures and other problems associated with the installation, operation and maintenance of the devices in the customers' homes. The water system must submit a copy of relevant insurance documents to the Division during the approval process. Water systems without insurance or warranties may submit an explanation to

the Division for review. Each explanation will be reviewed on a per case basis of how the water system will be covered and protected from POU device failures.

Liabilities associated with POU systems include, but are not limited to, property damage from device failure or leakage and situations where homeowners may refuse entry for maintenance. Since POU treatment is a relatively new strategy for compliance in water systems, other liabilities may become evident through time. Therfore, liability insurance should be considered. The costs for liability insurance will vary depending on whether the water system owns or leases the devices and the nature of any contractual agreements for maintenance. Liability insurance needs to cover circumstances where there could be damage to property from a malfunctioning device, such as water leakage, property damage during installation, etc. Water systems may be able to minimize their liability through properly developed access agreements. Water system operators or contractors will be entering homes; therefore, bonding of personnel may be a consideration.

C. Legal Considerations

Water systems will incur costs associated with hiring an attorney to draft and/or review access agreements. Additional costs to review or assist in drafting ordinances, and/or codes, covenants and restrictions may also be needed. While not comprehensive, the Division offers the following recommendations when drafting agreements:

- An additional legal consideration may include ensuring disclosure of the POU treatment system during real estate transactions, which includes both the sale of the water system and the sale of individual homes. Homeowners are ultimately responsible for disclosing the POU treatment information, but the water system will need to provide printed education materials and a blank access agreement for the homeowner. New homeowners need to be fully informed to reduce the likelihood of non-compliance.

- The Division recommends that the water system obtain legal advice prior to enacting an ordinance or service agreement change and the liabilities, legalities, responsibilities, etc. that would be held by both the customers and the water system. It is important for the water system to also consider how device responsibility will be held when the title of property is given to another party. A property owner's responsibilities should be contained in the title of the property and "run with the land" so subsequent owners understand and agree to the requirements attached to the POU devices. The water system should consult and coordinate with the County Clerk and Recorder, regional authority and/or municipality on how to establish this as a legal and enforceable requirement.

- The water system should also consider what legal responsibilities the water system holds during installation, operation and maintenance of the devices. For example, depending on what county a water system is in, a certified and licensed plumber, electrician or other professional may be required to install POU devices. Also, if a customer's plumbing, cabinetry, drywall, electrical, etc. to accommodate the device is modified incorrectly or damaged by a third party contracted by the water system to

install the devices, the water system may be ultimately responsible for damages related to device installation and for correcting improperly installed devices.

When working with individuals for access, the water system may expect to experience some resistance. The water system will need to plan for and address any situation where a customer refuses reasonable access for maintenance and sampling. For example, the water system may need to discontinue service to or fine customers who refuse reasonable access for maintenance or sampling, or for tampering with or bypassing the POU device. In some cases, the water system may need to work with the local government to pass an ordinance granting the water system the authority to manage non-complying customers effectively. The issuance of an ordinance for the POU OMMP may require the modification of existing ordinances. As an example, some governmental agencies require developed lots within a specific boundary to connect to centralized water and sewer collection systems. An existing ordinance such as this may need revision to allow the water system to discontinue service for non-participation in the POU OMMP.

Communications: Customer Education and Outreach

Customers will need to be involved in the POU OMMP process to ensure full participation and understanding. Engaging customers in continuing education is essential to the success of a POU treatment system.

After a POU system is installed, the water system will need to continue to provide education to ensure that all customers have been informed and educated on using the POU system for their drinking water. It is critical to communicate clearly to customers that there will be untreated taps in the home. Continued outreach is necessary to ensure that rental customers, new customers, or other occupants in situations where there is occupancy turnover have signed the user access agreements and have been educated to properly use the POU treatment device.

There are three main types of public education and outreach associated with POU treatment and their related cost considerations:

- First – inform customers of the water system's proposal to use POU treatment. This will usually be accomplished through homeowners' association meetings, town meetings, and/or mailings. The costs associated with holding meetings will likely include printed or newspaper announcements, mailing costs, room rental, and personnel time.

- Second – long-term outreach and education, usually in the form of printed materials. For example, to conserve treated water and help maximize longevity of the device customers should be advised that POU devices are intended for internal consumptive uses such as drinking and cooking while assuring customers that untreated water is safe for non-consumptive uses such as washing dishes and bathing. Outreach recipients must include consumers in rental homes and businesses. Costs could include drafting and printing materials, mailing costs, and time needed to hand deliver material.

- Third – scheduling maintenance activities, which include routine and emergency maintenance. Routine maintenance and sampling should be well coordinated to minimize additional visits and costs. Water systems need to plan scheduled maintenance well in advance and communicate schedules with the customers. This can be accomplished through meetings, flyers, door-hangers, mailings, or by phone. Customers also need to know how to manage emergencies such as a device failure, leakage, or other malfunctions. Water systems may need a dedicated phone line for emergencies or develop an automatic 24-hour emergency call list.

Division Approval

During the Division's approval process, the water system will need to provide documentation that the owner or owner's legal representative at each service connection has agreed to installation and use of the POU device and has granted access for installation, maintenance, and sampling. Documentation provided to the Division could be as simple as a list of addresses/connections served by the water system with a certification indicating all customers have entered into access agreements. The water system will need to provide documentation of the following:

- Owner or owner's legal representative at each service connection has agreed to installation and use of the POU device
- Owner or owner's legal representative at each service connection has granted access for installation, maintenance, and sampling
- A certification that the water system has notified and educated all customers of the program on what responsibilities and liabilities the water system and customers hold
- A certification that the water system has obtained, or will obtain prior to installation, 100% participation of all customers.
- A statement that details the service contract, ordinance change, etc. allowing the water system to legally disconnect or discontinue water service to or fine customers who tamper with or refuse to cooperate with the water system on installation, service, operations, maintenance, etc., of the POU devices.

D. PILOT TESTING

Pilot testing will involve selecting suitable POU devices, followed by pilot testing of the selected devices under field conditions. The Division recommends that water systems begin working with a State of Colorado licensed professional engineer at the start of the POU device selection phase.

POU Device Selection

The POU device selection for pilot testing may be the most critical step in the processes toward implementing a POU OMMP. The selection process sets a path forward which impacts more than just the quality of treatment. The POU device may influence long term management issues such as the ease of installation, maintenance schedules, waste generation, compliance sampling, and pre/post treatment requirements. The water system has many options to narrow during the

selection phase including, but not limited to, manufacturers, treatment process (ion exchange, reverse osmosis, new technology, etc.), device configurations, and optional equipment add-ons. The selection process takes forethought to allow the device to suitably adapt to the variable raw water and installation conditions. To provide flexibility, water systems may select one or more POU devices for pilot testing. Of course, more devices and configurations will likely impact the time, effort, and cost of the pilot program.

This guidance offers a discussion of the following items to help water systems identify and select the optimal POU treatment devices for pilot testing based on general planning and Division requirements:

- Standards and Certifications
- Water Chemistry
- Installation, Maintenance, and Management
- Mechanical Warnings – Performance Indication Devices
- Waste stream characterization
- Vendor qualifications

Each of these items is discussed in the following subsections.

Standards/Certifications

The Safe Drinking Water Act requires that water systems installing POU treatment devices as part of a compliance strategy use POU devices that are independently certified to relevant, published American National Standards Institute/National Sanitation Foundation product standards (now referred to as ANSI/NSF standards). ANSI/NSF standards related to radionuclide treatment that apply to radionuclides POU treatment are:

- Standard 42: Drinking Water Treatment Units — Aesthetic Effects (may be applicable to pretreatment);
- Standard 44: Cation Exchange Water Softeners;
- Standard 53: Drinking Water Treatment Units — Health Effects;
- Standard 58: Reverse Osmosis Drinking Water Treatment Systems; and,
- Standard 62: Drinking Water Distillation Systems.

POU ion exchange and reverse osmosis (RO) are the allowed compliance technologies for radionuclide reduction; therefore, devices for radionuclide reduction will be certified under Standards 44 and 58. Also note that Standards 42 and 55 apply to units that treat for aesthetic effects (including chlorine) which may be needed for RO pretreatment.

These standards currently do not address all regulated contaminants and are regularly updated to include additional contaminants. To obtain current information on the standards, contact NSF International at www.nsf.org or call 877-867-3435. To obtain current lists of certified devices, contact any and all of the ANSI-accredited certification organizations that maintain a current list of only those devices certified by each of their organizations:

- NSF International at www.nsf.org/Certified/DWTU or 877-867-3435
- Water Quality Association at www.wqa.org or 630-505-0160
- Underwriters Laboratories at www.ul.com or 877-854-3577

- CSA International at www.csa-international.org or 866-797-4272

If a water system plans to install a treatment device covered by one of the above standards, the water system must make sure that the product selected has been independently certified according to ANSI/NSF standards by one of the ANSI-accredited certifiers. The equipment vendor should be able to provide the ANSI-NSF certification listing for the particular treatment unit.

The Division will also consider devices that are not ANSI certified on a case by case basis if the product is certified under the Water Quality Association's (WQA's) "Gold Seal" program, since these products have been subjected to independent, third party testing and have met the standards established by the WQA. The WQA is an international trade association representing the household, commercial, and industrial water quality improvement industry. Under the "Gold Seal" program, WQA has established additional standards for water softeners (cation exchange systems), filters, RO systems, and distillation units.

- WQA S-100: Household and Commercial Water Softeners
- WQA S-200: Household and Commercial Water Filters (in-line)
- WQA S-300: Point-of-Use Reverse Osmosis Drinking Water Systems
- WQA S-400: Point-of-Use Distillation Drinking Water Systems

Water Chemistry

Each POU treatment unit has unique performance characteristics for specific site conditions. In fact, the same unit may perform significantly more or less effectively depending on raw water characteristics. A treatment technology that is effective in treating a particular contaminant in one community may not necessarily be effective in another.

The characteristics of a water system's raw water will determine the appropriate POU treatment technology. Manufacturers will ordinarily specify the range of raw water characteristics for which their equipment is suited. It is important for water systems to first establish the seasonal raw water characteristic extremes and then select suitable POU treatment devices for those specific characteristics. While various products may treat the site specific raw water, each product's useful life may vary significantly depending on specific water characteristics. The water system must consider the membrane or media replacement frequency and cost during the initial selection phase.

The POU device selection process must include an evaluation of the effectiveness of the POU technology for removing the radionuclide contaminant(s) of concern. There are raw water characteristics that will help in evaluating the effectiveness of the POU technology, such as inorganic constituents, including total dissolved solids (TDS), and pH. If significant seasonal variations of these constituents are expected or known, quarterly or more frequent sampling to determine the range of raw water properties may be needed. The choice of POU treatment technology should be based on the worst case water characteristics and highest water usage patterns. Following are two examples of how raw water chemistry may affect POU devices:

- For reverse osmosis (RO), TDS greater than 1,000 parts per million (ppm) and/or silica can limit membrane effectiveness and longevity.
- For ion exchange (IX), competition among ions for exchange sites on the resin can significantly impact the efficiency with which the contaminant(s) of concern is (are) removed. Manganese, copper, and iron can foul IX equipment.

The EPA document, "POU and POE Treatment Units: *Evaluation of Contaminant-Technology Scenarios"* may assist a water system in narrowing the list of potential treatment technologies to consider. In addition, the water system should evaluate each of the following factors when considering which type of treatment to implement in the community:

- The contaminant of concern
- Raw water characteristics such as pH, hardness, co-occurring contaminants, etc.
- Desired quality of treated water
- Operational requirements of the treatment technology (e. g., backwashing, pre-treatment, potential for microbial colonization, etc.)
- Technical skill required of operator
- Disposal requirements
- Applicable local, state, and federal regulations

While not identified in the list above, the concentration of radon in the raw water is of special interest and must be included in raw water quality analyses. POU devices do not provide protection from radon because inhalation is possible through other routes. Water systems anticipating installing centralized radon treatment should consider installing centralized radionuclide removal. Another issue to potentially affect public health is devices or pretreatments that will continually adsorb radon. The radioactive decay daughter products of radon can accumulate on devices such as a granulated activated carbon pre-filter and become a source of radiation exposure.

Installation, Maintenance, and Management

The initial selection of POU treatment devices may be narrowed by considering the long term installation, maintenance, and management issues associated with the device. Although pilot testing has not commenced, imagine the logistics of installing, accessing, maintaining, remotely operating, and sampling each device. If the water system can easily identify concerns with these issues, the POU device may not best serve the water system.

All POU devices must have a means of measuring total flow through the devices. The water system must obtain, maintain and review the flow measurements routinely for device observation, maintenance scheduling and water system planning. Totalized flow measurements are the easiest way to check if a device has reached the end of its useful life, as a means of determining performance by correlating surrogate or radionuclide testing with production rates and to help the water system anticipate when a device needs to be serviced, replaced or sampled.

POU devices must also include automatic performance indication devices, also called mechanical warning devices, designed to notify customers and possibly the water system of operational problems. Each POU treatment device must be equipped with an automatic

mechanical warning mechanism, such as a light or an alarm. In some cases, the requirement for an automatic mechanical warning mechanism could be met by an automatic shut-off of the treated water. Shut-off could be set for a certain amount of time or treated volume of water following service, for operational problems, water quality issues, or both. Each POU treatment device has options for alarm triggers, alarm notification, and alarm response action. Please consider carefully how the water system may be operated and managed as the availability of specific mechanical warnings may impact the plan.

Waste Stream Characterization

The waste characteristics may vary based on the treatment technique, the service life between backwash or cleaning cycle, raw water quality, and any pre/post treatment processes. As the waste products from the treatment process contain radionuclides, waste disposal must be evaluated. The water system must investigate the potential waste streams, the possible concentration of radionuclides, the likely disposal routes, and possible permitting requirements. While more accurate information will be developed during the pilot study, specific POU treatment devices may not be a suitable choice due to waste handling issues and can potentially be eliminated from a pilot study.

Vendor Qualifications

A wide range of POU treatment devices and vendors exist. Many vendors can be located through the Web sites of the certification agencies aforementioned in the "Standards/Certifications" section of this document. Before selecting a vendor, water systems should contact several vendors and request references. Several factors enter into choosing a vendor including reputation, knowledge of water chemistry, knowledge of the POU device technology, disclosure of costs, location, availability, and assistance with training and service. Please note that the Division does not recommend or endorse vendors or equipment manufacturers.

Pilot Testing

Public water systems must obtain approval from the Division <u>prior</u> to installing any POU device for compliance with the *Safe Drinking Water Act* and the *Colorado Primary Drinking Water Regulations*.

The need for pilot testing is strongly supported by the experience of other water systems that have installed POU treatment devices as part of a compliance strategy for arsenic reduction. Through pilot testing, water systems were able to identify and reject treatment devices that did not operate properly (i.e., did not adequately reduce the concentration of the contaminant of concern in finished water) due to the combination of contaminants present in local waters. As a result of pilot testing, these water systems installed appropriate units, avoiding unnecessary costs, and were able to achieve better rates of contaminant removal.

Pilot Testing Program

Before a water system investigates and finalizes a POU OMMP, a POU treatment device or set of POU treatment devices must undergo a pilot testing program. The pilot testing program must be developed by a State of Colorado licensed professional engineer and submitted to the Division

as an engineering report for review and approval prior to installation. The POU pilot program must test performance of selected POU device setups, their compatibility with the various raw water source conditions at the water system, and be extensive enough to establish the following treatment device site operating characteristics:

- contaminant removal efficiency
- service life
- performance indication devices
- waste characterization
- device location(s)
- device specifications
- raw water quality
- pilot test duration
- measured parameters
- device setup
- system conditions and variability
- surrogate monitoring
- pre/post treatment

Each of these key issues is addressed under the following headings:

Contaminant Removal Efficiency

The pilot study must be designed to establish the removal of the radionuclide contaminants in question at actual production rates. The percent removal of each tested POU devices must be determined under the representative conditions expected in the water system with specific care made to include operating extremes. Operating extremes should be considered based on influent pollutant concentrations and flow rates. Plotted data must be included to trend measured conditions such as production and contaminant removal efficiency of the device over time.

Service Life

The pilot study must be designed to determine when routine or common operations and maintenance are needed for each tested POU device to ensure functionality and longevity. Common operations and maintenance include the frequency of the backwash cycle, ion exchange resin recharge, cleaning cycles, pretreatment requirements, device checks, etc. The pilot study should also strive to determine when each tested POU device has to be replaced.

Performance Indication Devices

The pilot study must be designed to test the effectiveness of the mechanical warnings or other performance indication mechanisms. The warning or mechanism tests must correlate the alarms to measured data indicating functionality in accordance with manufacturer's specifications.

Waste Characterization

The pilot study proposal must explain how waste from the devices will be characterized. At a minimum, the total quantity of liquid waste generated on average per unit time, the ratio of liquid waste to finished water, total dissolved solids, total suspended solids, radionuclide

concentrations, pH, concurrent contaminants such as nitrate or other chemicals such as free chlorine must be measured from the liquid waste residuals. If the device setup generates other infrequent waste such as clean-in-place waste, filter cartridge replacement, resin replacement, etc., the pilot study proposal must provide a volumetric estimate of these wastes during the study. The Division may require more in depth analysis of wastes such as a spent radium specific ion exchange resin operated for continuous loading and not regeneration. The pilot study proposal must also identify where liquid waste residuals from all devices will be discharged, e.g. vaults, homeowner's ISDS (Individual Sewage Disposal Systems), central wastewater treatment. On a case-by-case basis, the Division may require additional parameters to be tested as a result of the destination of generated waste.

All waste studies must comply with local, State, and Federal regulations, laws, and permitting requirements.

Device Location(s)

The water system should first consider the location for pilot testing selected POU devices and setups. The water system may want to install devices at people's homes or plumb devices as a side stream from a well or pump house. Factors to consider when choosing installation location(s) are accessibility to devices, pilot test run time or volume of treated water needed to collect sufficient data and variability of water characteristics in the distribution system or customer's home. The water system's pilot test proposal should justify the reasoning for site selection and setup.

The Division recommends that water systems work through the Public Outreach, Coordination, and Negotiation steps, outlined previously, with one or more homeowners to install pilot POU treatment units within local households as part of the Pilot Testing Program. Installing POU treatment units within local households will provide a better understanding of the operations and management issues the water system will likely face during implementation. In addition to these household POU treatment devices, the Division recommends installing additional POU treatment units in a central location that allows testing under harsher conditions to identify the operating capacities and characteristics of the unit in a time enhanced scenario.

Device Specifications

The water system will have to consider which type, make and model of the device(s) to test based on treatment needed, costs, device capability, appurtenances needed, manufacturer's support, etc. Manufacturer's cut sheets submitted to the Division must show that each tested POU device has the appropriate ANSI-NSF standard certification. The Division will also review WQA's "Gold Seal" approved products on a case by case basis.

Raw Water Quality

The water system must examine the source water characteristics to establish a pilot study framework. Justifications for device selections, setups, pretreatments and surrogates must be based on available chemical data of all sources feeding the water system, including seasonal variations. Averages, variations and ranges of relevant chemical parameters must be submitted to the Division in support the pilot study proposal.

Pilot Test Duration

The pilot study must clearly explain how long devices will be tested. Devices may operate based on a measured volume of treated water, manufacturer's recommendations, a fixed amount of time, until a tested parameter reaches breakthrough, or other relevant selected paramter. The pilot study proposal must justify the test duration to be able to generate enough acceptable and useful data about the device performance. For example, if RO devices are installed in a customer's house and the pilot study setup is to operate for two months, the pilot study proposal must justify that enough water will be processed to measure membrane fouling.

Measured Parameters

The pilot study proposal must explain in detail what characteristics will be used to measure performance of the devices, setups, and appurtenances. Performance characteristics include quality of treated water, time to surrogate or contaminant breakthrough, time to failure, device cycle life before service or replacement, treated water production rate, waste produced, overall device integrity, effectiveness of device failsafe or warning indicators and effectiveness of appurtenances. If possible, devices should be tested to failure to collect breakthrough data and compare with anticipated performance limits or manufacturer's claims. The data and results should be used to optimize POU device and setup.

Device Setup

The setup and conditions used for each POU pilot arrangement must also be detailed in the proposal. The Division recommends pilot testing devices and setups under different conditions in order to optimize device and setup performance and to collect data on device setup and performance under varying conditions that may occur within the water system. Several treatment technologies may need to be incorporated into a single POU treatment system to address certain water quality problems. Treatment technologies may be more effective when coupled with one or more additional technologies. For example, pre-filtration may extend the life of reverse osmosis membranes, while a post-filtration activated carbon filter may improve the aesthetics of treated water, resulting in improved customer satisfaction. Appurtenances may also have to be modified to suit sample sites. For example, in high pressure areas, a pressure reducing valve may have to be used.

System Conditions and Variability

Based on the variability of multiple raw water sources, seasonal changes, pressures throughout the distribution system, range of free chlorine levels, and pretreatment, the pilot study should test performance characteristics of the devices under a range of conditions expected in the water system beside what is seen on average or normally expected. The pilot study proposal should discuss the range of water variability parameters and explain how the pilot study will be able to measure or reasonably predict how a device setup will function at all customer taps. The pilot study must consider testing devices at both normal operating conditions to establish baselines and extreme conditions to establish issues that may limit or shorten life expectancy of a device before replacement, service, and recharge. For example, for a reverse osmosis POU, the pilot study can operate one device normally while another is run without pretreatment, at low incoming pressure and the highest dose of chlorine the water system would use. The performance characteristics as mentioned above would be tested for both devices to determine ranges of performance.

Surrogate Monitoring

Because monitoring costs are relatively high for radionuclides, the pilot studies should examine whether a surrogate parameter such as calcium or conductivity accurately predicts device performance. Surrogate monitoring can be a cost effective and relatively quick and easy way of measuring device performance and can be used to correlate or interpolate a radionuclide removal percentage provided adequate pilot testing data are available. The selected surrogate(s) must be identified in the pilot study plan. Any surrogate(s) noted in the pilot study proposal should be of a sufficient and consistent concentration to ensure test accuracy and precision and should be based on the water quality expected prior to POU treatment.

When a reliable surrogate parameter has been chosen, the pilot study should incorporate the use of surrogates to establish a strong statistical correlation with certified laboratory test protocols for the radionuclide(s) contaminant of concern. The surrogate testing device should be selected before the pilot test and may be a hand-held device, field instrument, or bench-scale laboratory instrument. To ensure the accuracy of the water system's surrogate testing method and device, the water system must take splits of the samples to be analyzed by a certified laboratory using an appropriate test methodology to confirm the water system's surrogate test device accuracy and precision. To minimize testing errors, the testing device should be able to be calibrated, verified with a known standard and include temperature correction if appropriate. Please refer to Appendix D for a Table of Surrogate Parameters and Testing Methodology.

Pre/Post Treatment

If the POU device setup necessitates changes to the water system such as adding centralized pretreatment or adjusting operational parameters such as distribution pressures, the pilot study must explain what changes are needed. Similarly, centralized pretreatment device specifications and/or calculations must be submitted to the Division for review and approval. Operational changes that may affect existing treatment need to be reviewed and approved by the Division before implementation. For example, if well flow rates are increased while chlorine doses are lowered, the water system must provide an evaluation of the water system's disinfection and contact time to the Division for review and approval.

Once the water system completes the Division-approved pilot study, all data must be assembled into an engineering report. The report must include sufficient data, observations and calculations from the pilot study to support the water system's choice of specific device setups including pretreatment and appurtenances for compliance. The pilot study results must also support the water system's surrogate testing protocol including field or bench scale instruments to perform surrogate testing. Pilot test conclusions and results must be submitted with final design plans and other items for Division review and approval before implementation can be begin as outlined detail in Section F.

In conjunction with pilot test results, the water system may need to continue to work with an engineer to develop testing and maintenance schedules based on average and minimum run lengths and incorporating some margin of safety.[4] Updated O&M and Emergency Response

[4] EPA used a 100 percent margin of safety when determining appropriate maintenance and replacement schedules for POU and POE treatment units and the associated costs. These safety allowances were designed to

Plans will have to be developed based on pilot test results and conclusions. The water system may also consider working with the engineer to evaluate the viability of a POU program based on more accurate costs developed from pilot test conclusions.

Special Considerations

Multiple water systems with similar contaminants of concern and water quality may jointly participate in a pilot study provided the study is extensive enough to cover all participating water systems. The proposed joint pilot testing program must be approved by the Division prior to execution to be considered. The Division may require other information in addition to the information discussed previously for joint pilot studies. Please consult with the Division prior to embarking on a joint water system pilot study.

In lieu of a complete pilot study, the Division may consider a water system's proposed design provided that the manufacturer, design engineer or third part service contractor guarantees performance of unpiloted devices. The guarantee must indicate the performance standards of the POU and agree to remove, replace, upgrade, or service the treatment devices at no additional cost to the water system should the POU treatment units not satisfy the performance requirements. Prior to installation, the water system must receive approval of the POU OMMP from the Division in accordance with this guidance. As part of the submittal requirements, the manufacturer must provide data and results, including any surrogate parameter analysis, from studies of the proposed treatment device performing successfully with raw water characteristics similar to the water system's water. The guarantee or contract against failure needs to be submitted to the Division as part of the pilot testing plan submittal. The plan shall meet all requirements of this section.

E. INSTALLING, OPERATING AND MANAGING A POU TREATMENT SYSTEM

The water system is responsible for the success or failure of implementing a POU treatment system, even if the installation and maintenance of the POU devices is contracted to a third party, such as the POU vendor. Water systems may not delegate authority to the homeowner or customer for any operations or maintenance.

POU devices are typically installed under the kitchen sink to treat water used for cooking and drinking. This section provides information to assist with the installation planning for POU treatment systems and includes installer's qualifications, routing treated water to drinking water dispensing units, inspection requirements, and notifications to the Division.

POU installation can be a complicated and time-consuming process. Improper installation can lead to unit malfunction, a decrease in the unit's effective life, property damage, and difficulties with maintenance and sampling. Therefore, it is important to develop a standardized installation protocol to reduce the chance of inter-household variability in unit performance. In addition to testing a variety of system configurations, the water system should consider the following factors when developing installation protocol.

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cover the variance that exists in annual household consumption and water use and potential variations in source water quality.

- **Location of installation.** Water system staff will need regular access to all treatment devices after installation to provide maintenance and conduct routine sampling. POU units typically are installed under the kitchen sink to ensure treatment of all water used for drinking and cooking, and to protect the unit from damage and tampering. Basement installation of POU units may be possible in some areas depending on household layout.
- **Unit accessibility.** It is important to install the units in a manner that will permit the water system to service and monitor them quickly and easily. Basement installations may improve the water system's ability to access the unit without disrupting the customers' schedules. Installing a unit-bypass will greatly ease the process of replacing the treatment media or the unit itself when necessary. Sampling taps installed before and after the treatment unit will allow water system staff to obtain samples quickly and easily and isolate individual units as necessary. Remember, however, to consult with the manufacturer to ensure that the installation plan will not hamper unit operation.

Routine Operational and Maintenance Procedures

Using POU devices may lower capital costs as compared to centralized treatment but operations and maintenance costs from regular operations and monitoring of all devices in the water system may be considerable. Essential, proper, and routine O&M requires adequate managerial and logistical capacity to meet these challenges. Additionally, the challenges of POU necessitate the Division's greater scrutiny of the water system's operational procedures and routine maintenance program updated for the POU devices. These procedures and programs must be explained in detail, clearly defined and deemed acceptable by the Division before a POU program will be approved. Although the Division will review the procedures and programs submitted by the water system, this does not preclude the Division from requiring other ancillary and related procedures and programs to be submitted for review, e.g. emergency response plan, monitoring device calibration procedure, etc. The water system will also have to consider how to educate customers in the water system about basic operation, checking and reporting device status, and possibly taking samples for the water system for routine regulatory or performance monitoring. The water system should also delineate when a third party licensed professional such as a plumber is needed and what duties are allowed compared to what the water system is allowed.

The operational procedures at a minimum must include manufacturer's operational and maintenance instructions, manufacturer's device troubleshooting, complete sampling protocol of routine compliance and surrogate sampling, complete service protocol for routine device check, maintenance work and customer complaints. Service and sampling schedules must includereasonable response times. For example, device failures should take precedence (and be attended to within a few days) over devices warning the end of their useful life is near. (The POU device's flow meter or performance indicator mechanism should warn when the device nears the end of its useful life but include a safety factor.[5]) Similarly, customer complaints regarding the devices should be taken seriously by the water system, ranked appropriately and given response accordingly.

Emergency Response Plan

To be prepared for common emergencies, the water system must have plans or procedures for response. The water system should identify failures or common emergencies likely to occur

[5] NSF/ANSI Standard 53 requires that the performance indicator device (alarm or automatic shut off) activate between 80% and 110% of rated capacity.

within the water system that may significantly reduce a device's performance, stop a device from functioning, or even damage a device. Occurrences to consider are pressure surges, power outages, power surges, turbidity or chemical spikes from flushing distribution lines, pressure losses or line breaks, confirmed positive coliform samples, etc. By identifying susceptibilities of devices to various occurrences, the water system can anticipate problems and be able to provide appropriate service and/or parts replacements. Some emergencies may require the water system to notify the Division for assistance and guidance.

Customer Service

The water system must establish a formalized customer complaint system including record keeping. At a minimum, the customer complaint system should note specific device locations, when the complaint is received, what it is, when an investigation has begun, what the investigation determined (including chemical analyses if done), what corrective actions were taken and when the device returned to normal service.

The water system must submit its procedures or decision tree and timelines for dealing with customers who refuse to cooperate with the water system's operational, maintenance and monitoring requirements. This should include all the steps from first warning to final service disconnection and/or legal action against the customer taken by the water system. Recalcitrant customers who contribute to a water system's failure to attain and keep regulatory compliance may ultimately have to be removed from service in order for the water system to return to or achieve compliance.

POU Program Service Plan for Customers with Multiple Households and Non-Residencies

Water systems must include detail on customers who provide service to multiple households (such as apartment buildings or mobile home parks) and non-resident populations that cannot be feasibly serviced with one POU device (such as schools, businesses, hotels, motels, etc.). The water system must explain how non-transient non-community populations within the community will be provided service including estimated numbers of non-transients in a location and number of devices available for use. The water system should also consider how public notification and education may be provided in general to transient populations within a community regarding the availability of treated water from POU devices for those interested.

Installer's Qualifications and Permitting

POU devices must be owned, operated and maintained by the water system. The devices may not be installed or maintained by the homeowner or customer. Permits to install the devices may be required by the local building department. POU devices must be installed by an appropriately licensed plumber. An electrician may be required if the device requires power and the installation site is not supplied with adequate power.

Routing Treated Water

In addition to treating the water supplied at the kitchen tap, water supplied to instant hot water dispensers, refrigerator ice makers and water dispensers should be treated. Multiple POUs might be appropriate and even necessary; if one POU is used to treat the water supplied to all dispensing units, then the conducting tube must be of non-reactive material. Otherwise, as part of its educational campaign or program, the water system must inform its customers to manually make ice or heat water using treated water from the POU device.

Installation Issues

Some problems may arise during the installation process that may increase the difficulty and expense of installing POU devices. Existing plumbing can be a significant problem where there are no accessible water shut-off valves or old or inferior plumbing and/or fixtures. Other issues that cause difficulties for installers are unsanitary conditions from water damage, lack of space for mounting the units, and routing water lines to refrigerators in crawl spaces that may not be adequate.

Many of the installation issues can be identified and addressed during initial customer outreach. The water system should ask homeowners to identify where water shut-off valves are, whether they have refrigerator water dispensers and/or instant hot water dispensers, as well as any special considerations related to timing of installation.

Inspection

An inspection of installed units may be required by the local building department. The water system should ensure that it is aware of all local and state codes that apply to permitting and inspection.

Financial Evaluation

The water system needs to assess the capital, operational, and maintenance costs associated with the proposed POU OMMP and account for those costs in its current financial budget. Itemized projected expenses should be listed and include the O&M costs associated with the devices. The water system needs to provide a best estimate of costs considering critical technical details required for successful POU device implementation, such as using a licensed plumber instead of an operator for device installation, worker overtime, third party service contractor travel costs, insurance, incidental damages, device monitoring and testing, laboratory costs, etc. As part of the capital cost assessment, the water system should be aware that some devices installed may require home modification such as plumbing, cabinetry, electrical, etc. that meet building codes to accommodate the device. This analysis must be examined over a 20-year life cycle cost.

Also, to achieve some degree of redundancy as required by design criteria and as a safety measure, the water system needs to keep complete sets of extra devices with required appurtenances and pretreatment devices for at least 10% of the total number of devices in the water system. Similarly, for parts that are regularly changed, the water system must maintain at least an extra 10% in inventory. Water systems using a third party service contractor do not need to maintain a device or part inventory in excess but the contractor should be able to provide 10% of the water system's parts and devices within a week.

Operator and System Classification

As required by Regulation 100 (Water and Wastewater Facility Operators Certification Requirements), each water system in Colorado must be under the direct supervision of an operator certified at the appropriate level. State statute and regulations require that any process control or water system integrity decision about water quality or quantity that may affect public health must be made by a certified operator. Regulation 100 also requires that either the designated operator in responsible charge or another operator certified at the level of the water system must be available at all times the water system is in operation. "Available" means that the designated operator must either be on-site or be able to be contacted as needed so that

necessary decisions are made in a timely manner. Water systems utilizing a "Point-of-Use" OMMP are classified as level "C" water systems and must be under the supervision of an operator holding a class "C" or higher water treatment certification.

For questions regarding water system classification, operator certification requirements, or certification examination availability, please contact the Division's Facility Operator Program at either 303-692-3503 or 303-692-3510.

Training

Adequate training of water system staff is essential to the success of a POU OMMP. Many vendors offer training in the proper operation and maintenance of their equipment as part of their sales package. Equipment manufacturers frequently offer training programs to vendors. It may be possible to negotiate with the manufacturer and the vendor to attend these trainings. Some water systems managing POU treatment programs have arranged for the equipment vendor to install and maintain the devices, in which case the water system did not have to invest in additional training. Other water systems relied on the vendor to maintain the units for a period following their initial installation while water system personnel were being trained.

Non-governmental groups such as NSF and the Water Quality Association (an international industry association for POU distributors and retailers) may offer training programs in the use and operation of POU treatment units.

Compliance and Performance Monitoring

Before the devices are installed, the water system must obtain Division approval of a monitoring plan which ensures that the devices provide health protection equivalent to that provided by central water treatment.

Sampling of the water provided by the POU system is required both after initial installation and on a routine basis. Additional tests for bacterial and/or field-sampling may be required, depending on the type of POU device selected. Results of pilot testing will provide the information that will be considered when compliance sampling schedules are established. The level of radionuclides present, overall water quality, and availability of surrogate parameters will affect how often compliance samples will be required from each device. Compliance with radionuclide MCLs is determined based on the analytical result(s) obtained at each sampling point. If one sampling point is in violation of an MCL, the water system is in violation of the MCL. Each POU is considered a sampling point.

Compliance sampling at the POU devices is typically performed only for the regulated contaminant the device is intended to treat, although additional microbiological or other contaminant sampling may be required if appropriate. Water systems will continue to monitor at the frequency and location (entry point or distribution system) normally required for all other contaminants.

Initial Compliance Sampling

Prior to POU system installation, the Division will specify sampling requirements. Samples must be analyzed by a laboratory certified to perform drinking water analysis to demonstrate initial compliance with the treatment requirements for the contaminant being treated. Future

installation of new devices must also be sampled according to a schedule established by the Division.

Routine Compliance Sampling

For the purpose of determining compliance with the radionuclide MCLs, each POU is considered to be an entry point. The water system must conduct routine compliance sampling for the contaminant being treated at least once during every compliance period. The Division will determine the number of POU devices to be sampled during each compliance period after evaluating the results of the piloting testing. The water system will need to provide the physical locations of all POU devices, and identify the location(s) on each sample report during sampling operations.

The Division will accept for compliance only samples that have been analyzed in accordance with the EPA-approved methods listed in section 10.4.1 of the CPDWR. Compliance samples must be analyzed by a laboratory certified by the Division. The Division may require reporting of surrogate monitoring, however, surrogate parameter results may not be used to establish compliance with the contaminant MCL.

Bacterial Sampling

Additional sampling for bacteria performed at the tap with the installed POU device is recommended and may be required, particularly for POU devices that use an activated carbon element. If POU devices remove the disinfectant residual; higher levels of bacteria are often seen in the finished water of POU devices.

Because POU devices may remove chlorine residuals, total coliform bacteria samples should be taken prior to the devices or at different locations in order to ensure water is coliform free and that required measurable chlorine residual is measured in the distribution system. Although previous studies and empirical evidence has shown that POU effluent is usually not a source of coliform contamination or growth, the water system should consider taking some coliform samples after the device to check the microbiological safety of the device effluent.[6] The bacteriological sampling plan protocol should note issues when sampling where there is a POU tap.

Surrogate Sampling

Field sampling will be necessary to ensure that the POU devices are working adequately between compliance samples and to help the water system anticipate and plan device replacement or service. Results of field samples should be recorded in the maintenance logs kept by the water system, and made available to the Division upon request. In conjunction with routine compliance sampling, surrogate sampling is an integral part of a functional operations and maintenance plan for a POU program.

To help minimize the invasiveness and intrusion of the water system into a customer's home, the Water system may allow the customer or homeowner to collect a surrogate sample for the

[6] In some studies, heterotrophic plate counts of the effluent from devices using GAC filters are shown to be elevated and a potential health concern for people with weakened or compromised immune systems. The system could hold a liability and should consider obtaining a legal opinion.

water system. The water system could allow the customer or homeowner to drop off the surrogate sample to the water system or could pick up surrogate samples from outside customers' residences in a convenient manner in a sort of reverse "milk-drop" process. The water system should develop clear, easy, understandable and standardized sampling instructions for the customer to follow for proper sampling and/or data collection. The water system should still be prepared to take all samples, if necessary, in order to make the sampling program successful.

The type of field sampling needed depends on the contaminant and the type of POU treatment device. Pilot testing should evaluate and consider the most effective surrogate and test methodology based on factors such as accuracy, precision, cost-effectiveness, test device portability and ease of use, calibration needs, operator training, etc. For example, reverse osmosis POU devices could have treated water checked for total dissolved solids (TDS) as a surrogate using a pocket TDS meter (based on electrical conductivity) in the field when the operator performs maintenance or takes a compliance sample. The sampling is done with a TDS (electrical conductivity) meter that must be calibrated periodically and may be evaluated by the Division during sanitary surveys.

Results from field samples are used to determine whether the POU devices are working adequately and are not used for compliance, therefore, the analyses are performed with test kits in the field rather than a laboratory. The results are not reported to the Division although the logs may be reviewed during a sanitary survey. For any field test kits used by the water system, the water system should include the calibration plan according to the manufacturer's recommendation and the calibration method for the field-testing equipment in the water system's Operation and Maintenance Manual.

Maintenance

The success of a POU treatment system is largely dependent on an aggressive yet practical maintenance program. POU maintenance issues include routine maintenance, replacement of parts or devices, as well as emergency maintenance. Maintenance can only be performed by the water system staff, under the direction of a certified operator, or a qualified contractor. POU devices may not be maintained by the homeowner or customer.

POU devices require routine maintenance, mostly to change and dispose of spent media and evaluate the device's effectiveness using field sample kits. A review of available case study data reveals a clear connection between inadequate maintenance and deteriorating unit performance. The pilot test should provide information needed to develop a maintenance schedule. For example, effective unit capacity (i.e., total gallons treated below the MCL) should be determined during pilot testing. Also, the vendor or manufacturer should recommend the frequency of maintenance activities. Water systems should schedule routine maintenance to coincide with routine compliance sampling to reduce the costs of multiple visits.

POUs also have a life expectancy. The manufacturer should recommend the scheduled frequency for replacement of the devices and/or the components and the water system should consider this cost when evaluating the POU treatment alternative.

Urgent or emergency maintenance is required whenever a device's mechanical warning mechanism is activated, if a device fails, or if leaks occur. The water system should maintain a stock of replacement parts and additional devices in case emergency maintenance is necessary.

The following factors should be considered when developing a maintenance plan for POUs:

- **Preventive Maintenance**. To ensure customer safety, a substantial safety factor should be built into the maintenance schedule. An aggressive maintenance schedule will also help the system and its staff to head off small problems (e. g., leaks), before they become large ones (e. g., damaged floors or burst pipes) and will build up customer confidence.
- **Location of unit.** A unit's location will affect how easy it is to service. A unit that is difficult to reach or examine will take longer to inspect and service than one in a relatively open area. Spending time to consider maintenance requirements prior to installation will save time, reduce frustration, and will lead to lower costs in the long run.
- **Coordination with sampling.** To minimize the burden associated with gaining access to individual residences, POU sampling should be coordinated with routine maintenance and previously required on-site sampling such as monthly coliform sampling and annual sampling for copper and lead. Reducing the number of house visits will reduce administrative costs and travel time, resulting in substantial cost savings as well as reducing the disruption to the residents.
- **System experience.** Plan to adjust maintenance schedules based on water system experience. For example, some households served by the water system may have relatively higher sediment loads or have a higher demand for water, necessitating more frequent pre-filter replacement.

Waste Handling

POU devices generate solid and liquid waste residuals although in smaller amounts than with central treatment since the units only treat a small percentage of the water used in the home. Although EPA's guidance document on POU and POE devices states that "residuals generated by the POU or POE devices installed in residences are considered household waste and exempt from being regulated as hazardous waste under the Resource Conservation and Recovery Act (RCRA).", other oversight may apply such as from the county's environmental department. The water system must have a plan and method for waste disposal for the POU devices. Waste disposal must be addressed at least during the pilot study, and these issues will be handled on a case-by-case basis.

Radioactive Solid Waste

POU devices that use reverse osmosis membrane treatment do not accumulate radionuclides in/on the media, and therefore, do not require special solid waste handling. The solid waste associated with POU devices that use an adsorptive media will require special handling. The spent media associated with adsorptive processes are classified as Technically Enhanced Naturally Occurring Radioactive Material (TENORM). Additional requirements, considerations and evaluations of solid waste may apply under the regulatory oversight of the Department's Hazardous Materials and Waste Management Division (HMWMD). For more information, please contact the Solid Waste Unit or Health Physicist in the HMWMD. This

must be addressed in the plan for handling and disposing of wastes, and will be evaluated on a case-by-case basis.

Liquid Waste

There may also be a liquid waste associated with POU devices although the amount of concentrated liquid waste generated from POU devices is very minimal. For example, reverse osmosis units produce very small amounts of waste brine with high contaminant concentrations as part of the treatment process. If the waste is to be discharged to an ISDS system, then the local health department must be contacted on this issue. Similarly with the solid waste, additional requirements, considerations and evaluations of brine waste to an ISDS may apply under the regulatory oversight of the Department's Hazardous Materials and Waste Management Division (HMWMD) or EPA Region 8. For more information, please contact the Solid Waste Unit or Health Physicist in the HMWMD.

Recordkeeping

Water systems using POU treatment as a compliance strategy will be required to keep and maintain records associated with managing the POU treatment system.

The water system must maintain all records pertaining to the POU treatment system, including any and all contracts; lease agreements, maintenance records, logs of installed devices, legal documents, including insurance information, educational materials, and sampling results. All records pertaining to the approval of the POU treatment system must also be maintained by the water system. The Division may request copies of these records periodically and will inspect the records and maintenance logs during site visits or sanitary surveys.

Reporting

CDPHE will require water systems using POU treatment to submit documents pertaining to the operations and maintenance of the devices at a frequency and in a format specified by the Division.

Records that will be required may vary depending on the water system-specific circumstances. At a minimum, the water system should submit quarterly reports certifying that all devices are functioning and being maintained in accordance with the Division's approval. If any devices are not in compliance, the water system should explain the problem and a description of what is being done to return it to compliance.

F. POU PILOT TESTINGAND OPERATIONS, MAINTENANCE AND MONITORING PROGRAM SUBMITTALS

Change to a water system's treatment requires prior approval from the Division in accordance with Article 1.11.2 of the CPDWR. The water system's proposed POU Pilot Plan and Final POU Design Plans and POU Operating and Maintenance Plan must be submitted to, and approved by the Division prior to installation. The plans, specifications and programmatic submissions must sufficiently address the key provisions of this document as well as the federal and state laws and regulations that allow the use of a POU OMMP. All submissions to the Division shall be directed to the District Engineer identified as primary contact for the County where the project is located.

Please submit the following items for review and approval:

POU Pilot Testing Program Submittal

1. Application For Point Of Use Pilot Testing And Prerequisite Approval Form
2. Written Plan to Meet Participation and Education Requirements
3. Pilot Study Proposal addressing the following:
    a. contaminant removal efficiency
    b. service life
    c. mechanical warning system functionality
    d. waste characterization
    e. device location(s)
    f. device specifications
    g. raw water quality
    h. pilot test duration
    i. measured parameters
    j. device setup
    k. system conditions and variability
    l. surrogate monitoring
    m. pre/post treatment

POU Operations, Maintenance and Monitoring Program Submittal

1. Certification: Resolution of All Outstanding Violations & Deficiencies
2. Construction Approval Application
3. Updated Inventory Form
4. Application for Point of Use Device and Program Final Approval Form
5. Pilot Testing Discussion, Analysis, and Conclusions
6. Final Design Drawings, Plans and Specifcations
7. Financial Capacity
8. Final Waste Residuals Management Plan and Permits
9. Education and Outreach Plan
10. Water System Participation and Education Form
11. Emergency Response Plan
12. Compliance and Performance Monitoring Plan
    a. Updated General Monitoring Plan
    b. Radionuclide Rule Monitoring Plan
    c. Surrogate Monitoring Plan
13. Operations and Maintenance Plan
    a. Manufacturer’s Instructions and Troubleshooting
    b. Sampling Protocols
    c. Service Protocols
    d. Maintenance Schedule
14. Training Plan
15. Customer Service Plan
16. Enforcement and Access Plan

17. Coverage Plan (Insurance, Bonds, etc.)
18. Legal Opinion for POU Program Implementation, Operation and/or Enforcement (optional)

Appendix A: APPLICATION FOR POINT OF USE PILOT TESTING AND PREREQUISITE APPROVAL

ADDITIONAL SUBMITTED MATERIALS CHECK LIST
POINT-OF-USE TREATMENT FOR LONG TERM COMPLIANCE
ALL PUBLIC WATER SYSTEMS

Project and System Information	
Project Title	
System Name	
County	
PWSID (Assigned by Division)	

Required Items[1]			
Yes/No/NA	**Location**	**Plan Submittal Package Items**	
		Summary or Overview	
		Written Plan to Meet Public Education and Participation Requirements	
		Pilot Study Plan Proposal[2]	
			Contaminant Removal Efficiency
			Service Life
			Mechanical Warning System Functionality
			Waste Characterization
			Device Location(s)
			Device Specifications
			Raw Water Quality
			Pilot Test Duration
			Measure Parameters
			Device Setup
			Water system Conditions and Variability
			Surrogate Monitoring
			Pre/Post Treatment(s)

Notes: 1. This list is not necessarily all inclusive and does not preclude the Division from requiring other items for system to attain approval.

2. Drinking water designs for community water systems (CWS) must be designed by a Professional Engineer (P.E.) licensed in Colorado. The P.E. must stamp and sign the pilot study plan proposal.

Appendix B: APPLICATION FOR POINT OF USE DEVICE OPERATIONS, MAINTENANCE AND MONITORING PPROGRAM FINAL APPROVAL

ADDITIONAL SUBMITTED MATERIALS CHECK LIST POINT-OF-USE TREATMENT FOR LONG TERM COMPLIANCE ALL PUBLIC WATER SYSTEMS

(Colorado Primary Drinking Water Regulations 1.11)

Project and System Information	
Project Title	
System Name	
County	
PWSID (Assigned by Division)	

Required Items[1]			
Yes/No/NA	**Location**	**Plan Submittal Package Items**	
		Resolution of All Outstanding Violations & Deficiencies	
		Construction Approval Application	
		Updated Inventory Form	
		Pilot Testing Final Report[2]	
			Results and Data
			Discussion
			Calculations and Analysis
			Conclusions
		Final POU Device Typical Setup/Layout	
			Drawing of POU device setup with appurtenances
			Calculations
			Additional info, datasheets, specs, etc. on POU device and appurtenances not submitted in pilot test proposal
		Financial Capacity	
		Final Waste Residuals Management Plan (and Permits if applicable)	
		Education and Outreach Plan	
		100% Notification, Education and Participation of Customer's Form	
		Written POU Operations Plan	
		Emergency Response Plan	
		Compliance and Performance Monitoring Plans	
			Updated Bacti Sampling Plan/Addendum
			Updated General Monitoring Plan
			List of all POU device locations
			Radionuclide Monitoring Frequency and Sample Site Selection
			Surrogate Monitoring Frequency and Sample Site Selection
			Radionuclide and Surrogate Sample Collection Procedure
			Surrogate Testing Methodology and Procedure
		Operations and Maintenance Plan	
			Manufacturer's Instructions and Troubleshooting
			Sampling Protocols
			Service Protocols
			Maintenance Schedule and Procedures
		Training Plan	
		Customer Service Plan	
			POU Program's Service Plan to Non-Residencies and Customers with Multiple Households[2]
			Customer Complaints Program and Description
		Training Plan	
		Customer Service Plan	
		Enforcement and Access Plan	
		Coverage Plan (Insurance, Bonds, etc.)	
		Legal Opinion for POU Program Implementation, Operation and/or Enforcement (optional)	

Notes: 1. This list is not necessarily all inclusive and does not preclude the Division from requiring other items for system to attain approval.

2. Drinking water designs for community water systems (CWS) must be designed by a Professional Engineer (P.E.) licensed in Colorado. The P.E. must stamp and sign the required items.

Appendix C: Customer Point-of-Use Participation and Education Verification Form

PWSID No.: _____

Water system Name: _____

POU Program Customer Education

☐ *YES* ☐ *NO* The water system has notified 100% of its customers that POU devices will be used to attain compliance with specific regulated contaminants.

☐ *YES* ☐ *NO* The water system has explained to 100% of its customers of water system's need to obtain device access on property for installation, monitoring, maintenance, etc.

☐ *YES* ☐ *NO* The water system has explained to 100% of its customers of the responsibility that customers must meet in order for successful operation of the POU program and for the water system to stay in compliance.

Note: **If the water system cannot educate 100% of its customers on any of the above items, an explanation and justification must be provided as an addendum to this form.**

POU Program Customer Participation

☐ *YES* ☐ *NO* The water system has ability to ultimately disconnect service to non-cooperative customers who fail to provide the water system device access or fail to meet customer responsibilities for the POU device. (*If other means is used to ensure compulsory customer participation, please provide an explanation.*)

☐ *YES* ☐ *NO* The water system has 100% voluntary participation of customers who understand the purpose, property accessibility and customer responsibility for the water system's POU program.

☐ *YES* ☐ *NO* The water system has _____ % voluntary participation of customers who understand the purpose, property accessibility and customer responsibility for the water system's POU/POE program. (*If 100% voluntary participation cannot be achieved, an explanation must be provided to how 100% compulsory participation will be achieved.*)

_____ _____

Water system Legal Representative Name (Print) Title

_____ _____

Water system Legal Representative Name (Signature) Date

Appendix D: Surrogate and Methodology Testing

Surrogate and Methodology	EPA	ASTM	SM (18th, 19th ed.)	SM (20th ed.)	Treatment
Alkalinity					Distillation, RO, Cation IX,
Titrimetric		D1067-92B	2320B	2320B	
Electrometric titration					
Calcium:					Distillation, RO, Cation IX,
EDTA titrimetric		D511-93A	3500-Ca D	3500-Ca B	
AA, Direct Aspiration		D511-93B	3111B	3120B	
ICP	200.7				
Conductivity					Distillation, RO
Conductance		D1125-95A	2510B	2510B	
Magnesium					Distillation, RO, Cation IX,
Atomic Absorption		D511-93B	3111B		
ICP	200.7		3120B	3120B	
Complexation Titrimetric Methods		D511-93A	3500-Mg E	3500-Mg B	
Sodium					Distillation
ICP	200.7				
AA, Direct Aspiration			3111B		
Total Dissolved Solids					Distillation, RO
Gravimetric			2540C	2540C	
Hardness (total)					Distillation, RO, Cation IX,
ICP	200.7		2340B		
Colorimetric, automated EDTA	130.1				
Titrimetric, EDTA	130.2			2340C	
Sulfate					Distillation, RO, Anion IX
Ion Chromatography	300.0	D4327-97	4110B	4100B	
Colorimetric	375.2		4500-SO_4^{--} 2 F	4500-SO_4^{--} 2 F	
Gravimetric			4500-SO_4^{--} 2 C,D	4500-SO_4^{--} 2 C,D	
Turbidimetric			4500-SO_4^{--} 2 E	4500-SO_4^{--} 2 E	
Nitrate (as N)					Distillation, RO, Anion IX
Ion Chromatography	300.0	D4327-97	4110B	4110B	
Automated Cadmium Reduction	353.2	D3867-90A	4500-NO_3^{-} F	4500-NO_3^{-} F	
Ion Selective Electrode			4500-NO_3^{-}D	4500-NO_3^{-}D	
Manual Cadmium Reduction		D3867-90B	4500-NO_3^{-} E	4500-NO_3^{-} E	

Note: This table is a list of common surrogates that can be used but is not necessarily all inclusive.