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USACE / NAVFAC / AFCEC **UFGS-02 72 13.13 (February 2025)**

Preparing Activity: USACE **New**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2025
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POINT OF ENTRY TREATMENT FOR DRINKING WATER

02/25

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SECTION 02 72 13.13

POINT OF ENTRY TREATMENT FOR DRINKING WATER
02/25

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NOTE: This guide specification covers the requirements for drinking water treatment via a point of entry treatment (POET) system.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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PART 1 GENERAL

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NOTE: This guide specification is intended to be used when chemical contaminants have impacted a small potable water system such as an individual residence or small building. The chemical contaminants that are the focus of this specification include synthetic organic contaminants, of which organic solvents and per- and polyfluoroalkyl substances (PFAS) are most prevalent in Department of Defense (DoD) environmental restoration work. Other common contaminants that are known to be successfully treated by the POET systems covered in this specification section include arsenic, nitrate/nitrite, and perchlorate. The

treatment methods that are the focus of this specification include granular media such as activated alumina, ion exchange resins, and granular activated carbon. Reverse osmosis POET systems are not considered due to the limited water production capabilities of these systems and the large volumes of reject water that reverse osmosis systems generate. For more information on application of POETs, readers should consult EPA 815-R-06-010, Point-of-Use or Point-of-Entry Treatment Options for Small Drinking Water Systems.

This specification section is intended to be used in a performance-based application where the same contractor is responsible for design, procurement, and installation of the POET system. The specification section would need to be modified if the Government has a specific POET system design that is to be installed.

This specification is not intended to be used for point-of-use (POU) treatment applications where water is treated at a single tap (typically a sink/faucet). POU treatment units generally cannot be installed on showers/bathtubs, hot-water lines to sinks, dishwashing machines, or toilets. Because of this, POU treatment units cannot address health risks for contaminants which present inhalation or contact exposure risks at untreated taps. Furthermore, design and installation of POU treatment units is much simpler than POET systems; selecting a POU treatment unit essentially involves picking a certified treatment unit that is rated for the contaminant concentrations, water flow rates/volumes, and pressures at the tap to be treated. Installation, operation, and maintenance of a POU treatment unit should be done in accordance with the unit manufacturer's instructions.

Federal and state regulations place certain requirements on public water systems that use POETs to comply with the Safe Drinking Water Act. For example, regulatory approved monitoring plans are required and mechanical warning systems must be in-place to automatically notify customers of operational problems. This guide specification section is not intended to produce a fully compliant POET system for use in a public water system as defined by state and/or federal regulations. This section would need to be revised on a case-by-case basis depending on the applicable state/federal regulations. The Safe Drinking Water Act defines public water systems for federal regulations (i.e. a system that serves at least 15 connections and/or 25 individuals - see 40 CFR 125.58 for a complete definition). States and local regulations may also define public water systems more strictly than federal regulations (for example the State of Washington defines any system serving more than a

single home as a public water system). See EPA 815-R-06-010, Point-of-Use or Point-of-Entry Treatment Options for Small Drinking Water Systems for further discussion on regulation of POET units in public water systems.

The POET system considered in this guide specification section receives contaminated water from a source such as a groundwater well, spring, or surface water. Energy to move the water from the source through the POET system is provided by a pump, elevated storage tank, pressure tank, etc. Once water passes through the POET system it may pass through other treatment processes such as water softening before ultimately entering the distribution piping. This specification is limited to the POET system treatment processes. This specification does not cover requirements for all elements of a drinking water system, such as the wells, water storage equipment, common treatment processes like pH neutralization or softening, distribution piping, etc. Also note that the specification requires the contractor to develop an Operation and Maintenance Manual, but does not require the contractor to perform operations and maintenance (O&M) past the initial commissioning of the system.

Section 43 31 13.13 10 ACTIVATED CARBON-GAS AND LIQUID PURIFICATION FILTERS and Section 46 61 00 FILTRATION EQUIPMENT may provide supplementary information useful to designers editing this section.

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1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by

the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.1.2	(2012; R 2017; R 2022) Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)
ASME A112.1.3	(2000; R 2019) Air Gap Fittings for Use with Plumbing Fixtures, Appliances, and Appurtenances
ASME B40.100	(2022) Pressure Gauges and Gauge Attachments

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C700	(2020) Cold-Water Meters - Displacement Type, Metal Alloy Main Case
AWWA C710	(2020) Cold-Water Meters - Displacement Type, Plastic Main Case

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC	(2024) International Plumbing Code

NSF INTERNATIONAL (NSF)

NSF/ANSI 55	(2024) Ultraviolet Microbiological Water Treatment Systems
NSF/ANSI/CAN 61	(2024) Drinking Water System Components - Health Effects

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 505-B-04-900A	(2005) Intergovernmental Data Quality Task Force - Uniform Federal Policy for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs Part 1: UFP-QAPP Manual
UFP-QAPP WKSTS	(2012) Intergovernmental Data Quality Task Force - Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.146	Permit-required Confined Spaces

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Pre-Installation Meetings

****
NOTE: Pre-installation meetings (also known as

pre-design meetings) are highly encouraged prior to POET system installation because POET systems are often installed in locations where information about the water system and access to the water system is limited. A pre-installation meeting provides an opportunity to identify the location where the POET system components will be placed and discuss installation schedules and water outage durations. If any building modifications are needed to facilitate installation of the POET system, they can also be discussed during the pre-installation meeting.

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Conduct one [_____] pre-installation meeting with the[Contracting Officer][and][Contractor][and][POET system installation subcontractor][and][resident][owner][_____] present. Discuss the following project elements during the Pre-Installation Meeting:

a. Proposed location of POET system components.

b. Any potential modifications to the building necessary to install the POET system.

c. Proposed schedule for installing the POET system including anticipated duration of water outage and how the [resident][owner] will be notified that they can resume use of the water system.

1.3 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification

and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Installer Qualifications

Basis Of Design; G, [_____]

SD-06 Test Reports

Acceptance Test Report; G, [_____]

Inspection Report

SD-07 Certificates

Warranty

SD-10 Operation and Maintenance Data

Operation And Maintenance Manual; G, [_____]

SD-11 Closeout Submittals

Spare Parts

1.4 MAINTENANCE MATERIAL SUBMITTALS

1.4.1 Spare Parts

****

NOTE: The Designer should verify if requiring spare parts is allowed by the Government's contracting agency. Spare parts are generally not allowed. Reasons to consider requiring spare parts are if a POET system is connected to a critical water system that requires near continuous operation. Spare parts may include consumables such as particulate filter elements or ultraviolet lamps/sleeves, or unique/critical components such as treatment vessels or control heads. Specify the number of spare parts required.

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a. Concurrent with delivery and installation of the POET system, furnish the following spare parts [_____].

b. Provide special tools if the POET system equipment manufacturers or vendors recommend any special tools necessary for adjustment,

operation, maintenance, and disassembly of POET system equipment. Deliver special tools at the same time as the POET system equipment and hand over on completion of the work.

1.5 QUALITY CONTROL

1.5.1 Regulatory Requirements

****

NOTE: The Designer should be aware of state and local regulations regarding allowable equipment and components in POET systems. There are no federal regulatory requirements for private wells/water systems. Some states require the use of certified equipment and components, others do not. Because regulations change with time, Designers should verify if there are applicable regulations at the time of executing the project. For context, it is important to understand that the Safe Drinking Water Act (SDWA) does regulate POETs used in public water systems. The SDWA requires that public water systems use products certified to American National Standards Institute (ANSI) standards when such standards exist for POETs. Because of this precedent, this section requires use of products meeting ANSI standards.

Standards establish appropriate performance requirements for products and define means of testing products. The most prominent standards for water treatment and conveyance equipment used in POET systems are the National Sanitation Foundation (NSF)/ANSI standards. Certification is a process in which accredited, independent third-parties test products against standards. In the United States, ANSI accredits certification organizations. Some of the more well-known accredited certification organizations include NSF, UL, Water Quality Association (WQA), CSA Group, and International Association of Plumbing & Mechanical Officials (IAPMO). Designers and those executing projects should be aware that manufacturers may claim that their products meet standards without actually engaging an accredited organization to certify those products. Most certification organizations maintain lists of certified products; those lists should be consulted to verify if a product is in fact certified.

NSF/ANSI drinking water standards can generally be grouped into two categories. The first category of standards is meant to ensure that water treatment products do not impart undesirable or unacceptable qualities to the water being treated. This could occur if a product was constructed with hazardous chemicals that could leach from the product into water contacting the product. Standards in this category include NSF/ANSI/CAN 14, 372, 60, and 61. A product that is certified to only these standards

has no guarantee that it will reduce contaminants in water that it treats. The second category of standards focuses on treatment units that are meant to perform a function such as improve aesthetic qualities of water or reduce contaminants that create health effect issues. Products in these categories are typically rated at specific flow rates, pressures, and contaminant concentrations. Products in this second category are most often single-tap POU units as opposed to whole-home treatment units. Standards in this category include NSF/ANSI 42, 44, 53, 55, 58, and 62. Note that NSF/ANSI Standard 55 is for ultraviolet disinfection units that can be deployed as a component of a POET system.

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Provide NSF/ANSI/CAN 61 certified products for all POET system equipment, components, and treatment media, unless a more-specific NSF/ANSI standard is specified for a product elsewhere in this section or other referenced sections.

1.5.2 Qualifications

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NOTE: The Designer should edit the following subparagraphs to remove requirements not applicable to the project. Some requirements may be perceived as a burden for simple/small POET system installations, but the Designer should use caution when removing requirements for convenience. "Point-of-use/Point-of-entry for Drinking Water Treatment" by Lykins et.al. 1992 cited POET system installation failures caused by plumbers or water treatment dealers that had failed to read and follow instructions. Individual states may or may not require installers to be licensed and trained in water treatment when POET systems are being installed for private properties that are not associated with a public water system.

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Submit Qualifications as required in the following subparagraphs.

1.5.2.1 Installer Qualifications

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NOTE: The Designer should be aware of state and local regulations related to private water systems. As previously noted, there are no federal regulatory requirements for private wells/water systems. State regulatory requirements vary in their scope; some states regulate individuals and companies that engage in treatment of private water systems, other states do not. It is also important to understand that while all states have some form of well driller regulations, those regulations often do not address water treatment that occurs downstream of the well

and pump, so a state-licensed well driller or pump installer may not have training and experience relevant to installation of a POET system. Note that some private organizations such as the Water Quality Association certify water treatment installers. An option is provided in the following paragraph requiring the installer to be certified; this could be in addition to state certification, or standalone in the event the POET system is being installed in a state that does not certify for private water treatment.

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Installers are required to have a minimum of [2][_____] years experience in the installation of a minimum of [5][_____] similar POET systems. Installers are required to demonstrate satisfactory operation for a period not less than one year for each POET system counted toward meeting this requirement.[Installer must be licensed by [_____] to perform the work required by this specification section.][Installer must be professionally certified to [perform water treatment installations][_____] by [_____].] Submit information demonstrating conformance with the qualification requirements.

1.5.3 Lab Validation

Perform testing by a DoD Environmental Laboratory Accreditation Program (DoD ELAP) accredited commercial testing laboratory in accordance with[Section 01 45 00 QUALITY CONTROL][_____] and approved by the Contracting Officer. Submit testing laboratory validation for the testing to be performed. Do not permit work requiring testing until the Contracting Officer approves use of the testing laboratory.

1.6 DELIVERY, STORAGE, AND HANDLING

Cover all equipment and component openings during delivery and storage to prevent entrance of dirt, water, or debris. During delivery and storage, protect all equipment, components, and materials from the weather (humidity and temperature), dirt and dust, and other contaminants. Follow manufacturer's requirements for protecting equipment, materials, and components during delivery and storage. Reject any packages or containers of treatment media which are not properly labeled with the following information:[name of the material][name of the manufacturer][lot number][manufacture or filling date].

1.7 [PROJECT][SITE] CONDITIONS

[1.7.1 Environmental Requirements

****

NOTE: The following paragraph can be deleted if the Contractor is not required to determine the location of the POET system (i.e. the Government dictates the location of the POET system). POET systems should be installed in locations that have adequate space for the components, are accessible (no confined space), are not prone to flooding or excessive moisture, have adequate lighting, and have electrical supply if needed. POET systems should not be installed in locations that have no protection against

below-freezing temperatures. In some situations, there may not be an acceptable location in the interior of an existing structure to install a POET system; in these situations POET systems have been installed in enclosures built specifically for the system. Constructing an enclosure for a POET system is beyond the scope of this specification section; generally speaking designers need to ensure that an enclosure is appropriately insulated against freezing; structurally sound against wind, snow, and other loads; equipped with electrical power (if needed); large enough for equipment maintenance; and protected against excessive humidity.

****

Do not install the POET system in a location that is prone to flooding, excessive humidity, or freezing temperatures. Confirm that there is adequate physical space to install the POET system and do not install the POET system in a confined space as defined by 29 CFR 1910.146. If a location meeting the requirements in this paragraph cannot be found, notify the Contracting Officer [within 48 hours][_____].

]1.7.2 Existing Conditions

****

NOTE: Pertinent water system information should be summarized in this paragraph, placed in an appendix of the specifications, and/or described on drawings. Indicate the detail to which water system information has been investigated and indicate where obvious data gaps exist. The table should be edited with site-specific primary contaminants of concern (COCs).

The water quality data that is needed to appropriately design a POET system will depend mainly on the specific POET treatment technology being deployed; other factors to consider include the water source (groundwater, surface water, spring, etc.) and contaminants to be treated. If necessary water quality information is not available, provisions should be made to collect the information prior to finalizing POET system design and install.

Water demand as represented by average daily flow may not be known because many small/individual water systems are often not metered and do not keep water use data. If water demand is not known, literature references can generally be used by the designer. For residences, per capita water use is often represented in the range of 380-660 liters per capita per day 100-175 gallons per capita per day. Typical uses for other non-residential settings are given in EPA 570/9-91-004, Manual of Individual and Non-Public Water Supply Systems. One specific consideration for POET systems regarding water demand is potable vs. non-potable use. Every effort should be made to understand if there are

significant non-potable uses such as landscape watering, livestock watering, etc. These non-potable uses can require significant volumes of water at high flow rates, resulting in poorer than expected POET system performance if they are not understood and accounted for. In some instances, organizational policy or risk-informed decision making may also prohibit treating water used for non-potable purposes. In this case, the POET system installation would need to include modifications to the water system plumbing to separate potable and non-potable water feeds prior to the POET system.

Instantaneous flow rates and system pressures are important to understand when designing a POET system. For most small systems, flow and pressure are provided by a well pump that supplies a pressure/expansion tank. POET systems create additional pressure loss that the pump/pressure tank must overcome (for example a dual-vessel granular activated carbon system designed for 30 lpm 8 gpm has a pressure loss of approximately 70-100 kpa 10-15 psi. If the available flow and water pressure prior to the POET system installation are close to minimum values required for the water system, this may constrain the POET system design or may lead to requiring a new well pump or pressure tank. In very rare instances, system pressures may be high enough to approach/exceed allowable pressures for commercially available POET system components (e.g. pressures greater than 550 kpa 80 psi). In this case, a pressure reducing valve may be necessary; paragraph SYSTEM PIPING AND VALVES includes an optional requirement for a pressure reducing valve. Minimum allowable water pressures will vary; water pressures should never be less than 140 kpa 20 psi for sanitary purposes, and certain fixtures such as flush valves may not operate correctly at less than 210 kpa 30 psi. Desired pressures are typically 275-550 kpa 40-80 psi. Typical values for pump capacity, pressure tank size, and pressure are provided in EPA 570/9-91-004. For individual residences, typical maximum flow rates depend on the number of water fixtures and occupants but may be between 20-40 lpm 6-10 gpm as a general range. Local water supply well contractors or university extensions may be contacted for further information. For estimates of maximum flows for other small water systems, consult USACE Engineering Manual 1110-2-503, Chapter 4.

****

The existing conditions of the water system are presented[in Appendix [_____]][and][on the drawings][and][in the specifications]. These include[well construction][pump sizing][[pressure][expansion] tank details][presence of ancillary water treatment components][physical area available for POET system components][electrical outlet availability and type][wastewater collection point availability and type].

Known water quality and quantity parameters are given in [Table 1] [_____]. The existing conditions presented are the result of site investigations at specific times; variations in the existing site conditions could occur. Perform an independent interpretation of the existing condition data. Notify the Contracting Officer within [48 hours][_____] if discrepancies between the data provided and actual field conditions are discovered.

Table 1 - KNOWN WATER QUALITY AND QUANTITY PARAMETERS		
PARAMETER	CONDITION SUMMARY	NOTES
Primary COCs		
[_____]	[Range] [_____] - [_____] mg/L [Avg.] [_____] mg/L	
Water Quality Parameters		
Total Coliforms1		
Heterotrophic Plate Count	[Range] [_____] - [_____] CFU/mL [Avg.] [_____]CFU/mL	
Chlorine Residual	[Range] [_____] - [_____] mg/L [Avg.] [_____] mg/L	
Total Organic Carbon	[Range] [_____] - [_____] mg/L [Avg.] [_____] mg/L	
Total Suspended Solids	[Range] [_____] - [_____] mg/L [Avg.] [_____] mg/L	
pH	[Range] [_____] - [_____] S.U. [Avg.] [_____] S.U.	
Iron	[Range] [_____] - [_____] mg/L [Avg.] [_____] mg/L	
Manganese	[Range] [_____] - [_____] mg/L [Avg.] [_____] mg/L	
[_____]	[Range] [_____] - [_____] mg/L [Avg.] [_____] mg/L	
Water System Hydraulic Parameters		
Average Daily Flow	[_____] lpd [_____] gpd	
Maximum Flow	[_____] lpm [_____] gpm	
System Static Pressure	[_____] kpa [_____] psi	
System Dynamic Pressure	[_____] kpa [_____] psi	

Table 1 - KNOWN WATER QUALITY AND QUANTITY PARAMETERS		
PARAMETER	CONDITION SUMMARY	NOTES
Note 1: Indicate if any Total Coliform tests have had positive detections (e.g. Total Coliform greater than 0 colonies/100 mL)		

1.8 WARRANTY

****

NOTE: Modify the paragraph to only include the POET system components for which a warranty is desired and generally commercially available. Industry-standard warranty durations are likely to vary for the different POET system components, so a single duration may not be appropriate. Common warranty durations are: treatment vessels 5-10 years; control valves and vessel heads 3-5 years; UV system housings 10 years; UV system electrical 3 years; UV system bulbs, sleeves, sensors 1 year.

****

Provide a POET system with minimum warranties for the following components:

TABLE 2 - POET SYSTEM WARRANT COMPONENTS	
COMPONENT	WARRANTY DURATION
Treatment Vessel	[_____] Years
Treatment Vessel Control Head	[_____] Years
Particulate Filter Housing	[_____] Years
Ultraviolet System Housing	[_____] Years
Ultraviolet System Electrical Components	[_____] Years
Ultraviolet System Bulbs, Sleeves, Sensors	[_____] Years

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design Requirements

****

NOTE: Delete the first sentence if the Contractor will decide the type of treatment media/treatment process for the POET system.

****

[Provide an[activated carbon][ion-exchange][_____] POET system.]Design, construct, and install the POET system to comply with the design and performance requirements specified in this specification section. Supply auxiliary systems and equipment required to maintain a complete and

workable POET system, including, but not limited to, piping between units, auxiliary equipment for plumbing and power, and controls and interfaces between auxiliary equipment and the POET system. Construct the POET system[in the location specified on drawings][in the location determined during the PRE-INSTALLATION MEETING][_____]. Additional design requirements for specific components of the POET system are specified in the following subparagraphs.

2.1.1.1 Treatment Media Replacement Frequency

****

NOTE: Treatment media replacement frequencies will vary depending on water use, contaminant concentrations, general water quality, and POET system design. Minimum treatment media replacement frequencies should consider how frequently O&M visits can be conducted, turnaround time on analytical sampling, etc. Very short replacement frequencies of 3-6 months should be avoided due to the operations and maintenance burden; very long replacement frequencies (>5 years) should also be avoided because treatment media can become solidified in vessels after very long periods and toward the end of a very long operating period, the treatment media may have little remaining treatment capacity to manage an unexpected increase in contaminant concentrations.

****

Provide a POET system with an estimated treatment media replacement frequency of at least [_____] months. The treatment media replacement frequency is estimated in accordance with paragraph BASIS OF DESIGN.

2.1.1.2 Treatment Vessels

****

NOTE: General best-practice for POET systems is to provide two treatment vessels that operate in series-configuration (also known as "lead-lag"). Each vessel is typically sized to individually meet the effluent criteria for the POET system, which creates treatment redundancy. Designers may consider adding a third treatment vessel; the third vessel provides a factor of safety that treatment requirements will be met while allowing the first two treatment vessels to be operated for longer duration (thus using more of the treatment capacity of the media in the first two treatment vessels). If using this approach, the primary considerations would be total system pressure loss and available space for multiple treatment vessels.

Backwash requirements should be carefully considered. It is common to frequently backwash the treatment media vessels in POET systems installed for purposes such as softening or general aesthetic treatment; however this type of frequent backwashing can be detrimental in POET systems designed to adsorb dissolved contaminants. Furthermore,

backwashing is not recommended at all for some kinds of treatment media such as IX resins manufactured for PFAS or perchlorate; the resin beads are all similarly sized so they can be randomly redistributed in the vessel after a backwash. Properly performed backwashes require careful control of the backwash flowrate and duration, which may not be possible from an automatic backwash system for a POET system. Improperly performed backwashes can randomly redistribute treatment media particles in the treatment vessel; treatment media particles which are saturated with contaminants and located at the top of the bed can be inadvertently moved to the bottom of the bed. If this occurs, contaminants can desorb out of the treatment media into the treated water.

The Designer should confirm that an upflow configuration is appropriate for the site before specifying this configuration. A primary concern with upflow applications for trace contaminant removal is the possibility of re-sorting the treatment media in the vessel if actual flow rates periodically exceed flow rates that fluidize the treatment media. This can lead to a random redistribution of the treatment media as described in the paragraph above. This potential for re-sorting can be avoided by creating a packed bed configuration either by eliminating head-space in the vessel or adding something to confine the treatment media in-place. Such a design would need to be reviewed with POET system component vendors.

****

Provide [2][_____] treatment vessels designed to operate in [downflow][upflow] mode. When multiple treatment vessels are provided, the system must operate in [series][parallel][series or parallel] configuration[and each vessel must be designed to individually meet the contaminant reductions in accordance with paragraph PERFORMANCE REQUIREMENTS].[Provide a system capable of[manual][automatic flow-based][automatic time-based][_____] backwash].

2.1.1.3 System Piping and Valves

****

NOTE: Installing piping for complete bypass of the POET system is recommended during POET system install; in the event that the POET system needs to be bypassed in the future (either temporarily or permanently), the bypass would be available, and the Government would not need to hastily move to install the bypass. The final sentence of this paragraph provides an option to divert untreated water supply to location(s) where the Government does not intend to receive treated water, such as landscape watering, livestock watering, hose bibbs, yard hydrants, agricultural water use, or other non-potable uses.

****

Provide piping and valves to completely bypass the POET system.[Provide piping and valves to individually isolate the POET system[treatment vessels][particulate filter(s)][disinfection unit]].[Provide piping and valves to divert the water delivered to [_____] such that this water does not pass through the POET system.][Provide pressure reducing valves as necessary to reduce system pressures to within acceptable limits of POET system components.]

2.1.1.4 Particulate Filter

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NOTE: Particulate filters remove dirt, sediment, and debris that can otherwise become trapped in a treatment vessel and lead to poor performance. Particulate filters can also reduce or eliminate clogging in the treatment vessels, making backwashing un-necessary. Particulate filters located upstream of the treatment vessels are encouraged for POET systems. Less commonly, particulate filters are also placed downstream of treatment vessels if there is sensitive equipment such as a disinfection unit located further downstream or if there is concern about loss of fine particulates from the treatment vessels.

****

Provide a particulate filter [before][and][after] the treatment vessels.

2.1.1.5 Disinfection Unit

****

NOTE: This paragraph assumes that a chlorine residual is not required for disinfection due to any state or local regulations (refer to the Part 1 Designer's Note for more discussion about regulations of POETs in Public Water Systems). The need to provide continuous disinfection of the water treated by a POET system is a topic that has been extensively considered. See "Point-of-use/Point-of-entry for Drinking Water Treatment", 1992, by Lykins, Clark, and Goodrich for further discussion. It is generally understood that POET systems can provide a growth medium for naturally present bacteria. Heterotrophic plate count (HPC) monitoring typically shows an increase in colonies in water treated by POET systems. The Safe Drinking Water Act states "The design and application of the POE device must consider the tendency for increase in heterotrophic bacteria concentrations in water treated with activated carbon. It may be necessary to use frequent backwashing, post contactor disinfection, and heterotrophic plate count (HPC) monitoring to ensure that the microbiological safety of the water is not compromised."

Ultraviolet (UV) light disinfection units are a relatively common component of POET systems.

Popularity of UV systems can be attributed to their relative simplicity compared to disinfection processes which involve chemical dosing. UV systems for POU/POET applications are also the only type of disinfection with an associated NSF/ANSI standard.

Generally speaking, the decision to provide disinfection does not rely upon water quality analysis of the source water. The reason for providing disinfection in a POET system should generally not be to treat source water that is known or suspected to be microbiologically unsafe. NSF/ANSI 330 provides a four-part definition of "microbiologically unsafe" waters. Although there are NSF/ANSI 55-certified UV disinfection units designed to treat microbiologically unsafe waters, the opportunity for growth of microbiological agents in the POET system components prior to the disinfection unit would be high. If a source water is known or suspected to be microbiologically unsafe, the preferred course of action is to find an alternative water source.

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Provide an ultraviolet disinfection unit as the final water treatment component of the POET system.

2.1.1.6 Basis of Design

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NOTE: An optional requirement is included in Item a. for the Contractor to determine a design maximum flowrate for the treatment system. Delete this requirement if the Government has sufficient information to specify a design maximum flowrate (which would be done in Paragraph PERFORMANCE REQUIREMENTS).

****

Submit a Basis of Design document no less than [60][_____] calendar days before the anticipated POET system installation date.[Prepare[draft for Government review][draft-final for [regulatory][_____] review] and final versions of the Basis of Design.] Allow [30][_____] calendar days for[Government] review[and [30][_____] calendar days for regulatory review].[Allow [45][_____] days for comment resolution following each review and preparing the next version of the document.] The Basis of Design must include, but is not limited to, the following:

a. Concept of Operation - Explain how the proposed POET system will operate and how each component will contribute to providing water treatment to meet the requirement of this specification section.[Identify a design maximum flowrate for the system and average daily consumption rate.][Provide estimates of replacement frequency for treatment media based on vendor information, performance of similar POET systems, or estimation methods in [textbooks][peer-reviewed] articles.]

b. Process & Instrumentation Diagram - Show all major components with controls, valves, and instrumentation for measuring

[pressure][temperature][flow]. Identify connections to existing plumbing and any modifications that will alter how water is distributed to users.

c. POET System Layout Plan - Show proposed layout and anchorage of components; component relationship to other parts of the work; physical clearances for access to perform maintenance and operation.

d. Product Data - Provide manufacturer or vendor-created documents for all equipment, components, and material. Demonstrate that the proposed products meet the requirements of this specification section.

e. Building Modifications - Identify all building modifications necessary to install the POET system.

f. Installation and Commissioning Plan - Provide a schedule indicating anticipated duration of water system unavailability and overall installation and commissioning times. Identify all labor disciplines that will be involved in installation and commissioning.

g. O&M Consideration - Provide a basic consideration for how major O&M activities would be performed.

h. System Information Sheet - Develop a system information sheet that is no more than [2][_____] pages. Explain in plain language the purpose and function of the POET system, what O&M the Government will perform, any conditions which indicate an issue that should be reported to the Government, how the [resident][owner] can contact the Government[and the Government's designated O&M contractor] with any questions or problems, any actions to be taken if the POET system is unused for an extended period of time, and what O&M the [resident][owner] is authorized to perform.

2.1.1.7 Uniform Federal Policy Quality Assurance Project Plan

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NOTE: This section may reference a separate specification section requiring preparation of a quality assurance project plan or may be excluded entirely if the requirements are part of another specification section.

****

Prepare a Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) in accordance with the requirements set forth in EPA 505-B-04-900A and using the 2012 optimized UFP-QAPP worksheets (UFP-QAPP WKSTS). Submit the UFP-QAPP within [60][_____] calendar days before the anticipated POET system installation date. Do not perform work at the site, with the exception of site inspection and surveys, until the UFP-QAPP is approved.[Prepare[draft for Government review][draft-final for [regulatory][_____] review] and final versions of the UFP-QAPP.] Allow [30][_____] calendar days for[Government] review[and [30][_____] calendar days for regulatory review].[Allow [45][_____] days for comment resolution following each review and preparing the next version of the document.] Tailor the content to the requirements of the project and the site conditions.

2.1.2 Performance Requirements

****

NOTE: This paragraph should be edited to identify the effluent requirements for the COCs, which are generally dictated by regulatory requirements. The performance requirement includes an option provision for specifying the design maximum flowrate (if the Government does not require the Contractor to do this as part of the Basis of Design). Design maximum flowrate should be specified based on a combination of the actual maximum flow for the water system prior to POET system installation as well as the theoretical maximum flow based on literature references (see Designer's Note in paragraph EXISTING CONDITIONS). For example consider a residence with a current maximum flow of 20 lpm 5 gpm (limited by the current well pump capacity), but enough plumbing fixtures to theoretically need 40 lpm 10 gpm. In this case it would be prudent to specify the design maximum flow at 40 lpm 10 gpm in the event that the well pump is upsized in the future.

POET systems can in some circumstances cause unacceptable or undesirable water quality for parameters other than the COCs, so this paragraph should be edited to identify effluent requirements for non-COCs. Some of the most common occurrences of POETs creating unacceptable water quality include: 1) treatment media may contain residual contaminants from the manufacturing process which need to be adequately flushed-out before placing the POET system in-service (for example granular activated carbon is known to leach arsenic upon startup); 2) POET systems may introduce microbiological contamination during installation or provide a growth medium for microbiological contamination during operation; 3) bacteria can colonize a POET system and convert nitrate into the more toxic nitrite.

The Table reflects the recommended approach that for POET systems with multiple treatment vessels, COCs are reduced to the Performance Criteria in the effluent for each treatment vessel. For Water Quality parameters and flow characteristics, Performance Criteria only need to be met in the POET system effluent.

****

Provide a POET system capable of producing treated water meeting the performance criteria specified in Table 3[for a design maximum flowrate of [_____] lpm [_____] gpm].

TABLE 3 - POET SYSTEM PERFORMANCE CRITERIA		
PARAMETER	PERFORMANCE CRITERIA	LOCATION(S) WHERE PERFORMANCE CRITERIA APPLY
PRIMARY COCS		
[_____]	[_____]	[Effluent of Each Treatment Vessel] [and] [POET System Effluent]
Water Quality Parameters		
Total Dissolved Solids	[500] [_____] mg/L	[POET System Effluent] [_____]
Total Coliform	[0 colonies/ 100 mL][_____]	[POET System Effluent] [_____]
Heterotrophic Plate Count	[500] CFU/mL	[POET System Effluent] [_____]
Nitrate	[10] [_____] mg/L	[POET System Effluent] [_____]
Nitrite	[1] [_____] mg/L	[POET System Effluent] [_____]
pH	[6.5 - 8.5 S.U.] [_____]	[POET System Effluent] [_____]
Iron	[0.3] [_____] mg/L	[POET System Effluent] [_____]
Manganese	[0.05] [_____] mg/L	[POET System Effluent] [_____]
Flow Characteristics		
Total Pressure Loss (clean bed)	< [100] [_____] kpa [15] [_____] psi at flowrate of [15] [_____] lpm [4] [_____] gpm	[POET System Effluent] [_____]

2.2 EQUIPMENT

Provide equipment that is the standard product of a manufacturer regularly engaged in the manufacture of such products. Standard products are those products which have been in satisfactory commercial or industrial use for [2][_____] years prior to bid opening, include applications of equipment and materials under similar circumstances and of similar size, and have been for sale on the commercial market through advertisements, manufacturers' catalogs (digital or print), or brochures during the [2][_____] year period. Provide nameplates for each of the following items of equipment [_____]. Provide the following information on each nameplate: manufacturer's name, manufacturer's address, product name, and model or serial number. Secure each nameplate to the item of equipment.

2.2.1 Treatment Vessels

****

NOTE: Items a - d are standard requirements. Item c. sets the minimum height of the tank necessary to allow the treatment media to vertically expand during the initial sorting backwash; 50% is a conservative value for most treatment media, but this value can be reduced (or eliminated) in certain circumstances based on manufacturer recommendations for the specific type of treatment media. To avoid inadvertent exclusion of products which would otherwise meet all other requirements in this section, no requirement is given for vessel materials of construction; however the Designer can add a requirement on a project-specific basis if desired.

Items e. and f. provide options to specify the minimum size of the treatment vessels and how much treatment media is installed. Specifying these items may restrict the freedom of the contractor to meet performance requirements through whatever means they deem sufficient; however, specifying minimum requirements can protect the Government from the possibility of a contractor installing a treatment system that fails to meet performance requirements or requires frequent maintenance (that is, a "small" POET system may meet performance requirements during the initial sampling event but will likely require more frequent treatment media replacements).

For Item e. typical empty bed contact times for larger-scale treatment systems (not POETS) and various contaminants are provided below. It is common in the POET industry to provide lower empty bed contact times for GAC; for example EBCTs of 2-4 minutes are common for GAC treatment applications of PFAS and VOCs. Certain vendors and consultants claim that lower EBCTs are justified because flow in POET systems is often not continuous, so water effectively has a longer residence time than what can be calculated using the maximum system flow rate. Benefits of providing larger EBCTs include reduced treatment media change-out frequency and smaller pressure losses due to lower hydraulic loading rates. A concern with providing very large EBCTs is that when POET system flows are significantly lower than design/maximum, flows may not evenly distribute through the media and "channel" as described in item f. below.

	GAC - EMPTY BED CONTACT TIME (MIN)	IX RESIN - EMPTY BED CONTACT TIME (MIN)	ACTIVATED ALUMINA / GRANULAR FERRIC HYDROXIDE / SPECIALTY IRON-BASED - - EMPTY BED CONTACT TIME (MIN)
PFAS	10	1.5-2.5	N.A.
VOCs	5-7	N.A.	N.A.
Chlorine	2	N.A.	N.A.
Perchlorate	N.A.	1.5-2.5	N.A.
Arsenic	N.A.	2-5	7.5-10
Radon	5	N.A.	N.A.

For Item f. hydraulic loading rates should generally not be higher or lower than what is recommended by media manufacturers because at low and high loading rates flow can "channel" through the media leading to reduced performance. For GAC, hydraulic loading rates are typically 0.14-0.68 cm/sec 2-10 gpm/ft2; for IX resin hydraulic loading rates are typically 0.42-1.25 cm/sec 6-18 gpm/ft2.

****

Provide treatment vessels meeting the following requirements:

a. Maximum operating pressure at least [850][_____] kpa [120][_____] psi

b. Maximum operating temperature at least [40][_____] degrees C [100][_____] degrees F

c. Minimum sidewall height large enough for [50 percent][_____] treatment media bed depth expansion during backwash

d. Supported in an upright position with a leveling stand of approved construction[and lateral support strap or adjustable clamp fixed to a structural member located in proximity to the vessel].

e. Minimum empty bed contact time: [_____] minutes

f. Hydraulic loading rate between [_____] - [_____] lpm gpm

2.2.2 Treatment Vessel Control Heads

Provide treatment vessel control heads that are compatible with the treatment vessels and meet or exceed the design maximum flowrate and maximum operating temperatures and pressures required for the treatment

vessels.[Provide treatment vessel control heads with integrated bypass valves that allow for the vessel to by bypassed.][Provide treatment vessel control heads that are capable of [automatic][manual] backwash.]

2.2.3 Pipe and Fittings

****

NOTE: The type of pipe and fittings that is allowed or required will be as determined by local experience. UFGS Section 22 00 00 PLUMBING, GENERAL PURPOSE indicates preference for material in the following order: copper, galvanized steel, polyethylene pipe, polypropylene, and PVC. An option is given to specify the pipe and fitting material either by reference to Section 22 00 00 PLUMBING, GENERAL PURPOSE or by specifying directly in this section.

****

Provide pipe and fittings with internal diameters no smaller than the internal diameter of the existing plumbing system that the POET system is being installed into.[Provide pipe and fitting material in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.][Pipe and fitting material must be [_____] and must conform to the standard identified for the material in [ICC IPC][_____].]

2.2.4 Valves and Appurtenances

[Provide valves in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.][Provide valves constructed from [_____]. Valves must conform to the standard identified for the material in [ICC IPC][_____].] Provide [locks][and][tamper indication] for any valve which can create a bypass of the POET system, either in part or in whole.

2.2.5 Pressure Gauges

Place sufficient pressure gauges to measure pressure before and after each particulate filter and treatment vessel. Provide pressure gauges with a scale range of 0 to [700][_____] kpa [100][_____] psi. Provide pressure gauges in accordance with [ASME B40.100][_____].

2.2.6 Flow Meter

Place [1][_____] totalizing flow meter. Provide totalizing flow meter[s] in accordance with[Section 22 00 00 PLUMBING, GENERAL PURPOSE][AWWA C700 or AWWA C710]. Provide totalizing flow meters sized for the design maximum flowrate. Provide totalizing flow meters reading in [Cubic Meters][Cubic Feet][US Gallons].

2.2.7 Particulate Filter Housing

Provide a particulate filter housing that meets or exceeds the design maximum flowrate and maximum operating temperatures and pressures required for the treatment vessels. Provide a particulate filter housing that uses replaceable filter media consisting of either bags or cartridges. Provide a particulate filter housing that is compatible with the material selected for the piping and fittings, constructed of stainless steel or plastic, and built with a manually operated pressure relief valve. Provide a particulate filter housing with a maximum empty housing pressure loss of

[_____] kpa psi at [_____] lpm gpm as certified by the [manufacturer][vendor].

2.2.8 Sample Ports

Place sample ports at the influent, between treatment vessels, and effluent [; place additional sample ports [_____]]. Provide sample ports comprised of pipe fittings, pipe, and [ball][gate][_____] valves which comply with material, temperature, and pressure requirements of the associated piping system as specified in this Section.[Provide a tethered dust cap for each sample port.]

2.2.9 Air Gap Fitting

****

NOTE: Delete this paragraph if the POET system will not include any drain lines. Whenever a drain line is connected to a POET system there is a risk of backsiphoning contaminated wastewater into the POET system. To prevent this from occurring, the drain line should be installed with an air gap. Air gaps can consist of either physical separation between a drain line and the wastewater receiving point or an in-line air gap device. Typical minimum air gap requirements are double the effective opening of the pipe. An air gap fitting is a device with an internal air gap which physically connects a drain line to a wastewater receiving point. An alternative to requiring an air gap fitting is to just require that the drain line is installed with a sufficient air gap in accordance with ASME A112.1.2. The benefit of requiring an air gap fitting is that the discharge line and receiving line are physically connected, ensuring that discharge water goes into the intended location.

****

For all drain lines connected to the POET system, provide an air gap fitting in accordance with[Section 22 00 00 PLUMBING, GENERAL PURPOSE][ASME A112.1.3].

2.2.10 Ultraviolet Disinfection Unit

Provide an ultraviolet disinfection unit certified to NSF/ANSI 55 and rated for the design maximum flowrate and maximum operating temperatures and pressures required for the treatment vessels. Provide an ultraviolet disinfection unit designed to operate with [120V-60Hz AC current][_____]. Provide all appurtenant wiring, controls, and piping necessary to provide function of the unit in accordance with manufacturer recommendations.

2.2.11 Flow Regulator

****

NOTE: System flows may need to be regulated to ensure that the POET system components function as intended. Excessive flowrates can lead to short residence times and poor performance of primary treatment units and disinfection units. Note that flow regulators/restrictors are required for

NSF-certified ultraviolet disinfection systems.

Installing a flow regulator may be prudent even if the water system current maximum flowrate does not exceed the maximum flowrate of any POET system component. If a new pump/pressure tank with higher flowrate were added after installing the POET system, the flow regulator would already be in-place.

****

Provide a flow regulator rated at the smallest of the maximum flowrates for the POET system components. Place the flow regulator downstream of all other POET system components.

2.3 MATERIALS

2.3.1 Treatment Media

****

NOTE: The minimum requirement for any treatment media is that it will not introduce contaminants into the treated water at levels that could cause negative health effects. The NSF/ANSI 61 standard included in the paragraph below is the most widely used standard for this requirement. Only virgin treatment media should be used; regenerated/reactivated treatment media should not be used.

This paragraph should be edited to include additional treatment media requirements on a site-specific basis. Specific types of treatment media (e.g. coconut-shell based GAC, microporous IX resin, etc.) should only be required if site-specific information supports the requirement (for example if a treatability study has been completed). Note that specifying additional requirements on the type of treatment media restricts the freedom of the Contractor to meet Performance Requirements as they see fit.

For GAC, one more common requirement would be to specify that the GAC is acid-washed, a manufacturing process that removes some amount of ash/residual impurities from the GAC. Acid-washed GAC can require less flushing during installation compared to GAC that has not been acid-washed. Ion exchange resins can also impact initial water quality, but with different chemical impacts than GAC. For example, ion exchange resins can significantly lower the pH, raise chloride levels, and decrease sulfate levels. Although this is a transient condition, the Designer may wish to specify buffered ion exchange resins, which require less water to be flushed through them before effluent water reaches equilibrium with influent water. An optional requirement to this effect is provided.

****

Provide virgin treatment media.[Provide treatment media that is pre-conditioned to reduce the amount of on-site [flushing][soaking] needed prior to use (e.g. acid washed, buffered, or as appropriate for the specific treatment media).]

2.3.2 Particulate Filter Media

NOTE: This paragraph can be deleted if design of the particulate filter will be by the Contractor. Determining the appropriate particle size for a particulate filter can involve a variety of factors. Local well drillers or water treatment vendors can be an information resource for the Designer. Particle size distribution analysis (e.g. by Standard Method 2560) can also be performed on the water to be treated. In general, the Designer should avoid being overly conservative and selecting the smallest particle size available; the University of Nebraska - Lincoln Institute of Agriculture and Natural Resources Sediment Filtration NebGuide G1492 indicates that "If the pore size of the filter medium is too small or if the concentration of suspended solids in the water is too high, the filter may easily clog and require frequent replacement. In general, the largest rating size that will remove the intended contaminants will require the least maintenance."

The downstream components of the POET system that are being "protected" by the particulate filter may provide requirements for sizing the particulate filter. For example, an ion exchange resin vendor recommends a 5-micron filter in front of it's single-use PFAS-selective resin. Ultraviolet disinfection unit manufacturers also recommend or require particulate filters (typically in the 5-20 micron range). If source water is known or suspected to contain particles in a variety of sizes, options for particulate filtration can include installing two particulate filters in series (e.g. a 50-micron filter followed by a 10-micron filter) or specifying a depth-type filter which has graded opening sizes that decrease in size moving from the outside to the central core.

Provide filter material consisting of [acetate][acrylic][glass][nylon] [polyester][polypropylene][rayon][saran][cotton][polyethylene][_____] construction. Provide filter pore size of: [0.1][0.2][0.45][1][3][10][30][50][75][100][200][_____] microns.

[2.3.3 Support Media

NOTE: This paragraph should only be retained if the treatment vessels will use a gravel support media. Many treatment vessels use man-made collection systems that do not require support media.

****

Provide support gravel consisting of hard, rounded stones with a specific gravity of not less than[2.5 for silica gravel or 3.8 for high-density gravel][_____]. Ensure no more than [5][_____] percent by weight has a specific gravity less than required. Ensure gravel contains no more than [2][_____] percent by weight of thin, flat, or elongated pieces (pieces in which the larges dimension exceeds three times the smallest dimension), and is free from shale, mica, clay, sand, loam, and organic impurities of any kind.

]PART 3 EXECUTION

3.1 EXAMINATION

****

NOTE: Water will be offline for some amount of time during initial installation. The amount of time that the water system is offline can range from several hours to several days. Water system users should be notified prior to performing work, and provisions should be made for either providing alternate water or temporarily vacating the facility.

****

Verify all dimensions in the field; verify there is adequate physical space to place the POET system components and connect to existing water system plumbing without making unplanned building modifications.[Verify that electrical power for the POET system operation is available.][Verify that access to a wastewater discharge location is available.][Verify that any provisions for water shut-off (e.g. providing bottled water, temporarily vacating premises) are in place.] Notify the Contracting Officer of any discrepancies between the provided data and field conditions before performing the work.

3.2 PREPARATION

3.2.1 Surface Preparation

****

NOTE: In some instances, more extensive surface preparation may be necessary to ensure that an adequate area is provided for the POET system components. This may include leveling a floor, building a stand/pedestal, or other site-specific modifications. To the extent possible, necessary modifications should be identified during the PRE-INSTALLATION MEETING. Refer to another specification section (e.g. 03 30 00 CAST-IN-PLACE CONCRETE if installing a new concrete pad) for extensive preparation/modification activities.

****

Relocate any movable materials blocking access to the location where the POET system components will be installed. Coordinate with the [Contracting Officer][property owner][_____] prior to relocating materials, temporarily disassembling items, or otherwise modifying the structure to provide access for installing the POET system. Provide a clean and clear surface for placing the POET system components by

sweeping, shoveling, or otherwise removing any debris.

3.2.2 Temporary Water

Provide temporary water supply consisting of[bottled water][potable water tanks][_____] whenever the POET system installation will result in the water system being unavailable for greater than [_____] hours.

3.3 INSTALLATION

Maintain sanitary conditions when working on water-contacting components of the POET system; clean all tools and materials used during installation to avoid introducing any contaminants into the POET system. Install equipment in accordance with written instructions of the manufacturer and the Government-approved Basis of Design. The following sub-paragraphs provide minimum installation requirements; notify the Contracting Officer of any conflicts between this specification and manufacturer instructions.

3.3.1 Treatment Vessel Installation

****

NOTE: This paragraph includes a provision for securing the treatment vessel(s) to a structural support member. This is not common in industry, but is considered an inexpensive and easy to implement best practice against damage to the POET system due to tipping/movement of the vessels because of either incidental contact by persons or hazardous seismic activity.

****

Place treatment vessels[in the location specified in paragraph DESIGN REQUIREMENTS]. Ensure that the treatment vessels are level after placement.[Secure the treatment vessels to a structural support member using a [mounting][restraint] system which includes manufacturer instructions indicating acceptable methods for making connections to the structural support member and allowable loads. Follow manufacturer instructions. The [mounting][restraint] system must not exert pressure on the treatment vessel or be fastened to the vessel using screws, nails, bolts, etc. unless approved by the vessel manufacturer.]

3.3.2 Pipes, Valves, Fittings, Appurtenances Installation

Install piping, valves, fittings, and appurtenances in a neat manner with all joints tight and with no undue marring of finishes. Ensure that installed piping, valves, fittings, and appurtenances are free from strain and excessive stresses caused by weight or misalignment. Install in accordance with[Section 22 00 00 PLUMBING, GENERAL PURPOSE][_____].

3.3.3 Particulate Filter Installation

Install the particulate filter[s][upstream][and][downstream] of the primary treatment vessel[s]. Mount the particulate filter[s] in accordance with manufacturer written instructions and using manufacturer [provided][approved] mounting hardware.

3.3.4 Disinfection Unit Installation

Install the disinfection unit in accordance with manufacturer written

instructions.

3.3.5 Drain Line Installation

Install the drain line connecting the treatment vessel[s] to the wastewater drain location. Provide an air gap in accordance with[local plumbing code][ASME A112.1.2][_____].

3.3.6 Electrical Work

[Connect electrically-powered POET system components to existing electrical outlets that meet the POET system component manufacturer requirements. Connect only to electrical outlets which have integral ground fault circuit interrupter protection and are UL-listed for use in "wet locations".][Install electrical outlets to provide power to POET system components. Perform electrical work in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.]

3.3.7 Disinfection of Equipment and Components

****

NOTE: The disinfection procedure specified in International Plumbing Code essentially involves filling the water system with a water/chlorine solution, allowing that solution to stand for a period of time, and flushing until the chlorine is purged. This procedure cannot be completed after activated carbon or certain ion exchange resins have been installed in treatment vessels because the activated carbon will neutralize the chlorine and not allow it to enter downstream components; IX resin can be damaged when exposed to chlorine.

****

After all equipment and components are installed and before treatment media is installed, purge and disinfect the water system per[the procedure specified in ICC IPC][_____]. If treatment media is installed in the treatment vessels off-site in accordance with paragraph TREATMENT MEDIA INSTALLATION, perform the disinfection procedure on the treatment vessels prior to installing the treatment media. Then complete disinfection of the water system by bypassing the treatment vessels and following the purging and disinfection procedure specified above.

3.3.8 Treatment Media Installation

****

NOTE: Designers should consider requiring the Contractor to install and condition treatment media off-site in a controlled setting such as a shop. The reasons to install and condition treatment media off-site include 1) ensuring that there is an adequate supply of water to install/condition the media and 2) minimizing disruptions to the owners/tenants that will use the POET system. Reasons to avoid installing and conditioning the treatment media off-site generally are limited to logistical challenges (e.g. the filled treatment vessels would be too heavy/difficult to handle, treatment media is being installed in a vessel that

is already in-place, the POET system is being installed in a very remote location and there is no off-site facility within reasonable distance).

The amount of water needed to install and commission treatment media will depend on a variety of factors. A POET system with 0.1 cubic meters 4 cubic feet of GAC media treating water for a single household could require as much as 5,700-11,400 liters 1,500-3,000 gallons of water for initial flushing. Many water sources such as small residential-type wells have difficulty producing this volume of water in a short time. This flushing water also must be disposed, which can create issues if the discharge is going to a septic system/drainfield with limited capacity. On-site installation and conditioning of treatment media also necessitates using the contaminated/impacted water that the POET system is intended to treat, which may not be ideal in all circumstances.

Certain POET system treatment media types also require wetting. GAC media needs to be wetted to purge air from the pores for as much as 24 hours or more. If installing the media on-site this may add another day to the installation process, burdening the resident/tenant. Some designers may also wish to conduct initial sampling of installed treatment media to verify that chemicals are not leaching from the media at unacceptable levels; this can also extend the installation period and cause disruptions.

****

Install treatment media[off-site at a location with adequate water supply and wastewater handling facilities to complete the work described in the following sub-paragraphs][on-site at the location the POET system will serve].

3.3.8.1 Treatment Media Placement

****

NOTE: Specify the quantity of treatment media only if using a prescriptive design approach. If treatment media quantities and freeboard are specified, coordinate with Paragraph TREATMENT VESSELS to ensure that requirements do not conflict. If design of the POET system is performance based, use the less prescriptive text that refers to the design and performance requirements.

****

Place treatment media[in accordance with vessel [and][or] treatment media manufacturer directions]. Store and handle the treatment media in a manner that avoids contamination. Clean and disinfect any equipment used in placing the treatment media. Leave a freeboard of [_____] m ft between the top of the treatment media and the top of the vessel. Gently vibrate the vessel periodically to ensure the treatment media settles without voids or bridging.[Place sufficient quantities of treatment media in accordance with paragraph DESIGN REQUIREMENTS and paragraph PERFORMANCE

REQUIREMENTS.][Place treatment media to the quantities specified in the following table:

TABLE 4 - TREATMENT MEDIA PLACEMENT QUANTITIES	
Media Type	Quantity
[_____]	[_____]

]

3.3.8.2 Treatment Media Conditioning

****

NOTE: Specific steps for treatment media conditioning will vary based on the type of treatment media being used. However, there are general concepts of conditioning that apply to most granular treatment media.

Adequate contaminant removal by granular treatment media requires uniform flow through the media bed. Uniform flow can be disrupted in several ways. If gases are trapped in the treatment media, this will block some pathways for water flow, increasing the flow rates in the remaining pathways and effectively decreasing the residence time for contaminated water. Gases are removed during conditioning by wetting the treatment media; water soaks into the treatment media and displaces the gases that occupied the pore structure of the media. The 16 hour recommendation is based on a POET system using GAC; shorter timeframes may be used for other treatment media like IX resin depending on manufacturer recommendations.

Most treatment media consist of particles of varying size; to function best, the treatment media needs to be properly sorted by size in the vessel. Treatment media can become improperly sorted during shipment, handling, and placement treatment. An improperly sorted treatment media bed is more likely to have regions of excessively high or low flow, effectively decreasing the residence time for contaminated water. After treatment media is placed into a vessel, this improper sorting process is remedied by performing a sorting backwash. During a sorting backwash, water flows upward through the treatment media at a sufficient rate to suspend the treatment media particles in the flowing water (a process called fluidizing). The various treatment media particles are evenly sorted by size with smaller particles moving to the top of the bed and larger particles to the bottom. Sorting backwashes require water flow at a sufficient rate and time. Treatment media manufacturers will supply appropriate values, but for reference GAC media backwash flow rates are typically 0.2-0.54 cm/sec 3-8 gpm/square foot and times are 30-45 minutes. IX resin flows are typically 0.1-0.2 cm/sec 1.5-3.0 gpm/square foot and times

are 15-20 minutes. The treatment vessel must also have sufficient freeboard to allow the media to expand (typically 30 percent of bed height for GAC and 50-100 percent of bed height for resin). It should be noted that some IX resins do not require backwash during commissioning (e.g. IX resins for treating PFAS or perchlorate). Equally important, these types of IX resin should not be backwashed once they are placed in service.

All treatment medias should be assumed to have an initial equilibration period during which time the treatment media can impart undesirable or unacceptable qualities to the treated water. These undesirable/unacceptable qualities can be aesthetic (taste, odor, color) or chemical quality (leaching of specific chemicals at concentrations above regulatory standards). One of the most common occurrences is leaching of arsenic from GAC treatment media during conditioning. It is important to understand that these water quality impacts should be temporary and non-recurring if the treatment media has been properly selected, manufactured, and handled. Treatment media can also temporarily alter the chemistry of treated water, such as the change in pH that can temporarily occur with IX resins. Proper conditioning involves flushing a sufficient volume of water through the treatment media to waste, such that these water quality impacts are eliminated or reduced to acceptable levels. The volumes of water required for flushing vary widely depending on the treatment media type and characteristics of the water being used to flush the treatment media. Treatment medias can also be pre-conditioned by the manufacturer to reduce the amount of flushing needed during install and conditioning. A popular example is acid washing GAC media or buffering anion exchange resin. Ultimately, proper conditioning is verified by collecting samples of water passing through the POET system after conditioning is believed to be complete.

****

Perform the following treatment media conditioning steps in the sequence specified. For POET systems with multiple treatment vessels, perform the backwash and forward flush steps separately for each vessel; do not conduct the backwash or forward flush in series using the same water in both vessels. Follow manufacturer requirements if those requirements are more stringent than what is specified here:

a. Wetting: Wet the media for a minimum of [16][_____] hours. Ensure that the water level remains above the top of the media during wetting. Provide a continuous opening for gases to escape the vessel during wetting, but ensure the opening is covered with a gas-permeable [screen][filter] (e.g. fine mesh wire screen) to prevent foreign materials entering the vessel.

b. Backwash: Perform an upflow backwash at a flow rate of [_____] to [_____] cm/sec gpm/square foot for a duration of [_____] minutes.

Slowly open the water supply valve when starting backwash and slowly close the water supply valve when ending backwash. Once the minimum specified backwash duration has been met, collect a small volume of backwash water and visually inspect for particles; if particles are observed, continue backwashing until the backwash water is visually free of particles. Direct backwash water to the designated wastewater disposal location.

c. Forward Flush: Flush water through the treatment media at a flowrate of [_____] to [_____] lpm gpm. Flush a minimum of [_____] bed volumes of water through the treatment media.[After the minimum prescribed volume of water has been flushed through the treatment media, conduct the field water quality testing specified in paragraph FIELD WATER QUALITY TESTING. Continue to flush the treatment media if any of the field testing indicates unacceptable results.] Direct the flush water to the designated wastewater disposal location.

3.4 FIELD QUALITY CONTROL

Perform field tests and inspections[in the presence of the Contracting Officer] and provide labor, equipment, and incidentals required for the test. Provide for disposal of all waste residuals resulting from the test[offsite][onsite via existing solid waste and wastewater disposal resources]. Notify the Contracting Officer [_____] days prior to the date and time for the field tests and inspections. Rectify any deficiencies found and retest any work affected by such deficiencies.

3.4.1 Tests

3.4.1.1 Performance Tests

After installation of the complete POET system, complete an operating test to assure that the POET system operates properly. If any deficiencies are revealed during any tests, correct such deficiencies and repeat the test. Flow water through the POET system by opening downstream discharge points such as faucets, showers, etc. Conduct a performance test at a minimum of [2][_____] discharge points, with water flowing from each discharge point for at least [15][_____] minutes. Once a steady flowrate is observed and any entrained air has been purged, measure flowrates at each discharge point using a container and stopwatch over a period of [5][_____] minutes. Open additional taps if necessary to achieve a combined flowrate equal or greater than the flowrate given for the pressure loss requirement in paragraph PERFORMANCE REQUIREMENTS. Visually inspect the water recovered during the flow test; if particulates are observed in the water this represents a deficiency requiring correction. During the performance test measure pressure loss across the POET system; pressure loss exceeding the value in paragraph PERFORMANCE REQUIREMENTS represents a deficiency requiring correction.

[
For POET systems designed to be backwashed either automatically or manually, initiate a backwash cycle. Observe the backwash discharge piping for adequate flow and free discharge. Once the backwash cycle is over, observe treated water exiting the POET system to verify that there are no particulates present.]

3.4.1.2 Field Water Quality Testing

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NOTE: Field water quality testing is an optional

means of verifying that the treatment media has been adequately installed and conditioned. If no field water quality testing will be performed, delete this paragraph and the associated text in paragraph TREATMENT MEDIA CONDITIONING. Some parameters to consider for field water quality testing include pH, turbidity, dissolved solids, and arsenic (for activated carbon); parameters to test for should be determined based on the site water quality and treatment media used in the POET system.

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Conduct water quality tests in the field using[testing meters][and][field test kits]. Conduct field water quality testing as specified in the table:

Table 5 - Field Water Quality Testing

Parameter	Field Testing Method	Field Testing Frequency
pH	Multi-parameter Digital Water Quality Meter	After flushing minimum volume specified in paragraph TREATMENT MEDIA CONDITIONING
Dissolved Solids	Multi-parameter Digital Water Quality Meter	After flushing minimum volume specified in paragraph TREATMENT MEDIA CONDITIONING
Arsenic	Test Kit with Detection Range equal or less than 10 ug/L	After flushing minimum volume specified in paragraph TREATMENT MEDIA CONDITIONING
[_____]	[_____]	[_____]

3.4.1.3 Water Sampling and Analysis

After completing the required performance tests and correcting any deficiencies, collect water samples from the POET system. Collect samples from the[POET system influent,][between treatment vessels,][downstream of the final POET system component,][at a tap served by the POET system]. Collect, label, preserve, and transport water samples in accordance with[a project-specific UFP-QAPP][a basewide QAPP][_____]. Analyze water samples for the parameters listed in paragraph PERFORMANCE REQUIREMENTS. Failure to meet the performance requirements in paragraph PERFORMANCE REQUIREMENTS for any parameter represents a deficiency requiring correction.

3.4.1.4 Acceptance Test Report

Submit test reports demonstrating compliance with the Performance Requirements specified in this specification section.

3.4.2 Inspection

After completing the performance testing and water sampling described in Paragraph TESTS, complete a final inspection of the POET system. Carefully inspect all components for defects in workmanship and material. Clean

debris and foreign matter from exterior surfaces. Operate all valves and other mechanisms to check their proper functioning. Check all connections for tightness. Assure that there is no uncharacteristic vibration or noise from any components. If any deficiencies are revealed during the inspection, correct such deficiencies. Submit an Inspection Report documenting completion of the inspection. Include sufficient photographs of the POET system to clearly identify each component.

3.4.3 Manufacturer Field Service

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NOTE: Manufacturer field service may not be available depending on the manufacturer providing the POET system components. If the POET system is being installed by a properly licensed/trained individual, manufacturer field service may not be necessary. Delete this paragraph if manufacturer field service is not desired.

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Provide the services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified. The representative is required to supervise the installation, adjustment, and testing of the equipment. Include up to [5][7][10][_____] days of service.

3.5 CLOSEOUT ACTIVITIES

3.5.1 Operation and Maintenance Manual

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NOTE: Delete specific requirements from the following list if they are not applicable to the POET system being installed. Some requirements such as the Concept of Operations and Product Data will largely duplicate information previously provided in the Basis of Design, but this is intentionally done to ensure that the Operation and Maintenance Manual provides a single, complete document of the POET system. Delete the Sampling and Analysis Plan if sampling of the POET system will be completed in accordance with a separately prepared UFP-QAPP, Basewide QAPP, etc. Development of the O&M manual should include consideration for how treatment media will be replaced. Off-site replacement is often preferred when it is feasible because it allows for more control of the conditions when removing, placing, and conditioning treatment media.

Ideally, POET systems should be regularly used to avoid water stagnation, which can lead to bacterial growth particularly within the treatment media. For additional discussion on bacterial growth in POET systems, see EPA 815-R-06-010, Point-of-Use or Point-of-Entry Treatment Options for Small Drinking Water Systems. If there is an extended absence period when the POET system is not used, corrective actions will likely need to be taken before water from the POET system is used again. Extended

absences may be defined as periods as short as one week or as long as three weeks. A common corrective action is to flush several volumes of water through the POET system after the extended absence, although in some cases more extensive actions such as replacing the treatment media may be necessary. The Designer/Contractor should consider site-specific conditions, POET system design, and vendor recommendations when determining appropriate extended absence procedures.

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Submit an Operation and Maintenance Manual no more than [45][_____] calendar days after installation of the POET system. Provide [two][_____] hard copies of the Operation and Maintenance Manual and an electronic copy (PDF).[Prepare[draft for Government review][draft-final for[regulatory][_____] review] and final versions of the Operation and Maintenance Manual. Allow [30][_____] calendar days for[Government] review[and [30][_____] calendar days for regulatory review]. Allow [45][_____] days for comment resolution following each review and preparing the next version of the document.] The Operation and Maintenance Manual must include, but is not limited to, the following:

a. Table of Contents

b. Revision Tracking Table

c. Safety Precautions

d. Concept of Operations - Narrative description of the sequence or sequences of operation of the overall POETs system.

e. As-built Drawings - Revised version of the Process Flow Diagram from the Basis of Design. Provide a unique identifier for each vessel, sampling port, valve, pressure gauge, flow meter, and any other piece of equipment which provides data regarding POET systems operation. Provide a valve sequence indicating the position of each valve for normal operation (treatment), POET system bypass, and any other unique operating mode.

f. Routine Maintenance Activities - Identify all routine maintenance activities; include procedures for performing each activity and [schedule][frequency] for performing each activity.

g. Treatment Media Replacement - Indicate what data/conditions will trigger treatment media replacement (e.g. sampling results, [pressure][flow] readings, time-in-service, etc.). Provide a detailed instruction for replacing spent treatment media. Define sanitary and disinfection procedures to be followed throughout the process and during specific steps. Indicate how the treatment vessel will be isolated and taken out of service; how treatment media will be removed from the vessel; empty vessel visual inspection procedures; treatment media placement procedures; treatment media conditioning procedures.

h. Possible Breakdowns, Repairs, and Troubleshooting

i. Extended Absence Procedures - Identify what length(s) of time constitute an extended absence (POET system not being used). Identify procedures for communicating extended absences. Specify actions to

take to return the POET system to operation after an extended absence.

j. O&M Data Sheets - Provide separate data sheets for routine maintenance activities and treatment media replacement.

k. Product Data

l. Disposal - In accordance with applicable local and federal regulations, define any testing and waste characterization requirements for spent treatment media, wastewater generated during commissioning, and other wastes generated during operations and maintenance. Indicate proposed recycling and disposal locations to be used for the various waste streams.

m. System Shutdown - Identify conditions that would lead to the Government shutting down the POET system. Indicate if the POET system components would be removed or transferred to the [resident][property] owner.

[
n. Sampling and Analysis Plan]

3.5.2 Posting System Information Sheet

Post the system information sheet developed under paragraph Basis of Design [on][near][_____] the POET system. The system information sheet must be [laminated][under [glass][plexiglass]][_____]. Prior to posting the system information sheet, make revisions to reflect any changes to the system design after the Basis of Design document was finalized.

3.5.3 Training

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NOTE: The need for training should be assessed based on the complexity of the POET system, level of engagement and interest of the resident/owner, and number of O&M activities that Government employees and resident/owner are expected to complete. In general, private property residents/owners SHOULD NOT (emphasis added) be expected to complete O&M activities because of their assumed lack of technical experience and the potential Government liabilities associated with the resident/owner altering the function of the POET system in a negative way.
****

After completing all required activities in paragraph FIELD QUALITY CONTROL, conduct an on-site training session for [Government representatives][and][the [resident][owner]]. The training session must cover each item contained in the Operations and Maintenance Manual.[Brief the [resident][owner] on the information provided in the System Information Sheet.]

3.6 PROTECTION

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NOTE: The Designer should consult with decision makers and stakeholders to determine when the POET system is authorized for use after installation. A

conservative approach is to not authorize use of water from the POET system until after initial Acceptance Testing results have been received, reviewed for quality and usability, and most importantly found to meet the POET system's performance requirements. Variations of this approach include either not authorizing any water use or authorizing non-potable water uses such as flushing toilets, showering, etc. The burden of this approach is mainly felt by the resident/owner of the POET system due to the time that the water system will be unavailable for use. One important consideration is stagnation of water in the POET system if it is not used pending Acceptance Testing results. Some means should be provided to flush water through the POET system periodically until it is authorized for use. This could be accomplished with an automatic flushing control valve or manually (e.g. running water through a tap to waste). If the resident/owner of the POET system is expected to flush water through the system, this needs to be clearly communicated.

A less conservative approach is to authorize use of the water as soon as the POET system installation is complete and all FIELD QUALITY CONTROL activities have been performed and approved. Under this approach, the following paragraph could be deleted. This approach would ideally only be used if there is high confidence in the performance of the POET system (e.g. an identical system is being used for similar contaminants and water supply with success, the installer has extensive experience with the system, etc.)

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Protect the water system from use[for potable purposes] during the period between when installation is completed and the Government approves the Acceptance Testing results. [The Government will inform][Inform] the [resident][owner] that the water is not to be used for[any purpose][potable purposes] until they are notified that the water system is ready to be used. Ensure that a minimum of [_____] liters gallons of water is flushed through the POET system to waste at least [weekly][_____] during this period.[Place tags on all[potable] water fixtures indicating that the "water is not to be used pending testing results"].

-- End of Section --