CHAPTER 626. PUBLIC WATER SUPPLY CONSTRUCTION STANDARDS

SUBCHAPTER 3. PERMIT PROCEDURES

252:626-3-2. Applications

(a) Submit legible applications on forms provided by the DEQ and include:

(1) the type of entity that is applying,

(2) the legal description,

(3) a minimum of 2 sets of plans and specifications, with at least one set of construction plans printed on 11" x 17" paper and one set of specifications loosely bound that is suitable for scanning, or alternatively submit through DEQ's electronic submission portal as authorized,

(4) a final design analysis. Provided, an authorized design-build project may use the flexible permitting process upon approval by DEQ as provided in these rules. If design-build is used, the final design package must encompass the entire completed project,

(5) all appropriate fees, and

(6) engineering report approved by the DEQ for major waterworks projects, or smaller projects utilizing non-conventional processes.

(b) Public entities other than municipalities must provide certified copies of the results of the last election or appointment of the members of the governing body. Public entities must provide a citation of legal authority to own and operate the proposed facility.

(c) Applicants other than public entities must provide copies of documents that created them and provide a citation to their statutory authority.

252:626-3-6. Engineering report

(a) **Copies and timing.** Submit 3 copies of an approvable engineering report as required in OAC 252:626-3-2 for proposed new construction or modifications to PWS systems, or alternatively submit through DEQ's electronic submission portal, at least 30 days prior to the submission of the application for a permit to construct.

(b) **Purpose.** The purpose of the report is to present the Engineer's findings with enough attention given to detail(s) to allow adequate review of the project by the owner and applicable regulatory agencies.

(c) **Requirements.** The report must include all information necessary for a comprehensive evaluation of the proposed construction. The report must present, at a minimum, the following:

(1) **General information.** Include the following:

(A) a description of existing water works and wastewater facilities,

(B) identification of the municipality or area served,

(C) name and mailing addresses of the owner and official custodian,

(D) a statement as to whether the project will be constructed in phases. If the project is to be constructed in phases, the statement will include the number of phases necessary to complete the project and which portions of the project will be completed in each phase,

(E) a demonstration that adequate capacity, treatment and compliance with the primary drinking water standards are maintained during construction,

(F) a letter from the permittee approving the contents contained in the engineering report as submitted,

(G) a map showing legal and natural boundaries of entire service area, and

(H) a map showing new service areas or annexed areas.

(2) **Extent of water works system.** Include the following:

(A) a description of the area to be served,

(B) provisions for extending the waterworks system,

(C) establish the anticipated design average and peak flows for existing and potential industrial, commercial, institutional and other water supply needs for both the current service area and potential future service areas,

(D) a hydraulic analysis that demonstrates that a minimum of 25 psi shall be met at all times throughout the distribution system, and

(E) a site plan and schematic layout of treatment facilities.

(3) **Alternate plan.** Where feasible and practical, provide a minimum of 3 alternative solutions and discuss the alternatives, including cost estimates and reasons for selecting the one recommended.

(4) **Soil, ground water conditions, and foundation problems.** The report must include a description of the following:

(A) the character of the soil where water mains are to be laid,

(B) soil conditions, which might affect foundations of proposed structures, and

(C) the approximate elevation of ground water in relation to subsurface structures.

(5) **Water use data.** Provide the following water use data:

(A) a description of the population trends as indicated by available records, and the estimated population which will be served by the proposed water supply system or expanded system,

(B) present water consumption of existing systems and the projected average and maximum daily demands that were used as the basis of the design, and

(C) present or estimated yield of supply source(s) along with a copy of the water rights verification form and/or the purchase water contract.

(6) **Fire flow requirements.** Demonstrate that the plans meet the requirements regarding fire flows pursuant to the *International Fire Code,* published by the International Code Council, Inc., ~~2003~~2024 Edition, *Distribution System Requirements for Fire Protection, ~~M 31~~M31,* published by the AWWA, ~~3rd~~4th Edition or other recommendations of similar organizations for the fire service area.

(7) **Sewer system available.** Describe the methods of disposal for sanitary and all other wastewater from the treatment plant.

(8) **Sources of water supply.** For the alternative chosen, the report must describe the proposed source or sources of water supply to be developed, the reasons for their selection, and provide information required by OAC 252:626-7 and the following:

(A) surface water sources, including:
(i) hydrological data, stream flow and weather records,
(ii) safe yield, including all factors that may affect it,
(iii) maximum flood or pool elevation,
(iv) description of watershed, noting any existing or potential sources of contamination which may affect water quality, and
(v) quality of the raw water with special reference to fluctuations.
(B) ground water sources, including:
(i) sites considered,
(ii) advantages of the site selected,
(iii) elevations with respect to surroundings,
(iv) character of formations through which the source is to be developed,
(v) geologic conditions affecting the site,
(vi) summary of exploration; test well depth and method of construction; placement of liners or screen; test pumping rates and duration; water levels and specific capacity; chemical and radiological quality of the water,
(vii) sources of possible contamination including but not limited to wastewater collection and treatment facilities, landfills, outcroppings of consolidated water-bearing formations, waste disposal wells, slush pits, irrigation wells and abandoned wells, and
(viii) industrial and other private water supply. Where pertinent, use significant ground water developments within a 1 mile radius of the proposed ground water source, giving depths, size, protective casing depth, capacity, location, type and any available information pertaining thereto.

(9) **Proposed treatment processes.** Summarize and determine the adequacy of proposed processes and unit parameters for the treatment of the water under consideration. Pilot studies may be required for innovative design. Post treatment for membrane systems shall be in accordance with OAC 252:626-9-9 (f)(6).

(10) **Residuals management.** Submit a Residuals Management Plan that discusses the wastes and volume generated by existing and proposed water treatment processes, their volume, proposed treatment of waste products, points of discharge or method of disposal or land application.

(11) **Project sites.** Address the following in the report:
(A) discussion of various sites considered and advantages of those recommended,
(B) the proximity of residences, industries, and other establishments, and
(C) any potential sources of pollution that may influence the quality of the supply or interfere with effective operation of the water works system, including but not limited to, absorption systems, septic tanks, privies, sink holes, sanitary landfills, refuse and garbage dumps.

(12) **Cost estimates.** Address the following in the report:
(A) estimated cost of integral parts of the system,
(B) detailed estimated annual cost of operation, and
(C) proposed methods to finance both capital charges and operating expenses.

(13) **Future extensions.** Summarize future needs and services.

(14) **Design-build.** Authorized design-build projects may use the flexible construction permitting process as approved in the engineering report, including:
(A) Label cover documents prominently as "Design-build"
(B) Completed attestation form from applicant certifying that project is design-build;
(C) Description of design packages, including the number (maximum of six), scope of each package, expected schedule of each package, and expected schedule of completion for major construction items;
(D) The engineering report will address the entire scope of the project at 100% completion.

252:626-3-7. Plans and specifications

(a) Plans and specifications must address the entire project pursuant to the approved engineering report as required in OAC 252:626-3-2. If the applicant plans to phase construction, the approved engineering report shall contain a description of each phase of the project and the sequence of construction to ensure continuity of the system and that adequate capacity will be available for each phase.

(b) All detailed plans must be legible and drawn to a suitable scale. Plans for modifications or extensions to existing systems or plants must indicate clearly the connections or relation. Include the following:

(1) A general layout sheet that includes:
(A) title and date,
(B) name of municipality, rural water district, or other entity or person who owns the system,
(C) area or institution to be served,
(D) scale, in feet,
(E) north point,
(F) data used,
(G) boundaries of the municipality, rural water district, or area to be served,
(H) name, telephone number, and address of the designing engineer,
(I) the Engineer's seal and signature,
(J) location and size of existing water mains, and
(K) location and nature of existing water works structures and appurtenances affecting the proposed improvements.
(L) authorized design-build projects must label cover documents prominently as "Design-build" specify the design package number, and reference the approved engineering report number.

(2) Detailed sheets that include:

(A) stream crossings with profiles of the stream bed showing the normal, high and low water levels,
(B) profile sheets with a horizontal scale of not more than 100 feet to the inch and a vertical scale of not more than 10 feet to the inch. Both scales must be clearly indicated. A smaller horizontal scale may be used for rural water distribution systems, but in no case smaller than 500 feet to the inch. Plans with contour intervals of 10 feet or less may be provided in lieu of profiles,
(C) dimensional boundaries of property intended for ground water development. Show location with respect to known references such as street intersections or section lines,
(D) topography and arrangement of existing and proposed wells or structures, with contour intervals not greater than 2 feet. Contour intervals of greater than 2 feet can be used for water line plans. Contour intervals cannot be greater than 10 feet,
(E) elevations of the highest known flood level, floor of the structure, upper terminal of protective casings and outside surrounding grade, using Federal Emergency Management Agency (FEMA) or equivalent elevations as reference,
(F) drawings of well construction, showing diameter and depth of drill holes, casing and liner diameters and depths, grouting depths, elevations and designation of geological formations, water levels and other details to describe the proposed well completely,
(G) location of all existing and potential sources of pollution within 300 feet of the raw water source and within 100 feet of underground treated water storage facilities,
(H) size, length, and identity of sewers, drains, and water mains near the proposed water works,
(I) schematic flow diagrams and hydraulic profiles showing the flow through plant units,
(J) piping in sufficient detail to show flow through the plant, including waste lines, and locations of all sampling taps,
(K) locations of all chemical feeding equipment and points of chemical application, sanitary and other facilities, including but not limited to lavatories, showers, toilets, and lockers,
(L) all appurtenances, specific structures, equipment, water treatment plant waste disposal units and points of discharge,
(M) locations, dimensions and elevations of all proposed and existing plant units,
(N) adequate description of any features not otherwise covered by the specifications,
(O) location of all valves, and
(P) location of all storage tanks, including the capacity of the tanks and top and bottom elevations.

(c) Specifications must:

(1) supply complete, detailed, technical specifications for all parts of the proposed project, including a program for keeping existing water works facilities in operation during construction of additional facilities,
(2) cover in detail materials to be used, methods of making or drilling well(s), dimensions, depth, straightness of the hole, required logs, tests, records, locations of water formations, grouting or cementing, shooting and final testing of the well(s), for ground water systems,
(3) provide supporting data regarding reliability of operation, maintenance and operator training, if automatic equipment is proposed. Provide manual override for any automatic controls;
(4) be written so that a representative of the manufacturer will check the installation and supervise initial operation of the major items of mechanical equipment and pumps,
(5) provide complete sets of all special tools and accessories required for operation and maintenance, together with parts lists, and operation and maintenance manuals for each piece of mechanical equipment, and
(6) provide for an Operation and Maintenance (O & M) Manual for the operation and maintenance of the public water supply system. The O & M Manual shall include at a minimum:

(A) System Treatment Requirements;
(B) Description, Operation and Control of the Water Treatment Plant;
(C) Control of Unit Processes;
(D) Laboratory Testing;
(E) Common Operating Problems;
(F) Start-Up Testing and Procedures;
(G) Standard Operating Procedures;
(H) Alternative and Emergency Operations;
(I) Emergency Shutdown Operations and Emergency Response;
(J) Records Control and Retention;
(K) Safety;
(L) Public Water Supply System Maintenance Records;
(M) ~~Stormroom~~Storeroom and Inventory System; and
(N) Utilities.

(d) File as-built plans (plans of record) which identify any changes to the DEQ approved plans and specifications and an Engineer's certification that the construction was completed according to the requirements of this Chapter within 6 months after the project is completed.

SUBCHAPTER 9. TREATMENT

252:626-9-2. Pretreatment

(a) Provide pre-sedimentation basins for package and slow sand filter water treatment plants if the raw water turbidity is variable and exceeds 30 NTU at any time during the year. Surface water containing an excessive amount of suspended material or high organic content which cannot be readily removed by a package treatment plant or slow sand filtration requires pre-sedimentation and may require additional treatment prior to conventional treatment.
(b) Pre-sedimentation basins shall be designed in accordance with OAC ~~252:626-9-8~~252:626-9-8(a)(3)(B).
(c) Provide pre-sedimentation for microfiltration and ultrafiltration (MF/UF) for removal of total organic carbon or other soluble compounds, including, but not limited to iron and manganese. If the engineering report demonstrates that total organic carbon will not cause disinfection by-products violations then pre-sedimentation is not necessary. Other pretreatment methods, other than pre-sedimentation, shall be based on the results

of a three (3) month pilot study. The study shall also determine the need for additional treatment if the water is high in turbidity or includes undesirable soluble constituents such as iron and manganese.
(d) Pretreatment for nanofiltration and reverse osmosis (NF/RO) depends on the quality of the raw water. If the feed water has a turbidity of less than 1 NTU or an SDI of less than 5, then cartridge filters with a pore size range of less than 20 μm are required prior to the NF/RO treatment. If the feed water turbidity is 1 NTU or greater or the SDI is 5 or greater, then a more rigorous method of particulate removal, such as conventional treatment (including media filtration) or MF/UF membranes for particle removal is required. The use of MF/UF for pretreatment is more commonly known as an integrated membrane system (IMS). The IMS is one method allowed for the removal of particulate matter and microorganisms as well as some dissolved contaminants such as hardness, iron and manganese or disinfection by-product (DBP) precursors.

252:626-9-8. Clarification

(a) **Standard design.**

(1) **Rapid mix.** Rapid mix means the rapid dispersion of chemicals throughout the water to be treated. Provide for the following:

(A) equip mixing basins with mechanical mixing devices capable of adjustment to compensate for variations in raw water quality and flow. Commercial in-line static mixers capable of producing results equal to basins containing mechanical mixers at all anticipated flows will be acceptable,

(B) ~~the maximum detention time of the rapid mix basin, at design flow is 30 seconds~~provide good mixing of the raw water with the chemicals applied and prevent deposition of solids in the mixing zone, and

(C) locate the rapid mix and flocculation basins as close together as possible.

(2) **Flocculation.** Flocculation means the agitation of water at low velocities through gentle stirring by hydraulic or mechanical means. Arrange piping to allow either unit to be removed from service without disrupting operation of the treatment plant.

(A) Flow-through velocity must be 0.5 to 1.5 ft/min, with a detention time for floc formation of at least 30 minutes.

(B) Provide variable speed drives to control the speed of agitators to a peripheral paddle speed of 0.5 to 3.0 ft/s.

(C) Locate flocculation and sedimentation basins as close together as possible. The velocity of flocculated water through pipes or conduits to settling basins must be 0.5 to 1.5 ft/s. Design to minimize turbulence at bends and changes in direction.

(D) Provide a basin drain line of at least four inches (4") in diameter.

(E) Baffling may be used to provide for flocculation. The design shall be such that the velocities and flows in this paragraph will be maintained.

(3) **Sedimentation.** Conventional horizontal flow sedimentation basins shall conform to the following.

(A) Sedimentation must follow flocculation. Arrange piping to allow either unit to be removed from service without disrupting operation of the treatment plant.

(B) The following criteria apply to conventional sedimentation units:

(i) a minimum detention time of 4 hours is required except when used for lime-soda softening of ground water, the settling time is reduced to a minimum of 2 hours,

(ii) design basins to prevent short-circuiting. Design inlets to distribute water equally and at uniform velocities. Open ports, submerged ports, or similar entrance arrangements are required. Design port to provide uniform flows across the basin and control headloss to prevent floc breakage,

(iii) provide outlet weirs and maintain velocities suitable for settling in the basin,

(iv) limit flow rate over the weir to 20,000 gal/day/ft of weir length,

(v) limit the velocity through the basin to 0.5 ft/min,

(vi) design basins with mechanical residuals removal and slope the floor to conform to manufacturer's recommendations. Provide a basin drain line of at least 4 inches in diameter,

(vii) rectangular basins must have a minimum length-to-width ratio of 2:1, and

(viii) make provisions for the operator to observe or sample residuals being withdrawn from the unit.

(C) **Tube settlers.**

(i) Set tubes at a 60-degree angle to the flow.

(ii) A minimum detention time of three (3) hours is required for surface water treatment and two (2) hours for groundwater treatment.

(iii) Design tube settlers to maintain velocities suitable for settling in the basin and to minimize short-circuiting.

(iv) Size drain piping to facilitate a quick flush of the settler units and to prevent flooding other portions of the plant.

(v) Provide sufficient freeboard above the top of settlers to prevent freezing in the units in outdoor installations

(vi) The maximum application rate is 2 gpm per square foot of cross-sectional area.

(vii) Provide flushing lines, equipped with backflow prevention, to facilitate maintenance and cleaning.

(b) **Solids contact unit.**

(1) **Installation of equipment.** Supervision of all mechanical equipment installation by a representative of the manufacturer at the time of installation and initial operation is required.

(2) **Sampling taps.** Adequate piping with sampling taps located to permit the collection of samples from critical portions of the units are required.

(3) **Chemical feed.** Apply chemicals at points and means necessary to ensure satisfactory mixing with the water.

(4) **Mixing.** Rapid mix units ahead of the solids contact units, must comply with OAC 252:626-9-8 (a)(1). Construct solids contact mixing devices to provide good mixing of raw water with previously formed residuals particles, and prevent deposition of solids in the mixing zone.

(5) **Flocculation.** Flocculation equipment must:

(A) be adjustable (speed or paddle pitch),

(B) provide for coagulation in a separate chamber or baffled zone within the unit, and

(C) provide a combined flocculation and mixing period of not less than 30 minutes.

(6) **Residuals concentrators.** Provide either internal or external concentrators to obtain concentrated residuals with a minimum of wastewater.

(7) **Residuals removal.** Provide units with suitable controls for residuals withdrawal and the following:

(A) residuals pipes not less than 4 inches in diameter and equipped with appropriate cleanouts to facilitate cleaning,

(B) entrance to residuals withdrawal piping that will prevent clogging,

(C) valves located outside the tank for accessibility, and

(D) the ability for the operator to observe and sample residuals being withdrawn from the unit.

(8) **Settling zone detention period.** Minimum detention times for the settling zone (excluding the zones for mixing, flocculation, and sludge collection) are:

(A) three hours for suspended solids contact clarifiers and for softeners treating surface water, and

(B) one and one-half hours for suspended solids contact softeners treating only groundwater.

(9) **Suspended slurry concentrate.** Design softening units so that continuous slurry concentrates of 1% or more, by weight, can be maintained.

(10) **Weirs or orifices.** Design overflow weirs so that water at the surface of the unit does not travel more than 10 feet horizontally to the collection trough.

(A) Weirs must be adjustable, and at least equivalent in length to the perimeter of the tank.

(B) Do not exceed weir loading rates of:

(i) 14,400 gal/day/ft of weir length for units used as clarifiers, and

(ii) 28,800 gal/day/ft of weir length for units used as softeners treating only groundwater.

(C) Weirs must provide uniform rise rates over the entire area of the tank.

(D) Where orifices are used, the loading rates per foot of launder rates shall be equivalent to the weir loading rates.

(11) **Upflow rates.** Do not exceed upflow rates of:

(A) 1.0 gal/min/ft2 of area at the residuals separation line for units used as clarifiers, and

(B) 1.75 gal/min/ft2 of area at the slurry separation line, for units used as softeners treating only groundwater.

252:626-9-10. Softening

Select the softening process based on mineral qualities of raw water, desired finished water quality, requirements for disposal of residuals or brine waste, cost of plant, cost of chemicals and plant location.

(1) **Lime or lime-soda process.**

(A) **Residuals removal.** Provide mechanical residuals removal equipment in the sedimentation basin.

(B) **Rapid mix.** In addition to the rapid mix requirements of OAC 252:626-9-8(a)(1), the design of a softening plant must allow for the recycling of previously formed calcium carbonate crystals (lime residuals) to the rapid mix basin, and a rapid mix detention time of not more than 30 seconds.

(C) **Filtration.** In addition to the requirements for filter design as set forth in OAC 252:626-9-9, equip filters with a mechanical surface sweep to assist filter backwashing.

(D) **Stabilization.** Equipment for stabilization of water softened by the lime or lime-soda process is required.

(2) **Cation exchange process.**

(A) **Pre-treatment.** Pre-treatment is required when the content of iron, manganese, or a combination of the two, is 1 mg/l or more.

(B) **Design.** Automatic regeneration based on volume of water softened is required unless manual regeneration can be justified and is approved by the DEQ. Provide a manual override on all automatic controls.

(C) **Exchange capacity.** Do not exceed the resin manufacturer's recommended design capacity for hardness removal and regeneration.

(D) **Depth of resin.** The depth of the exchange resin must be at least 3 feet.

(E) **Flow rates.** Do not exceed 7 gal/min/ft2 flow rate for softening of bed area. Provide for backwash flow rate of 6 B 8 gal/min/ft2 of bed area.

(F) **Freeboard.** The freeboard will depend upon the specific gravity of the resin and the direction of water flow. Washwater collector shall be twenty-four inches (24") above the top of the resin on downflow units.

(G) **Underdrains and supporting gravel.** Design the bottoms, strainer systems and support for the exchange resin to conform to criteria provided for rapid rate gravity filters.

(H) **Brine distribution.** Provide for even distribution of the brine over the entire surface of both upflow and downflow units.

(I) **Blending configuration.** Provide piping around softening units to produce blended water of desirable hardness. Provide an automatic proportioning or regulating device and shut-off valve on each line. Install totalizing meters on the bypass line and on each softener unit. Treatment of the water will be required when iron and/or manganese levels in the blended water exceed the levels for secondary standards found in 40 CFR, Part 143.

(J) **Additional limitations.** Do not apply water with turbidity of 5 NTU or more directly to the cation exchange softener. Do not use silica gel resins for waters having a pH above 8.4 or containing less than 6 mg/l of silica. When the applied water contains a chlorine residual, the cation exchange resin must be a type that is not damaged by chlorine.

(K) **Sampling taps.** Provide smooth-nose sampling taps for the collection of representative samples. Locate the taps to provide sampling of the softener influent, effluent, and blended water. Install sampling taps for the blended water at least 20 feet downstream from the point of blending.

(L) **Brine and salt storage tanks.** Cover brine measuring or salt dissolving tanks and wet salt storage facilities and construct them of corrosion-resistant material. The make-up water inlet must have a free fall discharge of two pipe diameters above the maximum liquid level of the unit or obtain DEQ approval of other methods of protection from back-siphonage. Support the salt on graduated layers of gravel with a suitable means of collecting the brine. Equip wet salt storage basins with manhole or hatchway openings having raised curbs and watertight covers with overhanging edges similar to those required for finished water reservoirs. Overflow, where provided, must have a free fall discharge and terminate at an approved brine waste disposal facility.

(M) **Salt storage capacity.** Design salt storage large enough to accommodate a 30-day supply.

(N) **Stabilization.** Provide stabilization for corrosion control.

(O) **Waste disposal.** Provide a DEQ approved disposal plan for brine waste. If disposal is to an impoundment, then the impoundment must be lined with a synthetic liner in accordance with the requirements contained in OAC 252:656.

(P) **Construction material.** Pipes and contact materials must be resistant to the aggressiveness of salt.

(Q) **Housing.** Enclose and separate salt storage from other operating areas.

(3) **New technology.** Other forms of softening not covered in this subchapter shall be considered for approval under the conditions of OAC 252:626-3-8 until data from a sufficient number of installations demonstrate their ability to perform satisfactorily.

(4) **Water quality test equipment.** Provide test equipment for pH, alkalinity and total hardness to determine treatment effectiveness.

252:626-9-11. Disinfection

(a) **General.**

(1) **Surface and GWUDI.** All surface and GWUDI supplies require disinfection.

(2) **Groundwater.** Full-time disinfection of a groundwater supply is required whenever the record of bacteriological tests indicates the water is or was ever bacteriologically unsafe pursuant ~~to252626-7-4(a)(2)~~ to 252:626-7-4(a)(2).

(3) **Modification to disinfection process.** Do not make any changes to the disinfection process unless approved by the DEQ.

(4) **CT Standards.** Design the system to meet the CT standards in accordance with 40 CFR § 141.72. CT shall provide 4.0 log inactivation for viruses.

(5) **Accomplished log inactivation.** Total log removal/inactivation required for *Giardia, Cryptosporidium* and viruses shall be accomplished through filtration and disinfection as described in the "Microbial and Disinfection Byproduct Rules Simultaneous Compliance Guidance Manual," EPA 815-R-99-015.

(b) **Chlorination.**

(1) **Chlorinators.** Provide solution-feed-gas-type chlorinators positive displacement hypochlorite feeders or tablet chlorinators. Only NSF approved tablet chlorinators are allowed.

(2) **Capacity.** Design the capacity of chlorine feeders to produce a free chlorine residual of at least 2 mg/l in the water after a contact time needed to meet the required CT Value. The equipment must accurately operate over the desired feeding range.

(3) **Stand-by equipment.** Provide stand-by equipment to replace the largest unit during shutdowns and adequate spare parts for chlorinators. Hypochlorinators of adequate capacity may temporarily replace gas-type chlorinators in small plants.

(4) **Proportioning.** Provide automatic proportioning chlorinators where the rate of flow or chlorine demand is not constant.

(5) **Contact time and point of application.**

(A) At plants treating surface water, make provisions for applying disinfectant to raw water, water applied to filters, filtered water, and water entering the distribution system. At plants treating ground water, make provisions for applying chlorine to the detention basin inlet and water entering the distribution system.

(B) Design all basins used for disinfection to minimize short-circuiting and increase contact time.

(C) If primary disinfection is accomplished using ozone, chlorine dioxide, or any other chemical that does not provide a residual disinfectant, then chlorine or chloramines must be added to provide a residual disinfectant.

(6) **Testing equipment.** Provide chlorine residual test equipment recognized in the latest edition of "Standard Methods for the Examination of Water and Wastewater" published by AWWA, APHA, and WEF. Public water supply systems that serve a population greater than 3,300 shall have equipment that continuously measures and records chlorine residuals at the entry point to the distribution system.

(7) **Chlorinator piping.** Design the chlorinator water supply piping to prevent contamination of the treated water supply by back-siphonage or cross connections with non-potable water. At all facilities treating surface water, pre-chlorination and post-chlorination systems must be independent to prevent possible siphoning of partially treated water into the clear well.

(c) **Chloramines.** Disinfection with chloramines is not allowed for primary disinfection to meet CT requirements.

(d) **Chlorine dioxide.** Perform an oxidant demand study before selecting chlorine dioxide as a primary disinfectant.

(e) **Chlorine dioxide testing equipment.** When treatment with chlorine dioxide is used, provide equipment for testing concentrations of chlorine dioxide and chlorites.

(f) **Ultraviolet disinfection.** UV drinking water disinfection applications shall be closed channel reactors. Full-scale drinking water applications generally use UV low-pressure, UV low-pressure high-output, or UV medium pressure mercury vapor lamps. There are several factors to determine which lamp to use, including the number of lamps needed, lamp life, power usage, start-up time and germicidal efficiency.

(1) **Reactor dose monitoring approaches.** One of the following UV reactor dose-monitoring approaches shall be used:

(A) **UV intensity setpoint approach.** This approach relies on one or more "setpoints" for UV intensity that are established during validation testing, pursuant to the requirements contained in ~~252:626-9-11(e)(2)(C)~~252:626-9-11(f)(2)(C), to determine UV dose. During operations, the UV intensity as measured by the UV sensors must meet or exceed the setpoint(s) to ensure delivery of the required dose. In the UV intensity setpoint approach, UV transmittance does not need to be monitored separately. Instead, the intensity readings by the sensor account for changes in UV transmittance. The operating strategy can be with either a single setpoint (one UV intensity setpoint is used for all validation flow rates) or a variable setpoint (the UV intensity setpoint is determined using a lookup table or equation for a range of flow rates).

(B) **Calculated dose approach.** This approach uses a dose monitoring equation to estimate the UV dose based on the measured flow rate, UV intensity, and UV transmittance. The dose monitoring equation shall be developed through validation testing, pursuant to the requirements contained in ~~252:626-9-11(e)(2)(C)~~626-9-11(f)(2)(C). During reactor operations, the UV reactor control system inputs the measured parameters into the dose monitoring equation to produce a calculated dose. The water system operator divides the calculated dose by the validation factor and compares the resulting value to the required dose for the target pathogen and log inactivation level.

(2) **Design.** The following criteria shall be included in the design of the UV system:

(A) **Flow rate.** Maximum instantaneous flow rates shall be stated in the validation report pursuant to the requirements contained in ~~252:626-9-11(e)(2)(C)~~626-9-11(f)(2)(C).

(B) **Target pathogen(s) and log inactivation.** The log inactivation for the target pathogen(s) must be determined before sizing the UV reactor. The target microorganism(s) and their log-inactivation level shall be stated in the engineering report. The

required UV doses for *Cryptosporidium* and *Giardia* inactivation are lower than those needed for the inactivation of viruses. Most viruses can be easily inactivated with chlorine.

(C) **Validation.** To ensure the validation testing and data analysis is conducted in a technically sound manner and without bias, a person independent of the UV reactor manufacturer shall oversee the validation testing. Individuals qualified for such oversight shall include engineers experienced in testing and evaluating UV reactors and scientists experienced in the microbial aspects of biodosimetry. Appropriate individuals should have no real or apparent conflicts of interest regarding the ultimate use of the UV reactor being tested. The range of validated operating conditions must be included in the validation testing and submittal of a validation report shall be required. The validation testing shall be completed in accordance with procedures outlined in the publication, "Ultraviolet Disinfection Guidance Manual for the Final Long Term 2 Enhanced Surface Water Treatment Rule," EPA 815-R-06-007, (2006).

(D) **Sizing.** A fouling aging factor of 0.70 shall be used to size the UV reactor.

(E) **Required UV dose.** The validation process shall determine the dose monitoring for the required dose over the range of flow, UVT, lamp aging and fouling that will occur at the water treatment plant.

(F) **Water quality.** The following water quality parameters shall be included in the design of the system:

(i) Fouling factors, which include, temperature, pH, turbidity, iron, calcium, manganese, alkalinity and total hardness;

(ii) UV transmittance at 254 mn; and

(iii) UV transmittance from 200-300 mn for MP reactors only.

(G) **Operating pressure.** Provide the expected operating pressures for the UV system. The maximum operating pressure to be withstood by the lamp sleeves and UV reactor housing.

(H) **UV sensors.** A germicidal spectral response shall be specified. A minimum of one UV sensor shall be specified per UV reactor. The actual number shall be the same as used during the validation process pursuant to the requirements contained ~~in252:626-9-11(c)(2)(C)~~in 252:9-11(f)(2)(C). The following shall also be required:

(i) UV sensors used during validation shall read within 10% of the average of 3 or more reference sensor measurements.

(ii) UV sensors during operation shall be calibrated with 3 or more reference UV sensor measurements. Reference UV sensors are off-line UV sensors that shall be at least as accurate as the duty UV sensors and shall be constructed identically, unless changes are made to the reference sensor to make said sensor more accurate.

(iii) Reference UV sensors shall have calibration traceable to one of the following national standards:

(I) The National Physical Laboratory;

(II) The National Institute of Standards and Technology;

(III) Deutsche Vereinigung des Gas- und Wasserfaches (GVDW); and

(IV) Osterreichisches Normungsinstitut (ORNORM).

(I) **Hydraulics.** The following hydraulic information shall be provided:

(i) The maximum system pressure at the UV reactor;

(ii) The maximum allowable head loss through the UV reactor;

(iii) Special surge conditions that may be experienced; and

(iv) The hydraulic constraints based on the site-specific and validated conditions.

(J) **Location constraints.** Do not install UV disinfection upstream of filtration for surface and GWUDI water treatment plants due to the potential of particles interfering with UV disinfection.

(K) **Lamp Sleeves.** The following shall be applicable to all lamp sleeves installed:

(i) Lamp sleeves shall be annealed to minimize internal stress;

(ii) Lamp sleeve specifications shall describe the type of lamp sleeve cleaning system to be used, whether an off-line chemical clean, an off-line mechanical clean, or an on-line mechanical and/or chemical clean method is used. Indicate how the capacity of the system will be affected by the chosen cleaning system; and

(iii) Provide piping and valves necessary to properly dispose of chemicals used during the cleaning of the lamp sleeves.

(L) **Alarms.** At a minimum, the following UV reactor alarms shall be specified:

(i) Lamp or ballast failure;

(ii) Low UV intensity or low validated UV dose;

(iii) High temperature;

(iv) Operating conditions outside of validated range; and

(v) Wiper failure.

(M) **Instrumentation.** At a minimum, the following signals and indicators shall be specified:

(i) UV lamp status;

(ii) UV reactor status;

(iii) All signals used in the dose monitoring algorithm (e.g. at a minimum lamp output, UV intensity, flow, and UVT);

(iv) Lamp cleaning cycle and history;

(v) Accumulated run time for individual lamps or banks of lamps and reactors; and

(vi) Influent flow rate.

(N) **Controls.** At a minimum, the following UV reactor controls shall be specified:

(i) UV dose setpoints, UV intensity set points or UV transmittance setpoints as appropriate;

(ii) UV lamps, on and off control;

(iii) UV reactor, on and off control;

(iv) UV reactor manual and automatic control;

(v) UV reactor local and remote control;

(vi) Manual lamp power level control;

(vii) Manual lamp cleaning cycle control; and

(viii) Automatic lamp cleaning cycle setpoint control.

(O) **Startup Criteria.** The equipment installed shall meet the performance requirements contained in the specifications. The following specific performance criteria shall be included in the specifications:

(i) Allowable head loss at each design flow rate;

(ii) Estimated power consumption under the design operating conditions;

(iii) Disinfection capacity of each reactor under the design water quality conditions;

(iv) Sensitivity of equipment to variations in voltage or current; and

(v) Reference UV sensor, duty UV sensor, and UV transmittance analyzer performance.

(P) **Warranties.** A physical equipment warranty for a minimum of one year is required. Lamps shall be warranted to provide the lamp intensity under design conditions and warranted for a minimum number of operating hours taking into consideration the fouling and aging of the lamp.

(Q) **UV transmittance analyzer.** When a UV transmittance analyzer is provided, a calibrated spectrophotometer is required, capable to measure UV absorbance and/or UVT at 254 nm, across a 4 cm or 5 cm pathlength.

(R) **Back-up power supply.** Power surges and the appropriate power conditioning equipment must be addressed in the specifications.

SUBCHAPTER 17. FINISHED WATER STORAGE

252:626-17-1. General

(a) Construct tanks of reinforced concrete or steel in accordance with AWWA standard specifications. Adequately protect steel tanks against corrosion.

(b) Provide all tanks with a bypass.

(c) Provide safety equipment in accordance with OSHA standards.

(d) Maintain sufficient storage capacity to meet domestic demands and fire flow demands, where fire protection is provided.

(1) Satisfy fire flow requirements pursuant to the *International Fire Code,* published by the International Code Council, Inc., ~~2003~~2024 Edition, *Distribution System Requirements for Fire Protection, ~~M 31~~M31,* published by the AWWA, ~~3rd~~4th Edition where fire protection is provided.

(2) Systems not providing fire protection are required to maintain a minimum storage capacity of 24 hours capable of delivering 25 psi throughout the distribution system.

(e) **Location of standpipes and finished water storage.**

(1) Place the bottom of standpipes on a suitable foundation at the normal ground surface and above the 100-year flood plain.

(2) When the bottom of a finished water storage structure must be below normal ground surface, place it above the ground water table. Sewers, drains, standing water, and similar sources of possible contamination must be kept at least 50 feet from the finished water storage structure. Do not locate below ground finished water storage structures within 20 feet of a sanitary sewer or 50 feet from pressure sewer lines.

(3) The top of a reservoir must be at least two feet above the normal ground surface. Clearwells constructed under filters may be exempted from this requirement when the total design gives the same protection.

(f) **Protection.**

(1) **Cover of finished water storage.** Storage of treated water must have a watertight roof or cover, which will exclude birds, animals, insects and excessive dust. Locate the top of all finished water storage structures above possible flood elevations.

(2) **Protection from trespasses.** Provide fencing, locks on access manholes, and other necessary precautions to prevent vandalism, pilfering, trespassing, or sabotaging.

~~(3) Cathodic protection shall be provided for all steel tanks to prevent under bottom corrosion.~~

(g) **Drains.** Connection through a 6 inch air gap or two pipe diameters of the drain whichever is greater is allowed.

(h) **Overflow.** Provide all water storage structures with an overflow that terminates at an elevation between 12 and 24 inches above the ground surface, and release water over a drainage inlet structure or splash plate.

(1) Do not connect the water storage structure overflow line to a sewer or storm drain.

(2) Locate all overflow pipes so that any release of water is visible.

(3) Equip the ends of the pipes with flex gates.

(4) Design the overflow pipe with sufficient diameter to permit wasting of water in excess of the filling rate.

(i) **Access.** Design finished water storage structures with convenient access to the interior for cleaning and maintenance. Manholes located on top of storage structures must:

(1) be surrounded with a frame at least 4 inches in height above the surface of the roof at the opening,

(2) be elevated 24 to 36 inches above the top of sod covering ground level structures,

(3) be fitted with a solid watertight cover, which overlaps the framed opening and extends down around the frame at least 2 inches,

(4) be hinged at one side, and

(5) have a locking device.

(j) **Vents.** Vent all finished water storage structures. Overflows are not considered vents. Open construction between the side wall and roof is not allowed. Design of vents must:

(1) prevent the entrance of surface water, rainwater, birds, insects and animals,

(2) limit the introduction of dust,

(3) terminate in an inverted U with the opening 24 to 36 inches above the roof or sod covering on ground-level structures, and

(4) be covered with a 24 mesh corrosion resistant screen installed at a location least susceptible to vandalism.

(k) **Roof and side wall.** Make the roof and side walls of all structures watertight with no openings except properly constructed vents, manholes, overflows, risers, drains, pump mountings, control ports, and piping for inflow and outflow.

(1) Any pipes running through the roof or side wall of a metal finished water storage structure must be welded, or properly gasketed. In concrete storage structures, connect pipes to standard wall castings poured in place during the forming of the concrete. The wall castings must have seepage rings imbedded in the concrete.

(2) Curb and properly sleeve all openings in the storage structure roof or top to prevent entrance of surface water or floor drainage into the structure.

(3) Locate valves and controls outside the storage structure so that valve stems and similar projections will not pass through the roof or top of the structure.

(l) **Drainage of roof.** The roof of the storage structure must be well drained and designed not to hold water or snow. Do not allow downspout pipes to enter or pass through the reservoir.

(m) **Freezing.** Design finished water storage structures and their appurtenances to prevent freezing.

(n) **Internal catwalk.** Every catwalk over finished water in a storage structure must have a solid floor with raised edges so shoe scrapings and dirt will not fall into the water.

(o) **Outlet piping.** Locate the outlet pipes from all storage structures in a manner that will prevent the flow of sediment into the distribution system.

(p) **Grading.** Grade the area surrounding a ground level structure to prevent surface water from standing within 50 feet of the structure.

(q) **Painting and cathodic protection.** Provide proper protection to metal surfaces by paints or other protective coatings. Paint systems must be listed by NSF or UL as meeting the ANSI/NSF Standards for contact with potable water. Cathodic protective devices are required where soil conditions warrant.

(r) **Disinfection.** Disinfect finished water storage structures in accordance with AWWA standard specifications.

SUBCHAPTER 19. DISTRIBUTION SYSTEM

252:626-19-3. Water main design for all systems providing fire protection

(a) **Sizing of mains.** Size all lines after a hydraulic analysis pursuant to the *International Fire Code,* published by the International Code Council, Inc., ~~2003~~2024 Edition, *Distribution System Requirements for Fire Protection, ~~M 31~~M31,* published by the AWWA, ~~3rd~~4th Edition or other recommendations of similar organizations for the fire service area. The minimum main size is 6 inches in diameter.

(b) **Hydrants.**

(1) Fire hydrants must have a 4-1/2 inch pumper outlet and at least two 2-1/2 inch hose outlets.

(2) Fire hydrants shall only be connected to water systems and mains designed to carry fire-flows.

(3) Locate and space hydrants pursuant to the *International Fire Code,* published by the International Code Council, Inc., ~~2003~~2024 Edition, *Distribution System Requirements for Fire Protection, ~~M 31~~M31,* published by the AWWA, ~~3rd~~4th Edition or other recommendations of similar organizations for the fire service area.

(4) The minimum hydrant lead size is 6 inches in diameter.

(5) Provide a shut-off valve to allow hydrant maintenance or replacement.

(6) The lowest outlet shall be installed no less than 18 inches above the surrounding grade and the operating nut no higher than 4 feet above grade.

(7) Drains from fire hydrant barrels shall not be connected to sanitary sewers or storm drains.

(c) **Valves.** Install valves on all small distribution lines branching from larger mains. Locate positive closing valves for isolating a line so that a single break will:

(1) require no more than 500 feet of pipe be removed from service in high-service areas,

(2) require no more than 1,320 feet in other sections, and

(3) not require shutting down an artery.

APPENDIX E. GRAVEL SUPPORT FOR RAPID RATE ~~SLOW~~ SAND FILTERS

Figure 1

APPENDIX E. GRAVEL SUPPORT FOR RAPID RATE SAND FILTERS

Size	Depth
2½ to 1½ inches	5 to 8 inches
1½ to ¾ inches	3 to 5 inches
¾ to ½ inches	3 to 5 inches
½ to 3/16 inches	2 to 3 inches
3/16 to 3/32 inches	2 to 3 inches

Appendix E, Table I. Daily design flow

Motels or Hotel (1 bedroom per unit)	200 GPD
Motels (Kitchen facilities) per unit	250 GPD
Institution per Person:	
Resident workers	100 GPD
Non-resident Workers	20 GPD
Factories per person (excl. Industrial waste) each shift	20 GPD
Day school per pupil	8 GPD
Boarding School per pupil	75 GPD
Restaurants per patron	15 GPD
Trailer Parks per Unit	250 GPD
Drive-In Theater per car space	10 GPD
Self-service laundry (per customer)	50 GPD
Country Club per member	50 GPD
Service station per vehicle served	15 GPD
Retail store per toilet	500 GPD
Urban residence per person	100 GPD
Farm Residence per person	100 GPD
Livestock	
Beef Cow	12 GPD
Dairy Cow	50 GPD
Hog or sheep	4 GPD
Chicken	4 GPD
Turkey	7 GPD

Figure 2

Appendix E, Table II. Orifice sizing

Orifice Size (inches)	Head in Feet			
	2	4	6	8
	Gallons of Water Delivered per Day			
1/16	95	135	165	191
1/8	381	539	660	762
3/16	858	1,213	1,485	1,715
1/4	1,525	2,156	2,641	3,049
5/16	2,382	3,369	4,126	4,764
3/8	3,430	4,851	5,941	6,860
7/16	4,669	6,603	8,087	9,338
1/2	6,098	8,624	10,562	12,196
3/4	13,271	19,404	23,765	27,442
1	24,393	34,497	42,249	48,785
1-1/4	38,113	53,901	66,015	76,227
1-1/2	54,884	77,617	95,061	109,767
1-3/4	74,702	105,646	129,389	149,405
2	97,571	137,986	168,998	195,142

$$Q = C_d A(2gh)^{1/2}$$

$$C_d = 0.60$$

$$g = 32.2\ ft/s^2$$

A is ft^2, 1 ft^2 = 144 in^2

Appendix E, Figure 1. General Well Design
Appendix E. Figure 2. General Well Design

These two figures are drawings that are currently incompatible with the Word format of the other Chapter 626 appendices. See customer assistance for hard copies of these drawings.