R309-535. Facility Design and Operation: Miscellaneous Treatment Methods.

Table of Contents

R309-535-1. Purpose. 3
R309-535-2. Authority. 3
R309-535-3. Definitions. 3
R309-535-4. General. 3
R309-535-5. Fluoridation. 4
R309-535-6. Taste and Odor Control. 11
R309-535-7. Stabilization. 11
R309-535-8. Deionization. 12
R309-535-9. Aeration. 14
R309-535-10. Softening. 14
R309-535-11. Iron and Manganese Control. 15
R309-535-12. Point-of-Use and Point-of-Entry Treatment Devices. 18
R309-535-13. New Treatment Processes or Equipment. 19

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R309-535. Facility Design and Operation: Miscellaneous Treatment Methods.

R309-535-1. Purpose.

The purpose of this rule is to provide specific requirements for miscellaneous water treatment methods which are primarily intended to remove chemical contaminants from drinking water; or, adjust the chemical composition of drinking water. It is intended to be applied in conjunction with other rules, specifically R309-500 through R309-550. Collectively, these rules govern the design, construction, operation and maintenance of public drinking water system facilities. These rules are intended to assure that such facilities are reliably capable of supplying adequate quantities of water which consistently meet applicable drinking water quality requirements and do not pose a threat to general public health.

R309-535-2. Authority.

This rule is promulgated by the Drinking Water Board as authorized by Title 19, Environmental Quality Code, Chapter 4, Safe Drinking Water Act, Subsection 104(1)(a)(ii) of the Utah Code and in accordance with Title 63G, Chapter 3 of the same, known as the Administrative Rulemaking Act.

R309-535-3. Definitions.

Definitions for certain terms used in this rule are given in R309-110 but may be further clarified herein.

R309-535-4. General.

For each process described in this section pertinent rules are given. The designer must also, however, incorporate the relevant rules given in other sections into the plans and specifications for any of these specialized treatment methods. Where applicable, the following topics must be addressed:

(1) Plant Siting (see R309-525-6).
(2) Plant Reliability (see R309-525-7).
(3) Color Coding and Pipe Marking (see R309-525-8).

(4) Chemical Addition (see R309-525-11).

(5) Miscellaneous Plant Facilities (see R309-525-17, particularly sub-section R309-525-17(1), Laboratory).

(6) Operation and Maintenance Manuals (see R309-525-19).

(7) Safety (see R309-525-21).

(8) Disposal of Treatment Plant Waste (see R309-525-23).

(9) Disinfection (see R309-520).

R309-535-5. Fluoridation.

(1) This section does not require the addition of fluoride to drinking water by a public water system. However, a public water system that adds fluoride to drinking water shall comply with the fluoridation facility design and construction requirements of this section.

Guidance: A public water system may not exceed the primary maximum contaminant level for fluoride of 4.0 mg/L per R309-200-5(1)(c). A public water system that exceeds the secondary maximum contaminant level of 2.0 mg/L must issue the public notification required by R309-220-11.

A public water system that adds fluoride to drinking water should comply with the testing, monitoring and reporting requirements established by the local health department.

In Salt Lake and Davis counties, the local health departments have established the optimal level of fluoride in drinking water and the fluoridation monitoring and reporting requirements. Currently, the U.S. Department of Health and Human Services recommends an optimal fluoride concentration of 0.7 mg/L in drinking water to reduce cavities and tooth decay.

(2) General Requirements for all Fluoridation Installations.

The following requirements apply to all types of fluoridation.

(a) Chemicals and Materials.

(i) All chemicals used for fluoridation shall be certified to comply with ANSI/NSF Standard 60.

(ii) Materials used for fluoridation equipment shall be compatible with chemicals used in the fluoridation process.

(iii) Metal parts used in fluoridation equipment and present in the fluoridation room shall be corrosion resistant.

(iv) Lead weights shall not be used in fluoride chemical solutions to keep pump suction lines at the bottom of a day or bulk storage tank.

Guidance: Acid-resistant floor coating or a containment structure should be provided for areas likely to have acid spills.

(b) Chemical Storage.

(i) Fluoride chemicals shall be stored in covered or sealed containers, inside a building, and away from direct sunlight and a source of heat.

(ii) Fluoride chemicals shall not be stored with incompatible chemicals.

(iii) Bags or other containers for dry materials shall be stored on pallets.

(iv) Containers for dry materials shall be kept closed to keep out moisture.

(v) A solution tank shall be labeled to identify the contents of the tank.

(c) Secondary Containment.

(i) Secondary containment shall be provided for tanks containing corrosive fluoride solutions.

(ii) Secondary containment shall be sized to contain the maximum volume of solution handled.

(iii) Secondary containment shall be designed to be acid resistant.

Guidance: Secondary containment may consist of curbs, sumps, double-walled tanks, etc.

Fluorosilicic acid and sodium fluorosilicate solutions both have low pH and are corrosive.

(d) Means to Measure.

(i) A means to measure the flow of treated water shall be provided.

(ii) A means shall be provided to measure the solution level in a tank and the quantity of the chemical used.

Guidance: The means to measure the solution level in a tank may include a liquid level indicator, a calibrated level gauge on the side of a translucent tank, weight scales, etc.

(iii) A sampling point shall be provided downstream of the fluoridation facility for measuring the fluoride level of treated water.

(e) Fluoride Feed Pump.

(i) Sizing of fluoride feed pumps shall consider prevention of fluoride overfeed and operation efficiency.

(ii) A fluoride feed pump shall have an anti-siphon device.

(f) Electrical Outlet for Fluoride Feed Pump.
The electrical outlet used for a fluoride feed pump shall have interlock protection by being wired with the well or service pump, such that the feed pump is only activated when the well or service pump is on. The fluoride feed pump shall not be plugged into a continuously active ("hot") electrical outlet.

(g) Fluoride Injection.

(i) The fluoride injection line shall enter at a point in the lower one-third of the water line, and the end of the injection line shall be in the lower half of the water line.

(ii) The fluoride injection point shall allow adequate mixing.

Guidance: The design should minimize localized corrosion near the injection point.

(iii) The fluoride injection point shall not be located upstream of lime softening, ion exchange, or other processes that affect the fluoride level.

(iv) Each injector shall be selected based on the quantity of fluoride to be added, water flow, back pressure, and injector operating pressure.

(v) If injecting fluoride under pressure, a corporation stop shall be used at the fluoride injection point.

(vi) An anti-siphon device shall be provided for all fluoride feed lines at the injection point.

(h) Minimize Fluoride Overfeed.

(i) In addition to the feed pump control, a secondary control mechanism shall be provided to minimize the possibility of fluoride overfeed. It may be a day tank, liquid level sensor, SCADA control, flow switch, etc.

Guidance: The intent of the day tank is to limit the fluoride supply to the feed pump, especially if a large-size bulk tank is present. It is recommended that the day tank be sized to hold no more than 3 days of supply.

(ii) For fluoridation facilities that do not have operators on site, a day tank is required to minimize fluoride overfeed, unless two alternative secondary controls are provided.

Guidance: For example, a fluoridation facility without operators on site may use secondary controls based on both the bulk tank liquid level sensor and the treated water fluoride level.

Guidance: To avoid fluoride overfeed, a flooded suction line should be avoided for the fluoride feed pump. The elevation of a fluoride feed pump should be based on pump priming requirements and suction head limitations.

(i) Housing. Fluoridation equipment shall be housed in a secure building that is adequately sized for handling and storing fluoride chemicals.

(j) Heating, Lighting, and Ventilation.

(i) The fluoridation building shall be heated, lighted and ventilated to assure proper operation of the equipment and safety of the operator.

(ii) The ventilation in the fluoride operating area shall provide at least six complete room-air changes per hour.

(iii) The fluoride operating area shall be vented to outside atmosphere and away from air intakes.

(iv) Separate switches for fans and lights in the fluoride operating area shall be provided. The switches shall be located outside or near the entrance to the fluoride operating area, and shall be protected from vandalism.

(k) Cross Connection Control.
Cross connection control shall be provided by an air gap or an approved and properly operating backflow prevention assembly.

(3) Additional Requirements for Fluorosilicic Acid Installations.

(a) Fluorosilicic acid shall not be diluted manually on site before injection.

(b) Solution Tank Vents.

(i) A bulk tank shall be vented.

(ii) Tank venting shall be to the outside, above grade, away from air intakes, and where least susceptible to contamination (e.g., precipitation, dust, etc.)

(iii) A bulk tank shall not share a vent with a day tank if there is a risk of solution overflow from the bulk tank to the day tank.

(iv) A non-corrodible fine mesh (No. 14 or finer) screen shall be placed over the discharge end of a vent.

(c) If separate rooms are provided in a fluoridation facility constructed after January 1, 2017, the design shall include a view window between the control room and the fluorosilicic acid operating area.

Guidance: It is recommended to have a separate room for the fluoride operating area due to possible damage from fluoride chemicals and vapors to other equipment.

(d) Emergency eyewash stations and showers shall be provided.

(e) A neutralizing chemical shall be available on site to handle small-quantity accidental acid spills.

Guidance: The immediate use of a neutralizing chemical to handle an accidental acid spill is only suitable for small quantity spills during operation or maintenance, for example, minor spillage from the quick connect during unloading. For large quantity acid spills, secondary containment is the primary means of containing the acid to allow proper handling of the acid later on.

(f) The use of personal protective equipment (PPE) is required when handling fluorosilicic acid, and shall include the following:

(i) Full-face shield and splash-proof safety goggles

(ii) Long gauntlet acid-resistant rubber or neoprene gloves with cuffs

(iii) Acid-resistant rubber or neoprene aprons

(iv) Rubber boots

(4) Additional Requirements for Fluoride Saturator Installations.

(a) A water meter shall be provided on the make-up water line for a saturator to determine the amount of fluoride solution being fed.

(b) The minimum depth of undissolved fluoride chemical required to maintain a saturated solution shall be marked on the outside of the saturator tank.

Guidance: Sodium fluorosilicate should not be used in saturators due to its poor solubility.

(c) The saturator shall not be operated in a manner that undissolved chemical is drawn into the pump suction line.

(d) The make-up water supply line shall terminate at least two pipe diameters above the solution tank or have backflow protection.

(e) Make-up Water Softening.

(i) The make-up water used for sodium fluoride saturators shall be softened whenever the hardness exceeds 75 mg/L.

(ii) A sediment filter (20 mesh) shall be installed in the make-up water line going to the saturator. The filter shall be placed between the softener and the water meter.

(f) Dust Control.
Creation of fluoride dust shall be minimized during the transfer of dry fluoride compounds; when disposing of empty bags, drums, or barrels; and while cleaning.

(g) Emergency eyewash shall be provided.

(h) The use of personal protective equipment (PPE) is required when handling dry chemicals and shall include the following:

(i) National Institute for Occupational Safety and Health (NIOSH) approved particulate respirator with a soft rubber face-to-mask seal and replaceable cartridges

(ii) Chemical dust-resistant safety goggles

(iii) Acid-resistant gloves

(iv) Acid-resistant rubber or neoprene aprons

(v) Rubber boots

(5) Additional Requirements for Fluoride Dry Feed Installations.

(a) Volumetric and gravimetric dry feeders shall include a solution tank.

(b) A mechanical mixer shall be installed in the solution tank.

(c) Dust Control.

(i) Creation of fluoride dust shall be minimized during the transfer of dry fluoride compounds; when disposing of empty bags, drums, or barrels; and while cleaning.

(ii) If a hopper is provided, it shall be equipped with a dust filter and an exhaust fan that places the hopper under negative pressure.

(iii) Air exhausted from fluoride handling equipment shall discharge through a dust filter to the atmosphere outside of the building.

(d) Emergency eyewash shall be provided.

(e) The use of personal protective equipment (PPE) is required when handling dry chemicals and shall include the following:

(i) National Institute for Occupational Safety and Health (NIOSH) approved particulate respirator with a soft rubber face-to-mask seal and replaceable cartridges

(ii) Chemical dust-resistant safety goggles

(iii) Acid-resistant gloves

(iv) Acid-resistant rubber or neoprene aprons

(v) Rubber boots

R309-535-6. Taste and Odor Control.

Part 4, Section 4.9, Taste and Odor Control, in the Recommended Standards for Water Works (commonly known as "Ten State Standards"), 2007 edition is hereby incorporated by reference and compliance with those standards shall be required for the design and operation of taste and odor control facilities. This document is published by the Great Lakes-Upper Mississippi River Board of Public Health and Environmental Managers. A copy is available in the office of the Division for reference.

R309-535-7. Stabilization.

Part 4, Section 4.8, Stabilization, in the Recommended Standards for Water Works (commonly known as "Ten State Standards"), 2007 edition is hereby incorporated by reference and compliance with those standards shall be required for the design and operation of stabilization facilities. This document is published by the Great Lakes-Upper Mississippi River Board of Public Health and Environmental Managers. A copy is available in the office of the Division for reference.

R309-535-8. Deionization.

Current practical methods of deionization include Ion Exchange, Reverse Osmosis and Electrodialysis. Additional methods of deionization may be approved subject to the presentation of evidence of satisfactory reliability.

All properly developed groundwater sources having water quality exceeding 2,000 mg/l Total Dissolved Solids and/or 500 mg/l Sulfate shall be either properly diluted or treated by the methods outlined in this section. Deionization cannot be considered a substitute process for conventional complete treatment outlined in R309-525.

(1) Ion Exchange.

(a) General.

Great care shall be taken by the designer to avoid loading the media with water high in organics.

(b) Design.

(i) Pretreatment shall be provided per the manufacturer's recommendation.

(ii) Upflow or down flow units are acceptable.

(iii) Exchangers shall have at least a three foot media depth.

(iv) Exchangers shall be designed to meet the recommendations of the media manufacturer with regard to flow rate or contact time. In any case, flow shall not exceed seven gpm/sf of bed area. The plant shall be provided with an influent or effluent meter as well as a meter on any bypass line.

(v) Chemical feeders used shall conform with R309-525-8. All solution tanks shall be covered.

(vi) Regenerants added shall be uniformly distributed over the entire media surface of upflow or downflow units. Regeneration shall be according to the media manufacturer's recommendations.

(vii) The wash rate capability shall be in excess of the manufacturer's recommendation and shall be at least six to eight gpm/sf of bed area.

(viii) Disinfection (see R309-520) shall be required ahead of the exchange units where this does not interfere with the media.

Where disinfection interferes with the media, disinfection shall follow the treatment process.

(c) Waste Disposal.

Waste generated by ion exchange treatment shall be disposed of in accordance with R309-525-23.

(2) Reverse Osmosis.

(a) General.

The design shall permit the easy exchange of modules for cleaning or replacement.

(b) Design Criteria.

(i) Pretreatment shall be provided per the manufacturer's recommendation.

(ii) Required equipment includes the following items: pressure gauges on the upstream and downstream side of the filter; a conductivity meter present at the site; taps for sampling permeate, concentrate and blended flows (if practiced). If a continuous conductivity meter is permanently installed, piping shall be such that the meter can be disconnected and calibrated with standard solutions at a frequency as recommended by the manufacturer.

(iii) Aeration, if practiced, shall conform with provisions of R309-535-9.

(iv) Cleaning shall be routinely done in accordance with the manufacturer's recommendations.

(v) Where the feed water pH is altered, stabilization of the finished water is mandatory.

(c) Waste Disposal.

Waste generated by reverse osmosis treatment shall be disposed of in accordance with R309-525-23.

(3) Electrodialysis.

(a) General.

(b) Design.

(i) Pretreatment shall be provided per the manufacturer's recommendation.

(ii) The design shall include ability to: measure plant flow rates; measure feed temperature if the water is heated (a high temperature automatic cutoff is required to prevent membrane damage); measure D.C voltage at the first and second stages as well as on each of the stacks. Sampling taps shall be provided to measure the conductivity of the feed water, blowdown water, and product water. D.C. and A.C. kilowatt-hour meters to record the electricity used shall also be provided.

(c) Waste Disposal.

Waste generated by electrodialysis treatment shall be disposed of in accordance with R309-525-23.

R309-535-9. Aeration.

Part 4, Section 4.5, Aeration, in the Recommended Standards for Water Works (commonly known as "Ten State Standards"), 2007 edition, is hereby incorporated by reference and compliance with those standards shall be required for the design and operation of aeration facilities. This document is published by the Great Lakes-Upper Mississippi River Board of Public Health and Environmental Managers. A copy is available in the office of the Division for reference.

R309-535-10. Softening.

Part 4, Section 4.4, Softening, in the Recommended Standards for Water Works (commonly known as "Ten State Standards"), 2007 edition, is hereby incorporated by reference and compliance with those standards shall be required for the design and operation of softening facilities. This document is published by the Great Lakes-Upper Mississippi River Board of Public Health and Environmental Managers. A copy is available in the office of the Division for reference.

R309-535-11. Iron and Manganese Control.

Iron and manganese control, as used herein, refers solely to treatment processes designed specifically for this purpose. The treatment process used will depend upon the character of the source water. The selection of one or more treatment processes shall meet specific local conditions as determined by engineering investigations, including chemical analyses of representative samples of water to be treated, and receive approval of the Director. It may be necessary to operate a pilot plant in order to gather all information pertinent to the design. Consideration shall be given to adjust the pH of the raw water to increase the rate of the chemical reactions involved.

Removal or treatment of iron and manganese are normally by the following methods:

(1) Removal by Oxidation, Detention and Filtration.

(a) Oxidation.

Oxidation may be by aeration, or by chemical oxidation with chlorine, potassium permanganate, ozone or chlorine dioxide.

(b) Detention.

(i) Reaction time - A minimum detention time of twenty minutes shall be provided following aeration in order to insure that the oxidation reactions are as complete as possible. This minimum detention may be omitted only where a pilot plant study indicates no need for detention. The detention basin shall be designed as a holding tank with no provisions for sludge collection but with sufficient baffling to prevent short circuiting.

(ii) Sedimentation - Sedimentation basins shall be provided when treating water with high iron and/or manganese content, or where chemical coagulation is used to reduce the load on the filters. Provisions for sludge removal shall be made.

(c) Filtration.

(i) General - Minimum criteria relative to number, rate of filtration, structural details and hydraulics, filter media, etc., provided for rapid rate gravity filters shall apply to pressure filters where appropriate, and may be used in this application but cannot be used in the filtration of surface waters or following lime-soda softening.

(ii) Details of Design for Pressure Filter - The filters shall be designed to provide for:

(A) Loss of head gauges on the inlet and outlet pipes of each filter,

(B) An easily readable meter or flow indicator on each battery of filters,

(C) Filtration and backwashing of each filter individually with an arrangement of piping as simple as possible to accomplish these purposes,

(D) The top of the washwater collectors to be at least twenty-four (24) inches above the surface of the media,

(E) The underdrain system to efficiently collect the filtered water and to uniformly distribute the backwash water at a rate capable of not less than 15 gpm/sf of filter area,

(F) Backwash flow indicators and controls that are easily readable while operating the control valves,

(G) An air release valve on the highest point of each filter,

(H) An accessible manhole to facilitate inspections and repairs,

(I) Means to observe the wastewater and filters during backwashing, and

(J) Construction to prevent cross-connection.

(2) Removal by the Lime-soda Softening Process.

For removal by the lime-soda softening process refer to Part 4,

Section 4.4, Softening, in the Recommended Standards for Water Works (commonly known as "Ten State Standards"), 2007 edition as indicated in R309-535-10. Those standards are hereby incorporated by reference and compliance with those standards shall be required for removal by the lime-soda softening process.

(3) Removal by Manganese Greensand Filtration.

This process, consisting of the continuous feed of potassium permanganate to the influent of a manganese greensand filter, is more applicable to the removal of manganese than the removal of iron.

(a) Provisions shall be made to apply the permanganate as far ahead of the filter as practical and at a point immediately before the filter.

(b) An anthracite media cap of at least six inches shall be provided over manganese greensand.

(c) The normal filtration rate is three gpm/sf.

(d) The normal wash rate is 8 to 10 gpm/sf.

(e) Air washing shall be provided.

(f) Sample taps shall be provided:

(i) prior to application of permanganate,

(ii) immediately ahead of filtration,

(iii) at a point between the anthracite media and the manganese greensand,

(iv) halfway down the manganese greensand, and

(v) at the filter effluent.

(4) Removal by Ion Exchange.

This process is not acceptable where either the source water or wash water contains dissolved oxygen.

(5) Sequestration by Polyphosphates.

This process shall not be used when iron, manganese or a combination thereof exceeds 1.0 milligram per liter. The total phosphate applied shall not exceed 10 milligrams per liter as PO4. Where phosphate treatment is used, satisfactory chlorine residuals shall be maintained in the distribution system and the following required:

(a) feeding equipment shall conform to the requirements of R309-525-11(7),

(b) stock phosphate solution shall be kept covered and disinfected by carrying approximately 10 mg/l free chlorine residual,

(c) polyphosphates shall not be applied ahead of iron and manganese removal treatment. If no iron or manganese removal treatment is provided, the point of application shall be prior to any aeration, oxidation or disinfection steps, and

(d) phosphate chemicals must comply with ANSI/NSF Standard 60.

Sampling taps shall be provided for control purposes. Taps shall be located on each raw water source, and on each treatment unit influent and effluent.

Waste generated by iron and manganese control treatment shall be disposed of in accordance with R309-525-23.

R309-535-12. Point-of-Use and Point-of-Entry Treatment Devices.

Where drinking water does not meet the quality standards of R309-200 and the available water system treatment methods are determined to be unreasonably costly or otherwise undesirable, the Director may permit the public water supplier to install and maintain point-of-use or point-of-entry treatment devices. This approval shall only be given after receipt and satisfactory review of the following items.

(1) The Director shall only consider approving point-of-use or point-of-entry treatment upon receipt of an analysis that clearly demonstrates that central treatment is not feasible for the public water system. Unless waived by the Director, this analysis shall be in the form of an engineering report prepared by a professional engineer registered in the State of Utah. Systems serving fewer than 75 connections are excused from performing an analysis by a Registered Professional Engineer.

(2) The water system shall have a signed access agreement with each customer that allows water system personnel to enter their property on a scheduled basis to install and maintain the treatment devices. The agreement shall include educational information with regard to the health risks of consuming or cooking with water from non-treated taps. Systems with an initial 75% of their connections under a signed access agreement shall be allowed to proceed with the understanding that 100% of their connections are due within a 5 year period. For public water systems that own or control all connections to the public water system, this requirement will not apply.

(3) Documentation that legal authority, which includes a termination of service clause, has been adopted to ensure water system access to the property for installation, maintenance, servicing and sampling of each treatment unit. For public water systems that own or control all connections to the public water system, this requirement will not apply.

(4) Point-of-use or point-of-entry treatment devices used shall only be those proven to be appropriate, safe and effective as determined through testing and compliance with protocols established by EPA's Environmental Technology Verification Program (ETV) or the applicable ANSI/NSF Standard(s). A pilot study may be required to determine the suitability of the point-of-use or point-of-entry device in treating a particular source water. The scope and duration of the pilot study shall be determined by such factors as the characteristics of the raw water, manufacturer's ratings of the treatment device, and good engineering practices. The pilot study will generate data on service intervals, aid in specifying and calibrating alarm systems, and reveal any site specific problems with component fouling or microbial colonization.

(5) The water system shall provide an operation and maintenance plan demonstrating that the treatment units shall be installed and serviced in accordance with the manufacturer's instructions and that compliance sampling as required in R309-215-6 shall take place. The system shall provide documentation of an operation and maintenance contract or schedule annually as required in R309-105-16(4). If the operation and maintenance of the POU/POE devices is performed by water system personnel, it shall only be performed by a water operator certified at the level of the water system.

(6) The performance indicating device for the point-of-use/point-of-entry treatment device that will be used shall be specified in the submittal for plan approval.

(7) The water system shall submit a customer education and out-reach plan that includes at a minimum annual frequency of contact.

(8) Point-of-use or point-of-entry treatment devices for compliance with the nitrate MCL shall only be considered if treatment is provided at all taps that are accessible to the public.

R309-535-13. New Treatment Processes or Equipment.

The policy of the Board is to encourage, rather than to obstruct, the development of new methods and equipment for the treatment of water. Nevertheless, any new processes or equipment must have been thoroughly tested in full-scale, comparable installations, before approval of plans can be issued. The U.S. Environmental Protection Agency (EPA) has created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative or improved

environmental technologies through performance verification and dissemination of information. NSF International (NSF) in cooperation with the EPA operates the Package Drinking Water Treatment Systems (PDWTS) pilot, one of 12 technology areas under ETV. Engineers and Manufacturers are referred to Manager, ETV project, NSF International, P.O. Box 130140, Ann Arbor, Michigan 48113-0140.

No new treatment process will be approved for use in Utah unless the designer or supplier can present evidence satisfactory to the Director that the process will insure the delivery of water of safe, sanitary quality, without imposing undue problems of supervision, operation and/or control.

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