Rule R309-520. Facility Design and Operation: Disinfection.

As in effect on October 1, 2007

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R309-520-1. Purpose.

This rule specifies requirements for facilities which disinfect public drinking water. It is intended to be applied in conjunction with 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.

R309-520-2. 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 63, Chapter 46a of the same, known as the Administrative Rulemaking Act.

R309-520-3. Definitions.

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

R309-520-4. General.

Continuous disinfection shall be required of all ground water sources not consistently meeting standards of bacteriologic quality. Surface water sources or ground water sources under direct influence of surface water shall be disinfected during the course of required conventional surface water treatment or alternative surface water treatment. Disinfection shall not be considered a substitute for inadequate collection facilities. Systems having only sources classified as ground water (see R309-202-8) and which disinfect shall meet the requirements of R309-102-4.1.

R309-520-5. Allowable Primary Disinfectants.

Primary disinfection is defined as the means for providing adequate levels of inactivation of pathogenic micro organisms within the treatment process. Its effectiveness is measured through the "CT" values. Only three disinfectants; chlorine (gaseous and liquid hypochlorites), ozone, and chlorine dioxide are allowable for primary disinfection.

R309-520-6. Allowable Secondary Disinfectants.

Secondary disinfection is intended to provide an adequate disinfectant residual in the distribution system to maintain the bacteriological quality of treated water. Its effectiveness is measured through maintaining a detectable disinfectant residual throughout the distribution system. Allowable disinfectants are chlorine (gaseous and liquid hypochlorites), chloramine, and chlorine dioxide.

R309-520-7. Appropriate Uses of Chemical Disinfectants.

Chemical disinfection alone is appropriate only for groundwater not under the influence of surface water. Surface water, or groundwater under the direct influence of surface water, shall be coagulated and filtered in addition to being disinfected. For criteria to be used in determining required levels of treatment refer to R309-103- 2.7.

R309-520-8. Required Chemical Dosing and Contact Time.

Minimum levels for primary and secondary disinfection are specified in R309-103-2.7.

R309-520-9. Siting.

Disinfection installations shall be sited to permit convenient access through the entire year as well as considerations of safety (i.e. proximity to population or seismic fault zones).

R309-520-10. Chlorine.

(1) General Requirements for all Chlorination Installations.

(a) Chemical Types.

Disinfection by chlorination shall be accomplished by gaseous chlorine or liquid solutions of calcium or sodium hypochlorites.

(b) Feeding Equipment.

Solution-feed gas type chlorinators, direct-feed gas type chlorinators or hypochlorite liquid feeders of a positive displacement type shall be provided. Solution-feed gas type chlorinators are preferred. However, for small supplies requiring less than four pounds per day, liquid hypochlorinators are advised.

(c) Chlorine Feed Capacity.

The design of each chlorinator shall permit:

(i) the chlorinator capacity to be such that a free chlorine residual of at least 2 mg/l can be maintained in the system after 30 minutes of contact time during peak demand. The equipment shall be of such design that it will operate accurately over a feeding range of 0.2 mg/l to 2 mg/l.

(ii) assurance that a detectable residual, either combined or free, can be maintained at all times, at all points in the distribution system.

(d) Automatic Proportioning.

Automatic proportioning chlorinators shall be required where the rate of flow or chlorine demand is not reasonably constant.

(e) Injector/diffuser.

The chlorine solution injector/diffuser shall be compatible with the point of application to provide a rapid and thorough mix with all the water being treated. The center of a pipeline is the preferred application point.

(f) Contact Time and Point of Application.

(i) Due consideration shall be given to the contact time of the chlorine in water with relation to pH, ammonia, taste producing substances, temperature, biological quality, and other pertinent factors.

(ii) Where possible, the design shall minimize the formation of chloro-organic compounds. At plants treating surface water or ground water under the direct influence of surface water, provisions shall be made for applying chlorine to raw water, applied water, filtered water, and water entering the distribution system.

(iii) When treating ground water, provisions shall be made for applying chlorine to at least a reservoir inlet or transmission pipeline which will provide maximum contact time.

(iv) Care must be taken to assure that the point of application will, in conjunction with the pipe and tank configuration of the water system, allow required CT values to be achieved prior to the first consumer connection.

(g) Minimization of Chlorinated Overflow.

The chlorinator and associated water delivery facilities shall be designed so as to minimize the unnecessary release of chlorinated water into the environment from tank overflows (see also rules of Division of Water Quality pertaining to discharge or pollution).

(h) Chlorinator Piping.

The chlorinator water supply piping shall be designed to prevent contamination of the treated water supply by sources of questionable quality. At all facilities treating surface water, pre- and post-chlorination systems shall be independent where solution water is not finished water. All chlorinator solution water shall be at least of equal quality to the water receiving the chlorine solution.

(i) Water Measurement.

A means to measure water flow to be treated shall be provided.

(j) Residual Testing Equipment.

Chlorine residual test equipment recognized in the latest edition of "Standard Methods for the Examination of Water and Wastewater" shall be provided and shall be capable of measuring residuals to the nearest 0.1 mg/l in the range below 0.5 mg/l, to the nearest 0.3 mg/l between 0.5 mg/l and 1.0 mg/l and to the nearest 0.5 mg/l above 1.0 mg/l.

(k) Standby and Backup Equipment.

A spare parts kit shall be provided and maintained for all chlorinators to repair parts subject to wear and breakage. If there is a large difference in feed rates between routine and emergency dosages, a gas metering tube shall be provided for each dose range to ensure accurate control of the chlorine feed. Where chlorination is required for protection of the supply, standby equipment of sufficient capacity shall be available to replace the largest unit. Standby power shall be available, during power outages, for operation of chlorinators where protection of the supply is required.

(l) Heating, Lighting, Ventilation.

Chlorinator houses shall be heated, lighted and ventilated as necessary to assure proper operation of the equipment, and serviceability.

(m) Bypass Capability.

A chlorinator bypass shall be provided for periods during chlorinator servicing and power outages.

(2) Additional Requirement for Gas Chlorinators.

(a) Automatic Switch over.

Automatic Switch over of chlorine cylinders shall be provided, where necessary, to assure continuous disinfection.

(b) Injector.

Each injector shall be selected for the point of application with particular attention given to the quantity of chlorine to be added, the maximum injector waterflow, the total discharge back pressure, the injector operating pressure, and the size of the chlorine solution line. Gauges for measuring water pressure at the inlet and outlet of each injector shall be provided.

(c) Gas Scrubbers.

Gas chlorine facilities shall conform with the Uniform Fire Code, Article 80 and the Uniform Building Code, Chapter 9 as they are applied by local jurisdictions in the state. Furthermore, local toxic gas ordinances shall be complied with if they exist.

(d) Heat.

The design of the chlorination room shall assure that the temperature in the room will never fall below 32 degrees F or that temperature required for proper operation of the chlorinator, whichever is greater.

(e) Ventilation.

Chlorination equipment rooms which contain cylinders or equipment and lines with gaseous chlorine under pressure shall be vented such that:

(i) when fan(s) are operating, suction will provide one complete room air change per minute;

(ii) the ventilating fan(s) take suction near the floor, as far as practical from the door and air inlet, with the point of discharge so located as not to contaminate air inlets of any rooms or structures;

(iii) air inlets are through louvers near the ceiling;

(iv) louvers for chlorine room air intake and exhaust facilitate airtight closure;

(iv) separate switches for the fans and lights are outside of the room, at the entrance to the chlorination equipment room. Outside switches shall be protected from vandalism;

(v) vents from feeders and storage discharge above grade to the outside atmosphere; and

(vi) floor drains are discouraged. Where provided, the floor drains shall discharge to the outside of the building and shall not be connected to other internal or external drainage systems.

(f) Feeder Vent Hose.

The vent hose from the feeder shall discharge to the outside atmosphere above grade at a point least susceptible to vandalism and shall have the end covered with a No. 14 mesh non-corrodible screen.

(g) Housing.

Adequate housing shall be provided for the chlorination equipment and for storing the chlorine (see R309-520-10(1)(l) above).

(h) Housing at Water Treatment Plants.

Separate rooms for cylinders and feed equipment shall be provided at all water treatment plants. Chlorine gas feed and storage shall be enclosed and separated from other operating areas. The chlorine room shall be:

(i) provided with a shatter resistant inspection window installed in an interior wall and preferably located so that an operator may read the weighing scales without entering the chlorine room,

(ii) constructed in a manner that all openings between the chlorine room and the remainder of the plant are sealed, and

(iii) provided with doors equipped with panic hardware assuring ready means of exit and opening only to the building exterior.

(i) Cylinder Security.

Full and empty cylinders of chlorine gas shall be:

(i) isolated from operating areas;

(ii) restrained in position to prevent upset from accidental bumping or a seismic event;

(iii) stored in rooms separated from ammonia storage; and

(iv) stored in areas not in direct sunlight or exposed to excessive heat.

(j) Feed Line Routing.

Chlorine feed lines shall not carry pressurized chlorine gas beyond the chlorinator room. Only vacuum lines may be routed to other portions of the building outside the chlorine room and any openings for these lines must be adequately sealed.

(k) Weighing Scales.

Scales shall be provided for weighing cylinders. Scales should be of a corrosion resistant material and should be placed in a location remote from any moisture. Scales shall be accurate enough to indicate loss of weight to the nearest one pound for 150 pound cylinders and to the nearest 10 pounds for one ton cylinders.

(l) Pressure Gauges.

Pressure gauges shall be provided on the inlet and outlet of each chlorine injector as indicated in R309-520-10(2)(b). The preferred location is on the water feed line immediately before the inlet of the chlorine injector and at a point on the water main just ahead of chlorine injection. These locations should give accurate pressure readings while not being subjected to corrosive chlorinated water.

(m) Injector Protection.

A suitable screen to prevent small debris from clogging a chlorine injector shall be provided on the water feed line. Provision for flushing of the screen is required.

(n) Chlorine Vent Line Protection.

A non-corrodible fine mesh (No. 14 or finer) screen shall be placed over the discharge ends of all vent lines. All vent lines shall discharge to the outside atmosphere above grade and at locations least susceptible to vandalism.

(o) Gas Masks.

(i) Respiratory protection equipment, meeting the requirements of the National Institute for Occupational Safety and Health (NIOSH) shall be available where chlorine gas in one-ton cylinders is handled, and shall be stored at a convenient location, but not inside any room where chlorine is used or stored. The units shall use compressed air, have at least a 30 minute capacity, and be compatible with or exactly the same as units used by the fire department responsible for the plant.

(ii) Where smaller chlorine cylinders are used, suitable gas masks must be provided.

(p) Chlorine Leak Detection and Repair.

A bottle of Ammonium Hydroxide, 56% ammonia solution, shall be available for chlorine leak detection; where ton containers are used, a leak repair kit approved by the Chlorine Institute shall be provided. Continuous chlorine leak detection equipment is recommended. Where a leak detector is provided, it shall be equipped with both an audible alarm and a warning light.

R309-520-11. Ozone.

Proposals for use of ozone disinfection shall be discussed with the Division prior to the preparation of final plans and specifications.

Interim Standard - Ozonation, page xxxi, in the Recommended Standards for Water Works (commonly known as "Ten State Standards"), 1997 edition is hereby incorporated by reference and shall govern the design and operation of disinfection facilities utilizing ozone. 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.

R309-520-12. Chlorine Dioxide.

Proposals for the use of Chlorine Dioxide as a disinfectant shall be discussed with the Division prior to the preparation of final plans and specifications. The "CT" values for the inactivation of Giardia cysts using chlorine dioxide are independent of pH, with only temperature affecting the value. For chlorine dioxide, a 3-log inactivation of Giardia cysts will generally result in greater than 4-log virus inactivation, and assure meeting requirements. However, for chlorine dioxide, unlike chlorine where this relationship always hold true, at certain temperatures, the 4-log virus CT may be higher than the 3-log Giardia cyst CT.

R309-520-13. Chloramines.

Proposals for the use of Chloramines as a disinfectant shall be discussed with the Division prior to the preparation of final plans and specifications.

R309-520-14. Ultraviolet Light.

(1) Proposals for use of ultraviolet disinfection shall be discussed with the Division prior to the preparation of final plans and specifications.

(2) Secondary disinfection and maintenance of the required residual will be necessary where disinfection of the supply is required.

(3) Ultraviolet disinfection will be permitted where the design conforms to the minimum recommendations of the U.S. Public Health Service listed below.

(a) Ultraviolet radiation at a level of 2,537 Angstrom units must be applied at a minimum dosage of 16,000 microwatt-seconds per square centimeter per second (1,600 Finsen Units) at all points throughout the water disinfection chamber.

(b) Maximum water depth in the chamber, measured from the tub surface to the chamber wall, shall not exceed three inches.

(c) The ultraviolet tubes shall be:

(i) jacketed so that a proper operating tube temperature of about 105 degrees F is maintained; and

(ii) the jacket shall be of quartz or high silica glass with similar optical characteristics.

(d) A flow or time delay mechanism shall be provided to permit a two minute tube warm-up period before water flows from the unit.

(e) The unit shall be designed to permit frequent mechanical cleaning of the water contact surface of the jacket without disassembly of the unit.

(f) An automatic flow control valve, accurate within the expected pressure range, shall be installed to restrict flow to the maximum design flow of the treatment unit.

(g) An accurately calibrated ultraviolet intensity meter, properly filtered to restrict its sensitivity to the disinfection spectrum, shall be installed in the wall of the disinfection chamber at the point of greatest water depth from the tube or tubes.

(h) A diversion valve or automatic shut-off valve shall be installed which will permit flow into the finished drinking water system only when at least the minimum ultraviolet dosage is applied. When power is not being supplied to the unit, the valve should be in a closed position which prevents the flow of water into the finished drinking water system.

(i) An automatic, audible alarm shall be installed to warn of malfunction or impending shutdown.

(j) The materials of construction shall not impart toxic materials into the water either as a result of the presence of toxic constituents in materials of construction or as a result of physical or chemical changes resulting from exposure to ultraviolet energy.

(k) The unit shall be designed to protect the operator against electrical shock or excessive radiation.

(l) As with any drinking water treatment process, due consideration must be given to the reliability, economics, and competent operation of the disinfection process and related equipment, including:

(i) installation of the unit in a protected enclosure not subject to extremes of temperature which could cause malfunction; and

(ii) provision of a spare UV tube and other necessary equipment to effect prompt repair by qualified personnel properly instructed in the operation and maintenance of the equipment.

R309-520-15. Operation and Maintenance.

(1) Safety.

Chlorine gas facilities shall be operated in a manner which minimizes risks to water system personnel or the general public.

(2) Residual Chlorine.

Public drinking water systems supplied water from conventional surface water treatment or alternatives shall test for detectable chlorine residual or HPC within the distribution system as outlined in R309-104-4.7.4c.

(3) Chlorine Dosing.

Chlorine, when used in the distribution system, shall be added in sufficient quantity to achieve either "breakpoint" and yield a detectable free chlorine residual or a detectable combined chlorine residual in the distribution system at points to be determined by the Executive Secretary. Residual checks must be taken daily by the operator of any system using disinfectants. The Executive Secretary may, however, reduce the frequency of residual checks if he determines that this would be an unwarranted hardship on the water system operator and, furthermore, the disinfection equipment has a verified record of reliable operation. Suppliers, when checking for residuals, must use test kits and

methods which meet the requirements of the U.S. EPA. The "DPD" test method is recommended for free chlorine residuals. Information on the suppliers of this equipment is available from the Division.

(4) ANSI/NSF Standard 60 Certification.

All chemicals, including chlorine gas, added to drinking water supplied by a public water system shall be certified as complying with ANSI/NSF Standard 60, Drinking Water Treatment Chemicals.

KEY

drinking water, primary disinfectants, secondary disinfectants, operation and maintenance

Date of Enactment or Last Substantive Amendment

August 15, 2000

Notice of Continuation

March 13, 2007

Authorizing, Implemented, or Interpreted Law

19-4-104
