COMMONWEALTH OF PUERTO RICO
DEPARTMENT OF HEALTH
ENVIRONMENTAL HEALTH DIVISION

4538

# AMENDMENTS ADOPTED TO REGULATION OF THE SECRETARY OF HEALTH NUMBER 50 "Surface Water Treatment Rule"

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COMMONWEALTH OF PUERTO RICO
DEPARTMENT OF HEALTH
ENVIRONMENTAL HEALTH DIVISION
SAN JUAN, PUERTO RICO

REGULATION NO. 76

AMENDMENTS ADOPTED TO REGULATION OF THE SECRETARY OF HEALTH NUMBER 50 APPROVED ON JUNE 20, 1983 AND FILED WITHIN THE DEPARTMENT OF STATE ON JUNE 21, 1983 FILE NO. 3,000

INTRODUCTION

This document contains the amendment adopted to Regulation of the Secretary of Health Number 50, June 20, 1983, related to the 1986 amendments to the "Safe Drinking Water Act of 1974", Public Law 93-523 as amended on December 16, 1974, Amendments of 1986, Public Law 99-939, 100 Stat. 642.

Said amendments include:

* Maximum Contaminant Level goals for Giardia lamblia, viruses and Legionella.

* National Primary Drinking Water regulations for public water systems using surface water sources or ground water sources under the direct influence of surface water including:

(1) Criteria under which filtration (including coagulation and sedimentation, as appropriate) and procedures by which the Secretary will determine which systems must install filtration and (2) disinfection requirements.

* Limits on turbidity as criteria for determining whether a public water system is required to filter; and determining whether filtration, if required, is adequate.

In Article II the following definitions are added and arranged alphabetically to read as follows:

ARTICLE II - DEFINITIONS

1. "Coagulation" means a process using coagulant chemicals and mixing by which colloidal and suspended materials are destabilized and agglomerated into flocs.

2. "Conventional filtration treatment" means a series of processes including coagulation, flocculation, sedimentation, and filtration resulting in substantial particulate removal.

3. "CT" or "CTcalc" is the product of "residual disinfectant concentration" (C) in mg/l determined before or at the first customer, and the corresponding "disinfectant contact time" (T) in minutes, i.e., "C" x "T". If a public water system applies disinfectants at more than one point prior to the first customer, it must determine the CT of each disinfectant sequence before or at the first customer to determine the total percent inactivation or "total inactivation ratio." In determining the total inactivation ratio, the public water system must determine the residual disinfectant concentration of each disinfection sequence and corresponding contact time before any subsequent disinfection application point(s). "CT99.9" is the CT value required for 99.9 percent (3-log) inactivation of Giardia lamblia cysts. CT99.9 for a variety of disinfectants and conditions appear in Tables 1.1- 1.6, 2.1, and 3.1 of Article VI B5) (b) 3. CT calc./CT 99 is the inactivation ratio. The sum of the inactivation ratios,

or total inactivation ratio shown as (CT99.9/CT calc.), is calculated by adding together the inactivation ratio for each disinfection sequence. A total inactivation ratio equal to or greater than 1.0 is assumed to provide a 3-log inactivation of Giardia lamblia cysts.

4. "Diatomaceous earth filtration" means a process resulting in substantial particulate removal in which (a) a precoat cake of diatomaceous earth filter media is deposited on a support membrane (septum), and (b) while the water is filtered by passing through the cake on the septum, additional filter media known as body feed is continuously added to the feed water to maintain the permeability of the filter cake.

5. "Direct filtration" means a series of processes including coagulation and filtration but excluding sedimentation resulting in substantial particulate removal.

6. "Disinfectant contact time" ("T" in CT calculations) means the time in minutes that it takes for water to move from the point of disinfectant application or the previous point of disinfectant residual measurement to a point before or at the point where residual disinfectant concentration ("C") is measured. Where only one "C" is measured, "T" is the time in minutes that it takes for water to move from the point of disinfectant application to a point before or at the point where residual disinfectant concentration ("C") is measured. Where more than one "C" is measured, "T" is (a) for the first measurement of "C", the time in minutes that it takes for water to move from the first or only point of disinfectant

application to a point before or at the point where the first "C" is measured and (b) for subsequent measurements of "C", the time in minutes that it takes for water to move from the previous "C" measurement point to the "C" measurement point for which the particular "T" is being calculated. Disinfectant contact time in pipelines must be calculated based on "plug flow" by dividing the internal volume of the pipe by the maximum hourly flow rate through that pipe. Disinfectant contact time within mixing basins and storage reservoirs must be determined by tracer studies or an equivalent demonstration.

7. "Disinfection" means a process which inactivates pathogenic organisms in water by chemical oxidants or equivalent agents.

8. "Filtration" means a process for removing particulate matter from water by passage through porous media.

9. "Flocculation" means a process to enhance agglomeration or collection of smaller floc particles into larger, more easily settleable particles through gentle stirring by hydraulic or mechanical means.

10. "Ground water under the direct influence of surface water" means any water beneath the surface of the ground with (a) significant occurrence of insects or other microorganisms algae, or large-diameter pathogens such as Giardia lamblia, or (b) significant and relatively rapid shifts in water characteristics "such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions. Direct influence must be determined for individual sources in accordance

with criteria established by the Secretary. The Secretary determination of direct influence may be based on site-specific measurements of water quality and/or documentation of well construction characteristics and geology with field evaluation.

11. "Legionella" means a genus of bacteria, some species of which have caused a type of pneumonia called Legionnaires Disease.

12. "Point of disinfectant application" is the point where the disinfectant is applied and water downstream of that point is not subject to recontamination by surface water runoff.

13. "Residual disinfectant concentration" ("C" in CT calculations) means the concentration of disinfectant measured in mg/l in a representative sample of water.

14. "Sedimentation" means a process for removal of solids before filtration by gravity or separation.

15. "Slow sand filtration" means a process involving passage of raw water through a bed of sand at low velocity (generally less than 0.4 m/h) resulting in substantial particulate removal by physical and biological mechanisms.

16. "Surface water" means all water which is open to the atmosphere and subject to surface runoff.

17. "Waterborne disease outbreak" means the significant occurrence of acute infectious illness, epidemiologically associated with the ingestion of water from a public water system which is deficient in treatment, as determined by the appropriate local or Secretary agency.

18. "Virus" means a virus of fecal origin which is infectious to humans by waterborne transmission.

Article VI 5) is amended by adding an introductory paragraph to read as follows:

Article VI 5) Maximum contaminant levels for turbidity.

The requirements in this section apply to unfiltered systems until December 30, 1991, unless the Secretary has determined prior to that date, in writing pursuant to section 1412(b)(7)(C)(iii), that filtration is required. The requirements in this section apply to filtered systems until June 29, 1993. The requirements in this section apply to unfiltered systems that the Secretary has determined, in writing pursuant to section 1412(b)(7)(C)(iii), must install filtration, until June 29, 1993, or until filtration is installed, whichever is later.

Article VI 8) is amended by adding an introductory paragraph to read as follows:

Article VI 8) Turbidity sampling and analytical requirements.

The requirements in this section apply to unfiltered systems until December 30, 1991, unless the Secretary has determined prior to that date, in writing pursuant to section 1412(b)(7)(iii), that filtration is required. The requirements in this section apply to filtered systems until June 29, 1993. The requirements in this section apply to unfiltered systems that the Secretary has determined, in writing pursuant to section 1412(b)(7)(C)(iii), must install filtration, until June 29, 1993, or until filtration is installed, whichever is later.

Article IX is amended by adding new paragraphs (a)(1)(iii)(D) and (e)(10) to read as follows:

Article IX Requirements for Public Notification by Public Water Systems.

(D) Occurrence of a waterborne disease outbreak, as defined in Article II in an unfiltered system subject to the requirements of Article VI B of this Regulation, after December 30, 1991 (see Article VI B2)(b)4.)B.

(10) Microbiological contaminants (for use when there is a violation of the treatment technique requirements for filtration and disinfection in Article VI B of this Regulation). The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that the presence of microbiological contaminants are a health concern at certain levels of exposure. If water is inadequately treated, microbiological contaminants in that water may cause disease. Disease symptoms may include diarrhea, cramps, nausea, and possibly jaundice, and any associated headaches and fatigue. These symptoms, however, are not just associated with disease causing organisms in drinking water, but also may be caused by a number of factors other than your drinking water. EPA has set enforceable requirements for treating drinking water to reduce the risk of these adverse health effects. Treatment such as filtering and disinfecting the water removes or destroys microbiological contaminants. Drinking water which is treated to meet EPA requirements is associated with little to none of this risk and should be considered safe.

In Article VI, a new 20 is added to read as follows:

20) Maximum contaminant level goals for microbiological contaminants.

MCLGs for the following contaminants are as indicated:

| Contaminant | MCLG |
|---|---|
| (1) Giardia lamblia | zero |
| (2) Viruses | zero |
| (3) Legionella | zero |

A new Section B is added to Article VI to read as follows:

ARTICLE B - FILTRATION AND DISINFECTION

1) General requirements.

(a) The requirements of this Section B constitute national primary drinking water regulations. These regulations establish criteria under which filtration is required as a treatment technique for public water systems supplied by a surface water source and public water systems supplied by a ground water source under the direct influence of surface water. In addition, these regulations establish treatment technique requirements in lieu of maximum contaminant levels for the following contaminants: Giardia lamblia, viruses, heterotrophic plate count bacteria, Legionella, and turbidity. Each public water system with a surface water source or a ground water source under the direct influence of surface water must provide treatment of that source water that complies with these treatment technique requirements. The treatment technique requirements consist of installing and properly operating water treatment

processes which reliably achieve:

1. At least 99.9 percent (3-log) removal and/or inactivation of Giardia lamblia cysts between a point where the raw water is not subject to recontamination by surface water runoff and a point downstream before or at the first customer; and

2. At least 99.99 percent (4-log) removal and/or inactivation of viruses between a point where the raw water is not subject to recontamination by surface water runoff and a point downstream before or at the first customer.

(b) A public water system using a surface water source or a ground water source under the direct influence of surface water is considered to be in compliance with the requirements of paragraph (a) of this section if:

1. It meets the requirements for avoiding filtration in 2) and the disinfection requirements in 3)(a) or

2. It meets the filtration requirements in 4) and the disinfection requirements in 3)(b).

(c) Each public water system using a surface water source or a ground water source under the direct influence of surface water must be operated by qualified personnel who meet the requirements specified by the Secretary.

2) Criteria for avoiding filtration.

A public water system that uses a surface water source must meet all of the conditions of paragraphs (a) and (b) of this Article VI B2), and is subject to paragraph 2 (c) beginning December 30, 1991, unless the Secretary has determined, in writing pursuant to section 1412(b)(7)(C)

(iii), that filtration is required. A public water system that uses a ground water source under the direct influence of surface water must meet all of the conditions of paragraphs 2 (a) and 2 (b) and is subject to paragraph 2 (c) beginning 18 months after the Secretary determines that it is under the direct influence of surface water, or December 30, 1991, whichever is later, unless the Secretary has determined, in writing pursuant to section 1412(b)(7)(C)(iii), that filtration is required. If the Secretary determines in writing pursuant to section 1412(b)(7)(C)(iii) before December 30, 1991 that filtration is required, the system must have installed filtration and meet the criteria for filtered systems specified in Article VI 3)(b) and Article VI B4) by June 29, 1993. Within 18 months of the failure of a system using surface water or a ground water source under the direct influence of surface water to meet any one of the requirements of paragraphs 2 (a) and 2 (b) after June 29, 1993, whichever is later, the system must have installed filtration and meet the criteria for filtered systems specified in Article VI B3)(b) Article VI B4).

(a) Source water quality conditions. 1. The fecal coliform concentration must be equal to or less than 20/100 ml, or the total coliform concentration must be equal to or less than 100/100 ml (measured as specified in Article VI B5)(a) 1 and 2 and (b) 1), in representative samples of the source water immediately prior to the first or only point of disinfectant application in at least 90

percent of the measurements made for the six previous months that the system served water to the public on an ongoing basis. If a system measures both fecal and total coliforms, the fecal coliform criterion, but not the total coliform criterion, in this paragraph must be met.

2. The turbidity level cannot exceed 5 NTU (measured as specified in Article VI B5)(a) 4 and (b) 2) in representative samples of the source water immediately prior to the first or only point of disinfectant application unless: (i) the Secretary determines that any such event was caused by circumstances that were unusual and unpredictable; and (ii) as a result of any such event, there have not been more than two events in the past 12 months the system served water to the public, or more than five events in the past 120 months the system served water to the public, in which the turbidity level exceeded 5 NTU. An "event" is a series of consecutive days during which at least one turbidity measurement each day exceeds 5 NTU.

(b) Site-specific conditions. 1. (i) The public water system must meet the requirements of Article VI B3)(a)(1) at least 11 of the 12 previous months that the system served water to the public, on an ongoing basis, unless the system fails to meet the requirements during 2 of the 12 previous months that the system served water to the public, and the Secretary determines that at least one of these failures was caused by circumstances that were unusual and unpredictable.

(ii) The public water system must meet the requirements of Article VI B3)(a) 2 at all times the system

serves water to the public.

(iii) The public water system must meet the requirements of Article VI B3)(a)(3) at all times the system serves water to the public unless the Secretary determines that any such failure was caused by circumstances that were unusual and unpredictable.

(iv) The public water system must meet the requirements of Article VI B3)(a)(4) on an ongoing basis unless the Secretary determines that failure to meet these requirements was not caused by a deficiency in treatment of the source water.

2. The public water system must maintain a watershed control program which minimizes the potential for contamination by Giardia lamblia cysts and viruses in the source water. The Secretary must determine whether the watershed control program is adequate to meet this goal. The adequacy of a program to limit potential contamination by Giardia lamblia cysts and viruses must be based on: the comprehensiveness of the watershed review; the effectiveness of the system's program to monitor and control detrimental activities occurring in the watershed; and the extent to which the water system has maximized land ownership and/or controlled land use within the watershed. At a minimum, the watershed control program must:

(i) characterize the watershed hydrology and land ownership; (ii) identify watershed characteristics and activities which may have an adverse effect on source water quality; and (iii) monitor the occurrence of activities which may have an adverse effect on source water quality.

The public water system must demonstrate through ownership and/or written agreements with landowners within the watershed that it can control all human activities which may have an adverse impact on the microbiological quality of the source water. The public water system must submit an annual report to the Secretary that identifies any special concerns about the watershed and how they are being handled; describes activities in the watershed that affect water quality; and projects what adverse activities are expected to occur in the future and describes how the public water system expects to address them. For systems using a ground water source under the direct influence of surface water, an approved wellhead protection program developed under section 1428 of the Safe Drinking Water Act may be used, if the Secretary deems it appropriate, to meet these requirements.

3. The public water system must be subject to an annual onsite inspection to assess the watershed control program and disinfection treatment process. Either the Secretary or a party approved by the Secretary must conduct the on-site inspection. The inspection must be conducted by competent individuals such as sanitary and civil engineers, sanitarians, or technicians who have experience and knowledge about the operation and maintenance of a public water system, and who have a sound understanding of public health principles and waterborne diseases. A report of the on-site inspection summarizing all findings must be prepared every year. The on-site inspection must indicate to the Secretary's satisfaction that the watershed control program

and disinfection treatment process are adequately designed and maintained. The on-site inspection must include:

(i) a review of the effectiveness of the watershed control program;

(ii) a review of the physical condition of the source intake and how well it is protected;

(iii) a review of the system's equipment maintenance program to ensure there is low probability for failure of the disinfection process;

(iv) an inspection of the disinfection equipment for physical deterioration;

(v) a review of operating procedures;

(vi) a review of data records to ensure that all required tests are being conducted and recorded and disinfection is effectively practiced; and

(vii) identification of any improvements which are needed in the equipment, system maintenance and operation, or data collection.

4. The public water system must not have been identified as a source of a waterborne disease outbreak, or if it has been so identified, the system must have been modified sufficiently to prevent another such occurrence, as determined by the Secretary.

5. The public water system must comply with the maximum contaminant level (MCL) for total coliforms in Article VI 6) at least 11 months of the 12 previous months that the system served water to the public, on an ongoing basis, unless the Secretary determines that failure to meet this requirement was not caused by a deficiency in treatment

of the source water.

6. The public water system must comply with the requirements for trihalomethanes in Article VI 4) and Article VI 16).

(c) Treatment technique violations. 1. A system that (i)4 fails to meet any one of the criteria in paragraphs (a) and (b) Article VI B2) and/or which the Secretary has determined that filtration is required, in writing pursuant to section 1412(b)(7)(C)(iii), and (ii) fails to install filtration by the date specified in the introductory paragraph Article VI B2) is in violation of a treatment technique requirement.

2. A system that has not installed filtration is in violation of a treatment technique requirement if:

(i) The turbidity level (measured as specified in Article VI B5)(a) 4 and (b) 2) in a representative sample of the source water immediately prior to the first or only point of disinfection application exceeds 5 NTU; or

(ii) The system is identified as a source of a waterborne disease outbreak.

3) Disinfection.

A public water system that uses a surface water source and does not provide filtration treatment must provide the disinfection treatment specified in paragraph (a) of this Article VI B3) beginning December 30, 1991, unless the Secretary determines that filtration is required in writing pursuant to section 1412(b)(7)(C)(iii). A public water system that uses a ground water source under the direct

influence of surface water and does not provide filtration treatment must provide disinfection treatment specified in paragraph (a) of this Article VI B3) beginning December 30, 1991 or 18 months after the Secretary determines that the ground water source is under the influence of surface water, whichever is later, unless the Secretary has determined that filtration is required in writing pursuant to section 1412(b)(7)(C)(iii). If the Secretary has determined that filtration is required, the system must comply with any interim disinfection requirements the Secretary deems necessary before filtration is installed. A system that uses a surface water source that provides filtration treatment must provide the disinfection treatment specified in paragraph (b) of this Article VI B3) beginning June 29, 1993, or beginning when filtration is installed, whichever is later. A system that uses a ground water source under the direct influence of surface water and provides filtration treatment must provide disinfection treatment as specified in paragraph (b) of this Article VI B3) by June 29, 1993, or beginning when filtration is installed, whichever is later. Failure to meet any requirement of this Article VI B3) after the applicable date specified in this introductory paragraph is a treatment technique violation.

(a) Disinfection requirements for public water systems that do not provide filtration. Each public water system that does not provide filtration treatment must provide disinfection treatment as follows.

1. The disinfection treatment must be sufficient to

ensure at least 99.9 percent (3-log) inactivation of Giardia lamblia cysts and 99.99 percent (4-log) inactivation of viruses, every day the system serves water to the public, except any one day each month. Each day a system serves water to the public, the public water system must calculate the CT value(s) from the system's treatment parameters, using the procedure specified in Article VI B5) (b) 3, and determine whether this value(s) is sufficient to achieve the specified inactivation rates for Giardia lamblia cysts and viruses. If a system uses a disinfectant other than chlorine, the system may demonstrate to the Secretary, through the use of a Secretary-approved protocol for on-site disinfection challenge studies or other information satisfactory to the Secretary, that CT99.9 values other than those specified in Tables 2.1 and 3.1 in Article VI B5)(b) 3 or other operational parameters are adequate to demonstrate that the system is achieving minimum inactivation rates required by paragraph (a) 1 of this Article VI B3).

2. The disinfection system must have either (i) redundant components, including an auxiliary power supply with automatic start-up and alarm to ensure that disinfectant application is maintained continuously while water is being delivered to the distribution system, or (ii) automatic shut-off of delivery of water to the distribution system whenever there is less than 0.2 mg/l of residual disinfectant concentration in the water. If the Secretary determines that automatic shut-off would cause unreasonable risk to health or interfere with fire protection, the

system must comply with paragraph (a) 2(i) of this Article VI B3).

3. The residual disinfectant concentration in the water entering the distribution system, measured as specified in Article VI B5)(a) 5 and (b) 5, cannot be less than 0.2 mg/l for more than 4 hours.

4. (i) The residual disinfectant concentration in the distribution system, measured as total chlorine, combined chlorine, or chlorine dioxide, as specified in Article VI B5)(a) 5 and (b) 6, cannot be undetectable in more than 5 percent of the samples each month, for any two consecutive months that the system serves water to the public. Water in the distribution system with a heterotrophic bacteria concentration less than or equal to 500/ml, measured as heterotrophic plate count (HPC) as specified in Article VI B5)(a) 3, is deemed to have a detectable disinfectant residual for purposes of determining compliance with this requirement. Thus, the value "V" in the following formula cannot exceed 5 percent in one month, for any two consecutive months.

$$V = \frac{c + d + e}{a + b} \times 100$$

where:

a = number of instances where the residual disinfectant concentration is measured;

b = number of instances where the residual disinfectant concentration is not measured but heterotrophic bacteria plate count (HPC) is measured;

c = number of instances where the residual disinfectant

concentration is measured but not detected and no HPC is measured;

d = number of instances where residual disinfectant concentration is measured but not detected and where the HPC is >500/ml; and

e = number of instances where the residual disinfectant concentration is not measured and HPC is >500/ml.

(ii) If the Secretary determines, based on site-specific considerations, that a system has no means for having a sample transported and analyzed for HPC by a certified laboratory under the requisite time and temperature conditions specified by Article VI B5)(a) 3 and that the system is providing adequate disinfection in the distribution system, the requirements of paragraph (a) 4(i) of this Article VI B3) not apply to that system.

(b) Disinfection requirements for public water systems which provide filtration. Each public water system that provides filtration treatment must provide disinfection treatment as follows.

(1) The disinfection treatment must be sufficient to ensure that the total treatment processes of that system achieve at least 99.9 percent (3-log) inactivation and/or removal of Giardia lamblia cysts and at least 99.99 percent (4-log) inactivation and/or removal of viruses, as determined by the Secretary.

(2) The residual disinfectant concentration in the water entering the distribution system, measured as specified in Article VI B5)(a) 5 and (c) 2, cannot be less

than 0.2 mg/l for more than 4 hours.

(3)(i) The residual disinfectant concentration in the distribution system, measured as total chlorine, combined chlorine, or chlorine dioxide, as specified in Article VI B5)(a) 5 and (c) 3, cannot be undetectable in more than 5 percent of the samples each month, for any two consecutive months that the system serves water to the public. Water in the distribution system with a heterotrophic bacteria concentration less than or equal to 500/ml, measured as heterotrophic plate count (HPC) as specified in Article VI B5)(a) 3, is deemed to have a detectable disinfectant residual for purposes of determining compliance with this requirement. Thus, the value "V" in the following formula cannot exceed 5 percent in one month, for any two consecutive months.

$$V = \frac{c + d + e}{a + b} \times 100$$

where:

a = number of instances where the residual disinfectant concentration is measured;

b = number of instances where the residual disinfectant concentration is not measured but heterotrophic bacteria plate count (HPC) is measured;

c = number of instances where the residual disinfectant concentration is measured but not detected and no HPC is measured;

d = number of instances where no residual disinfectant concentration is detected and where the HPC is >500/ml; and

e = number of instances where the residual disinfectant concentration is not measured and HPC is >500/ml.

(ii) If the Secretary determines, based on site-specific considerations, that a system has no means for having a sample transported and analyzed for HPC by a certified laboratory under the requisite time and temperature conditions specified in Article VI B5)(a) 3 and that the system is providing adequate disinfection in the distribution system, the requirements of paragraph (b) 3 (i) of this Article VI B3) do not apply.

4. Filtration

A public water system that uses a surface water source or a ground water source under the direct influence of surface water, and does not meet all of the criteria in Article VI B2)(a) and (b) for avoiding filtration, must provide treatment consisting of both disinfection, as specified in Article VI B3)(b), and filtration treatment which complies with the requirements of paragraph (a), (b), (c), (d), or (e) of this Article VI B4) by June 29, 1993, or within 18 months of the failure to meet any one of the criteria for avoiding filtration in Article VI B2)(a) and (b), whichever is later. Failure to meet any requirement of this section after the date specified in this introductory paragraph is a treatment technique violation.

(a) Conventional filtration treatment or direct filtration.

1. For systems using conventional filtration or direct filtration, the turbidity level of representative samples of a system's filtered water must be less than or equal to 0.5 NTU in at least 95 percent of the measurements taken each month, measured as specified in Article VI B5)(a) 4 and (c)

1, except that if the Secretary determines that the system is capable of achieving at least 99.9 percent removal and/or inactivation of Giardia lamblia cysts at some turbidity level higher than 0.5 NTU in at least 95 percent of the measurements taken each month, the Secretary may substitute this higher turbidity limit for that system. However, in no case may the Secretary approve a turbidity limit that allows more than 1 NTU in more than 5 percent of the samples taken each month, measured as specified in Article VI B5) (a) 4 and (c) 1.

2. The turbidity level of representative samples of a system's filtered water must at no time exceed 5 NTU, measured as specified in Article VI B5)(a) 4 and (c) 1.

(b) Slow sand filtration.

1. For systems using slow sand filtration, the turbidity level of representative samples of a system's filtered water must be less than or equal to 1 NTU in at least 95 percent of the measurements taken each month, measured as specified in Article VI B5)(a) 4 and (c) 1, except that if the Secretary determines there is no significant interference with disinfection at a higher turbidity level, the Secretary may substitute this higher turbidity limit for that system.

2. The turbidity level of representative samples of a system's filtered water must at no time exceed 5 NTU, measured as specified in Article VI B5)(a) 4 and (c).

(c) Diatomaceous earth filtration.

1. For systems using diatomaceous earth filtration, the turbidity level of representative samples of a system's

filtered water must be less than or equal to 1 NTU in at least 95 percent of the measurements taken each month, measured as specified in Article VI B5)(a) 4 and (c) 1.

(2) The turbidity level of representative samples of a system's filtered water must at no time exceed 5 NTU, measured as specified in Article VI B5)(a) 4 and (c) 1.

(d) Other filtration technologies. A public water system may use a filtration technology not listed in paragraphs (a)-(c) of this Article VI B4) if it demonstrates to the Secretary, using pilot plant studies or other means, that the alternative filtration technology, in combination with disinfection treatment that meets the requirements of Article VI B3) (b), consistently achieves 99.9 percent removal and/or inactivation of Giardia lamblia cysts and 99.99 percent removal and/or inactivation of viruses. For a system that makes this demonstration, the requirements of paragraph (b) of this Article VI B4) apply.

5) Analytical and monitoring requirements.

(a) Analytical requirements. Only the analytical method(s) specified in this paragraph, or otherwise approved by EPA, may be used to demonstrate compliance with the requirements of Article IV B2), 3) 4). Measurements for pH, temperature, turbidity, and residual disinfectant concentrations must be conducted by a party approved by the Secretary. Measurements for total coliforms, fecal coliforms, and HPC must be conducted by a laboratory certified by the Secretary or EPA to do such analysis. Until laboratory certification criteria are developed for the analysis of HPC and fecal

coliforms, any laboratory certified for total coliform analysis by EPA is deemed certified for HPC and fecal coliform analysis. The following procedures shall be performed in accordance with the publications listed in the following section. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. Copies of the methods published in Standard Methods for the Examination of Water and Wastewater may be obtained from the American Public Health Association et al., 1015 Fifteenth Street, N.W., Washington, D.C. 20005; copies of the Minimal Medium ONPG-MUG Method as set forth in the article "National Field Evaluation of a Defined Substrate Method for the Simultaneous Enumeration of Total Coliforms and Escherichia coli from Drinking Water: Comparison with the Standard Multiple Tube Fermentation Method" (Edberg et al.), may be obtained from the American Water Works Association Research Foundation, 6666 West Quincy Avenue, Denver, Colorado, 80235; and copies of the Indigo Method as set forth in the article "Determination of Ozone in Water by the Indigo Method" (Bader and Hoigne), may be obtained from Ozone Science & Engineering, Pergamon Press Ltd., Fairview Park, Elmsford, New York 10523.

1. Fecal coliform concentration - Method 908C (Fecal Coliform MPN Procedures), pp. 878-880, Method 908D (Estimation of Bacterial Density), pp. 880-882, or Method 909C (Fecal Coliform Membrane Filter Procedure), pp. 896-898, as set forth in Standard Methods for the Examination of Water and Wastewater, 1985, American Public Health Association et al., 16th edition.

2. Total coliform concentration - Method 908A (Standard Total Coliform Multiple - Tube (MPN) Tests), pp. 872-876, Method 908B (Application of Tests to Routine Examinations), pp. 876-878, Method 908D (Estimation of Bacterial Density), pp. 880-882, Method 909A (Standard Total Coliform Membrane Filter Procedure), pp. 887-894, or Method 909B (Delayed - Incubation Total Coliform Procedure), pp. 894-896, as set forth in Standard Methods for the Examination of Water and Wastewater, 1985, American Public Health Association et al., 16th edition; Minimal Medium ONPG-MUG Test, as set forth in the article "National Field Evaluation of a Defined Substrate Method for the Simultaneous Enumeration of Total Coliforms and Escherichia coli from Drinking Water: Comparison with the Standard Multiple Tube Fermentation Method" (Edberg et al.), Applied and Environmental Microbiology, Volume 54, pp. 1595-1601, June 1988. (Note: the Minimal Medium ONPG-MUG Test is sometimes referred to as the Auto analysis Colilert System). Systems may use a five-tube test or a ten-tube test.

3. Heterotrophic Plate Count - Method 907A (Pour Plate Method), pp. 864-866, as set forth in Standard Methods for the Examination of Water and Wastewater, 1985, American Public Health Association et al., 16th edition.

4. Turbidity - Method 214A (Nephelometric Method Nephelometric Turbidity Units), pp. 134-136, as set forth in Standard Methods for the Examination of Water and Wastewater, 1985, American Public Health Association et al., 16th edition.

5. Residual disinfectant concentration - Residual disinfectant concentrations for free chlorine and combined

chlorine (chloramines) must be measured by Method 408C (Amperometric Titration Method), pp. 303-306, Method 408D (DPD Ferrous Titrimetric Method), pp. 306-309, Method 408E (DPD Colorimetric Method), pp. 309-310, or Method 408F (Leuco Crystal Violet Method), pp. 310-313, as set forth in Standard Methods for the Examination of Water and Wastewater, 1985, American Public Health Association et al., 16th edition. Residual disinfectant concentrations for free chlorine and combined chlorine may also be measured by using DPD colorimetric test kits if approved by the Secretary. Residual disinfectant concentrations for ozone must be measured by the Indigo Method as set forth in Bader, H., Hoigne, J., "Determination of Ozone in Water by the Indigo Method; A Submitted Standard Method"; Ozone Science and Engineering, Vol. 4, pp. 169-176, Pergamon Press Ltd., 1982, or automated methods which are calibrated in reference to the results obtained by the Indigo Method on a regular basis, if approved by the Secretary. (Note: This method will be published in the 17th edition of Standard Methods for the Examination of Water and Wastewater, American Public Health Association et al.; the Iodometric Method in the 16th edition may not be used.) Residual disinfectant concentrations for chlorine dioxide must be measured by Method 410B (Amperometric Method) or Method 410C (DPD Method), pp. 323-324, as set forth in Standard Methods for the Examination of Water and Wastewater, 1985, American Public Health Association et al., 16th edition.

6. Temperature - Method 212 (Temperature), pp. 126-127, as set forth in Standard Methods for the Examination of

Water and Wastewater, 1985, American Public Health Association et al., 16th edition.

7. pH - Method 423 (pH Value), pp. 429-437, as set forth in Standard Methods for the Examination of Water and Wastewater, 1985, American Public Health Association, 16th edition.

(b) Monitoring requirements for systems that do not provide filtration. A public water system that uses a surface water source and does not provide filtration treatment must begin monitoring, as specified in this paragraph (b), beginning December 31, 1990, unless the Secretary has determined that filtration is required in writing pursuant to section 1412(b)(7)(C)(iii), in which case the Secretary may specify alternative monitoring requirements, as appropriate, until filtration is in place. A public water system that uses a ground water source under the direct influence of surface water and does not provide filtration treatment must begin monitoring as specified in this paragraph (b) beginning December 31, 1990 or 6 months after the Secretary determines that the ground water source is under the direct influence of surface water, whichever is later, unless the Secretary has determined that filtration is required in writing pursuant to section 1412(b)(7)(C)(iii), in which case the Secretary may specify alternative monitoring requirements, as appropriate, until filtration is in place.

1. Fecal coliform or total coliform density measurements as required by Article VI B2)(a) 1 must be performed on representative source water samples immediately prior to the first or only point of disinfectant application. The system must sample for fecal or total coliforms at the

following minimum frequency each week the system serves water to the public:

| System size (persons served) | Samples/week |
|---|---|
| ≤500 | 1 |
| 501-3,300 | 2 |
| 3,301-10,000 | 3 |
| 10,001-25,000 | 4 |
| >25,000 | 5 |

Must be taken on separate days

Also, one fecal or total coliform density measurement must be made every day the system serves water to the public and the turbidity of the source water exceeds 1 NTU (these samples count towards the weekly coliform sampling requirement) unless the Secretary determines that the system, for logistical reasons outside the system's control, cannot have the sample analyzed within 30 hours of collection.

2. Turbidity measurements as required by Article VI B2)(a) 2 must be performed on representative grab samples of source water immediately prior to the first or only point of disinfectant application every four hours (or more frequently) that the system serves water to the public. A public water system may substitute continuous turbidity monitoring for grab sample monitoring if it validates the continuous measurement for accuracy on a regular basis using a protocol approved by the Secretary.

3. The total inactivation ratio for each day that the system is in operation must be determined based on the CT99.9 values in Tables 1.1 - 1.6, 2.1, and 3.1 of this

Article VI B5), as appropriate. The parameters necessary to determine the total inactivation ratio must be monitored as follows:

(i) The temperature of the disinfected water must be measured at least once per day at each residual disinfectant concentration sampling point.

(ii) If the system uses chlorine, the pH of the disinfected water must be measured at least once per day at each chlorine residual disinfectant concentration sampling point.

(iii) The disinfectant contact time(s) "T" must be determined for each day during peak hourly flow.

(iv) The residual disinfectant concentration(s) ("C") of the water before or at the first customer must be measured each day during peak hourly flow.

(v) If a system uses a disinfectant other than chlorine, the system may demonstrate to the Secretary, through the use of a Secretary-approved protocol for on-site disinfection challenge studies or other information satisfactory to the Secretary, that CT99.9 values other than those specified in Tables 2.1 and 3.1 in this Article VI B5) other operational parameters are adequate to demonstrate that the system is achieving the minimum inactivation rates required by Article VI B3)(a) 1.

TABLE 1.1

CT VALUES (CT99.9) FOR 99.9 PERCENT INACTIVATION OF *GIARDIA LAMBLIA* CYSTS BY FREE CHLORINE AT 0.5°C OR LOWER*

| Residual (mg/l) | pH | | | | | | |
|---|---|---|---|---|---|---|---|
| | ≤ 6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | ≤ 9.0 |
| ≤ 0.4 | 137 | 163 | 195 | 237 | 277 | 329 | 390 |
| 0.6 | 141 | 168 | 200 | 239 | 286 | 342 | 407 |
| 0.8 | 145 | 172 | 205 | 246 | 295 | 354 | 422 |
| 1.0 | 148 | 176 | 210 | 253 | 304 | 365 | 437 |
| 1.2 | 152 | 180 | 215 | 259 | 313 | 376 | 451 |
| 1.4 | 155 | 184 | 221 | 266 | 321 | 387 | 464 |
| 1.6 | 157 | 189 | 226 | 273 | 329 | 397 | 477 |
| 1.8 | 162 | 193 | 231 | 279 | 338 | 407 | 489 |
| 2.0 | 165 | 197 | 236 | 286 | 346 | 417 | 500 |
| 2.2 | 169 | 201 | 242 | 297 | 353 | 426 | 511 |
| 2.4 | 172 | 205 | 247 | 298 | 361 | 435 | 522 |
| 2.6 | 175 | 209 | 252 | 304 | 368 | 444 | 533 |
| 2.8 | 178 | 213 | 257 | 310 | 375 | 452 | 543 |
| 3.0 | 181 | 217 | 261 | 316 | 382 | 460 | 552 |

*These CT values achieve greater than a 99.99 percent inactivation of viruses. CT values between the indicated pH values may be determined by linear interpolation. CT values between the indicated temperatures of different tables may be determined by linear interpolation. If no interpolation is used, use the CT99.9 value at the lower temperature and at the higher pH.

TABLE 1.2

CT VALUES (CT 99.9) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY FREE CHLORINE AT 5.0°C*

| Free Residual (mg/l) | pH | | | | | | |
|---|---|---|---|---|---|---|---|
| | ≤ 6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | ≤ 9.0 |
| ≤ 0.4 | 97 | 117 | 139 | 166 | 198 | 236 | 279 |
| 0.6 | 100 | 120 | 143 | 171 | 204 | 244 | 291 |
| 0.8 | 103 | 122 | 146 | 175 | 210 | 252 | 301 |
| 1.0 | 105 | 125 | 149 | 179 | 216 | 260 | 312 |
| 1.2 | 107 | 127 | 152 | 183 | 221 | 267 | 320 |
| 1.4 | 109 | 130 | 155 | 187 | 227 | 274 | 329 |
| 1.6 | 111 | 132 | 158 | 192 | 232 | 281 | 337 |
| 1.8 | 114 | 135 | 162 | 196 | 238 | 287 | 345 |
| 2.0 | 116 | 138 | 165 | 200 | 243 | 294 | 353 |
| 2.2 | 118 | 140 | 169 | 204 | 248 | 300 | 361 |
| 2.4 | 120 | 143 | 172 | 209 | 253 | 306 | 368 |
| 2.6 | 122 | 146 | 175 | 213 | 258 | 312 | 375 |
| 2.8 | 124 | 148 | 178 | 217 | 263 | 318 | 382 |
| 3.0 | 126 | 151 | 182 | 221 | 268 | 324 | 389 |

*These CT values achieve greater than a 99.99 percent inactivation of viruses. CT values between the indicated pH values may be determined by linear interpolation. CT values between the indicated temperatures of different tables may be determined by linear interpolation. If no interpolation is used, use the CT99.9 value at the lower temperature, and at the higher pH.

TABLE 1.3

CT VALUES (CT99.9) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY FREE CHLORINE AT 10°C*

| Free Residual (mg/l) | pH | | | | | | |
|---|---|---|---|---|---|---|---|
| | ≤ 6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | ≤ 9.0 |
| ≤ 0.4 | 73 | 88 | 104 | 125 | 149 | 177 | 209 |
| 0.6 | 75 | 90 | 107 | 128 | 153 | 183 | 218 |
| 0.8 | 78 | 92 | 110 | 131 | 158 | 189 | 226 |
| 1.0 | 79 | 94 | 112 | 134 | 162 | 195 | 234 |
| 1.2 | 80 | 95 | 114 | 137 | 166 | 200 | 240 |
| 1.4 | 82 | 98 | 116 | 140 | 170 | 206 | 247 |
| 1.6 | 83 | 99 | 119 | 144 | 174 | 211 | 253 |
| 1.8 | 86 | 101 | 122 | 147 | 179 | 215 | 259 |
| 2.0 | 87 | 104 | 124 | 150 | 182 | 221 | 265 |
| 2.2 | 89 | 105 | 127 | 153 | 186 | 225 | 271 |
| 2.4 | 90 | 107 | 129 | 157 | 190 | 230 | 276 |
| 2.6 | 92 | 110 | 131 | 160 | 194 | 234 | 281 |
| 2.8 | 93 | 111 | 134 | 163 | 197 | 239 | 287 |
| 3.0 | 95 | 113 | 137 | 166 | 201 | 243 | 292 |

*These CT values achieve greater than a 99.99 percent inactivation of viruses. CT values between the indicated pH values may be determined by linear interpolation. CT values between the indicated temperatures of different tables may be determined by linear interpolation. If no interpolation is used, use the CT99.9 value at the lower temperature, and at the higher pH.

TABLE 1.4

CT VALUES (CT99.9) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY FREE CHLORINE AT 15°C*

| Free Residual (mg/l) | pH | | | | | | |
|---|---|---|---|---|---|---|---|
| | ≤ 6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | ≤ 9.0 |
| ≤ 0.4 | 49 | 59 | 70 | 83 | 99 | 118 | 140 |
| 0.6 | 50 | 60 | 72 | 86 | 102 | 122 | 146 |
| 0.8 | 52 | 61 | 73 | 88 | 105 | 126 | 151 |
| 1.0 | 53 | 63 | 75 | 90 | 108 | 130 | 156 |
| 1.2 | 54 | 64 | 76 | 92 | 111 | 134 | 160 |
| 1.4 | 55 | 65 | 78 | 94 | 114 | 137 | 165 |
| 1.6 | 56 | 66 | 79 | 96 | 116 | 141 | 169 |
| 1.8 | 57 | 68 | 81 | 98 | 119 | 144 | 173 |
| 2.0 | 58 | 69 | 83 | 100 | 122 | 147 | 177 |
| 2.2 | 59 | 70 | 85 | 102 | 124 | 150 | 181 |
| 2.4 | 60 | 72 | 86 | 105 | 127 | 153 | 184 |
| 2.6 | 61 | 73 | 88 | 107 | 129 | 156 | 188 |
| 2.8 | 62 | 74 | 89 | 109 | 132 | 159 | 191 |
| 3.0 | 63 | 76 | 91 | 111 | 134 | 162 | 195 |

*These CT values achieve greater than a 99.99 percent inactivation of viruses. CT values between the indicated pH values may be determined by linear interpolation. CT values between the indicated temperatures of different tables may be determined by linear interpolation. If no interpolation is used, use the CT99.9 value at the lower temperature, and at the higher pH.

TABLE 1.5

CT VALUES (CT99.9) FOR 99.9 PERCENT INACTIVATION OF *GIARDIA LAMBLIA* CYSTS BY FREE CHLORINE AT 20°C*

| Free Residual (mg/l) | pH | | | | | | |
|---|---|---|---|---|---|---|---|
| | ≤ 6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | ≤ 9.0 |
| ≤ 0.4 | 36 | 44 | 52 | 62 | 74 | 89 | 105 |
| 0.6 | 38 | 45 | 54 | 64 | 77 | 92 | 109 |
| 0.8 | 39 | 46 | 55 | 66 | 79 | 95 | 113 |
| 1.0 | 39 | 47 | 56 | 67 | 81 | 98 | 117 |
| 1.2 | 40 | 48 | 57 | 69 | 83 | 100 | 120 |
| 1.4 | 41 | 49 | 58 | 70 | 85 | 103 | 123 |
| 1.6 | 42 | 50 | 59 | 72 | 87 | 105 | 126 |
| 1.8 | 43 | 51 | 61 | 74 | 89 | 108 | 129 |
| 2.0 | 44 | 52 | 62 | 75 | 91 | 110 | 132 |
| 2.2 | 44 | 53 | 63 | 77 | 93 | 113 | 135 |
| 2.4 | 45 | 54 | 65 | 78 | 95 | 115 | 138 |
| 2.6 | 46 | 55 | 66 | 80 | 97 | 117 | 141 |
| 2.8 | 47 | 56 | 67 | 81 | 99 | 119 | 143 |
| 3.0 | 47 | 57 | 68 | 83 | 101 | 122 | 146 |

*These CT values achieve greater than a 99.99 percent inactivation of viruses. CT values between the indicated pH values may be determined by linear interpolation. CT values between the indicated temperatures of different tables may be determined by linear interpolation. If no interpolation is used, use the CT99.9 value at the lower temperature, and at the higher pH.

TABLE 1.6

CT VALUES (CT99.9) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY FREE CHLORINE AT 25°C AND HIGHER

| Free Residual (mg/l) | pH | | | | | | |
|---|---|---|---|---|---|---|---|
| | ≤ 6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | ≤ 9.0 |
| ≤ 0.4 | 24 | 29 | 35 | 42 | 50 | 59 | 70 |
| 0.6 | 25 | 30 | 36 | 43 | 51 | 61 | 73 |
| 0.8 | 26 | 31 | 37 | 44 | 53 | 63 | 75 |
| 1.0 | 26 | 31 | 37 | 45 | 54 | 65 | 78 |
| 1.2 | 27 | 32 | 38 | 46 | 55 | 67 | 80 |
| 1.4 | 27 | 33 | 39 | 47 | 57 | 69 | 82 |
| 1.6 | 28 | 33 | 40 | 48 | 58 | 70 | 84 |
| 1.8 | 29 | 34 | 41 | 49 | 60 | 72 | 86 |
| 2.0 | 29 | 35 | 41 | 50 | 61 | 74 | 88 |
| 2.2 | 30 | 35 | 42 | 51 | 62 | 75 | 90 |
| 2.4 | 30 | 36 | 43 | 52 | 63 | 77 | 92 |
| 2.6 | 31 | 37 | 44 | 53 | 65 | 78 | 94 |
| 2.8 | 31 | 37 | 45 | 54 | 66 | 80 | 96 |
| 3.0 | 32 | 38 | 46 | 55 | 67 | 81 | 97 |

*These CT values achieve greater than a 99.99 percent inactivation of viruses. CT values between the indicated pH values may be determined by linear interpolation. CT values between the indicated temperatures of different tables may be determined by linear interpolation. If no interpolation is used, use the CT99.9 value at the lower temperature, and at the higher pH.

TABLE 2.1

CT VALUES (CT99.9) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY CHLORINE DIOXIDE AND OZONE*

| | Temperature | | | | | |
|---|---|---|---|---|---|---|
| | ≤ 1°C | 5°C | 10°C | 15°C | 20°C | ≥ 25°C |
| Chlorine dioxide | 63 | 26 | 23 | 19 | 15 | 11 |
| Ozone | 2.9 | 1.9 | 1.4 | 0.95 | 0.72 | 0.48 |

*These CT values achieve greater than 99.99 percent inactivation of viruses. CT values between the indicated temperatures may be determined by linear interpolation. If no interpolation is used, use the CT99.9 value at the lower temperature for determining CT99.9 values between indicated temperatures.

TABLE 3.1

CT VALUES (CT99.9) FOR 99.9 PERCENT INACTIVATION OF GIARDIA LAMBLIA CYSTS BY CHLORAMINES*

| Temperature | | | | | |
|---|---|---|---|---|---|
| ≤ 1°C | 5°C | 10°C | 15°C | 20°C | ≥ 25°C |
| 3,800 | 2,200 | 1,850 | 1,500 | 1,100 | 750 |

*These values are for pH values of 6 to 9. These CT values may be assumed to achieve greater than 99.99 percent inactivation of viruses only if chlorine is added and mixed in the water prior to the addition of ammonia. If this condition is not met, the system must demonstrate, based on on-site studies or other information, as approved by the Secretary, that the system is achieving at least 99.99 percent inactivation of viruses. CT values between the indicated temperatures may be determined by linear interpolation. If no interpolation is used, use the CT99.9 value at the lower temperature for determining CT99.9 values between indicated temperatures.

4. The total inactivation ratio must be calculated as follows:

(i) If the system uses only one point of disinfectant application, the system may determine the total inactivation ratio based on either of the following two methods:

(A) One inactivation ratio (CTcalc/CT99.9) is determined before or at the first customer during peak hourly flow and if the CTcalc/CT99.9 $\geq$ 1.0, the 99.9 percent Giardia lamblia inactivation requirement has been achieved; or

(B) Successive CTcalc/CT99.9 values, representing sequential inactivation ratios, are determined between the point of disinfectant application and a point before or at the first customer during peak hourly flow. Under this alternative, the following method must be used to calculate the total inactivation ratio:

(1) Determine $\frac{CTcalc}{CT99.9}$ for each sequence.

(2) Add the $\frac{CTcalc}{CT99.9}$ values together $\left(\frac{CTcalc}{CT99.9}\right)$

(3) If $\left(\frac{CTcalc}{CT99.9}\right) \geq 1.0$, the 99.9 percent Giardia lamblia inactivation requirement has been achieved.

(ii) If the system uses more than one point of disinfectant application before or at the first customer, the system must determine the CT value of each disinfection sequence immediately prior to the next point of disinfectant application during peak hourly flow. The CTcalc/CT99.9 value of each sequence and $\frac{CTcalc}{CT99.9}$ must be calculated using the method in paragraph (b) 4. (i) (B) of this Article VI B5) to determine if the system is in compliance with Article VI B3)(a).

(iii) Although not required, the total percent inactivation for a system with one or more points of residual disinfectant concentration monitoring may be calculated by solving the following equation:

$$\% \text{ inactivation} = 100 - \frac{100}{10^z}$$

$$\text{where } z = 3 \times \frac{(CTcalc)}{(CT99.9)}$$

5. The residual disinfectant concentration of the water entering the distribution system must be monitored continuously, and the lowest value must be recorded each day, except that if there is a failure in the continuous monitoring equipment, grab sampling every 4 hours may be conducted in lieu of continuous monitoring, but for no more than 5 working days following the failure of the equipment, and systems serving 3,300 or fewer persons may take grab samples in lieu of providing continuous monitoring on an ongoing basis at the frequencies prescribed below:

| System size by population | Samples/day* |
|---|---|
| ≤ 500 | 1 |
| 501-1,000 | 2 |
| 1,001-2,500 | 3 |
| 2,501-3,300 | 4 |

*The day's samples cannot be taken at the same time. The sampling intervals are subject the Secretary review and approval.

If at any time the residual disinfectant concentration falls below 0.2 mg/l in a system using grab sampling in lieu of continuous monitoring, the system must take a grab sample every 4 hours until the residual concentration is equal to or greater than 0.2 mg/l.

6. (i) The residual disinfectant concentration must be measured at least at the same points in the distribution system and at the same time as total coliforms are sampled, as specified in Article VI 7), except that the Secretary may allow a public water system which uses both a surface water source or a ground water source under direct influence of surface water, and a ground water source, to take disinfectant residual samples at points other than the total coliform sampling points if the Secretary determines that such points are more representative of treated (disinfected) water quality within the distribution system. Heterotrophic bacteria, measured as heterotrophic plate count (HPC) as specified in paragraph (a) 3 of this Article VI B5), may be measured in lieu of residual disinfectant concentration.

(ii) If the Secretary determined on site-specific considerations, that a system has no means for having a sample transported and analyzed for HPC by a certified laboratory under the requisite time and temperature conditions specified by paragraph (a) 3 of this Article VI B5) and that the system is providing adequate disinfection in the distribution system, the requirements of paragraph (b)6.(i) of this Article VI B5) do not apply to that system.

(c) Monitoring requirements for systems using filtration treatment. A public water system that uses a surface water source or a ground water source under the influence of surface water and provides filtration treatment must monitor in accordance with this paragraph (c) beginning June 29, 1993, or when filtration is installed, whichever is later.

1. Turbidity measurements as required by Article VI B4)

must be performed on representative samples of the system's filtered water every four hours (or more frequently) that the system serves water to the public. A public water system may substitute continuous turbidity monitoring for grab sample monitoring if it validates the continuous measurement for accuracy on a regular basis using a protocol approved by the Secretary. For any systems using slow sand filtration or filtration treatment other than conventional treatment, direct filtration, or diatomaceous earth filtration, the Secretary may reduce the sampling frequency to once per day if it determines that less frequent monitoring is sufficient to indicate effective filtration performance. For systems serving 500 or fewer persons, the Secretary may reduce the turbidity sampling frequency to once per day, regardless of the type of filtration treatment used, if the Secretary determines that less frequent monitoring is sufficient to indicate effective filtration performance.

2. The residual disinfectant concentration of the water entering the distribution system must be monitored continuously, and the lowest value must be recorded each day, except that if there is a failure in the continuous monitoring equipment, grab sampling every 4 hours may be conducted in lieu of continuous monitoring, but for no more than 5 working days following the failure of the equipment, and systems serving 3,300 or fewer persons may take grab samples in lieu of providing continuous monitoring on an ongoing basis at the frequencies each day prescribed below:

| System size by population | Samples/day* |
|---|---|
| ≤ 500 | 1 |
| 501-1,000 | 2 |
| 1,001-2,500 | 3 |
| 2,501-3,300 | 4 |

*The day's samples cannot be taken at the same time. The sampling intervals are subject the Secretary review and approval.

If at any time the residual disinfectant concentration falls below 0.2 mg/l in a system using grab sampling in lieu of continuous monitoring, the system must take a grab sample every 4 hours until the residual disinfectant concentration is equal to or greater than 0.2 mg/l.

3. (i) The residual disinfectant concentration must be measured at least at the same points in the distribution system and at the same time as total coliforms are sampled, as specified in Article VI 7), except that the Secretary may allow a public water system which uses both a surface water source or a ground water source under direct influence of surface water, and a ground water source to take disinfectant residual samples at points other than the total coliform sampling points if the Secretary determines that such points are more representative of treated (disinfected) water quality within the distribution system. Heterotrophic bacteria, measured as heterotrophic plate count (HPC) as specified in paragraph (a) 3) of this Article VI B5), may be measured in lieu of residual disinfectant concentration.

(ii) If the Secretary determines, based on site-specific considerations, that a system has no means for having a sample transported and analyzed for HPC by a certified laboratory under the requisite time and temperature conditions

specified by paragraph (a) 3 of this Article VI B5) and that the system is providing adequate disinfection in the distribution system, the requirements of paragraph (c)3. (i)of this Article VI B5) do not apply to that system.

6) Reporting and recordkeeping requirements.

(a) A public water system that uses a surface water source and does not provide filtration treatment must report monthly to the Secretary the information specified in this paragraph (a) beginning December 31, 1990, unless the Secretary has determined that filtration is required in writing pursuant to section 1412(b)(7)(C)(iii), in which case the Secretary may specify alternative reporting requirements, as appropriate, until filtration is in place. A public water system that uses a ground water source under the direct influence of surface water and does not provide filtration treatment must report monthly to the Secretary the information specified in this paragraph (a) beginning December 31, 1990 or 6 months after the Secretary determines that the ground water source is under the direct influence of surface water, whichever is later, unless the Secretary has determined that filtration is required in writing pursuant to section 1412(b)(7)(C)(iii), in which case the Secretary may specify alternative reporting requirements, as appropriate, until filtration is in place.

1. Source water quality information must be reported to the Secretary within 10 days after the end of each month the system serves water to the public. Information that must be reported includes:

(i) The cumulative number of months for which results are reported.

(ii) The number of fecal and/or total coliform samples, whichever are analyzed during the month (if a system monitors for both, only fecal coliforms must be reported), the dates of sample collection, and the dates when the turbidity level exceeded 1 NTU.

(iii) The number of samples during the month that had equal to or less than 20/100 ml fecal coliforms and/or equal to or less than 100/100 ml total coliforms, whichever are analyzed.

(iv) The cumulative number of fecal or total coliform samples, whichever are analyzed, during the previous six months the system served water to the public.

(v) The cumulative number of samples that had equal to or less than 20/100 ml fecal coliforms or equal to or less than 100/100 ml total coliforms, whichever are analyzed, during the previous six months the system served water to the public.

(vi) The percentage of samples that had equal to or less than 20/100 ml fecal coliforms or equal to or less than 100/100 ml total coliforms, whichever are analyzed, during the previous six months the system served water to the public.

(vii) The maximum turbidity level measured during the month, the date(s) of occurrence for any measurement(s) which exceeded 5 NTU, and the date(s) the occurrence(s) was reported to the Secretary.

(viii) For the first 12 months of record keeping, the dates and cumulative number of events during which the turbidity exceeded 5 NTU, and after one year of recordkeeping for turbidity measurements, the dates and cumulative number of events during which the turbidity exceeded 5 NTU, in the previous 12 months the system served water to the public.

(ix) For the first 120 months of recordkeeping, the dates and cumulative number of events during which the

turbidity exceeded 5 NTU, and after 10 years of record-keeping for turbidity measurements, the dates and cumulative number of events during which the turbidity exceeded 5 NTU in the previous 120 months the system served water to the public.

(2) Disinfection information specified in Article VI B5)(b) must be reported to the Secretary within 10 days after the end of each month the system serves water to the public. Information that must be reported includes:

(i) For each day, the lowest measurement of residual disinfectant concentration in mg/l in water entering the distribution system.

(ii) The date and duration of each period when the residual disinfectant concentration in water entering the distribution system fell below 0.2 mg/l and when the Secretary was notified of the occurrence.

(iii) The daily residual disinfectant concentration(s) (in mg/l) and disinfectant contact time(s) (in minutes) used for calculating the CT value(s).

(iv) If chlorine is used, the daily measurement(s) of pH of disinfected water following each point of chlorine disinfection.

(v) The daily measurement(s) of water temperature in °C following each point of disinfection.

(vi) The daily CTcalc and CTcalc/CT99.9 values for each disinfectant measurement or sequence and the sum of all CTcalc/CT99.9 values ((CTcalc/CT99.9)) before or at the first customer.

(vii) The daily determination of whether disinfection achieves adequate Giardia cyst and virus inactivation, i.e., whether (CTcalc/CT99.9) is at least 1.0 or, where disinfectants other than chlorine are used, other indicator conditions that the Secretary determines are appropriate, are met.

(viii) The following information on the samples taken in the distribution system in conjunction with total coliform monitoring pursuant to Article VI B3):

(A) number of instances where the residual disinfectant concentration is measured;

(B) number of instances where the residual disinfectant concentration is not measured but heterotrophic bacteria plate count (HPC) is measured;

(C) number of instances where the residual disinfectant concentration is measured but not detected and no HPC is measured;

(D) number of instances where no residual disinfectant concentration is detected and where HPC is >500/ml;

(E) number of instances where the residual disinfectant concentration is not measured and HPC is >500/ml;

(F) for the current and previous month the system served water to the public, the value of "V" in the following formula:

$$V = \frac{c + d + e}{a + b} \times 100$$

where

a = the value in paragraph (a) 2. (viii)(A) of this Article VI B6),

b = the value in paragraph (a) 2. (viii)(B) of this Article VI B6),

c = the value in paragraph (a) 2. (viii)(C) of this Article VI B6),

d = the value in paragraph (a) 2. (viii)(D) of this Article VI B6),

and e = the value in paragraph (a) 2. (viii)(E) of this Article VI B6),

(G) if the Secretary determines, based on site specific considerations, that a system has no means for having a sample transported and analyzed for HPC by a certified laboratory under the requisite time and temperature conditions specified by Article VI B5)(a) 3 and that the system is providing adequate disinfection in the distribution system, the requirements of paragraph (a) 2. (viii)(A)-(F) of this Article VI B6) do not apply to that system.

(ix) A system need not report the data listed in paragraphs (a) 2. (i), and (iii)-(vi) of this section if all data listed in paragraphs (a) 2(i)-(viii) of this Article VI B6) remain on file at the system, and the Secretary determines that:

(A) the system has submitted to the Secretary all the information required by paragraphs (a) 2(i)-(viii) of this Article VI B6) for at least 12 months; and

(B) the Secretary has determined that the system is not required to provide filtration treatment.

(3) No later than ten days after the end of each Federal fiscal year (September 30), each system must provide to the Secretary a report which summarizes its compliance with all watershed control program requirements specified in Article VI B2)(b) 2.

(4) No later than ten days after the end of each Federal fiscal year (September 30), each system must provide to the Secretary a report on the on-site inspection conducted during

that year pursuant to Article VI B2)(b) 3, unless the on-site inspection was conducted by the Secretary. If the inspection was conducted by the Secretary, the Secretary must provide a copy of its report to the public water system.

(5) (i) Each system, upon discovering that a waterborne disease outbreak potentially attributable to that water system has occurred, must report that occurrence to the Secretary as soon as possible, but no later than by the end of the next business day.

(ii) If at any time the turbidity exceeds 5 NTU, the system must inform the Secretary as soon as possible, but no later than the end of the next business day.

(iii) If at any time the residual falls below 0.2 mg/l in the water entering the distribution system, the system must notify the Secretary as soon as possible, but no later than by the end of the next business day. The system also must notify the Secretary by the end of the next business day whether or not the residual was restored to at least 0.2 mg/l within 4 hours.

(b) A public water system that uses a surface water source or a ground water source under the direct influence of surface water and provides filtration treatment must report monthly to the Secretary the information specified in this paragraph (b) beginning June 29, 1993, or when filtration is installed, whichever is later.

(1) Turbidity measurements as required by Article VI B5)(c) 1. must be reported within 10 days after the end of each month the system serves water to the public. Information that must be reported includes:

(i) The total number of filtered water turbidity measurements taken during the month.

(ii) The number and percentage of filtered water turbidity measurements taken during the month which are less than or equal to the turbidity limits specified in Article VI B4) for the filtration technology being used.

(iii) The date and value of any turbidity measurements taken during the month which exceed 5 NTU.

(2) Disinfection information specified in Article VI B5) (c) must be reported to the Secretary within 10 days after the end of each month the system serves water to the public. Information that must be reported includes:

(i) For each day, the lowest measurement of residual disinfectant concentration in mg/l in water entering the distribution system.

(ii) The date and duration of each period when the residual disinfectant concentration in water entering the distribution system fell below 0.2 mg/l and when the Secretary was notified of the occurrence.

(iii) The following information on the samples taken in the distribution system in conjunction with total coliform monitoring pursuant to Article VI B3):

(A) number of instances where the residual disinfectant concentration is measured;

(B) number of instances where the residual disinfectant concentration is not measured but heterotrophic bacteria plate count (HPC) is measured;

(C) number of instances where the residual disinfectant concentration is measured but not detected and no HPC is measured;

(D) number of instances where no residual disinfectant concentration is detected and where HPC is >500/ml;

(E) number of instances where the residual disinfectant concentration is not measured and HPC is >500/ml;

(F) for the current and previous month the system serves water to the public, the value of "V" in the following formula:

$$V = \frac{c + d + e}{a + b} \times 100$$

where

a = the value in paragraph (b)2. (iii)(A) of this Article VI B6),

b = the value in paragraph (b)2. (iii)(B) of this Article VI B6),

c = the value in paragraph (b)2. (iii)(C) of this Article VI B6),

d = the value in paragraph (b)2. (iii)(D) of this Article VI B6), and

e = the value in paragraph (b)2. (iii)(E) of this Article VI B6).

(G) if the Secretary determines, based on site-specific considerations, that a system has no means for having a sample transported and analyzed for HPC by a certified laboratory within the requisite time and temperature conditions specified by Article VI B5)(a) 3 and that the system is providing adequate disinfection in the distribution system, the requirements of paragraph (b)2. (iii)(A)-(F) of this Article VI B6) do not apply.

(iv) A system need not report the data listed in paragraph (b)2. (i) of this Article VI B6) if all data listed in paragraphs (b)2. (i)-(iii) of this Article VI B6) remain on file at the system and the Secretary determines that the system has submitted all the information required by paragraphs (b)2. (i)-(iii) of this Article VI B6) for at least 12 months.

3. (i) Each system, upon discovering that a waterborne disease outbreak potentially attributable to that water system has occurred, must report that occurrence to the Secretary as soon as possible, but no later than by the end of the next business day.

(ii) If at any time the turbidity exceeds 5 NTU, the system must inform the Secretary as soon as possible, but no later than the end of the next business day.

(iii) If at any time the residual falls below 0.2 mg/l in the water entering the distribution system, the system must notify the Secretary as soon as possible, but no later than by the end of the next business day. The system also must notify the Secretary by the end of the next business day whether or not the residual was restored to at least 0.2 mg/l within 4 hours.

The amendments to Regulation of the Secretary of Health Number 50, June 20, 1983, when approved by the Secretary under the power granted by Public Law No. 5, of July 21, 1977, shall become effective immediately after being filed in the Department of State under the executive order signed by the Honorable Governor of the Commonwealth of Puerto Rico, under the Authority granted to him through Section II of Law Number 112, June 30, 1957, know as the Regulations Law of Puerto Rico.

Approved in San Juan, Puerto Rico this 9 day of September , 1991.

Effective date

José Soler Zapata, M.D.
Secretary of Health

Filed within the Department of State, this day of , 19 .