SUBCHAPTER L: ULTRAVIOLET LIGHT DISINFECTION
§§217.291 - 217.300
Effective December 4, 2015

§217.291. Ultraviolet Light Disinfection System Definitions.

(a) Module--A grouping of ultraviolet lamps electrically and physically connected to each other.

(b) Bank--A grouping of modules that:

(1) can be automatically turned on and off in relation to effluent flow variations;

(2) is electrically or physically connected together or physically adjacent to each other; and

(3) forms a complete unit capable of treating the full design width and depth of the disinfection channel.

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§217.292. Ultraviolet Light Disinfection Systems Effluent Limitations.

Ultraviolet light disinfection systems must disinfect the effluent to the bacteria limits in the wastewater treatment facility's wastewater permit.

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§217.293. Ultraviolet Light Disinfection Systems Redundancy Requirements.

(a) An ultraviolet (UV) disinfection system must include at least two banks positioned in series in a disinfection channel.

(b) A UV light disinfection system must meet the dosage requirements determined in §217.295 of this title (relating to Ultraviolet Light Disinfection Dosage and System Sizing) under all conditions.

(c) An owner must maintain an inventory of replacement equipment, including lamps, ballasts, quartz sleeves, banks, and modules, to replace equipment during emergency repairs and scheduled maintenance. The minimum inventory of replacement

lamps, ballasts, and quartz sleeves is described in §217.298(b) of this title (relating to Ultraviolet Light Disinfection System Cleaning and Maintenance).

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§217.294. Ultraviolet Light Disinfection Systems Monitoring and Alarms.

(a) An ultraviolet (UV) system shall continuously monitor and display the following information on the system control panel:

(1) the flow rate in each disinfection channel;

(2) the relative intensity of the lamps in one bank of a disinfection channel;

(3) the operational status and condition of each bank;

(4) the on or off status of each lamp in the system;

(5) the number of operating hours of the lamps in each bank in the system;

(6) the total number of hours of operation for each bank in the system; and

(7) the transmissivity of UV light in the disinfection channel.

(b) Flow pacing is required and shall be accomplished by automatically turning the appropriate number of banks on or off in proportion to effluent flow. Set points used to energize the banks must be adjustable.

(c) A UV system must include an alarm system.

(1) A wastewater treatment facility that is not supervised 24-hours per day must have a telemetry system with battery backup as part of the alarm system. A telemetry system must notify a wastewater treatment facility operator in the event of a UV alarm and must distinguish between major and minor alarms.

(2) A UV system must include the following minimum alarm conditions:

(A) A minor alarm must activate if:

(i) the UV intensity of the system is less than 45%, relative to the peak intensity after 100 hour burn in; or

(ii) there is a lamp outage.

(B) A major alarm must activate if:

(i) the UV intensity of the system is less than 25%, relative to the peak intensity after 100 hour burn in;

(ii) more than 10% of the lamps fail;

(iii) there is a loss of flow signal upon failure of a bank to energize;

(iv) there is an outage of any module or bank; or

(v) the transmissivity is low, based on the manufacturer's recommendations.

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§217.295. Ultraviolet Light Disinfection Dosage and System Sizing.

(a) An ultraviolet light (UV) system must be sized based upon the results of an independent bioassay that meets the following minimum criteria.

(1) The lamp and ballast in a bioassay test system must have the same spectral characteristics and 254 nanometers (nm) wavelength output as the full-scale system.

(2) Spacing of the lamps in a bioassay test unit must be the same as in the full-scale system.

(3) The arrangement of the lamps must mirror the full-scale system.

(4) The maximum scale-up factor is 10.

(5) Scale down is prohibited.

(6) The minimum number of lamps in a bioassay is four lamps per reactor.

(b) If a variable output lamp is used, detailed documentation from the lamp manufacturer must be provided to document 254 nm ultraviolet output, operational wattage versus lamp input power (voltage and current), along with data demonstrating power requirements to the lamp and ballast to achieve the stated output.

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§217.296. Ultraviolet Light Disinfection Bioassay Test Procedure.

(a) A bioassay procedure must conform to one of the following protocols:

(1) National Water Research Institute's *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse* (3rd edition, 2012); or

(2) NSF International, The Public Health and Safety Company, 40 CFR §35.6450 *Environmental Technology Verification Protocol* (October 2002).

(b) The following minimum standards are required for validation of a bioassay.

(1) The source of water for the test organism solution must be identified and its UV transmittance must be recorded. If potable water is used, the bioassay must also address how disinfectant residues were removed.

(2) The depth of the suspension must be 1.0 centimeter.

(3) The organism density must be 105 to 107 plaque forming units or colony forming units per milliliter.

(4) The dose response relationship must be based on a range of five to seven exposure times.

(5) The bioassay procedure must be conducted at least three times, each from a separate dilution of the same stock suspension. All results must be included for a bioassay to be valid.

(6) A minimum of two controls (unexposed) must be sampled and analyzed with each dose run. All results must be included for a bioassay to be valid.

(7) The diameter of the collimating tube must be at least equal to the diameter of the Petri dishes. Any difference between the diameter of the collimating tube and the diameter of the Petri dishes must be accounted for in the supporting calculations.

(8) The narrow band detector used for intensity determination must be calibrated for accuracy.

(9) 254 nanometer ultraviolet must be measured and reported as the dose response.

(10) The speed of the mixing bar must not cause spatter or cavitation.

(11) Any difference between the velocity profile in the bioassay and the velocity profile in the full-scale unit must be justified.

(12) Any difference between the gallons per minute per inch of UV lamp in the bioassay and the gallons per minute per inch of UV lamp in the full-scale unit must be justified.

(13) The lamp intensity data obtained in the bioassay must be used to set the operating parameters of the lamps.

(14) Lamp intensity used in the flow through test reactor shall be set after a 100-hour burn in and stabilization period.

(15) Electrical input for 100% lamp output must be recorded and verified.

(16) Lamp intensity in the bioassay must be measured at the exact height of the surface of the suspension.

(17) No operating condition may be used that has not been proven effective by the bioassay.

(18) Any variation from the criteria in this subsection must:

(A) be justified by using industry best practices such as *Standardization of Method for Fluence (UV Dose) Determination in Bench-Scale UV Experiments,* Bolton and Linden (2003); and

(B) approved through the variance procedures in §217.4 of this title (relating to Variances).

(19) Bioassay procedures and results must be signed and sealed by a licensed professional engineer.

(c) Effluent percent transmission during the full scale testing shall be established in accordance with the terms and conditions of the wastewater treatment facility's wastewater permit.

§217.297. Ultraviolet Light Disinfection Reactor Design.

(a) An approach channel must be unobstructed and have a minimum length of 4.0 feet before the first ultraviolet (UV) bank.

(b) The downstream channel length must be unobstructed for a minimum length of 4.0 feet following the last bank of UV lamps and before a fluid-level control device.

(c) Inlet channels must provide equal flow distribution across all UV channels.

(d) A downstream discharge point of a UV system must include a level control that ensures that the UV lamps remain submerged, according to the manufacturer's recommendations, regardless of flow.

(e) The UV system must prevent an individual's exposure to UV light from the UV system, including upstream and downstream portions of a UV channel.

(f) An enclosed UV system must have a dehumidifier or must be designed to prevent corrosion of electrical components.

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§217.298. Ultraviolet Light Disinfection System Cleaning and Maintenance.

(a) An ultraviolet (UV) disinfection system must include provisions for draining each UV disinfection channel to another treatment unit within the wastewater treatment facility and for routine cleaning of the UV lamps and modules.

(b) A UV system must include the following replacement parts, as a percentage of the total system, equal to at least:

(1) 5% of the lamps;

(2) 2% of the ballasts; and

(3) 5% of the quartz sleeves.

(c) The UV system must ensure continuous disinfection during maintenance.

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§217.299. Ultraviolet Light Disinfection System Safety.

Signs must be posted in an ultraviolet (UV) reactor area with "WEAR UV-RATED EYE PROTECTION" and "DO NOT LOOK AT UV LAMPS" in English and Spanish. Anyone in a reactor area must wear appropriate personal protection, including a UV-rated face shield and safety glasses or goggles.

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§217.300. Post-Disinfection Requirements.

(a) Sample points. Sampling points must be identified in the engineering report. A design must include a sufficient number of sampling points to:

(1) allow an operator to monitor the disinfection system for process control; and

(2) allow monitoring of permitted effluent limits.

(b) Dissolved Oxygen Requirements. A wastewater treatment facility must be designed with the ability to add post-aeration if needed to meet effluent limits for dissolved oxygen in the wastewater permit. If the wastewater permit requires a minimum dissolved oxygen of 5.0 milligrams per liter or greater, the engineering report must include calculations that demonstrate how the post-aeration system will maintain the minimum dissolved oxygen level.

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