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| **Project Name:** |       | **Date:** |       |
| **Engineer Name:** |       | **AK P.E. License No.:** |       |
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| This checklist is required for the construction of new or modifications of existing surface water treatment systems utilizing UV disinfection. Additional information and guidance can be obtained in the EPA *UV Disinfection Guidance Manual* (UVDGM), November 2006, (EPA 815-R-06-007). Tables referenced in this checklist refer to the *UVDGM, which can be* downloaded from the EPA website at <https://www.epa.gov/dwreginfo/long-term-2-enhanced-surface-water-treatment-rule-documents>. Other useful UV system design references include: AWWA Standard F110-12 “*Ultraviolet Disinfection Systems for Drinking Water,*” August 2012; “*Ultraviolet Disinfection-Guidelines for Drinking Water and Water Reuse*” National Water Research Institute (NWRI), 3rd ed., August 2012.Approval of a UV disinfection system for microbial treatment credit will be contingent on DEC’s approval of the third party validation of the proposed UV reactor make and model. Design engineers are highly encouraged to contact their local DEC engineer early in the UV selection process to verify if the proposed UV reactor has been approved by the State. If not, a validation report needs to be submitted for DEC review (See checklist 6.6a) at least 30 days prior to the construction approval request. Please be advised that sufficient water quality data to support the proposed design (e.g. UV Transmittance) may take up to a year to collect and will be requested as part of the construction approval submittal for the UV system.**Note:** When completing this checklist, please answer the question and also include where in the submittal detailed information is found for each submittal requirement. Please be as specific as possible (specify document name, page number, section number, paragraph, etc.). This will accelerate the review process. |

| **Submittal Requirements** | ***Reference*** |
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| 1. **Treatment Objectives:** What is the treatment objective for the proposed technology? What are the target pathogens (e.g. *Giardia*, *Cryptosporidium*, and/or viruses) and what are the design minimum log-inactivation credits for each of these pathogens?
 | *18 AAC 80.205(a)(4) and (b)(5)&(9)**40 CFR 141.720(d)**UVDGM 1.4 and 3.4.2* |
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| 1. **Minimum UV Dose:** What is the proposed minimum operational dose to achieve the desired level of inactivation? Will this dose include an added safety margin (e.g. 10% - 20%) to provide flexibility and reduce occurrence of off-specification events?
 | *UVDGM 3.4.2* |
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| 1. **Dose Monitoring:** Explain the selected dose monitoring strategy – Will the system use the calculated dose, set-line, or set-point approach?
 | *UVDGM 3.5.2* |
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| 1. **Validation:** Has the specific make and model of the proposed UV unit been validated by a third party? Has DEC reviewed and approved this UV system’s validation report or certificate? If not, please include information required in Checklist 6.6a.
 | *40 CFR 141.720(d)(2)* |
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| 1. **Design Documents:** Do the drawings and specifications cover construction of the treatment system? Include a schematic profile and scaled plan view drawing depicting the placement and location of the UV unit(s) within the treatment process. Specifications should include make, model, and description of key UV system components (e.g. reactor vessel, lamps, sleeves, and sensors).
 | *18 AAC 80.205(a)(2) UVDGM 4.6 UVDGM Checklist 5.1 NWRI Guidelines Chapter 1 Sec. 8* |
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| 1. **Design Criteria:** Provide design criteria used for selecting and sizing the proposed UV disinfection system. Include relevant calculations such as water demand analysis.
 | *UVDGM 3.4.3* |
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| 1. **UV Transmittance:** Provide UV transmittance (UVT) measurements at 254 nm and associated design analysis (e.g. cumulative frequency diagram) for the water to be treated by the UV reactor; UVT samples should be analyzed unfiltered. Weekly measurements collected over 2 to 3 months will be the minimum data expected for stable sources of water. Weekly measurements for 6 to 12 months will be the minimum data expected for sources with varying water quality. More frequent sampling may be needed to capture water quality events (e.g. major rain events, lake turnover, etc.). Data collected should address the range of UVT expected during operation; include the design UVT value in the data analysis. Was correlation of UVT with WTP flow considered in the analysis? If MP lamps will be used, include UVT scans in the germicidal range (200-300 nm) sufficient to cover expected seasonal variations; this will help in estimating a site specific action spectra correction factor. For unfiltered systems, consider capturing UVT data that includes high turbidity events and algal blooms.
 | *UVDGM Table 3.2 & Secs. 3.4.4.1 & 3.4.4.3 AWWA F110-12 Sec. 4.2.4.2* |
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| 1. **Water Quality Interferences:** Address potential water quality constituents in the raw or filtered water that could interfere with UV disinfection (e.g. algae, iron, manganese, calcium, alkalinity, hardness, ORP, pH, organics, color, turbidity, upstream treatment chemicals). Are these constituents within the manufacturer’s acceptable ranges and/or within the ranges accounted for during validation testing?
 | *UVDGM 2.5.1, 3.4.4, & 3.4.4.2* |
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| 1. **Pretreatment:** If pretreatment is required, provide design criteria for pre-treatment process. Was an evaluation of raw water quality used to design a pretreatment to handle water quality changes, e.g. turbidity variability caused by rainfall?
 | *Ten States Standards* |
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| 1. **UV Interference:** Address UV interference with other treatment processes or equipment (e.g. reduction of chlorine residual, UV degradation of materials like gaskets, glass, and plastics of nearby inline components such as water meters, and valves).
 | *UVDGM 2.5.2 & 3.2.1* |
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| 1. **Fouling and Aging Factors:** Justify the fouling and aging factors selected for this design and the source water characteristics.
 | *UVDGM 3.4.5* |
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| 1. **Filtration Avoidance:** For filtration avoidance (i.e. unfiltered) systems, explain how the proposed design will control debris that could cause sleeves and UV lamps to break.
 | *UVDGM 4.5.1* |
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| 1. **Redundancy:** What level of redundancy will be considered in the UV system design? Unfiltered water systems will be expected to have some level of redundancy in their UV system design (e.g. n+1 UV reactors).
 | *UVDGM 3.8.1* |
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| 1. **Distribution System Disinfectant Residual:** What secondary disinfectant will be used to maintain a disinfectant residual in the distribution system? Will additional virus inactivation be provided with the secondary disinfectant? Please provide relevant design criteria and calculations. Note: for unfiltered systems, LT2 requires the use of two disinfectants to achieve the combined disinfection requirements for *Giardia*, *Cryptosporidium*, and viruses.
 | *UVDGM 3.2.1 40 CFR 141.712(d)* |
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| 1. **Mercury Contamination:** Should a UV lamp break, what engineered design features and O&M measures will be in place to control mercury contamination?
 | *UVDGM Appendix E* |
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| 1. **Disinfection Benchmark:** For existing unfiltered systems modifying disinfection, has a disinfection benchmark been established?
 | *40 CFR 141.540* |
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| 1. **Electric Power Quality:** Has an electric power quality assessment been performed to ensure the power source will meet the manufacturer’s specification and tolerances for the selected UV system? Have potential electrical harmonic distortion issues caused by the UV system on other electrical systems been addressed? Are UV reactors provided with GFI circuitry?
 | *UVDGM 3.4.6 & 4.4 IEEE Standard 519 NWRI Guidelines Chapter 1 Sec. 4* |
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| 1. **Backup Power:** How will the UV system design address power outages? Are backup power and power conditioning equipment specified (e.g. UPS, generators)? If so, how will the power supply transition be managed?
 | *UVDGM 3.4.6 & 4.4 NWRI Guidelines Chapter 1 Sec. 4* |
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| 1. **Spare Parts:** What inventory of critical spare parts will be kept at the water treatment plant?
 | *UVDGM 6.3.3* |
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| 1. **Diversion Piping:** Will there be diversion piping installed after the UV unit to prevent water not treated to specifications from entering the distribution system (i.e. treat-to-waste piping)?
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| 1. **Hydraulic Design:** Describe the proposed UV facility hydraulic design. How will inlet and outlet piping configuration ensure a UV dose delivery equal to or greater than during validation testing? Will piping configuration ensure the reactor is flooded (i.e. all lamps submerged) during normal operation?
 | *40 CFR 141.720(d)(2)(i) UVDGM 3.6.2, 4.1 & E.2.1.3, AWWA F110-12 Sec.5.2.1.4* |
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| 1. **Alarms and Controls:** Please describe UV system alarms and control system interlocks. This should include alarm follow-up actions (e.g. auto shut-off) and the system’s capability for effective and safe manual operation.
 | *UVDGM 4.3.3 & Table 4.2* |
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| 1. **Flow Control:** How will flow be regulated and monitored to ensure the UV system is operating within its validated flow rate?
 | *UVDGM 4.1.2* |
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| 1. **UV Cleaning Systems:** Describe the quartz sleeve and UV sensor window cleaning system.
 | *18 AAC 80.030 NWRI Guidelines Chapter 1 Sec. 3* |
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| 1. **Cross-connection:** Has the UV design addressed potential cross connection issues (e.g. cooling water for MP reactors)?
 | *18 AAC 80.025* |
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| 1. **Operator On-site Training:** Will the water system operator(s) be trained to operate the UV unit? Who will provide the training? What will be the scheduled date for training relative to the proposed system startup?
 | *18 AAC 80.007**UVDGM 6.7.2* |
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| 1. **Startup Testing:** Provide a description of functional and performance tests required during startup. Please note that copies of these tests will be requested for operational approval.
 | *UVDGM 6.1.3-6.1.5* |
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| 1. **O&M Manual:** Provide information on the main contents of the O&M manual and the timing for its completion. Please refer to recommended O&M activities in UVDGM tables 6.3 and 6.4.
 | *UVDGM 6.1.1, 6.2, 6.3, & 6.4, AWWA F110-12 Sec. 5.3 NWRI Guidelines Chapter 1 Sec. 8* |
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| 1. **Monitoring and Recording:** Describe proposed UV system monitoring/recording equipment, activities, and frequencies (refer to UVDGM tables 6.7 and 6.8 for recommendations). Has the design of the UV monitoring and recording equipment and the O&M manual considered regulatory monitoring and reporting requirements the operator will need to fulfill? (See DEC Monthly Operator Reports.)
 | *40 CFR 141.720(d)(3) 40 CFR 141.721(f) UVDGM 6.4 & 6.5* |
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| 1. **Lamp Status:** How will the lamp status be monitored? **Please note:** lamp status may be monitored with UV intensity sensors if each lamp has a dedicated UV intensity sensor.
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| 1. **Calibration:** Describe how, and how often, the calibration of key UV system sensors will be verified (UV intensity, UVT, flow meters). Will a designated “reference” UV intensity sensor be available to the operator? If so, how often will the reference sensor be calibrated?
 | *40 CFR 141.720(d)(3) UVDGM 6.4.1.1, 6.4.1.2, & 6.3.2.3* |
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| 1. **UV Lamp Disposal:** How will spent UV lamps be disposed of (they are considered hazardous waste under RCRA)? Does the manufacturer have a recycling program?
 | *UVDGM 6.3.2.6* |
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| **Additional submittal requirements for systems using the calculated dose monitoring approaches** | ***Reference*** |
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| 1. **Dose:** Provide the validated UV dose range. What will be the minimum operational validated dose and its associated target pathogen inactivation credit?
 | *40 CFR 141.720(d)(1) UVDGM 3.5 & 5.10* |
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| 1. **Dose Calculation:** Will the relative UV intensity term (S/So) in the calculated dose equation be based on the lowest measured lamp intensity in the reactor? Provide an example calculation of UV dose at worst-case conditions of UVT, flow, and UV intensity (e.g. design fouling/aging factor). Please include all relevant validation factor parameters.
 | *UVDGM Table B.11* |
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| 1. **UVT Calibration:** What means will be provided for calibration verification of online UVT analyzers?
 | *UVDGM 6.4.1.2 AWWA F110-12 Sec. 4.5.7* |
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| 1. **P&ID:** Provide process and instrumentation diagrams, PLC logic loop descriptions, and a process control narrative. Please include alarm descriptions and triggers.
 | *UVDGM 4.3* |
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| 1. **O&M Manual:** Will the O&M manual include UV system operational curves to allow the operator to visually verify the delivered dose given key input parameters (e.g. flow, UV intensity, UVT)?
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| 1. **Manual Override:** Is there a manual override of dose monitoring equation inputs to temporarily keep the UV system running in case a sensor malfunctions? Are emergency operations addressed in the O&M manual?
 | *UVDGM 6.1.1 & 6.4.1.2* |
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| 1. **Access to PLC Equations:** Will operators or field commissioning staff have access to the programmed dose monitoring equation parameters? DEC may request access during inspection to verify the programmed equation is the same as the validated one.
 | *AWWA F110-12 Sec. 4.6.2* |
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| **Additional submittal requirements for systems using the set-point dose monitoring approach** | ***Reference*** |
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| 1. **Set-point Conditions:** Please summarize the set-point conditions (e.g. flow, UV intensity, lamp status values). What will be the validated dose at set-point and its associated target pathogen inactivation credit?
 | *UVDGM 3.5.2.1 & 5.6.1* |
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| 1. **UV Transmittance:** Will UV transmittance be measured (note: not typically required for set-point based systems)? If so, how?
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