# **EXAMPLE 25 GPM WASTEWATER CHAMBERED SYSTEM**

# **SECTION 11**

**CHAMBERED ULTRAVIOLET WASTEWATER DISINFECTION SYSTEM**

1. GENERAL
   1. SCOPE OF WORK
2. Furnish, install, test and put into operation two (2) closed vessel (CHAMBERED), gravity flow low-pressure, high output, manual wiper quartz cleaning, ultraviolet (UV) light systems (SYSTEM) for the disinfection of wastewater, complete, in place as shown on the Drawings and as specified herein.
3. The EQUIPMENT SUPPLIER shall furnish all components of the SYSTEM as specified herein, including:
   * + 1. Two (2) UV vessel style Wastewater Disinfection System with manual quartz wiping
       2. Two (2) Ballast Control Centers (BCCs)
       3. Two (2) UV monitoring system
       4. One (1) Set of spares
4. The EQUIPMENT SUPPLIER shall provide the following services to ensure the safe and efficient operation of the SYSTEM:
   * + 1. SYSTEM commissioning and installation inspection
       2. SYSTEM startup
       3. Operator training
5. The CONTRACTOR shall furnish all labor, materials, equipment and appurtenances required to install, test and place into satisfactory operation the SYSTEM furnished by the EQUIPMENT SUPPLIER, including, but not limited to:
   * + 1. Mechanical installation of SYSTEM components, anchor bolts, air piping, air piping supports, fittings, valves and appurtenances.
       2. Electrical installation of SYSTEM components.
   1. QUALITY ASSURANCE
      1. All SYSTEM components shall be supplied to the CONTRACTOR by a single EQUIPMENT SUPPLIER.
      2. The EQUIPMENT SUPPLIER shall have at least ten (10) years’ experience in furnishing UV systems of similar design to the equipment specified herein. As part of their submittal package, the EQUIPMENT SUPPLIER shall submit following documentation:
         1. Evidence that UV systems of similar design have been in successful operation for at least five (5) years in at least five (5) separate installations. Provide location of installation, contact person name and phone number, capacity of generation system and year installed.
      3. The SYSTEM shall be designed, fabricated, assembled, and tested by UVSYSCO NY USA. The system shown on the Drawings is the SUN-4M-HO-MW UV system. If a system other than the SUN-M-HO is accepted, the CONTRACTOR shall prepare and submit to the Engineer for approval detailed drawings and equipment list showing all necessary changes and embodying all special features of the system to be furnished.

The system shall integrate low pressure high output UV lamps with wattage >85 watts. Lamp life shall be 12,000 hours.

The submittal shall address changes to all disciplines, including structural, mechanical, instrumentation and control and electrical. Such changes, if approved, shall be at no additional cost to the OWNER. The CONTRACTOR shall assume the cost of, and responsibility for, satisfactorily accomplishing all the necessary changes for installation of the alternate system as approved by the ENGINEER.

* + 1. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
       1. American Society for Testing Materials (ASTM)
       2. National Electric Code (NEC)
       3. National Electrical Manufacturer’s Association (NEMA)
       4. Occupational Safety and Health Association (OSHA)
       5. “Municipal Wastewater Disinfection” US EPA Design Manual, EPA/625/1-86/021
       6. American Welders Society (AWS)
       7. Underwriter’s Laboratories (UL)
    2. Manufacturer’s Representative
       1. The services of a full-time employee of the EQUIPMENT SUPPLIER shall be provided on the project site as the EQUIPMENT SUPPLIER representative. The representative shall have complete knowledge of the SYSTEM including proper installation, operation and maintenance.
       2. The EQUIPMENT SUPPLIER’S representative shall inspect the installation and supervise any required modifications, additions, or other changes required to allow the EQUIPMENT SUPPLIER to certify that the complete installation is appropriate and is expected to operate as expected.
       3. The EQUIPMENT SUPPLIER’S representative shall instruct the OWNER and ENGINEER’S personnel on the operation and maintenance of the SYSTEM. The instruction shall include classroom training on UV Technology and the specific installation, and field training on proper operation and maintenance procedures, along with complete demonstration of the same.
       4. The EQUIPMENT SUPPLIER’S representative shall provide minimum services in accordance with the following table:

Purpose No. of Days

Startup and Functional Testing ½ day

Operator Training ½ day

* + - 1. The number of days indicated above shall be provided on an 8-hour day on-site basis.
  1. SUBMITTALS
     1. The EQUIPMENT SUPPLIER shall submit, in accordance with section 01\_\_\_, complete shop drawings to establish compliance with this section. Submittals shall include the following and all other information requested in other paragraphs of this specification section for approval:

# Manufacturers Data - The following information shall be submitted to the engineer as required by this specification:

# Complete description of equipment being proposed in sufficient detail to permit a thorough comparison with this specification

# UV system equipment layout including chamber dimensions and installation requirements

# Electrical schematics and enclosure dimensions

# Documentation on cleaning and maintenance requirements of the equipment

# Manufacture’s literature including cut sheets on all components and accessories.

* + 1. Design Data
       1. Supporting documentation from the US EPA UV DIS calculations or manufacturers’ bioassay demonstrating that the dose required in the performance section is being met or exceeded. Only bioassay results using MS2 phage or similar bacteria shall be acceptable as a means of  
          determining dosage and validating the calculations. Only EPA Point Source Summation Method will be acceptable.
    2. The EQUIPMENT SUPPLIER shall submit one (1) copy of complete Instructions Manuals with detailed operation and maintenance data for each component of the SYSTEM. The instructions manual shall include:
       1. Safety Precautions
       2. Protective Equipment and Clothing
       3. Technical Data, including detailed descriptions of SYSTEM operation, and each component.
       4. Installation data, procedures and recommendations
       5. Operation instructions, including startup and shutdown procedures and sequence.
       6. Service and Maintenance data, include all information and instructions required by plant personnel to keep equipment properly cleaned, lubricated and adjusted so that it functions economically throughout its full design lift
       7. Illustrations
       8. Project Parts List
       9. Name, address and phone number of manufacturer and manufacturer’s local service representative.
  1. SPARE PARTS AND SPECIAL TOOLS
     1. Included in the proposal, the EQUIPMENT SUPPLIER shall furnish spare parts required to ensure adequate operation of the SYSTEM. Spare parts shall include as a minimum:
        1. Two (2) UV lamps
        2. Two (2) Quartz sleeves
        3. Four (4) Orings/washers
        4. Four (4) Wiper rings
        5. One (1) Operators kit (eye protection, cleaning)
     2. The EQUIPMENT SUPPLIER shall furnish all special tools required for the proper installation, operation and maintenance of any component of the SYSTEM.
     3. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the CONTRACTOR at the completion of the contract.
  2. DESCRIPTION OF SYSTEM
     1. The equipment specified herein shall be low pressure high intensity amalgam light disinfection equipment designed to reduce microorganisms in wastewater with UV influent characteristics as specified.
     2. The lamp array shall be vertical with all lamps parallel to each other and parallel to the flow.
     3. Influent Characteristics to Disinfection
        1. The UV disinfection system shall be designed to disinfect at the flow rates and with the characteristics shown below:

# Peak Flow per unit 25 GPM

# Minimum Flow (MGD) 0

# Total Suspended Solids (mg/L) <30

# UV Transmittance @ 253.7-nm 65%

# Temperature (°F) 35-85

* + - * 1. UV Dosage >30 mJ
        2. Redundancy 100 %
    1. UV Vessel Configuration
       1. UV manufacturer shall provide the UV disinfection chamber with connections as shown on the drawings.
       2. The minimum design requirements of the UV system supplied shall be as follows:
          1. Number of UV Chambers 2
          2. Number of UV lamps per chamber 4
          3. Lamp type Low pressure high output
          4. UV lamp wattage 80
          5. Minimum UVC Lamp Output (W) 27
          6. Number of UV Intensity Sensors per chamber 1
          7. Chamber Dimensions (nominal) TBD horizontal or vertical

Chamber Length (in) 40”

Chamber Diameter (in) 8”

Connection type (in) 4”-opposing ends

Space required for lamp removal 40” above

* + 1. System Performance
       1. The end of lamp life UV dose produced by the system shall not be less than 30,000 uWs/cm2 with 90% UV transmittance @ 253.7-nm. Lamp output must be at least 90% of initial level after 9,000 hrs of operation and with no fouling on the quartz sleeves.
       2. The system design shall be based on the following criteria:
          1. UV transmission (T10) 65%
          2. UV Lamp End of Life Factor 90%
          3. Quartz Sleeve Fouling Factor 90%

(based on clean sleeves)

1. PRODUCTS
   1. MATERIALS AND EQUIPMENT
      1. General
         1. The UV disinfecting system shall be furnished complete with 316L stainless steel UV disinfection chambers, Ballast Control Centers (BCC), UV intensity monitoring system, and manual plugner style quartz wiping system.
         2. All metal components exposed to or in contact with plant effluent, including all anchoring hardware, shall be Type 304L or 316L SS. All materials exposed to UV light shall be unaffected by prolonged exposed to same and shall be Type 304L or 316L SS, Type 214 quartz, Viton, EPDM or Teflon.
         3. All metal components not in contact with plant effluent and/or UV light shall be Type 304L SS.
   2. ULTRAVIOLET LAMPS
      1. The UV lamps shall be low-pressure high output UV lamps.
      2. UV Lamps shall have the following characteristics:
         1. Lamp shall be low-pressure high output type with a UV output per lamp of 27 UVC watts and lamp input of 80 watts.
         2. Lamps shall be mercury slim line type of the pre-heat design with a 4-pin connection at one end.
         3. Lamps shall be equal to or exceed the performance of type GHO36T5L.
         4. Medium pressure lamps shall not be acceptable.
      3. Lamps shall have electrical connections at one end with four pins per connection and shall be dielectrically tested for 2,500 volts. Lamp bases shall be of ceramic construction resistant to UV and ozone. Lamp socket should also be of ceramic construction resistant to UV and ozone and should be of a multi-level (step) design to prevent arcing. Lamp tubes shall be of a material capable of transmitting 94 percent of the radiation produced therein.
      4. Changing lamps will not require removal of the quartz sleeves from the UV lamp chamber. Lamps shall be capable of being replaced by plant operating personnel without tools.
      5. The UV system manufacturer shall guarantee operating life of lamps for a period of 12,000 hours.
      6. Lamps shall be non-ozone producing type.
   3. QUARTZ SLEEVES AND WATERTIGHT SEAL
      1. Lamp sleeves shall be type GE TYPE 214 clear fused quartz circular tubing. Sleeves shall be rated for transmission of 94% or more and sleeves shall not be subject to solarization over the length of their life. The nominal wall thickness shall be between 1.0 and 2.0 mm.
      2. The open ends shall be sealed by an end seal and compressed O-ring.
      3. To seal the open end of the quartz sleeve in the chamber’s head, a Viton oring shall be compressed by a stainless steel washer and screw-in compression fitting.
   4. UV LAMP VERTICAL CHAMBER
      1. Each chamber shall be constructed from 14-gauge 316L stainless steel and shall be electropolished and shall have ?? Flange, a 1” FNPT drain port and a 5/8” sensor port.
      2. The UV lamps shall be symmetrically installed in a manner to maximize the dosage of UV radiation seen by the water.
      3. The chamber shall be constructed with a removable head for vessel inspection and repair. Heads shall be compressed against an EPDM gasket by tightening the nuts and bolts.
      4. The chamber shall have four (4) with each lamp placed in its individual quartz sleeve.
      5. Chambers shall be constructed in a manner not to allow UV light to radiate. Chambers shall be designed such that operating personnel at the plant can change the lamps and quartz sleeves.
      6. The chambers shall be directly wired to the Ballast Control Centers via a junction box. The J-box shall be wired in a UL watertight flexible conduit and shall be connected to the BCC.
      7. The sleeve nut shall not require special tools for removal.
      8. Manual Quartz Cleaning System
         1. The UV chamber shall have a manual style quartz wiping system to allow the protective sleeves to be cleaned on a periodic basis.
         2. Wiper mechanism shall be constructed from 316L stainless steel. Rod and wiper ring holders shall be constructed of 316L stainless steel.
         3. Wiper rings shall be EPDM.
         4. Wiper rod shall be pushed by hand.
   5. UV INTENSITY SENSOR
      1. Each chamber shall have one (1) UV intensity sensor.
      2. The sensor shall be solar blind and shall measure only the germicidal spectrum wavelength (254 nm).
      3. The UV intensity shall be displayed in a window kit through a digital meter with a 0 to 100% output reading.
   6. BALLAST CONTROL CENTER / ELECTRICAL
      1. The UV electrical control system shall be designed to provide maximum reliability of the UV disinfection system. Plant services and supplies shall be segregated into sensible groups to allow for safe and simple maintenance or servicing whist ensuring maximum possible disinfection capability is maintained.

All heat sensitive components shall be adequately cooled with dry air utilizing forced or natural ventilation.

Systems that lack positive mechanical heat transfer such as fans (or air conditioning) for the sensitive electronic components are not acceptable.

* + 1. The lamps in the chamber shall be powered from a stainless steel Ballast Control Center (BCC). Power requirement of 120, 50/60 Hz 10 amp power shall be provided to each unit. Each BCC shall be provided with power cords to be used with GFCI outlet. UV meters shall be provided with power cords to be used with GFCI outlet.
    2. Each unit shall be rated at .34 kW/hr. and shall have a duplex GFCI outlet.
    3. A junction box shall be wired from the BCC and shall be mounted on the chamber. The junction box shall contain the lamp harnesses and sensor connections.
    4. Ballast Control Centers (BCCs)
       1. The BCCs shall be wall mounted stainless steel enclosure with forced air fan cooling. The BCC shall house electronic ballasts that are specially designed for use with low pressure high output lamps. BCC shall be equipped with breakers and power cut of switches.
          1. Each electronic ballast shall control, operate and display information for low-pressure high output lamps.
          2. Ballasts shall be wired using quick connects and shall be readily removed from the electrical enclosure.
    5. BCC Dimensions

Type: Wall mounted

Rating: Modified NEMA 4x modified

Height: 16”

Width: 16”

Depth: 8”

* + 1. BCC Controls and Displays

The BCC shall house and displays the following:

* + - * 1. Electronic ballasts
        2. Ultraviolet meter
        3. The status of each lamp (on/off) shall be displayed via a dedicated green LED. An energized LED will indicate proper functioning of the UV lamp. The LED shall indicate lamp “off” status when extinguished.
        4. Running time meter - Each chamber shall have a corresponding non-resettable five (5) character digital running time meter.
        5. Hand/Off/Auto shall be supplied to allow for remote On/Off functionality. – this is an option to be determined.

1. EXECUTION
   1. SHIPPING AND EQUIPMENT DELIVERY
      1. All equipment and materials shall be inspected against approved Shop Drawings at time of delivery. Equipment and materials damaged or not meeting requirements of the approved Shop Drawings shall be immediately returned to the EQUIPMENT SUPPLIER for replacement or repair.
      2. The CONTRACTOR shall handle and store the equipment and materials in a dry location and protect them from the elements according to the manufacturer’s instructions.
   2. COMMISSIONING AND START-UP
      1. The EQUIPMENT SUPPLIER shall inspect equipment installation, piping and wiring to ensure proper installation of each component in accordance with approved submittals. CONTRACTOR shall make at its own cost any modifications required to meet EQUIPMENT SUPPLIER installation recommendations. A written statement certifying that the equipment has been properly installed and interconnected shall be provided by the EQUIPMENT SUPPLIER.
      2. The EQUIPMENT SUPPLIER shall coordinate commissioning of the system and verify that each component of the SYSTEM is ready for operation. SYSTEM commissioning shall include testing and calibration of each component of the system. A written statement certifying that the SYSTEM has been commissioned and is ready for operation shall be provided.
      3. The EQUIPMENT SUPPLIER shall coordinate initial SYSTEM start-up to ensure operating procedures are followed in accordance with approved submittal’s instructions manuals.
   3. START UP TRAINING
      1. The EQUIPMENT SUPPLIER shall provide installation support at the site for a period no less than 1/2 day. Installation support shall incorporate installation of quartz sleeves, installation of lamps and review of electrical installation.
      2. The EQUIPMENT SUPPLIER shall provide operator training at the site for a period no less than 1/2 day. Training shall include operation, maintenance and troubleshooting for each component of the SYSTEM.

* 1. WARRANTY
     1. The SYSTEM shall be free from defects in materials and workmanship for a period of 12 months from Final Acceptance of the system, or 18 months from shipment, whichever occurs first.
     2. Lamps shall be warranted for a period of 12,000 hours operating time under normal operating conditions.

END OF SECTION.