

Bryan W. Shaw, Ph.D., P.E., *Chairman*
Toby Baker, *Commissioner*
Zak Covar, *Commissioner*
Richard A. Hyde, P.E., *Executive Director*



PWS_2430001_CO_20141110_EXCEPTION

Texas Commission on Environmental Quality

Protecting Texas by Reducing and Preventing Pollution

November 10, 2014

Mr. David W. Sloan, P.E., BCEE
Freese and Nichols
4055 International Plaza, Suite 200
Fort Worth, TX 76109

Subject: City of Wichita Falls – PWS ID No. 2430001
Request for an Exception to the UV-Pathogen-Removal Rule
Wichita County, Texas

RN 105598759;

CN 600129316

Dear Mr. Sloan:

On October 17, 2014, the Texas Commission on Environmental Quality (TCEQ) received your letter dated October 17, 2014, requesting an exception for innovative/alternate treatment to apply an ultra violet (UV) light for a pathogen-removal process for UV disinfection credit at the City of Wichita Falls (City) Cypress surface water treatment plant (SWTP). The requirements for UV-pathogen-removal are specified in Title 30 of the *Texas Administrative Code* (30 TAC) §290.42(g)(5). The City proposes to use the TrojanUV Swift™ ECT 8L24-2L model for UV disinfection treatment at the Cypress SWTP. Your letter includes data from a SWTP revised concentration time (CT) study that shows the TrojanUV Swift™ ECT 8L24-2L UV-reactor system will be operated at a maximum flow rate of 10.0 million gallons per day (MGD). Based on our review of your letter and data, we are **granting** an exception for UV-pathogen-removal treatment under these conditions:

1. The City must operate the TrojanUV disinfection unit as required by the Enclosure 1, *TCEQ TrojanUVSwift™ 8L24-2L Approval Letter*, dated October 14, 2014.
2. A flow-measuring device must be installed on the inlet piping of each UV reactor.
3. UV light sensor and UVT analyzers must be properly calibrated as required in 30 TAC §290.46(s)(2)(D).
4. The City must continuously monitor and record UV intensity as measured by a UV sensor, lamp status, flow rate through the unit, UV transmittance, and lamp power, in accordance with 30 TAC §290.111(d)(3)(A).

5. The City must monitor and record the amount of water treated by each UV unit each month and the amount of water produced each month when the unit is not operating within validated conditions in accordance with 30 TAC §290.111(d)(3)(B). A UV unit is considered to be operating outside the validated conditions when:
 - a. the validated dose falls below that dose needed to achieve the target level of pathogen inactivation,
 - b. the reactor operates at a flow rate that exceeds the maximum validated flow rate,
 - c. the UV transmittance of the water falls below the minimum validated UVT, or
 - d. one or more of the lamps is inoperative.
- e. The Cypress SWTP must provide a minimum 3.0-log inactivation of *Cryptosporidium* through the use of UV light. If the Cypress SWTP produces off-spec water for more than four (4) consecutive hours during a day, the SWTP must be taken off-line, and the UV reactor must be inspected, and, if necessary, repaired.
6. If the TrojanUV Swift™ 8L24-2L reactor is operated at flow rates below 1.0 MGD or the UV transmittance of the water being treated by this reactor exceeds 98%, the calculated reduction equivalent dose (RED_{calc}) value must be based on a minimum validated flow rate of 1.0 MGD and a maximum validated UVT of 98%.
7. Standard Operating Procedures (SOPs) must be written for the handling of “off-spec” water, water produced under conditions outside the validated operating parameters. These SOPs must be submitted to the TCEQ for review at the same time the construction plans are submitted.
8. Monitoring and recording, using the SWMOR-Alt form (see Enclosure 2), are required for flow rate, UV sensor readings, lamp status, etc., at least once every 15 minutes, when disinfection credit is being claimed.
9. The City must keep a copy of the Trojan UV validation report on site, and the SWTP operators must have a way to verify that the proper control algorithms and coefficients are being used for each Trojan UV unit at the SWTP.

The proposed UV system has been sized to provide a 3.0-log inactivation of *Cryptosporidium*. The Cypress SWTP installation will involve the 24-inch TrojanUVSwift™ ECT 8L24-2L reactor with 2 lamps. The 8L24-2L reactor will operate at flow rates of up to 10.0 MGD, with a second 8L24-2L reactor serving as the stand-by reactor. The maximum approved disinfection credits for the reactor and operating condition are described in the table below.

TrojanUVSwift™ ECT 8L24-2L UV Disinfection Design Criteria

Design Criteria	Type of Unit	Design Value
Flow Rate	MGD	0.0 - 10.0
<i>Cryptosporidium</i> disinfection	Log inactivation	3.0
<i>Giardia</i> disinfection	Log inactivation	3.0

Engineering plans and specifications for the proposed UV disinfection system **are** required to be submitted to the TCEQ’s Utilities Technical Review Team (UTRT, MC 159) for review and approval of their construction as specified in 30 TAC §290.39(h)(1). Please contact the UTRT leader, Ms. Vera Poe, P.E., by phone at (512) 239-6988, or email at Vera.Poe@tceq.texas.gov for submission instructions for the plan review of your plans-and-specifications submittal.

Mr. David W. Sloan, P.E., BCEE
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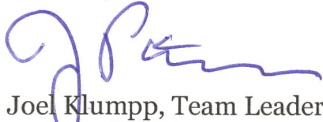
All granted exceptions are subject to periodic review with subsequent amendments, revision, or revocation possible if evidence is found that the granting of an exception results in a degradation of water quality or water supply.

This exception is not intended to waive compliance with any other TCEQ requirement in 30 TAC Chapter 290, or in the conditional approval letter, dated August 5, 2014, for Full-Scale Operation of the Temporary DPR Project. This exception cannot be used as a defense in any enforcement action resulting from noncompliance with any other requirement of 30 TAC Chapter 290.

If you have any questions, or need further assistance, please contact Mr. Bill Melville, P.E., at Bill.Melville@tceq.texas.gov, or by telephone at (512) 239-4729, or by correspondence at the following address:

Technical Review & Oversight Team (MC 159)
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087.

Sincerely,



Joel Klumpp, Team Leader
Technical Review & Oversight Team
Plan & Technical Review Section
Water Supply Division
Texas Commission on Environmental Quality

JPK/WRM

Enclosures: 1. TCEQ TrojanUVSwift™ 8L24-2L Approval Letter, dated October 14, 2014
2. SWMOR-Alt Form

cc: The Honorable Glenn Barham, Mayor, City of Wichita Falls, P.O. 1431,
Wichita Falls, TX 76307-1431

Bryan W. Shaw, Ph.D., P.E., *Chairman*
Toby Baker, *Commissioner*
Zak Covar, *Commissioner*
Richard A. Hyde, P.E., *Executive Director*



PWS_CO_20141014_UV Validation Report

Texas Commission on Environmental Quality
Protecting Texas by Reducing and Preventing Pollution
October 14, 2014

Mr. Robert Haas, P.E., PMP
Trojan Technologies
3020 Gore Rd.
London, Ontario, Canada
N5V 4T7

Re: Approval of Trojan Technologies TrojanUVSwift™ 8L24-2L UV Disinfection System

Dear Mr. Haas:

The Texas Commission on Environmental Quality (TCEQ) has completed its review of the final validation report entitled "Trojan Technologies UV Validation of the TrojanUVSwift™ 8L24-2L, Rev B" (Report) which is dated March 2008. The TCEQ received the Report on June 26, 2014. We have also reviewed the Report appendices and other supplemental information which your company provided. **Based on this review, we are conditionally approving the use of the TrojanUVSwift™ 8L24-2L ultraviolet light (UV) system for drinking water disinfection in the State of Texas.**

Approval Conditions

The TCEQ is approving the use of the Model 8L24-2L reactor for disinfection credit with the following conditions.

- 1) A public water system that wants to use ultraviolet light (UV) as a means of meeting disinfection requirements in Texas must obtain the TCEQ's prior written approval for each installation. To obtain this approval, the system's consulting engineer will need to submit the following materials for our review and approval:
 - a) A written request to use innovative or alternative treatment technologies as required by Title 30 of the *Texas Administrative Code* (30 TAC) §290.42(g)(5); and
 - b) Sealed engineering plans and specifications for the proposed installation.
- 2) The UV reactor must meet the following specifications:

Number of Lamps	2
Lamp Model and Part Number (P/N)	Medium-Pressure Lamp from Heraeus-Noblelight Trojan Technologies Lamp Assembly P/N 820695-024
Number of UV Intensity Sensors	1
Sensor Model and PN	TrojanUVSwift™ 24 Double Sensor, P/N 015363-S2-798S
Lamp and Sensor Sleeves Model and P/N	Fused type 021 AL quartz sleeves from GE Quartz, Inc. Trojan Technologies P/N 820820-876

- 3) The reactor must be installed in accordance with section 3.6.2 of the USEPA's Ultraviolet Disinfection Guidance Manual (UVDGM). Based on the information provided in Section 2.1 of the Report, the installation must provide at least 120 inches of straight pipe with a 24-inch diameter immediately upstream of the reactor. This section of pipe may contain no valves or other appurtenances which would alter the hydraulic characteristics of the flow within the reactor. Alternately, the engineering plans must include a computational fluid dynamics (CFD) model showing that the hydraulics of the proposed installation are equivalent to those achieved during validation testing.
- 4) Per Title 40 of the Code of Federal Regulations (40 CFR) §141.720(d)(1), the UV reactor must be operated within the validated conditions shown in the table below:

Validated UV Transmittance (UVT) Range	70 - 98%
Validated Flow Rate Range	1.0 – 25.6 MGD
Minimum Cryptosporidium Inactivation Credit Allowed and its corresponding Required Dose (D_{req})	1.0-log @ 2.5 mJ/cm ²
Maximum Cryptosporidium Inactivation Credit Allowed and its corresponding Required Dose (D_{req})	4.0-log @ 22.0 mJ/cm ²

Note: mJ/cm² = millijoules per square centimeter

- 5) Based on the information contained in Sections 1.4 and 5.5.2 of the Report, the reactor's Validated Dose (D_{val}) algorithm for *Cryptosporidium* inactivation must be based on the following equation.

$$D_{val} = \frac{RED_{calc}}{VF} = \frac{RED_{calc}}{B_{RED} \times \left[1 + \frac{U_{val}}{100}\right]}$$

Where: D_{val} = Validated UV Dose, in mJ/cm²;
 RED_{calc} = the calculated Reduction Equivalent Dose, in mJ/cm², as described in item 6.
VF = the Validation Factor;
 B_{RED} = the Reduction Equivalent Dose (RED) Bias factor, as described in item 8; and
 U_{IN} = the uncertainty of validation, as described in item 9.

- 6) When determining the value of D_{val} , the reactor's control algorithm must use the U_{val} formula and B_{RED} for the T1 phage when the RED_{calc} value is below 12 mJ/cm² and the U_{val} formula and B_{RED} for the MS2 phage when the value of RED_{calc} is 12 mJ/cm² or higher. This approach will ensure that the reactor operates under validated conditions and simplify the calculation of the uncertainty of validation value.

- 7) Based on information contained in Sections 1.2 and 5.5.2 of the Report, the UV reactor's calculated Reduction Equivalent Dose must be determined using the following equation.

$$RED_{calc} = \frac{10^{A'} \times UVA^{B' \times UVA} \times Q^{C'} \times \left(\frac{S/S_0}{Q} \right)^{D'+E' \times UVA + F' \times UVA^2}}{ASCF}$$

- Where:
- RED_{calc} = the calculated Reduction Equivalent Dose, in mJ/cm^2 ;
 - UVA = UV absorbance in base 10 of the water in a 1 centimeter (cm) light path, cm^{-1} ,
 $= -\log_{10} \left(\frac{\%UVT}{100} \right)$
 - UVT = the UV water transmittance through 1 cm, measured at 254 nm, expressed as a value between 70 and 98;
 - S = the UV intensity measured by the sensor output under actual operating conditions, in milliwatts per square centimeter (mW/cm^2);
 - S_0 = the corresponding UV intensity, in mW/cm^2 , with new lamps and sensor and without any fouling;
 - Q = flow rate, in million gallons per day (MGD);
 - $A', B', C', D', E', \text{ and } F'$ = dose equation coefficients shown in Table 1.2 of the Report; and
 - $ASCF$ = the absorbance spectra correction factor,
 $= 1.3$.

- 8) Based on the information contained in Sections 1.2 and 5.4.3 of the Report, the predicted output of the UV sensor must be determined using the following equation.

$$S_0 = \left(A \times P^{B+C \times UVT + D \times UVT^2} + E \times P^{F+G \times UVT + H \times UVT^2} \times \sin(I \times \theta) \right) \times \exp(J \times UVT)$$

- Where:
- S_0 = the predicted sensor output under ideal conditions (new sensor, new lamp, and no fouling), in mW/cm^2 ;
 - P = the lamp power ballast setting, expressed as percentage, on a scale of 0 to 100% power;
 - UVT = the UV water transmittance through 1 cm, measured at 254 nm, expressed as a value between 70 and 98;
 - S_0 = the predicted output of a new, clean UV sensor at the operating UVT, in mW/cm^2 ;
 - θ = the sensor viewing angle shown in Table 5.2 of the Report, expressed as radians; and
 - $A, B, C, D, E, F, G, H, I, \text{ and } J$ = coefficients in Table 1.1 (and Table 5.3) of the Report.

- 9) The value of RED Bias factor (B_{red}) must either be determined based on the site-specific UV transmittance of the feed water or based on an assumed UVT value of 70%. In either case, the B_{red} must be determined using the RED Bias Tables shown in Appendix G of the UVDGM and the UV sensitivity of the T1 or the MS2 phage, as appropriate. Based on the data presented in the Report, the UV sensitivity (dose-response) of the T1 phage used during the validation testing was 5.068 mJ/cm² per log inactivation as shown in Table 5.4b of the Report, and the UV sensitivity (dose-response) of the MS2 phage used during the validation testing is described by the following equation.

$$\text{UV sensitivity} = A + B \times \log \text{ inactivation}$$

Where: UV sensitivity = the UV sensitivity of the phage used in the validation test, in mJ/cm²;

log inactivation = the desired log inactivation of the target pathogen; and

A and B = the coefficients shown in Table 5.4a of the Report.

- 10) Based on the information contained in Section 6.2.4 of the Report, the uncertainty of interpolation must be based on the following equations, as applicable.

$$U_{val} = \sqrt{U_{IN}^2 + U_S^2 + U_{DR}^2}$$

Where: U_{val} = the uncertainty of the validation data

U_{IN} = the uncertainty of interpolation for the MS2 and T1 phages, as described in item 11;

U_S = the UV Sensor uncertainty,
= 0, based on the validation test data; and

U_{DR} = the uncertainty of the dose response of the specific phages used in the validation test,
= 0, based on the minimum log removal credit allowed for this reactor in Texas.

- 11) Based on the information contained in Section 6.2.4.1 of the Report, the uncertainty of interpolation must be based on the following equations, as applicable.

$$U_{IN, MS2} = \frac{742.3}{RED_{calc}} \quad \text{or} \quad U_{IN, T1} = \frac{160.4}{RED_{calc}}$$

Where: $U_{IN, MS2}$ = the uncertainty of interpolation used when using the UV sensitivity and B_{RED} of the MS2 phage to calculate the value of D_{val} ;

$U_{IN, T1}$ = the uncertainty of interpolation used when using the UV sensitivity and B_{RED} of the T1 phage to calculate the value of D_{val} ; and

RED_{calc} = the calculated reduction equivalent dose, in mJ/cm².

- 12) The engineering plans and specifications must include the proposed algorithms and correction factors that will be used to calculate the value of the validated dose (D_{val}) and the corresponding log inactivation for each of the pathogens for which inactivation credit is being requested.

Validation Report Summary

The Report indicates the validation study on the 8L24-2L model reactor was conducted by Carollo Engineers at the Portland UV Validation Facility in Portland, Oregon. Laboratory services were provided by the GAP EnviroMicrobial Services (GAP), which is located in London, Ontario, Canada and is accredited in accordance with the Canadian Association for Laboratory Accreditation (CALA) requirements. All testing and analyses were conducted in accordance with the requirements of the UVDGM. The 8L24-2L reactor was validated using the MS2 and T1 bacteriophages over a three-dimension matrix of ultraviolet transmittance (UVT), flow, and power input, **with all Lamps installed but only Lamp 1 and Lamp 2 operational and all other Lamps off**. Super Hume™ was used to adjust the UVT of the feed water and the chlorine residual of the feedwater was measured several times each day to ensure the water contained no detectable chlorine residual.

The dose-response, or sensitivity, of the two viral surrogates was determined using GAP's collimated beam apparatus and monochromatic, low-pressure UV lamps. Samples for this part of the validation test were collected from the Influent tap on the reactor validation stand during each day that biosimetric tests were conducted on the reactor. Each sample was exposed to at least six different UV doses (including an undosed control blank), and each exposure was performed in triplicate.

The biosimetric tests performed on the 8L24-2L reactor were conducted using new medium-pressure UV lamps, and Lamps 1 and 2 were "burned in" for a total of 100 hours before the biosimetric testing was initiated. A total of 25 biosimetric tests were conducted on the 8L24-2L reactor using the MS2 phage, and a total of 21 tests were conducted using the T1 phage. Three to five sample sets (feed water and product water) were analyzed for each test condition. The boundary conditions for the results are summarized in the table shown below.

Parameter	Boundary Conditions
Input Power Level	30% to 100% of full power rating (i.e., 2.7 to 9.1 kilowatts (kW))
UVT ₂₅₄	70 to 98%
Flow Rate	1.0 to 25.5 MGD
Measured MS2 RED	10.00 to 120.00 mJ/cm ²
Measured T1 RED	2.5 to 20 mJ/cm ²

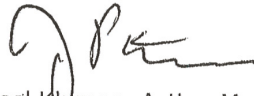
For any questions, please contact Bill Melville, P.E., at Bill.Melville@tceq.texas.gov, or at (512) 239-4729, or at:

Water Supply Division, MC-159
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Sincerely,



William R. Melville, P.E.
Technical Review & Oversight Team
Plan & Technical Review Section
Texas Commission on Environmental Quality



Joel Klumpp, Acting Manager
Plan & Technical Review Section
Water Supply Division
Texas Commission on Environmental Quality

cc: Ms. Vera Poe, P.E., Team Leader, Utilities Technical Review Team – MC 159

SURFACE WATER MONTHLY OPERATING REPORT

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

Turbidity Data Page

PUBLIC WATER SYSTEM NAME:

PLANT NAME OR NUMBER:

PWS ID No.:

Plant ID No.:

Connections:

3,000

Month:

Year:

Population:

20,000

PERFORMANCE DATA																		
Date	Raw Water Pumpage (MGD)	Treated Water Pumpage (MGD)	RAW WATER ANALYSES		SETTLED WATER TURBIDITY (Optional Data)						FINISHED WATER QUALITY							
			NTU	Alk.	Basin No.						Combined Filter Effluent Turbidity						Lowest Residual	Time
					1	2	3	4	5	6	NTU1	NTU2	NTU3	NTU4	NTU5	NTU6		
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Total			NOTE: ONLY use the "Time" column to show the length of time that the disinfectant residual entering the distribution system fell below the acceptable level.															
Avg																		
Max																		
Min																		