

From: David Sloan
Sent: Tue, 14 Oct 2014 21:37:38 +0000
To: Russell Schreiber (Wichita Falls); Kerry D. Maroney
Cc: Daniel Nix (Wichita Falls); Shawn Garcia
Subject: FW: Wichita Falls DPR - UV Disinfection
Attachments: TrojanUVSwift_8L24-2L_Approval_Letter_20141014.pdf

TCEQ came through with the letter we needed. I'm attaching their approval of the 2-lamp validation, which should be consistent with Trojan's proposal.

DAVID SLOAN / FREESE AND NICHOLS, INC.

From: Joel Klumpp [mailto:joel.klumpp@tceq.texas.gov]
Sent: Tuesday, October 14, 2014 4:19 PM
To: David Sloan
Cc: Bill Melville; Tamira Konkin-Garcia; Jack Schulze
Subject: RE: Wichita Falls DPR - UV Disinfection

David,

Please see attached for the validation study approval letter for the Trojan UV Swift 8L24-2L.

Thanks,

Joel

Joel Klumpp | Team Leader | Technical Review and Oversight Team | TCEQ
12100 Park 35 Circle, Bldg. F | Austin, Texas 78753 | ☎ (512) 239-4453 Fax: (512) 239-6050 | ✉:
Joel.Klumpp@tceq.texas.gov

From: David Sloan [mailto:DWS@freese.com]
Sent: Tuesday, October 14, 2014 9:11 AM
To: Joel Klumpp
Cc: Bill Melville
Subject: RE: Wichita Falls DPR - UV Disinfection
Importance: High

Joel, sorry I was on the phone when you called, but I'm available to talk about Wichita Falls' UV.

DAVID SLOAN / FREESE AND NICHOLS, INC.

From: Joel Klumpp [mailto:joel.klumpp@tceq.texas.gov]
Sent: Monday, October 13, 2014 2:55 PM

To: David Sloan

Cc: Vera Poe; Cari-Michel Lacaille; Bill Melville; Tamira Konkin-Garcia; Jack Schulze; Linda Brookins

Subject: Wichita Falls DPR - UV Disinfection

David,

The TCEQ has completed review of the validation study for the TrojanUVSwift™ 8L24 ultraviolet light (UV) system. The letter will be mailed today with the validated conditions shown 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

Please let me know if you have any questions.

Regards,

Joel

Joel Klumpp | Team Leader | Technical Review and Oversight Team | TCEQ

12100 Park 35 Circle, Bldg. F | Austin, Texas 78753 | ☎ (512) 239-4453 Fax: (512) 239-6050 | ✉
Joel.Klumpp@tceq.texas.gov

From: Joel Klumpp

Sent: Tuesday, September 09, 2014 1:48 PM

To: David Sloan

Cc: Vera Poe; Cari-Michel Lacaille; Bill Melville; Tamira Konkin-Garcia; Jack Schulze

Subject: RE: Wichita Falls DPR - UV Disinfection

David,

Here is an update on the TCEQ review of the validation studies for the two UV reactors that you have indicated the City of Wichita Falls is interested in:

ETS SX-850-20

TCEQ review has been completed and the reactor is approved with the validated conditions shown in the table below. This letter will be finalized and mailed on 9/11/14.

Per Title 40 of the Code of Federal Regulations (40 CFR) §141.720(d), the reactor must be operated within the validated conditions shown in the table below.

Minimum Validated UV Transmittance (UVT)	69%
Maximum Validated Flow Rate	17.98 MGD (12,483 gpm)
Minimum Cryptosporidium Inactivation Credit Allowed and its corresponding Required Dose (D _{req})	2.0-log @ 5.8 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

UV Swift 2L24

TCEQ review of the validation study continues. A conference call between TCEQ and Trojan will take place on 9/11/14. As soon as the required information can be provided by Trojan, review of the validation study will be concluded and a response letter will be prepared.

Please call me at 512-239-4453 with any questions.

Regards,

Joel

Joel Klumpp | Team Leader | Technical Review and Oversight Team | TCEQ

12100 Park 35 Circle, Bldg. F | Austin, Texas 78753 | ☎️💻 (512) 239-4453 Fax: (512) 239-6050 | ✉️:
Joel.Klumpp@tceq.texas.gov

From: David Sloan [<mailto:DWS@freese.com>]

Sent: Tuesday, August 19, 2014 11:08 AM

To: Joel Klumpp

Cc: Vera Poe; Linda Brookins; Ada Lichaa; Russell Schreiber (Wichita Falls); Kerry D. Maroney

Subject: RE: Wichita Falls DPR - UV Disinfection

Joel: Thank you for the information on the UV reactors and approval status. I just met with Patrick Bollman from ETS, and he explained that the SX-850-20 is within a common series of reactors with the SX-425-10, is configured the same (but with more lamps), was validated in the same way by the same third party, and incorporates the same control and monitoring strategy. They are prepared to submit their validation information for the larger unit at once if that will facilitate its consideration for the Wichita Falls project. They will also make staff available to assist in the review process. Please advise how we can best facilitate this submittal and review.

Obviously we are also eager for updates on the Trojan review as soon as information is available.

Best regards,

DAVID SLOAN / FREESE AND NICHOLS, INC.

From: Joel Klumpp [<mailto:joel.klumpp@tceq.texas.gov>]

Sent: Monday, August 18, 2014 4:34 PM

To: David Sloan

Cc: Vera Poe; Linda Brookins; Ada Lichaa

Subject: RE: Wichita Falls DPR - UV Disinfection

David,

Per a conversation between Linda Brookins, Director, TCEQ Water Supply Division, and Russell Schreiber, the City of Wichita Falls hopes to select a UV disinfection unit which has already been reviewed and approved by TCEQ. At this time, it does not appear that a TCEQ-approved model will work for the City. Regarding the status of the two reactor models noted in your email:

1. UV Swift 2L24 at Bistone MWD:

Our database has an entry for a UV-disinfection reactor exception request for Bistone MWD which is assigned to staff for review. This staff person is out of the office at this time and the documents we can access today do not contain any specifics on the validation report or even provide the model number. We will check to confirm that the reactor is a Swift-2L24 and let you know the status of our review.

2. ETS SX-850-20:

We will need to review the validation report on the larger unit. The entire review process of the SX-850-20 report can be expedited to a thirty day turn-around, provided:

- a. The report is organized in the same format as the one for the SX-425-10 which we have reviewed; and
- b. The control and monitoring algorithms for the two reactors are not really dissimilar.

Both of these reactors use medium-pressure lamps so you will need to be sure they include an Absorbance Spectrum Correction Factor (ASCF) in the Validation Factor (VF) used to calculate the Validated Dose (D_{val}). We have been awaiting the imminent release of the AWWARF/IUVA report on ASCF for almost 2 years now.

The TCEQ is very aware of the need to proceed rapidly in order to ensure adequate time for review, approval, and construction of UV disinfection equipment in the event the City needs to operate their Emergency Temporary DPR Project for longer than six months. We will expedite the review of all submittals related to UV disinfection equipment for this project.

I'll get back to you soon with additional information about the UV Swift 2L24 at Bistone MWD.

Best Regards,

Joel

Joel Klumpp | Team Leader | Technical Review and Oversight Team | TCEQ

12100 Park 35 Circle, Bldg. F | Austin, Texas 78753 | ☎ (512) 239-4453 Fax: (512) 239-6050 | ✉ Joel.Klumpp@tceq.texas.gov

From: David Sloan [<mailto:DWS@freese.com>]
Sent: Thursday, August 14, 2014 12:42 PM
To: Joel Klumpp; Vera Poe
Subject: Wichita Falls DPR - UV Disinfection
Importance: High

Joel & Vera:

We are assisting the City of Wichita Falls with the design of UV disinfection equipment for their interim potable reuse facility.

We have contacted several UV manufacturers, and have received several recommendations for equipment. We understand two manufacturers currently have equipment approved by TCEQ for disinfection credit:

Trojan UV: Oxidation-style units approved for CRMWD and Midlothian. They have recommended the UV Swift 2L24, and noted it is anticipated to be approved very soon for a Bistone WD project. Can you please confirm this?

ETS UV Technology: SX425-10 reactor is approved for the Brownwood DPR project. They have recommended the SX-850-20 model, which is similarly configured and tested, but larger and better suited to the Wichita Falls application. Can you estimate how long it might take to provide a confirmation that this reactor could be used?

The City is trying to proceed as expeditiously as possible to allow the facility to continue operating given their continued extreme drought conditions. Other manufacturers are also interested in competing for this, but we are concerned about the available time to implement. The two noted above appear best positioned to receive quick approval.

I appreciate your response at your earliest convenience.

Best regards,

DAVID W. SLOAN, P.E., BCEE
SENIOR PROCESS ENGINEER
BOARD CERTIFIED ENVIRONMENTAL ENGINEER

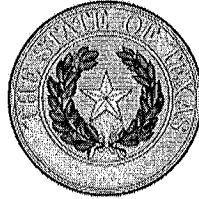


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Bryan W. Shaw, Ph.D., P.E., *Chairman*
Toby Baker, *Commissioner*
Zak Covar, *Commissioner*
Richard A. Hyde, P.E., *Executive Director*



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 biodosimetric 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 biodosimetric 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 biodosimetric testing was initiated. A total of 25 biodosimetric 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

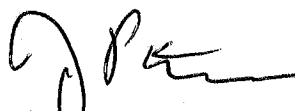
For any questions, please contact Bill Melville, P.E., at Bill.Melville@tceq.texas.gov, or at (512) 239-4729, or at:

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

