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State of California—Health and Human Services Agency
California Department of Public Health



ARNOLD SCHWARZENEGGER
Governor

December 14, 2007

Oliver Lawal
Director of Engineering - Americas
ITT - Water & Wastewater
14125 South Bridge Circle
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Dear Mr. Lawal,

CONDITIONAL ACCEPTANCE OF ITT, WEDECO LBX 1000 UV DISINFECTION
SYSTEM, VALIDATION REPORT, FINAL DECEMBER 2007

The California Department of Public Health (Department) Drinking Water Program's Water Recycling Committee (WRC) has reviewed the revised submittal entitled "LBX 1000 UV Disinfection System Validation Report" (Carollo Engineers, December 2007)¹ which contains the bioassay results of the testing in Portland. The Wedeco LBX 1000 closed-vessel UV disinfection system was tested and the results analyzed in accordance with the 2003 Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse published by the National Water Research Institute/AWWA Research Foundation. This system has a 65.5-cm chamber and forty 330-W low-pressure high-output (LPHO) lamps oriented parallel to the flow. It has a calibrated germicidal sensor that meets international standards (DVGW, 2006; ÖNORM, 2001) and is integral to the performance monitoring of the system.

The reduction equivalent dose (RED) for the LBX 1000 UV system is a function of flow rate (Q), UVT, and normalized UV sensor value (S/S_0). Detailed testing was performed to determine the flow-specific performance of the LBX 1000 reactor for flow rates ranging from 0.58 to 3.51 MGD (403 to 2,438 gpm) at UVTs ranging from 54 to 77 percent, and sensor intensities ranging from 1.9 to 7.5 mW/cm².

The WRC finds that the validation testing and report have sufficiently demonstrated the ability of the LBX 1000 UV Disinfection System to meet the minimum coliform and virus disinfection criteria found in Title 22 of the California Code of Regulations (CCR) for

¹ Agencies interested in this technology can obtain copies of the December 2007 Carollo Engineers report from Oliver Lawal, Director of Engineering – Americas, ITT - Water & Wastewater, 14125 South Bridge Circle, Charlotte, NC 28273.

recycled waters that have received treatment through an accepted membrane filtration process.

The acceptance of the validation report is conditioned on the following: The following criteria must be met and/or demonstrated.

1. Since this reactor was only tested using potable water, acceptance is limited to recycled water applications in which the filtration process is a membrane. LBX 1000 UV Disinfection System must be preceded by membrane filtration meeting the definition of "filtered wastewater" under CCR, Title 22, Section 60301.320 (b).
2. Conditional acceptance for the LBX 1000 reactor is limited to the following parameter ranges:
 - a. from 0.58 to 3.51 MGD (403 to 2,438 gpm)
 - b. UVTs at or above 54 percent²,
 - c. UV sensor intensities ranging from 1.9 to 7.5 mW/cm².
3. Two empirical equations were developed based on the performance data collected during the validation test and they must be used for calculation of the RED value in actual installations. These equations are to be used as part of the automatic UV disinfection control system for calculating UV dose and should be specified as a permit provision.

$$S = e^{-7.919} \times e^{0.0367 \text{ UVT}} \times P^{1.229}$$

$$\text{RED}_{\text{calc}} = 10^{1.2771} \times A_{254}^{-0.9793} \times [S/S_0]^{0.8751} \times [1/Q]^{0.9036}$$

Where:

S = Measured UV sensor value (mW/cm²).

S₀ = UV intensity at 100 percent lamp power (new lamps) with clean sleeves, typically expressed as a function of UVT (mW/cm²).

P = Power setting, either 210 W, 270 W, or 330 W for the witnessed tests

RED = RED calculated with the UV dose-monitoring equation (mJ/cm²).

A₂₅₄ = UV absorbance at 254 nm (cm⁻¹).

Q = Flow rate (million gallons per day [mgd]).

B = Number of operating banks of lamps within the UV reactor (= 1 in this case).

4. To verify performance to the site-specific recycled water, upon completion of construction and prior to operation, an on-site check-point bioassay must be performed on the reactor using seeded MS2 coliphage in a method similar to that demonstrated in the 2007 report from Carollo Engineers. The on-site bioassay

² At UVT values above 77 percent, the value (77 percent UVT, or A₂₅₄ = 0.114) should be used as the default value in the RED calculation.

protocol must be approved by the Department and must be conducted over a range of flows. Results, documenting virus disinfection performance of the system to the standards found in Title 22 of the California Code of Regulations, must be submitted to the Department for approval.

5. Conditional acceptance is predicated upon using a calibrated germicidal sensor that meets international standards (DVGW, 2006; ÖNORM, 2001) and is integral to the performance monitoring of the system.
6. The LBX 1000 uses Wedeco's XLR30 UV lamps, which have a maximum power of 330 Watts. These lamps have been tested and approved by CDPH for an end of lamp life (EOLL) factor of 0.88 over 10,074 hours of operation³. However, this validation report does not address the determination of lamp aging or lamp fouling factors. Instead, this validation is based upon dose-pacing methodology, relying on detailed and accurate UV sensor readings to confirm adequate UV dose delivery similar to drinking water UV applications, so that the regulated UV dose is delivered and the combined effects of lamp aging and sleeve fouling are incorporated. Detailed information related to the UV sensors to be employed under this project is presented in Appendix A in the 2007 report from Carollo Engineers.
7. The accuracy and repeatability of the on-line UV sensors must be demonstrated to the Department. The site specific engineering report must specify the frequency that calibration checks should be performed.
8. The LBX system provides the option of an automated mechanical wiping mechanism to reduce sleeve fouling; however, this is not essential due to the fact that this reactor is proposed to be controlled via a calibrated germicidal sensor, which will account for the amount of lamp fouling in its intensity readings.
9. On-line monitoring of flow, UVT, and intensity must be provided at all times.
10. The LBX 1000 UV system is designed with a built-in automatic reliability feature that must be triggered when the system is below the target UV dose. If the measured UV intensity goes below the minimum UV Intensity, the UV reactor in question must alarm and start the next available reactor. Further conditions that should shut a reactor down include: intensity monitor failure, reactor failure, multiple lamp failure, and ballast high temperature.

Review and acceptance of individual systems will be handled on a case-by-case basis by the Department's individual District offices. Approval for the use of your technology in any and all water recycling applications is granted through the Regional Water Quality Control Board's Water Reclamation permitting process.

³ The lamp testing results are documented in "10,074-Hour Lamp Aging Report - SLR 32143 HP Lamp, Final, May 2005", by Carollo Engineers.

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Should you have any questions regarding the content of this letter, please feel free to contact me at (brian.bernados@cdph.ca.gov; 619.525.4497) or Jeff Stone (jeffrey.stone@cdph.ca.gov; 805.566.9767).

Sincerely,



Brian Bernados, P.E.
Technical Specialist

Cc Water Recycling Committee

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