Bryan W. Shaw, Ph.D., *Chairman*
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PWS/6000800/CO/10-23-2013/Challenge Study

Texas Commission on Environmental Quality

Protecting Texas by Reducing and Preventing Pollution

October 23, 2013

Mr. Aaron Balczewski, Director of Process Technology
Siemens Water Technologies
725 Wooten Road
Colorado Springs, Co 80915

Re: Siemens Memcor® S10N Hollow-Fiber Ultrafiltration Cartridges
Review and Approval of Challenge Testing
Removal of Microbial Contaminants

Dear Mr. Balczewski:

Membrane filtration systems installed on, or replaced after, April 1, 2012 for the removal of *Cryptosporidium* and *Giardia* must undergo challenge testing to evaluate the membrane's removal efficiency and for the Texas Commission on Environmental Quality (TCEQ) to establish a challenge test log removal value ($LRV_{C\text{-}Test}$) as required by Title 30 of the Texas Administrative Code (30 TAC) §290.42(g)(3). In addition, these regulations require a membrane manufacturer to provide the non-destructive performance test (NDPT) and associated quality control release value (QCRV) that will be used to verify that all manufactured membrane modules that were not subject to challenge testing will achieve at least the same log removal as those that were challenge tested.

CHALLENGE STUDY DATA FOR SIEMENS S10N ULTRAFILTRATION MODULES

We reviewed the submitted challenge study data for compliance with the *Cryptosporidium* treatment requirements in the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The criteria for compliance is found in Title 40 of the Code of Federal Regulations (40 CFR) §141.719(b)(2). Additional guidance for compliance with these requirements can be found in the United States Environmental Protection Agency (USEPA) Membrane Filtration Guidance Manual (EPA 815-R-06-009). The TCEQ reviewed challenge study data presented in *NSF Test Report - Final Report: Siemens Industry, Inc. S10N Ultrafiltration Modules- Product Specific Challenge Tests for Cryptosporidium and Virus Removal Credits under LT2ESWTR*, prepared by the National Sanitation Foundation (NSF) International organization (in a report dated January 2, 2013). Based on our review, we have determined that the challenge study is compliant with LT2ESWTR requirements. Please review the following in regards to the approved log removal value demonstrated during challenge testing ($LRV_{C\text{-}Test}$) and the non-destructive performance test (NDPT) for production membrane modules that did not undergo challenge testing:

TCEQ APPROVED $LRV_{C\text{-}TEST}$

The TCEQ is approving a **$LRV_{C\text{-}Test}$ of 5.03** for the removal of *Cryptosporidium* for the Siemens Industry, Inc. S10N UF membrane modules. The following are the parameters of the approved challenge study:

Full-scale module tested	Siemens Industry, Inc. S10N UF Modules
Number of Independent Modules Tested	2
Criterion of Selected Modules	Modules that had failed the Non-Destructive Performance Test (NDPT) were selected for testing in accordance with California Department of Public Health Requirements
Serial Numbers of Tested Modules	WPB3021P and WPB3L828
Nondestructive Performance Testing (NDPT)Process	Diffusive Airflow Test
Quality Control Release Value (QCRV)	9 seconds per milliliter (s/mL)- minimum allowable time for displacement of water for the S10N module
Challenge Particulate	*B. atrophaeus* endospores (as a surrogate for *Cryptosporidium*)
Detection Limit	1 Colony Forming Unit (CFU) per 100 mL
Feed Concentration Range	1.53×10^6 CFU/100mL to 2.16×10^6 CFU/100mL (corresponding to 6.19 to 6.34 $\log_{10}$)
Maximum Flux Rate	80 gallons per minute per square-foot (gfd)
Mode of Operation	Continuously stirred tank reactor with no reject recirculation (deposition mode)

LIMITS OF TCEQ APPROVED $LRV_{C\text{-}Test}$

The TCEQ approved $LRV_{C\text{-}Test}$ is only valid for the Siemens Industry, Inc. S10N UF membrane modules operated under the parameters that were used for the challenge testing and only for modules that have passed the nondestructive performance test (NDPT). From our review of the challenge study, an acceptable Siemens Industry, Inc. S10N UF membrane module must comply with the following to receive the approved $LRV_{C\text{-}Test}$:

1) Specifications of the approved Siemens S10N UF modules:
   a) Constructed of polyvinylidene fluoride (PVDF) hollow-fiber membranes;
   b) A module outside diameter of 5.2 inches;
   c) Module length of 47.0 inches;
   d) A nominal pore size of 0.04 microns;
   e) An absolute membrane pore size of 0.1 microns;
   f) Liquid-membrane contact angle of 50 degrees;
   g) A fiber inner diameter of 0.54 millimeters (mm);
   h) A fiber outer diameter of 1.03 mm;
   i) Potting depth of 90 mm;
   j) Nominal membrane surface areas of 250-ft^2;
   k) An outside to inside flow path;
   l) Operated in dead-end mode;
   m) Maximum certified filtrate flux rate of 80 gallons per square-foot per day (gfd);
   n) Operating temperature range of >0° to 35 °C (>32° to 95 °F);
   o) At less than or equal to 30°C, a maximum transmembrane pressure of 22 pounds per square-inch (psi);
   p) A pH operating range of 6.0 to 9.0;

q) Allowable pH range for cleaning of 2.0 to 10.0 (brief exposure to 10.5 is acceptable); and
r) Maximum chlorine tolerance during cleaning of 1,000 milligrams per liter (mg/L).

2) Prior to shipment to a Texas public water system, each new Siemens S10N UF membrane module must have passed the NDPT, a pressure-based diffusive airflow test (DAF) as specified by Siemens Industry, Inc. and as described below:
   a) Drain the filtrate side of the membrane.
   b) Apply a constant pressure of 17.4 psi on the filtrate side of the membrane.
   c) After an initial stabilization period, measure the flow of water into a sight tube of known volume to measure the displacement of water in seconds per milliliter.
   d) For the S10N UF module, the passing Quality Control Release Value (QCRV) is 9 seconds per milliliter.

3) If the NDPT result for a Siemens S10N UF membrane module exceeds the QCRV, the TCEQ shall not allow that Siemens S10N UF membrane module to be installed at a Texas public water system for microbial contaminant removal credit.

4) Siemens Industry, Inc. must notify the TCEQ in writing if the Siemens S10N UF membrane modules (as challenge tested by NSF International) are modified or if the NDPT method is modified in any manner. After receiving written notification, the TCEQ shall determine if the modified Siemens S10N UF membrane module shall be required to undergo challenge testing or if the modified NDPT method is acceptable.

5) The TCEQ shall grant Texas public water systems using membrane filtration log removal credits for *Giardia* and *Cryptosporidium* that shall not exceed the lower of:
   a) The TCEQ approved $LRV_{C\text{-}Test}$; or,
   b) The maximum removal efficiency that can be verified through a membrane unit's site-specific direct integrity test (LRV_{DIT}).

6) Each Siemens S10N UF membrane module must conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and must be certified by a testing organization accredited by ANSI.

7) Please note that the approved $LRV_{C\text{-}Test}$ is for the current Federal and Texas statutes, and the EPA and TCEQ rules. If any of these statutes or rules are revised, the TCEQ approved $LRV_{C\text{-}Test}$ in this letter may also be revised.

Please provide a copy of this letter to each of your Texas public water system customers. This letter is **not** to be construed as:

- A TCEQ granted exception for any Texas public water system to use the Siemens S10N UF membranes. Each Texas public water system must request and receive site-specific approval to use membrane filtration in accordance with 30 TAC §290.42(g) and §290.39(l);

- TCEQ approval for a Texas public water system to install Siemens S10N UF membranes; or

- TCEQ approval for a Texas public water system's required concentration time (CT) study.

If you have questions concerning this letter, or if we can be of additional assistance, please contact David Williams, P.E. at the letterhead address, by e-mail at david.a.williams@tceq.texas.gov, or by telephone at (512) 239-0945.

Sincerely,

David A. Williams, P.E.
Technical Review and Oversight Team
Plan and Technical Review Section
Texas Commission on Environmental Quality

Ada Lichaa, P.G., Manager
Plan and Technical Review Section
Water Supply Division
Texas Commission on Environmental Quality

AL/DAW

cc: Mr. Derek Turner, P.E., Jacob and Martin, Ltd., 1508 Santa Fe Drive, Suites 204-205, Weatherford, Texas 76086