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PWS_6000800_CO_20180131_Challenge Study

Texas Commission on Environmental Quality

Protecting Texas by Reducing and Preventing Pollution

January 31, 2018

Mr. Brian Wise
Nanostone Water Inc.
10250 Valley View Road, Suite 143
Eden Prairie, MN 55344

Re: Nanostone Ultrafiltration (UF) CM-151 Ceramic Membrane Modules
Review and Approval of Challenge Testing for the Removal of Microbial
Contaminants

Dear Mr. Wise,

On August 31, 2017, the Texas Commission on Environmental Quality (TCEQ) received a copy of the August 30, 2017 initial report of the challenge study conducted on the Nanostone CM-151 Ultrafiltration (UF) Ceramic membrane modules. The challenge study was conducted by NSF International, in accordance with the NSF International (NSF)/ American National Standards Institute (ANSI) Standard 419-2015: Public Drinking Water Equipment Performance - Filtration. Upon review, we found that the initial report did not satisfy the minimum requirements specified in Title 40 of the Federal Code of Regulations (40 CFR) §141.719(b)(2)(vii) for establishing a quality control release value (QCRV) for a non-destructive performance test (NDPT). On November 20, 2017, a complete report (dated November 17, 2017) was provided by Mr. Stanton Smith of Nanostone Water Company to Mr. David Williams of my staff, which included the NSF/ANSI 419 certification of the Nanostone CM-151 Ceramic UF membranes and a QCRV for NDPT. We have reviewed the November 17, 2017 challenge study for these modules for compliance with the state and federal rules. Based on our review, we are **approving** an LRV_{C-Test} and a QCRV for the manufacturer's NDPT for the Nanostone CM-151 ceramic UF membranes as outlined in this letter.

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

NSF/ANSI Standard 419 is based on the Environmental Technology of Microfiltration Verification (ETV) *Generic Protocol for the Product Specific Challenge Testing of Microfiltration or Ultrafiltration Membrane Modules* (May 2011) and the product-specific challenge testing requirements in the United States Environmental Protection Agency (USEPA) Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The criteria for compliance are found in 40 CFR §141.719 and described in the USEPA *Membrane Filtration Guidance Manual* (MFGM). The NSF certification of performance is only based on the reduction of *Cryptosporidium* as it is linked to the QCRV.

CHALLENGE STUDY DATA FOR NANOSTONE CM-151 CERAMIC ULTRAFILTRATION MEMBRANE MODULES

We reviewed the submitted challenge study data for compliance with the *Cryptosporidium* treatment requirements in the LT2ESWTR. Specifically, the criteria for compliance is found in 40 CFR §141.719(b)(2). Additional guidance for compliance with these requirements can be found in the USEPA MFGM. Based on our review of the challenge study data for the Nanostone CM-151 UF membrane modules, the TCEQ has determined that the challenge study is compliant with LT2ESWTR requirements. Please review the conditions in the following pages, regarding the approved log removal value demonstrated during challenge testing (LRV_{C-Test}) and the approved NDPT for production membrane modules that did not undergo challenge testing.

TCEQ-APPROVED LRV_{C-TEST}

For the Nanostone CM-151 Ceramic UF modules, the TCEQ is approving a **LRV_{C-Test} of 5.31** for the removal of *Cryptosporidium* for systems operated in deposition mode. The LRV_{C-Test} approval by the TCEQ does not apply to systems operated in cross flow mode, as this hydraulic configuration was not demonstrated in this challenge test study. For the purposes of this letter, the TCEQ will be referring to the updated report (Job Number J-00267328) provided by Mr. Stanton, dated November 20, 2017, and the challenge study attached therein as the basis of our review. The following are the parameters of the approved challenge study:

Full-scale Modules Tested	Nanostone CM-151 Ceramic UF Modules
Number of Independent Modules Tested	5
Criterion for Selecting Modules	None*
Model Number / Serial Numbers of Tested Modules	CM-151, Module #1 (11001SE0022) CM-151, Module #2 (11001SE0023) CM-151, Module #3 (11001SE0044) CM-151, Module #4 (11001SE0021) CM-151, Module #5 (11001SE0040)
Nondestructive Performance Testing (NDPT) Process (Manufacturing)	Pressure decay test with a minimum starting test pressure between 21.5 - 22.8 pounds per square inch (psi) for 5 minutes.
Quality Control Release Value (QCRV) for Pressure Decay Test	0.637 psi/min (allowable decay rate)
Challenge Particulate	<i>Bacillus atrophaeus</i> American Type Culture Collection (ATCC) number 9372 (as a surrogate for <i>Cryptosporidium</i>) with an average diameter of 0.8 microns (µm) and an average length of 1.8 µm
Detection Limit	1 colony forming unit (CFU) per 100 mL
Feed Concentration Range	Geometric mean between 9.59 x 10 ⁵ and 1.33 x 10 ⁶ CFU per 100 mL
Max Filtrate Flux Rate	300 gallons per square-foot per day (gfd) at 45 °C
Mode of Operation / Flow Configuration	Deposition mode / Inside-out

* The challenge study established a QCRV of 0.637 psi/min, based on the highest average pressure decay rate observed from the tested modules used to establish the LRV_{C-Test} (as required by 40 CFR §141.719(b)(2)(vii)). Any membrane module that does not meet the QCRV established in the challenge study is not eligible for the approved LRV_{C-Test} of 5.31-log.

LIMITS OF TCEQ-APPROVED LRV_{C-TEST}

The TCEQ-approved LRV_{C-Test} is valid only for the Nanostone CM-151 Ceramic UF modules operated under the parameters used for this challenge testing and only for modules that have passed the NDPT. From our review of the challenge study, an acceptable Nanostone CM-151 Ceramic UF module must comply with the following specifications to receive the TCEQ-approved LRV_{C-test}:

- 1) Specifications of the approved Nanostone CM-151 Ceramic UF modules:
 - a) Ceramic UF membranes;
 - b) Nominal membrane surface area of 262 square feet (ft²);
 - c) Nominal membrane pore size of 0.03 μm;
 - d) Module diameter - 8.3 inches (in.);
 - e) An inside-to-outside flow path;
 - f) Operational mode: deposition (no cross-flow);
 - g) Maximum filtrate flux: 300 gfd;
 - h) Maximum filtrate flow: 54.6 gallons per minute (gpm);
 - i) Maximum operating temperature range: 45°C;
 - j) Maximum inlet pressure: 100 psi;
 - k) Maximum trans-membrane pressure (TMP) of 100 psi; and
 - l) Operating pH range: 2 - 12.

- 2) Prior to shipment to a Texas public water system (PWS), each new Nanostone CM-151 Ceramic UF module must have passed the NDPT, a pressure decay test, as specified in pages 8-9 of your report (Job Number J-00267328), dated November 20, 2017:
 - a. "After the wetting of the ceramic membranes is ensured, all valves of the PDIT-facility are closed.
 - b. Turn off the system and isolate the membrane skid by closing the appropriate valves.
 - c. Keep the feed and reject valves closed and the permeate valves open to atmosphere.
 - d. Pressurize the feed side to a pressure between 21.5 psi and 22.8 psi of filtered air and push the water through the membrane into the permeate side.
 - e. Close the air line and allow the system to equilibrate for 3 minutes.
 - f. Begin the decay test and record the pressure on the feed side of the membrane at time zero and 5 minutes. Subtract the two pressures and divide by 5 minutes to calculate the pressure decay per minute."

- 3) If a Nanostone CM-151 Ceramic UF module fails the NDPT (membranes having pressure decay rates greater than 0.637 psi/min), the TCEQ will not approve the Nanostone CM-151 Ceramic UF module to be installed at any Texas PWS for microbial contaminant removal credit.

- 4) For use by a PWS in Texas for microbial contaminant removal credit, only Nanostone CM-151 Ceramic UF modules that have been certified by NSF International are allowed. **Only modules that have passed a NDPT with a QCRV for the pressure decay test of 0.637 psi/min or less will be approved for use (membranes having pressure decay test values greater than 0.637 psi/min will not be allowed for use).**

- 5) The results of the Nanostone CM-151 Ceramic UF module's NDPT must be recorded with the module's assigned unique serial number. The NDPT result for each Nanostone CM-151 Ceramic UF module delivered to a Texas PWS must be provided upon delivery of the Nanostone CM-151 Ceramic UF module to the system.

- 6) Nanostone Water, Inc. must notify the TCEQ in writing if the Nanostone CM-151 Ceramic UF module or the NDPT method are modified in any manner. After receiving written notification, the TCEQ shall determine if the modified modules will be required to undergo challenge testing or if the modified NDPT method is acceptable.

- 7) The TCEQ will grant log removal credits to Texas PWSs using membrane filtration for *Giardia* and *Cryptosporidium*. The log removal credits shall not exceed the lower of:

- a. The TCEQ-approved LRV_{C-Test} ; or,
 - b. The maximum removal efficiency that can be verified through a membrane unit's site specific direct integrity test (LRV_{DIT}).
- 8) Each Nanostone CM-151 Ceramic UF module must conform to ANSI/NSF Standard 61 and must be certified by a testing organization accredited by ANSI.
- 9) Please note that the approved LRV_{C-Test} is for the current Federal and Texas statutes, and the USEPA and TCEQ rules. If these statutes or rules are revised, the TCEQ-approved LRV_{C-Test} in this letter may also be revised.

Please provide a copy of this letter to each of your Texas PWS customers. This letter **may not** be construed as:

- A granted TCEQ exception for any Texas PWS to use the Nanostone CM-151 Ceramic UF module. Each Texas PWS must request and receive site-specific approval to use membrane filtration in accordance with 30 TAC §290.42(g) and §290.39(1);
- TCEQ approval for a Texas PWS to install a Nanostone CM-151 Ceramic UF module. All engineering plans and specifications must be approved by the TCEQ prior to installation; or
- TCEQ approval for a Texas PWS's required concentration time (CT) study.

If you have any questions about this letter, or if we can be of additional assistance, please contact Ms. Yadhira A. Resendez, E.I.T., at the letterhead address, by e-mail at yadhira.resendez@tceq.texas.gov, or by telephone at (512) 239-1018.

Sincerely,



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