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PWS CG_Travis_CO_20260617_Challenge

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

June 17, 2026

Mr. Jon Belanger, Product Engineering & Technical Service Manager
Acuriant Technologies, Inc.
One Marina Park Drive, Suite 1410
Boston, Massachusetts 02210

RE: Nanostone CUF | Flow™ Ceramic Membrane Modules
Review and Approval of Challenge Testing for the Removal of Microbial Contaminants

Dear Mr. Belanger:

On October 28, 2025, the Texas Commission on Environmental Quality (TCEQ) received a copy of the July 17, 2025 challenge study report of the Nanostone CUF | Flow™ ultrafiltration (UF) ceramic membrane modules. The challenge study was conducted by BCS Laboratories in accordance with the NSF International (NSF)/American National Standards Institute (ANSI) Standard 419: Public Drinking Water Equipment Performance - Filtration. We have reviewed the 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 Quality Control Release Value (QCRV) for the manufacturer's Non-Destructive Performance Test (NDPT) for the Nanostone CUF | Flow™ UF membranes as outlined in this letter.

REQUIREMENTS FOR CHALLENGE STUDY APPROVAL

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 FOR NANOSTONE CUF | FLOW™ CERAMIC ULTRAFILTRATION MEMBRANE MODULES

We reviewed the submitted challenge study data for compliance with the *Cryptosporidium* treatment requirements in the LT2ESWTR. 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 CUF | Flow™ 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 and QCRV for production membrane modules that did not undergo challenge testing.

TCEQ APPROVED LRV_{C-TEST}

For the Nanostone CUF | Flow™ UF membrane modules, the TCEQ is approves a **LRV_{C-Test} of 5.68** 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. The following are the parameters of the approved challenge study:

Full-scale Modules Tested	Nanostone CUF Flow™ Modules
Number of Independent Modules Tested	5
Criterion for Selecting Modules	None*
Model ID / Serial Numbers of Tested Modules	2505008 / 12101ZL0059 2505013 / 12102AC0104 2505016 / 12102AC0074 2505011 / 12102AC0102 2505010 / 12102AC0101
Nondestructive Performance Testing (NDPT) Process (Manufacturing)	Five-minute pressure decay test
Revised Quality Control Release Value (QCRV) for Pressure Decay Test*	0.2 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	1.69 x 10 ⁶ and 3.13 x 10 ⁶ CFU per 100 mL
Max Filtrate Flux Rate (Manufacturer)	294 gallons per square-foot per day (gfd) at 20 °C
Mode of Operation / Flow Configuration	Deposition mode / Inside-out

* The challenge study established a QCRV of 0.2 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 5.68-log.

LIMITS OF TCEQ-APPROVED LRV_{C-TEST}

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

- 1) Specifications of the approved Nanostone CUF | Flow™ modules:
 - Constructed of aluminum oxide ceramic
 - Nominal membrane feed-side surface area of 366 square feet (ft²)
 - Nominal and maximum membrane pore size of 30 nanometers (nm)
 - Module outside diameter: 249 millimeters (mm)
 - Module length: 1,918 mm

- Potting material: - urethane
 - An inside-to-outside flow path
 - Operational mode: deposition
 - Maximum filtrate flux: 294 gallons per square-foot per day (gfd) at 20° C
 - Temperature tolerance range: 1 to 45°C
 - Maximum inlet pressure: 101 psi
 - Maximum trans-membrane pressure (TMP) at 20° C: 101 psi
 - Maximum TMP at any temperature: 101 psi
 - Operating pH range: 2 - 12
 - pH tolerance (cleaning): 2 - 12
- 2) Prior to shipment to a Texas public water system (PWS), each new Nanostone CUF Flow™ module must have passed the manufacturer's NDPT, a pressure decay test as described on page 13 of the challenge study report:
- Ensure membrane is fully wetted per protocols - ensure feed tank is isolated and the feed piping drained less than 5 minutes prior to starting the pressure decay test.
 - For the test membrane: open isolation valves to atmosphere to drain the membrane, then close drain and vent valves after approximately one minute or full draining. Leave filtrate valve open to atmosphere.
 - Open air-supply valve to membrane skid to allow air into the test membrane from the lower inlet port. Pressurize the concentrate (inlet) side stepwise first to 500 mbar (set point 575 mbar with a monitoring time of 45 seconds), then to 1.000 bar (set point 1.075 bar with a monitoring time of 70 seconds to the final pressure of 1.500 bar (set point of 1.575 bar (22.843 psi) with a monitoring time of 90 seconds using filtered high purity air).
 - Shut off the air supply line and allow system to equilibrate for 3 minutes. Record pressure at time zero and begin timer for the pressure decay test. Following 5 minutes, record pressure. Subtract the two pressures and divide by 5 minutes to calculate the pressure decay per minute.
 - At end of test, slowly vent system to atmosphere to complete test.
- 3) If the NDPT result for a Nanostone CUF | Flow™ module exceeds the QCRV (where the measured decay rate was greater than the QCRV of 0.2 psi/min), the TCEQ shall not allow the Nanostone CUF | Flow™ module to be installed at any Texas PWS for microbial contaminant removal credit.
- 4) The manufacturer must notify the TCEQ in writing if the Nanostone CUF | Flow™ 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.
- 5) The manufacturer must record the results of each Nanostone CUF | Flow™ module's NDPT with the module's assigned unique serial number. The NDPT result for each Nanostone CUF | Flow™ membrane module delivered to a Texas PWS must be provided upon delivery of the Nanostone CUF | Flow™ membrane modules. Each Texas public water system must provide the TCEQ with the NDPT result for each module installed for microbial contaminant removal credit.
- 6) For use by a PWS in Texas for microbial contaminant removal credit, only Nanostone CUF | Flow™ modules that have been certified to NSF/ANSI Standard 419 are allowed. **Only modules that have passed a NDPT with a QCRV for the pressure decay test of 0.2 psi/min or less will be approved for use (membranes having pressure decay test values greater than 0.2 psi/min will not be allowed for use).**

- 7) The TCEQ will grant log removal credits for *Giardia* and *Cryptosporidium* to Texas PWSs using membrane filtration. 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 the site-specific direct integrity test (LRV_{DIR}) of the membrane filtration unit.
- 8) Each Nanostone CUF | Flow™ 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 and their consulting engineers. This letter **may not** be construed as:

- A TCEQ granted exception for any Texas PWS to use the Nanostone CUF | Flow™ 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 CUF | Flow™ 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 Mr. David Williams, P.E., at the letterhead address, by e-mail at david.williams@tceq.texas.gov, or by telephone at (512) 239-4674.

Sincerely,



Chirag Patel, Team Leader
Technical Review and Oversight Team
Plan and Technical Review Section
Water Supply Division
Texas Commission on Environmental Quality

CCP/daw