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PWS\_6000800\_CO\_20140127\_Challenge Study

## Texas Commission on Environmental Quality

*Protecting Texas by Reducing and Preventing Pollution*

January 27, 2014

Mr. Craig Brown, Chief Engineer  
GE Power & Water  
3135 Easton Turnpike  
Fairfield, CT 06828-0001

Re: GE/Zenon ZeeWeed® 500D Membrane-440 ft<sup>2</sup>  
Review and Approval of Challenge Testing  
Removal of Microbial Contaminants

Dear Mr. Brown:

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<sub>C-Test</sub>) 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 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 GE/ZENON ZEEWEED® 500D MEMBRANE 440-FT<sup>2</sup> 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 *California Department of Public Health, Conditional Acceptance Testing For ZeeWeed®500D Membrane - 440ft<sup>2</sup>*, prepared by MWH Americas, Inc., (in a report dated December 2010) for GE/Zenon. Based on our review, we have 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<sub>C-Test</sub>) and the NDPT for production membrane modules that do not undergo challenge testing.

**TCEQ-APPROVED LRV<sub>C-TEST</sub>**

For the GE/Zenon ZeeWeed® 500D Membrane-440 ft<sup>2</sup> modules, the TCEQ is approving a **LRV<sub>C-Test</sub> of 6.2** for the removal of *Cryptosporidium* for systems operated in deposition mode and a **LRV<sub>C-Test</sub> of 6.1** for the removal of *Cryptosporidium* for the GE/Zenon ZeeWeed® 500D Membrane-440 ft<sup>2</sup> modules for systems operated in feed-and-bleed mode. The following are the parameters of the approved challenge study:

Full-scale module tested	GE/Zenon ZeeWeed® 500D Membrane-440 ft <sup>2</sup> 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	9912000420000003747 and 9912000420000003938
Nondestructive Performance Testing (NDPT) Process	Pressure-Decay Test
Quality Control Release Value (QCRV)	0.15 pounds per square-inch per minute (psi/min)
Challenge Particulate	0.5-micron fluorescent latex microspheres, supplied by Duke Scientific (as a surrogate for <i>Cryptosporidium</i> )
Detection Limit	10 objects per unit volume (equivalent to 1 object per liter multiplied by the dilution factor used in the preparation)
Feed Concentration Range	1.5 x 10 <sup>7</sup> Plaque Forming Units (PFU)/mL to 1.7 x 10 <sup>7</sup> PFU/mL
Test Flux Rate	60 gallons per minute per square-foot (gfd)
Modes of Operation	1.) Feed-and-bleed mode at 98% recovery with an average empirically determined Volumetric Concentration Factor (VCF) of 4.1 2.) Deposition mode

**LIMITS OF TCEQ-APPROVED LRV<sub>C-TEST</sub>**

The TCEQ approved LRV<sub>C-Test</sub> is only valid for the GE/Zenon ZeeWeed® 500D Membrane-440 ft<sup>2</sup> modules operated under the parameters that were used for the challenge testing and only for modules that have passed the NDPT. From our review of the challenge study, an acceptable GE/Zenon ZeeWeed® 500D Membrane-440 ft<sup>2</sup> module must comply with the following specifications to receive the TCEQ-approved LRV<sub>C-Test</sub>:

- 1) Specifications of the approved GE/Zenon ZeeWeed® 500D Membrane-440 ft<sup>2</sup> modules:
  - a) Constructed of hydrophilic non-ionic polyvinylidene fluoride (PVDF) hollow-fiber membranes;
  - b) Number of fibers per element is 3,354;
  - c) A nominal membrane pore size of 0.04 microns;
  - d) A fiber inside diameter of 0.8 millimeters (mm);
  - e) A fiber outside diameter of 1.9 mm;
  - f) Fiber active length of 75.2 inches;
  - g) Active membrane area per module of 440-ft<sup>2</sup>;

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- h) An outside to inside flow path;
  - i) Operational modes: Direct filtration, Feed-and-bleed;
  - j) Operating temperature range of  $>0^{\circ}$  to  $40^{\circ}$  C ( $>32^{\circ}$  to  $104^{\circ}$  F);
  - k) At  $\leq 40^{\circ}$  C, a maximum trans-membrane pressure (TMP) of 12 pounds per square-inch (psi);
  - l) A pH operating range of 5.0 to 9.5;
  - m) Allowable pH range for cleaning of 2.0 to 10.5; and
  - n) Maximum chlorine tolerance during cleaning of 500,000 parts-per-million-hours (ppm-hrs).
- 2) Prior to shipment to a Texas public water system (PWS), each new GE/Zenon ZeeWeed<sup>®</sup> 500D Membrane-440 ft<sup>2</sup> module must have passed the NDPT, a pressure-decay test as specified by California Department of Public Health (CDPH) and as described below:
    - a) Pressurize the outside of the membrane lumen.
    - b) Set and maintain a constant pressure (held-pressure) on the outside of the membrane lumen.
    - c) Monitor the pressure-decay over time in psi per minute (psi/min).
    - d) For the GE/Zenon ZeeWeed<sup>®</sup> 500D Membrane-440 ft<sup>2</sup> module, the QCRV is 0.15 psi/min.
  - 3) If the GE/Zenon ZeeWeed<sup>®</sup> 500D Membrane-440 ft<sup>2</sup> module fails the NDPT (where the measured decay rate was greater than the QCRV), the TCEQ shall not allow that GE/Zenon ZeeWeed<sup>®</sup> 500D Membrane-440 ft<sup>2</sup> module to be installed at a Texas PWS for microbial contaminant removal credit.
  - 4) GE/Zenon must notify the TCEQ in writing if the GE/Zenon ZeeWeed<sup>®</sup> 500D Membrane-440 ft<sup>2</sup> modules (as challenge-tested by the CDPH) are modified or if the NDPT method is modified in any manner. After receiving written notification, the TCEQ shall determine if the modified GE/Zenon ZeeWeed<sup>®</sup> 500D Membrane-440 ft<sup>2</sup> module shall be required to undergo challenge testing or if the modified NDPT method is acceptable.
  - 5) The TCEQ shall 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 ( $LRV_{DIR}$ ).
  - 6) Each GE/Zenon ZeeWeed<sup>®</sup> 500D Membrane-440 ft<sup>2</sup> 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  $LRV_{C-Test}$  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  $LRV_{C-Test}$  in this letter may also be revised.

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

- A TCEQ-granted exception for any Texas PWS to use the GE/Zenon ZeeWeed<sup>®</sup> 500D Membrane-440 ft<sup>2</sup> modules. 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(l);
- TCEQ approval for a Texas PWS to install a GE/Zenon ZeeWeed<sup>®</sup> 500D Membrane-440 ft<sup>2</sup>; or
- TCEQ approval for a Texas PWS's required concentration time (CT) study.

Mr. Craig Brown, Chief Engineer

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If you have any questions regarding this letter, or if we can be of additional assistance, please contact Bill Melville, P.E., at the letterhead address, by e-mail at [bill.melville@tceq.texas.gov](mailto:bill.melville@tceq.texas.gov), or by telephone at (512) 239-4729.

Sincerely,



William R. Melville, P.E.  
Technical Review & Oversight Team  
Plan & Technical Review Section  
Texas Commission on Environmental Quality



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

AL/WRM

cc: Mr. Justin A. Scarth, P.E., DCS Engineering, LLC, 1101 S. Capital of Texas Highway,  
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