

## LT2ESWTR Compliance for Membrane Integrity Verification

Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) identifies the log removal requirements for *Cryptosporidium* and the verification method to ensure the membrane integrity.

The EPA Membrane Guidance Manual identifies 4 types of tests and their method that must be conducted for LT2ESWTR compliance. The tests are;

1. Challenge Test (CT)
2. Direct Integrity Test (DIT)
3. Non-Destructive Performance Test (NDPT)
4. Continuous Indirect Integrity Monitoring (CIIM)

These are achieved in the *Cuf* process.

### Challenge Testing (CT)

Challenge testing was conducted as per LT2ESWTR using a particulate marker method at a flux of 500 GFD and achieved greater than 5 log removal. The integrity of the membrane was performed using a **Conservative Marker** which is enumerated by a particle counter on both the inlet and outlet as specified in the EPA Guidance Manual for LT2ESWTR. The Conservative Marker, (2-3 micron TiO<sub>2</sub> nano-particulate), is added at the required loading in the feed stream to challenge the membrane at the rated flux. Particle counters are used to measure the log difference between the feed water and filtrate water to determine the Log Removal Value (LRV).

### Non-Destructive Performance Test (NDPT) & Direct Integrity Test (DIT)

The Challenge Test utilized on the *Cuf* process is simple, automated, very low cost and only takes 15 minutes to perform. For all these reasons, *Cuf* systems utilize the exact same challenge test for both, non-destructive performance testing (NDPT) on all modules at the time of manufacture and direct integrity testing (DIT) during plant operations. The TiO<sub>2</sub> marker is NSF/ANSI 61 certified as part of the Purifics Drinking Water Systems UL System Certification.

Having one common integrity test is a key benefit of the *Cuf* process. Every membrane module is challenge tested. No surrogate integrity testing (such as bubble decay) is required. The DIT is conducted once per day or as regulations require. *Cuf* systems for LT2ESWTR compliance are equipped with the necessary instrumentation and automation consisting of particle counters, flow meters and flow control to conduct DIT at the installed location as identified in the figures below. DIT testing is automated, logged and responds to test results as per the EPA Membrane Filtration Guidance Manual. The Manual also states, "A marker based direct integrity test can be viewed as a "Mini Challenge Study"" Ref Sections 3.9.3 & 4.2.2

### Continuous Indirect Integrity Monitoring (CIIM)

Continuous Indirect Integrity Monitoring is performed using Turbidity monitoring of the feed and filtrate stream. This is performed using inline turbidity sensors and is monitored and logged by the *Cuf* systems PLC. The systems PLC will automatically take the required action if the turbidity limit is exceeded.



## LT2ESWTR Instrumentation Set Up

The required Process Flow to conduct all LT2ESWTR tests and the required instrumentation are shown below.

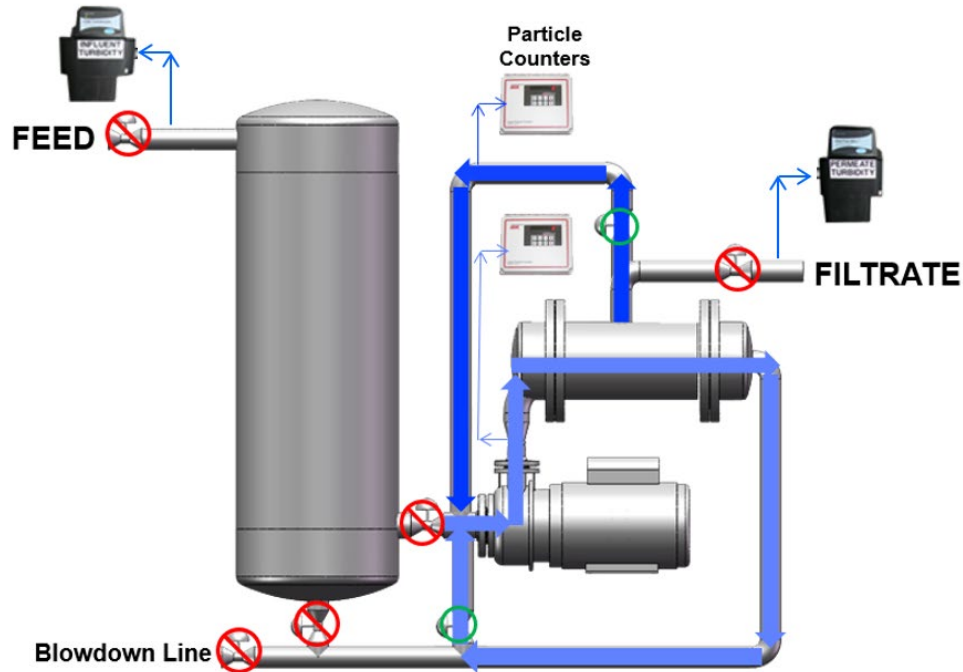


Figure 1: Process Flow



Figure 2: Instrumentation

## Reference Documents

- 3<sup>rd</sup> Party Verification “Direct Integrity Challenge Study – A Field Verification Testing for LT2ESWTR Compliance” conducted by NEWT (Nanotechnology-Enabled Water Treatment)
- Regulatory Verification by TCEQ (Texas Commission on Environmental Quality)
- USEPA Membrane Filtration Guidance Manual for LT2ESWTR
- LT2ESWTR Challenge, NDPT, DIT & CIIM Method Documentation for *Cuf*

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