The Surface Water Treatment Rules – Revised Monthly Reporting Forms; (New Forms for Membranes and UV)

http://www.epa.gov/region8/waterops/reporting/forms.html#swtr

Lander 3/22/2011

Green River 3/23/2011

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Current SWTR Treatment Techniques for Filtered Systems Require:

- 99% (2-logs) removal of *Cryptosporidium***
- 99.9 % (3-logs) removal and/or inactivation of *Giardia*
- 99.99% (4-logs) removal and/or inactivation of Viruses

** *Some PWSs must achieve higher reductions as a result of LT2.*

Do The Filters Achieve Those Logs Removal?

- Depends upon adequate filter design & operation (**see WY Water Quality Division Rules and Regs Chapter 12 at http**://deq.state.wy.us/wqd/www/permitting/pages/pws.asp)

- Is monitored by measuring the turbidity of the filtered water (combined filter effluent (CFE), and for some filtration types, individual filter effluents (IFE))

Revised Monthly Operating Reports – Why?

- Reports have gaps in CFE turbidity readings (>4 hours apart)
- Blank reporting periods (Failure to monitor or is plant off?)
- Various interpretations of when to measure and report the CFE readings
- Confusion about reporting disinfectant residuals in the distribution system

➔ Simplify where possible, and address newer technologies (membranes and UV)

Combined Filter Effluent Turbidity Requirement:

The SWTRs require turbidity measurements of representative samples of the system's filtered water (CFE) at least once every 4 hours (or more frequently) that the system serves water to the public (i.e. plant is operating).)

What is a Representative CFE Sample?

- Sample as close as possible to where the water from the individual filters is combined.

- Do not need to report to EPA the time of each sample, just the CFE turbidity readings. (The plant records should document the times correlating to these measurements)

- Do NOT report any turbidity values when the filter plant is off, or is not sending water to the clearwell for distribution (e.g. backwashing, filter-to-waste, etc.)

What is a Representative CFE Sample?

Optimum design for filtration plants allows the ability to filter-to-waste any off-spec water. <u>But what if your plant does not have ability to filter-to-waste?</u>

- Turbidity of water produced immediately after backwash, or when filters are first brought back online, is not "representative."
  ➔Don't report these as CFE 4-hour readings.
- Turbidity readings with entrained air (at pump startup or in sample line to turbidimeter prior to flushing) are not "representative."
  ➔Don't report these as CFE 4-hour readings.

➔However, this water <u>is</u> going to consumers as drinking water. These turbidity readings must be reported if they are the daily maximum, but explain the cause and duration on the report.

Rounding – if last digit is ≥ 5, round up.

Otherwise round down. Compliance is based on #of significant digits specified in the regulation.

- 0.34 NTU is not an exceedance of 0.3 NTU *(because it rounds down to 0.3)*
- 0.35 NTU is an exceedance of 0.3 NTU *(because it rounds up to 0.4)*
- 1.4 NTU is not an exceedance of 1 NTU *(because it rounds down to 1)*
- Is 5.5 NTU an exceedance of 5 NTU???

Examples of How/When to Report Turbidity:

Plants that operate 24/7 –

- Report the CFE turbidity reading at the same 4-hour intervals each day (e.g.,8 am, 12 noon, 4pm, 8 pm, etc.) *These values are compared to the 95% monthly limit (0.3 or 1 NTU)*

- Report the highest CFE turbidity reading of the day (even if it doesn't fall on the 4 hour interval). *These values are compared to the maximum limit (1 or 5 NTU) that the CFE may at no time exceed during the month*

MONTHLY REPORTING SHEET FOR **COMBINED FILTER EFFLUENT (CFE) TURBIDITY – CONVENTIONAL OR DIRECT FILTRATION S**YSTEMS

MONTH _____ SYSTEM NAME ____Big City, WY_____

YEAR _____ PWS ID# _____

REQUIRED # OF 4-HOUR TURBIDITY READINGS/DAY = ___6_____ (UNLESS PLANT OFF – INDICATE "PO" IN EACH CELL)

**REPORT MAXIMUM TURBIDITY READING THAT DAY, EVEN IF IT WAS BETWEEN 4 HOUR READINGS

DO NOT REPORT RESULTS COLLECTED DURING BACKWASH, FILTER-TO-WASTE, OR ANY TIME WATER IS NOT BEING PRODUCED FOR CONSUMPTION

DATE	1ST (NTU)	2ND (NTU)	3RD (NTU)	4TH (NTU)	5TH (NTU)	6TH (NTU)	DAILY MAX** (NTU)
1	0.04	0.06	0.02	0.06	0.03	0.04	0.21
2	0.05	0.06	0.02	0.02	0.08	0.03	0.09
3	0.04	0.06	0.02	0.06	0.03	0.04	0.11
4	0.05	0.06	0.02	0.02	0.08	0.03	0.09
5	0.04	0.06	0.02	0.06	0.03	0.04	0.11
6	0.05	0.06	0.02	0.02	0.08	0.03	0.09
7	0.04	0.06	0.02	0.06	0.03	0.04	0.11
8	0.05	0.06	0.02	0.02	0.08	0.03	0.09
9	0.04	0.06	0.02	0.06	0.03	0.04	0.11
10	0.05	0.06	0.02	0.02	0.08	0.03	0.09
11	0.04	0.06	0.02	0.06	0.03	0.04	0.11
12	0.05	0.06	0.02	0.02	0.08	0.03	0.09
13	0.04	0.06	0.02	0.06	0.03	0.04	0.11
14	0.05	0.06	0.02	0.02	0.08	0.03	0.09
15	0.04	0.06	0.02	0.06	0.03	0.04	0.11
16	0.05	0.06	0.02	0.02	0.08	0.03	0.09
17	0.04	0.06	0.02	0.06	0.03	0.04	0.11
18	0.05	0.06	0.02	0.02	0.08	0.03	0.09
19	0.04	0.06	0.02	0.06	0.03	0.04	0.11
20	0.05	0.06	0.02	0.02	0.08	0.03	0.09
21	0.04	0.06	0.02	0.06	0.03	0.04	0.11
22	0.05	0.06	0.02	0.02	0.08	0.03	0.09
23	0.04	0.06	0.02	**0.39**	0.03	0.04	**0.41**
24	0.05	0.06	0.02	0.02	0.08	0.03	0.09
25	0.04	0.06	0.02	0.06	0.03	0.04	0.11
26	0.05	0.06	0.02	0.02	0.08	0.03	0.09
27	0.04	0.06	0.02	0.06	0.03	0.04	0.11
28	0.05	0.06	0.02	0.02	0.08	0.03	0.09
29	0.04	0.06	0.02	0.06	0.03	0.04	0.11
30	0.05	0.06	0.02	0.02	0.08	0.03	0.09
31	0.05	0.09	0.06	0.06	0.11	0.02	0.19

Combined Effluent Turbidity Performance Criteria

A. Total number of combined effluent filtered water turbidity measurements made = _____**186**____

B. Total Number of combined effluent filtered water turbidity measurements that are less than or equal to **0.3** NTU = _____**185**____

C. The percentage of turbidity measurements meeting the specified limits = B/A x 100= __**185**_ / _**186**____ x 100 = ___**99.5**_____**%**

D. Record the date and turbidity value for any measurements exceeding **1 NTU**: if none, enter Anone@

Plants that operate continuously for part of the day (>4 hours)

- report CFE turbidity within 1st 4 hours and then every subsequent 4 hours until shutdown for the day**.
- *EXAMPLE – TURN ON PLANT AT 8:30 AM, SHUT DOWN AT 5:20 PM. Report 4-hr readings at 9 am, 1 pm, and 5 pm and "PO" for the others*
- Report the highest CFE turbidity reading of the operating day (if you monitor continuously, this value may be higher than the 4-hour readings)

*** ref pgs. 61-62 of the EPA LT1ESWTR Turbidity Technical Guidance Manual, August 2004*

MONTHLY REPORTING SHEET FOR **COMBINED FILTER EFFLUENT (CFE) TURBIDITY – CONVENTIONAL OR DIRECT FILTRATION** SYSTEMS

MONTH _____ SYSTEM NAME ____Small Town, WY_____

YEAR _____ PWS ID# _____

REQUIRED # OF 4-HOUR TURBIDITY READINGS/DAY = ___6_____ (UNLESS PLANT OFF – INDICATE "PO" IN EACH CELL)

**REPORT MAXIMUM TURBIDITY READING THAT DAY, EVEN IF IT WAS BETWEEN 4 HOUR READINGS

DO NOT REPORT RESULTS COLLECTED DURING BACKWASH, FILTER-TO-WASTE, OR ANY TIME WATER IS NOT BEING PRODUCED FOR CONSUMPTION

DATE	1ST (NTU)	2ND (NTU)	3RD (NTU)	4TH (NTU)	5TH (NTU)	6TH (NTU)	DAILY MAX** (NTU)
1	0.04	0.06	0.02	PO	PO	PO	0.21
2	0.05	0.06	0.02	PO	PO	PO	0.09
3	0.04	0.06	0.02	PO	PO	PO	0.11
4	0.05	0.06	0.02	PO	PO	PO	0.09
5	0.04	0.06	0.02	PO	PO	PO	0.11
6	0.05	0.06	PO	PO	PO	PO	0.09
7	0.04	0.06	0.02	PO	PO	PO	0.11
8	**0.41**	**0.31**	**0.34**	PO	PO	PO	0.43
9	0.04	0.06	0.02	PO	PO	PO	0.11
10	0.05	0.06	0.02	PO	PO	PO	0.09
11	0.04	0.06	0.02	PO	PO	PO	0.11
12	0.05	0.06	0.02	PO	PO	PO	0.09
13	0.04	0.06	0.02	PO	PO	PO	0.11
14	0.05	0.06	0.02	PO	PO	PO	0.09
15	0.04	0.06	0.02	PO	PO	PO	0.11
16	0.22	**0.37**	0.02	PO	PO	PO	0.09
17	0.04	0.06	0.02	PO	PO	PO	0.11
18	0.05	0.06	0.02	PO	PO	PO	0.09
19	0.04	0.06	0.02	PO	PO	PO	0.11
20	**0.33**	**0.31**	**0.35**	PO	PO	PO	0.09
21	0.04	0.06	0.02	PO	PO	PO	0.11
22	0.05	0.06	0.02	PO	PO	PO	0.09
23	0.27	**0.38**	**0.37**	PO	PO	PO	**1.1****
24	0.05	0.06	0.02	PO	PO	PO	0.09
25	0.04	0.06	0.02	PO	PO	PO	0.11
26	0.05	0.06	0.02	PO	PO	PO	0.09
27	PO	PO	PO	PO	PO	PO	PO
28	0.05	0.06	0.02	PO	PO	PO	0.09
29	0.04	0.06	0.02	PO	PO	PO	0.11
30	0.05	0.06	0.02	PO	PO	PO	0.09
31	0.05	0.09	0.06	PO	PO	PO	0.19

** high reading 6 minutes after plant restarted; did not last 15 minutes; no filter to waste capacity

Combined Effluent Turbidity Performance Criteria

A. Total number of combined effluent filtered water turbidity measurements made = _____**89**____

B. Total Number of combined effluent filtered water turbidity measurements that are less than or equal to **0.3** NTU = ____**84**___

C. The percentage of turbidity measurements meeting the specified limits = B/A x 100= __**84**_ / _**89**____ x 100 = ___**94**_____**%**

D. Record the date and turbidity value for any measurements exceeding **1 NTU**: if none, enter Anone@

Plants that operate intermittently, less than 4 hours at a time

- Report CFE turbidity near the end of each operating period**.

EXAMPLE – plant starts up at 8:30 am and producing water from 8:30 am to 10 am, then again from 1 pm to 3 pm, then 9:30 pm to 12 midnight . Report CFE turbidity at 9:30 am, 2:30 pm, and 11:30 pm – so three readings reported that day (and "PO" for the remainder)

- Report the highest CFE turbidity reading of the operating day (If you monitor continuously, this value may be higher than the 4-hour readings)

*** ref pgs. 61-62 of the EPA LT1ESWTR Turbidity Technical Guidance Manual, August 2004*

Other SWTR Monthly Reporting Issues
(see SWTR Fact Sheet)

Notify EPA within 24 hours if:

- (1) CFE turbidity exceeds the maximum limit
- (2) point of entry chlorine residual drops below 0.2 mg/L, or
- (3) you lose pressure in the distribution system.

☞ *Document time/date of these calls on the monthly SWTR report*

Other SWTR Monthly Reporting Issues

- Measure/record disinfectant residual concentrations in the distribution system at least when taking BACT samples each month. Write the chlorine value on your lab slip.
- Number of these measurements in the distribution system, and % nondetectable, is reported only on page 1.
- Distribution system residuals must not be >5% nondetect in two consecutive months.

Membranes and UV Disinfection

Why is EPA now requiring special monthly reporting for membranes and UV?

(1) LT2 -- additional *Cryptosporidium* reduction credit:

- If a system > Bin 1 adds these for compliance, the LT2 rule has specific validation/operation/reporting requirements.
- Need to justify the 5.5 logs *Cryptosporidium* maximum treatment exemption requested by some systems

(2) To justify high (3-log) *Giardia* reduction credit given under the original SWTRs

UV and Membranes are very effective microbial treatment technologies.

EPA Guidance Manuals and Fact Sheets at

http://water.epa.gov/lawsregs/rulesregs/sdwa/lt2/compliance.cfm

&

see draft WY UV Policy and draft WY Membrane policy

UV Disinfection - Basics

<u>UV dose</u> : *The amount of UV energy per unit area (mJ/cm^2) delivered to organisms in a reactor* (= UV intensity x time)

UV Required Dose Requirements

Source: USEPA, Long Term 2 Enhanced Surface Water Treatment Rule

	UV Dose Required (mJ/cm2)		
Log Inactivation Credit	*Crypto*	*Giardia*	Virus
0.5	1.6	1.5	39
1.0	2.5	2.1	53
1.5	3.9	3.0	79
2.0	5.8	5.2	100
2.5	8.5	7.7	121
3.0	12	11	143
3.5	15	15	163
4.0	22	22	186

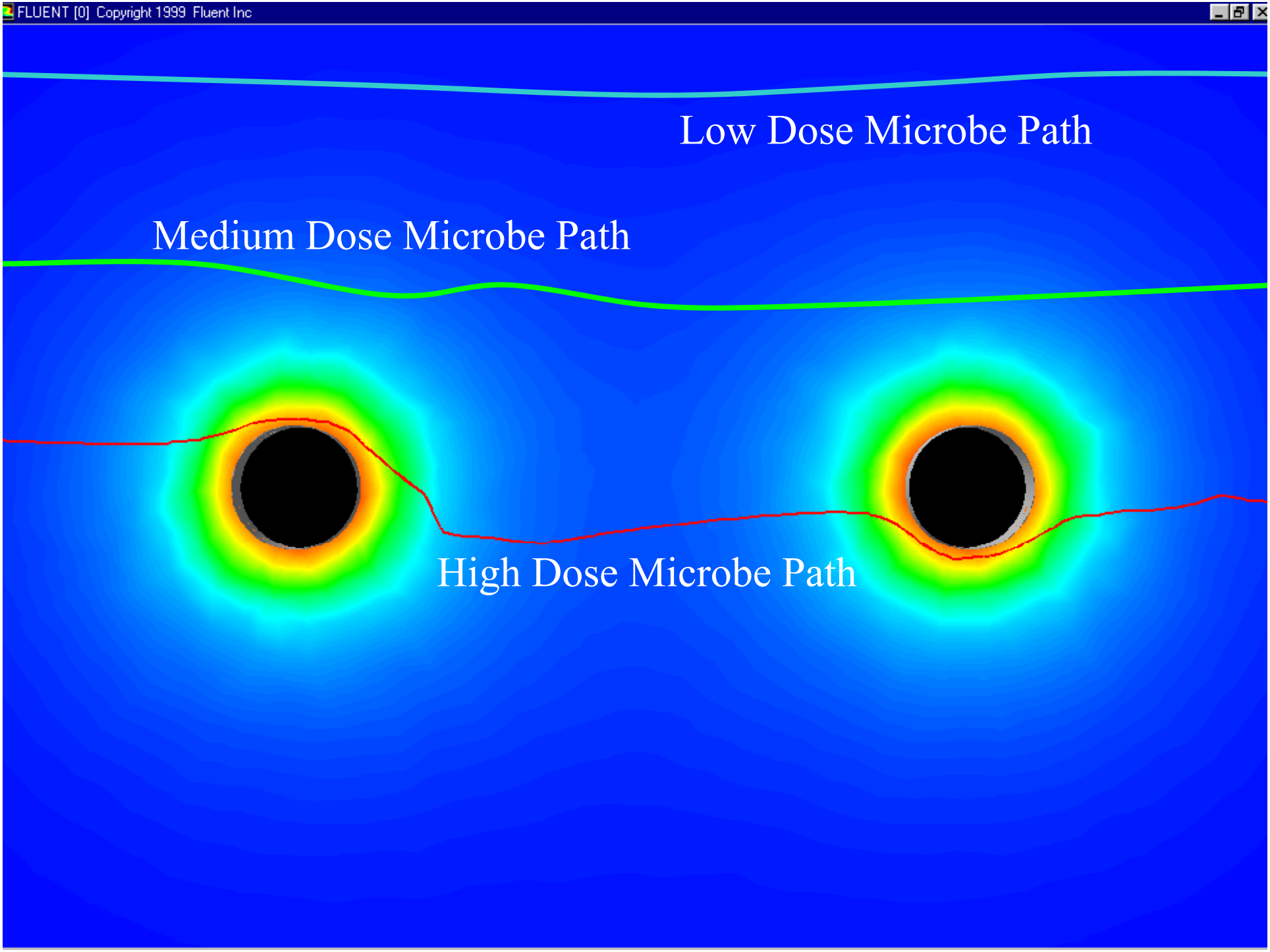
Two Key UV Requirements:

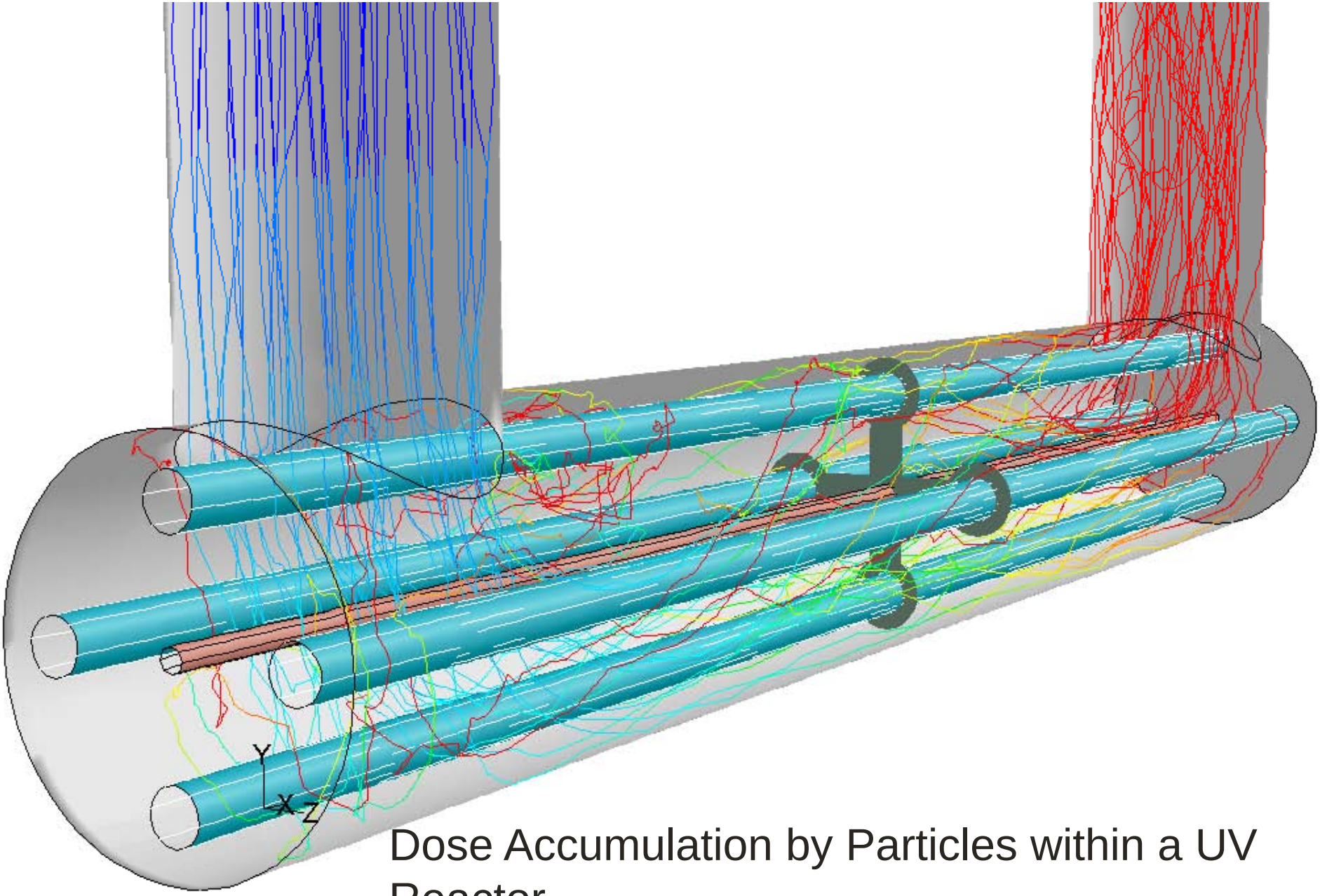
(1) *Validated (Delivered) Dose Must Be ≥ Required Dose in order to receive the associated logs inactivation credit.*

(2) *At least 95% of the volume of water served each month must have been treated at this Required Dose.*

Validated (Delivered) dose is a function of:

- UV intensity, measured by intensity sensors. Depends on lamp output, lamp placement, aging, fouling
- UV transmittance (UVT), *water* property measured by UVT analyzer. This is the percent of light passing through the water over specified distance (~ 1 cm)
- Water flow rate and reactor design (hydraulics in the reactor)


FLUENT [0] Copyright 1999 Fluent Inc
Low Dose Microbe Path
Medium Dose Microbe Path
High Dose Microbe Path



Dose Accumulation by Particles within a UV Reactor

How Do We Know That The Water Received the Required Dose?

1. The Reactor undergoes a Validation Test (usually conducted by the UV manufacturer or a third party to pre-validate their reactors.) *This establishes design & operating conditions under which the validated dose is achieved.*
2. The Water System must conduct ongoing *monitoring to verify that reactors are operating within validated conditions:*
   - UV intensity
   - Flow rate
   - Lamp status
   - UVT of water if part of dose monitoring strategy

UV Dose Monitoring Strategies - LT2

- (1) UV Intensity Setpoint – often best for small systems. During operations, *the measured UV intensity must meet or exceed the setpoint(s) established during validation to provide Validated Dose*. Reactor also must be operated within validated operating conditions (flow rate, lamp status) to receive credit.
- Simplest to operate and control
- Not the most energy efficient, since reactor may be overdosing at low flow rates

Daily Reporting Sheet for UV Systems (<40 gpm)

MONTH _____ **PWS ID #_____**
YEAR _____ **PWS NAME _____**

UV validated dosage = _____
Maximum flow rate allowed (gpm) = _____
If Water Plant is Not Operating indicate "PO"

Date	Lamp Status (Safe (ON)/In alarm (Fail)	UV Intensity (Safe (OK)/ Low (Fail))	Describe any maintenance/lamp changeout
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			

System cannot provide off-spec water more than 1 day/month (more than 5%). Off-spec occurs if you are serving inadequately treated water: Lamp is in failure alarm, UV intensity too low, UV unit off or bypassed, or flow rate >max gpm rated for the unit.

UV Dose Monitoring Strategies - LT2, cont.

- (2) Calculated Dose Approach – uses dose monitoring equation to estimate UV dose based upon measured flow rate, UV intensity, and UVT.
  - "Dose-pacing" by adjusting lamp power or turning banks of lamps on/off, to respond to changes in UVT, lamp intensity, or flow rate.
  - Calculated dose / Validation (safety) factor = Validated UV Dose
  - Validated Dose compared to Required Dose to receive LT2 treatment credit.

Comparison of UV Dose Monitoring Strategies:

- Calculated Dose approach requires more extensive validation testing than Intensity Setpoint approach
- Calculated Dose stategy needs more advanced UV reactor monitoring and control
- With Calculated Dose approach, lamp output can be reduced at low flow conditions to reduce energy costs
- For larger UV units (>40 gpm), the PWS must calibrate the monitoring equipment to ensure reactors are delivering the validated dose

UV Compliance Requirement

- The PWS must document that at least 95% of the volume of water supplied to the public during each month met the UV specs for the credited logs inactivation. Water is off-spec if any of the following conditions exist:
  - UV lamps not energized
  - UV intensity too low
  - Flow is too high
  - UV sensor is out of calibration (and no correction factor used)
  - UV equipment components not as good as those used during validation test
  - UVT measurement too low (if needed)
  - UVT analyzer out of calibration (if needed)

UV Monthly Reporting Requirements

- PWS must conduct and document ongoing monitoring to verify that reactors are operating within validated conditions (i.e. achieves at least the Required Dose)

- Monthly reporting – percent of water entering the distribution system that was NOT treated by UV reactors operating within validated conditions on a monthly basis (it should be <5%)

  (For small UV systems this means no more than 1 day/full month should be off-spec)

Month/ Year			Maximum Validated Flow Rate	420 gpm					Calculated Dose				
System/T.P.			Minimum Validated UVT	90%			Validated Dose=		VF x CF				
PWSID #			Target Log Inactivation				Calculated Dose = Dose that is calculated by Validated PLC Algorithm						
UV Reactor #			Target Pathogen				VF = Validation Factor						
Process Train			Dose Required ($D_{req'd}$)				CF = UV intensity sensor correction Factor						
Operator Signature			Validation Factor (VF)					The CF is only applies if sensors do not meet recommended criteria					
								(NOTE - a CF will not be needed in most cases)					
Operational Data			**Dose Requirements**	**Data at Daily Minimum Validated Dose**									
	Run Time (hrs)	**Total Production Gallons**	**$Dose_{rec'd}$[1] (mj/cm^2)**	**Sensor Correction Factor[2]**	**Calculated Dose[3] (mJ/cm^2)**		**Daily Minimum Validated Dose[4]**	**Max Flow Rate gpm**	**Minimum UVT**	**Total Off-Specification Volume**			
Day			**[A]**	**[B]**	**[C]**		**[D]** ([C]/VF/[B])	**≤420 gpm**	**(%)**	**(MG)**			
1	13.64	157,000	40	1.0	151		150.8	220.00	95	**0**			
2	9.72	113,000	40	1.0	150		150.2	221.00	95	**0**			
3	12.84	165,000	40	1.0	136		136.0	222.00	95	**0**			
4	7.14	81,000	40	1.0	156		155.7	223.00	96	**0**			
5	13.89	158,000	40	1.0	155		155.2	224.00	96	**0**			
6	14.13	163,000	40	1.0	153		153.0	225.00	96	**0**			
7	10.28	117,000	40	1.0	149		148.6	220.00	92	**0**			
8	14.56	166,000	40	1.0	148		148.4	221.00	92	**0**			
9	11.90	135,000	40	1.0	149		149.1	222.00	92	**0**			
10	12.31	140,000	40	1.0	149		148.8	223.00	92	**0**			
11	14.46	165,000	40	1.0	148		148.2	224.00	92	**0**			
12	17.94	207,000	40	1.0	147		146.6	225.00	92	**0**			
13	15.52	176,000	40	1.0	149		149.1	220.00	92	**0**			
14	12.21	139,000	40	1.0	150		150.2	221.00	93	**0**			
15	14.88	169,000	40	1.0	155		155.4	222.00	96	**0**			
16	16.73	193,000	40	1.0	153		152.9	223.00	96	**0**			
17	12.46	142,000	40	1.0	150		150.0	224.00	96	**0**			
18	11.85	135,000	40	1.0	152		151.6	225.00	94	**0**			
19	12.86	146,000	40	1.0	152		152.2	200.00	94	**0**			
20	13.38	153,000	40	1.0	150		150.0	201.00	92	**0**			
21	19.41	222,000	40	1.0	144		144.6	202.00	92	**0**			
22	13.52	155,000	40	1.0	148		147.5	203.00	92	**0**			
23	10.81	123,000	40	1.0	152		151.9	204.00	94	**0**			
24	15.50	177,000	40	1.0	151		151.3	225.00	94	**0**			
25	13.07	149,000	40	1.0	152		151.6	220.00	94	**0**			
26	10.69	122,000	40	1.0	155		154.6	221.00	96	**0**			
27	13.21	153,000	40	1.0	156		155.5	222.00	98	**0**			
28	11.53	131,000	40	1.0	158		158.5	223.00	98	**0**			
29	12.85	146,000	40	1.0	153		153.0	224.00	96	**0**			
30	11.12	127,000	40	1.0	155		154.5	225.00	96	**0**			
31	12.67	143,000	40	1.0	156		156.3	226.00	96	**0**			

[1] Dreq'd is the dose required for the target log inactivation without a VF or Sensor CF applied and can be found in UVDGM Table 1.4

[2] Sensor CF will be 1 if no CF is used

[3] Calculated dose is calculated using the dose algorithm in the PLC

[4] The validated dose is the dose based on the calculated dose that is normalized on the Validation Factor and Correction Factor

[5] Off specification worksheet (Figure 6.5) should be used to calculate daily off specification volume.

If UVT, flowrate, and/or Validated dose off-spec occur simultaneously, the off speciation time should only be counted once.

WATER IS OFF-SPEC IF VALIDATED DOSE IS BELOW REQUIRED DOSE, FLOW RATE IS ABOVE MAXIMUM VALIDATED FLOW RATE, OR UVT IS BELOW MINIMUM VALIDATED UVT OR IF UV SENSORS DID NOT MEET CALIBRATION CRITERIA AND A UV SENSOR CORRECTION FACTOR WAS NOT APPLIED

Month/ Year	
System/T.P.	
PWSID #	
UV Reactor	
Process Train	
Operator Signature	

UV Reactor Number	Total Run Time (hrs)	Total Production (MG)	Number of Off-Spec Events	Total off-Spec Volume (MG)
TOTAL	0	0		0

Total Production = B

Total offSpec Volume = A

Compliance Calculation — **VALUES**

Total Volume of OffSpecification Water Produced (MG) = A	0
Total Volume of Drinking Water Produced (MG) = B	0
Total % of Off-Specification Water Produced = A/B x 100	#DIV/0!

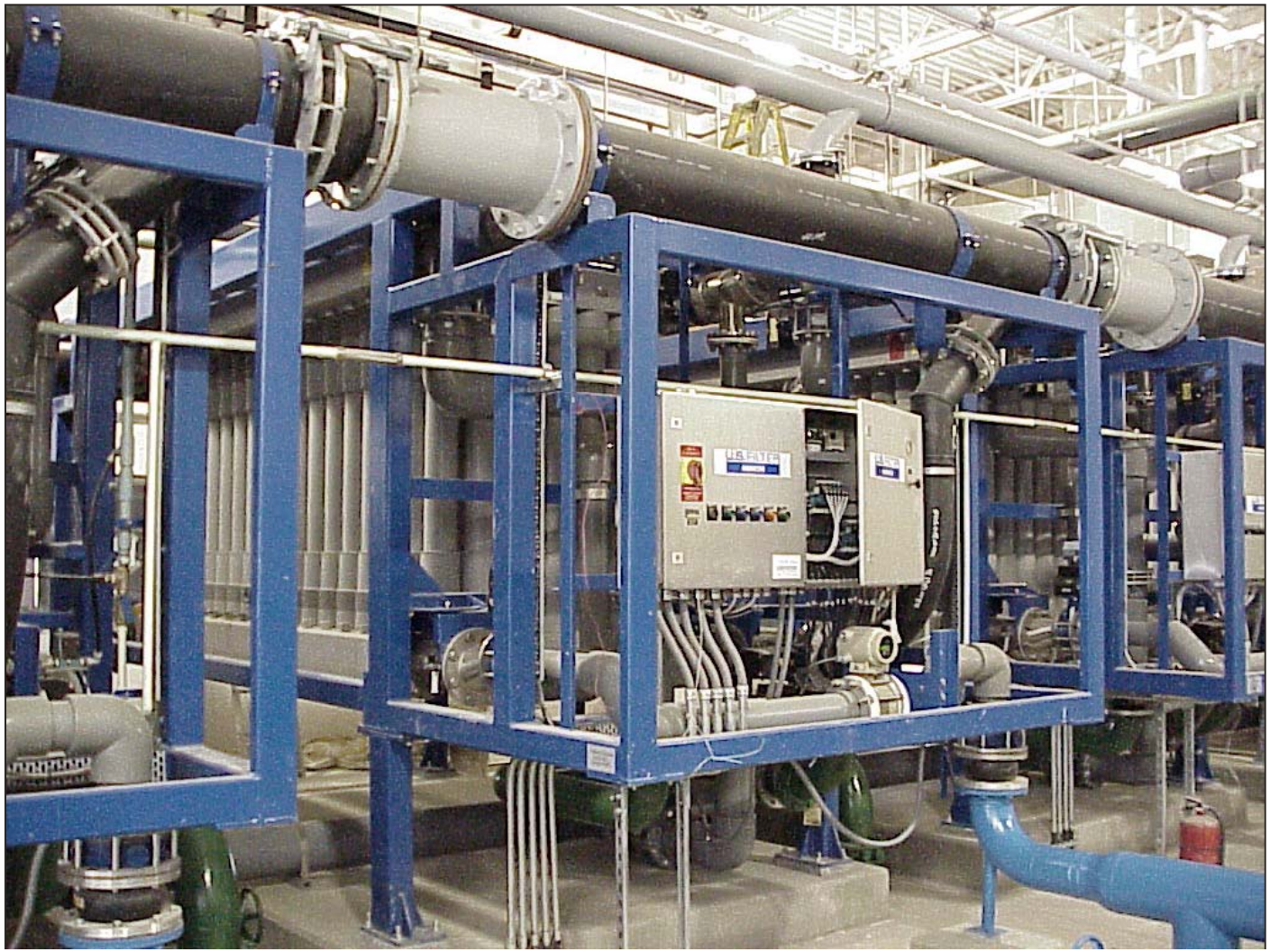
Facility Meets Off-Specification Requirement (<5% of Volume on Monthly Basis) (Y/N)

Of the _____ UV sensors, _____ have been checked for calibration and _____ were within acceptable range of tolerance

The following reactors had a Sensor Correction Factor for at least part of the month

Reactor Number	Sensor Correction Factor

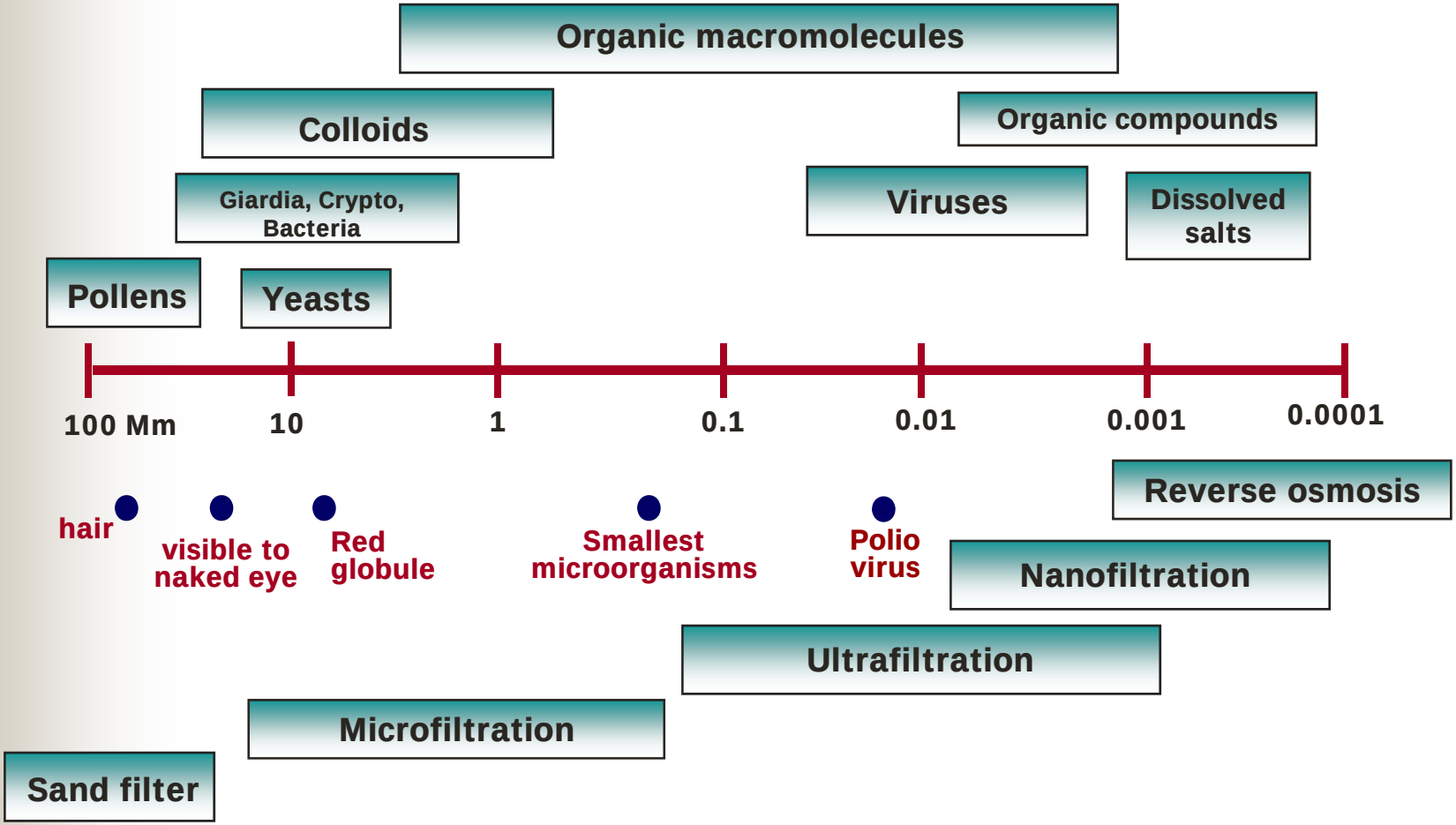
Membrane Filtration



Categories of Membranes

- **Low-pressure (or vacuum driven)**
  - Microfiltration (MF)
  - Ultrafiltration (UF)
- **High-pressure**
  - Nanofiltration (NO)
  - Reverse Osmosis (RO)

Membrane Applications



Membrane Basics:

Membrane module cutaway showing hollow fibers

Modules -

- Single inlet/outlet, and can be Challenge Tested with particles in a laboratory (to measure log removal)
- Integrity of module must be determined with nondestructive performance test (NDPT) like pressure hold.
- This sets a Quality Control Release Value (QCRV) for all modules sold to the PWS (since not all are challenge tested)

Modules assembled in membrane unit or skid at the treatment plant. Share common inlet and outlet valving.

Membrane Unit/Skid

- Unit can be isolated for Daily Direct Integrity (DI) Testing (e.g. measure pressure loss of the entire unit)
- This DI test helps identify and isolate breaches.
- A log removal value based upon the DI test is calculated empirically

3 Main LT2 Requirements for Your Log Removal Credit

- Initial product-specific **challenge testing (on single modules).**
- Membrane unit must undergo **periodic** (at least daily) direct integrity (DI) testing to ensure that it continues to meet the log removals it was credited for, and
- **Continuous** indirect integrity testing during operation (typically measure turbidity of filtrate) to check integrity in between the daily DI test

Challenge Testing - ($\mathbf{LRV_{C\text{-}Test}}$)

- **One time, product-specific** test event; done on modules by the manufacturer or independent 3rd party
- Very specific requirements in LT2 on:
  - Challenge particulates (Crypto or suitable surrogate)
  - Maximum feed concentration
  - Test operating conditions, # of modules tested
  - Equation used to calculate removal efficiency

In ADDITION…..

- The LT2 rule does not require that every membrane module used by a water system be challenge tested.
- A quality control release value (QCRV) must be established by the manufacturer during challenge testing of modules (such as pressure or vacuum decay)
- **Membrane modules that do not meet this QCRV are not eligible for the removal credit established during challenge testing….so only accept modules certified to meet this QCRV!**

Direct Integrity (DI) Testing

- This is a physical test applied directly to the membrane unit in order to identify and isolate integrity breaches
- Must be conducted at least once/day to each membrane unit in the field
- Must have a specified resolution of 3 microns or less (size of smallest integrity breach that gives a response from DI test)

Direct Integrity Testing , cont

- Manufacturer must establish an upper control limit for the DI test (e.g. 0.5 psig/min)
- When the control limit is exceeded, the membrane unit must be removed from service, repaired, then returned to service only if it passes another DI test.
- The manufacturer must calculate the minimum **$LRV_{DIT.}$ for your unit as installed.** It is based upon the smallest integrity test response that can be reliably measured when a breach occurs – i.e. it is the logs removal being achieved when the membrane first reaches the upper control limit (FAILS the DI test)

- Maximum removal credit granted for LT2 is the LOWER value of either
  - The Log Removal Value (**$LRV_{C\text{-}Test}$**) demonstrated during challenge testing of membrane modules

OR

  - The maximum log removal value (**LRV_{DIT}**) that can be verified by the direct integrity test on the membrane unit

Membrane Compliance Requirements

Direct Integrity (DI) Testing –

At least once/day on each membrane unit. Corrective action required if control limit reached (e.g. take offline for repair)

Continuous Indirect Integrity Monitoring – uses filtered water quality parameter (e.g. turbidity) to infer membrane integrity

- Control limit is 0.15 NTU
- If exceed 0.15 NTU in two consecutive 15 minute readings from a membrane unit, triggers a DI test.

Membrane Compliance Requirements

Treatment Technique: Combined Filter Effluent

- measure and report the turbidity of representative samples of the system's filtered water (combined filter effluent or CFE) at least once every 4 hours (or more frequently) that the plant is operating.
- the CFE turbidity must not exceed 0.3 NTU for at least 95% of the measurements reported each month
- the CFE turbidity must never exceed 1 NTU

Additional Membrane Monthly Reporting Requirements – New page for each Unit

-- any DI test results exceeding the control limit, and the corrective action taken in response;

-- any membrane unit turbidity monitoring results triggering DI testing (e.g. exceeding 0.15 NTU in two consecutive 15 minute readings), and the corrective action that was taken

All previous guidance re. representative samples for CFE, how to report from intermittent operations, rounding, notifying EPA, etc. apply to membranes

DATA SHEET FOR INDIVIDUAL MEMBRANE UNIT
DAILY DIRECT INTEGRITY (DI) TESTS AND REPAIRS
(FILL OUT ONE PAGE PER UNIT/SKID)

MONTH _____ PWSID # _____
YEAR _____ PWS NAME _____
MEMBRANE UNIT # _____

Date	Daily DI Test Successful (Indicate Y/N Within Control Limit?)	Describe Results of Triggered** or Unsuccessful DI Tests and any Corrective Actions Taken (Diagnostic tests, module repairs or replacements). Identify serial # of module ** Two 15-min consecutive filtrate turbidity readings exceeding 0.15 NTU triggers DI test – based on turbidity when water is being produced for consumption
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If Plant Not Operating Indicate "PO"

Date of Last Chemical Cleaning (CIP) of the Membrane Unit _____

Was DI Test Acceptable After Cleaning? _____

Date of last Calibration of Individual Unit Filtrate Turbidimeter(s) _____

http://www.epa.gov/region8/waterops/reporting/forms.html#swtr

Surface Water Treatment Rules (SWTR)

	Instructions for SWTR Monthly Operating Reports (PDF) (3 pages, 29 KB) Includes: Instructions for All Types of Filtration; Instructions for Entry Point Residual Disinfectant; Instructions for Distribution System Disinfectant Residual; Instructions for Membrane Filtration; and Instructions for Ultraviolet Disinfection.
	IESWTR Form for Conventional or Direct Filtration ≥ 10K (PDF) (3 pages, 20 KB) Use this form for systems using conventional or direct filtration and serving populations of at least 10,000 people. The IESWTR monthly report for turbidity and disinfection data contains the Daily Data Sheet for Combined Filter Effluent (CFE) Turbidity, Disinfectant Residual Data, and Individual Filter (IF) Turbidity Monitoring data. The form is also available in MS Word format (3 pages, 179 KB) and in MS Excel format (3 pages, 61 KB) for use in completing the report on your computer.
	LT1SWTR Form for Conventional or Direct Filtration < 10K (PDF) (3 pages, 20 KB) Use this form for systems using conventional or direct filtration and serving populations of less than 10,000 people. The LT1SWTR monthly report for turbidity and disinfection data contains the Daily Data Sheet for Combined Filter Effluent (CFE) Turbidity, Disinfectant Residual Data, and Individual Filter (IF) Turbidity Monitoring data. The form is also available in MS Word format (3 pages, 163 KB) and in MS Excel format (3 pages, 61 KB) for use in completing the report on your computer.
	LT1SWTR Form for Alternative Technology Filtration (MF, UL, RO) (PDF) (3 pages, 19 KB) Use this form if your system uses Membrane Filtration (Microfiltration, Ultrafiltration, or Reverse Osmosis). This form asks for disinfectant residual and turbidity data and for you to perform certain calculations. The form is also available in MS Word format (3 pages, 151 KB) and in MS Excel format (3 pages, 58 KB) for use in completing the report on your computer.
	LT1SWTR Form for Alternative Technology Filtration (BF, DE, SS, CT) (PDF) (2 pages, 16 KB) Use this form if your system uses bag filtration, diatomaceous earth, slow sand, or cartridge filtration. This form asks for disinfectant residual and turbidity data and for you to perform certain calculations. The form is also available in MS Word format (2 pages, 120 KB) and in MS Excel format (2 pages, 45 KB) for use in completing the report on your computer.
	SWTR Daily Reporting Sheet for UV Systems (PDF) (1 pages, 10 KB) This form should be completed and submitted monthly to EPA Region 8 when a small (generally < 40 gpm) public water system utilizes ultraviolet disinfection. The form is also available in MS Word format (1 page, 50 KB) and in MS Excel format (1 page, 25 KB) for use in completing the report on your computer.

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