

Surface Water Treatment Optimization Goals and Performance Limiting Factors

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Optimization Goals

Multi-Stage Barrier Concept

- ❖ **Select the best source water available (and protect that source)**
- ❖ **Provide flocculation & sedimentation barrier to allow particulates to settle thereby reducing the work load for filters**
- ❖ **Provide filtration barrier to physically remove particles that may harbor microbial contaminants**
- ❖ **Provide disinfection barrier with adequate contact time to inactivate microbial contaminants**

Optimization Goals

Overall Objective To provide multiple barriers against the passage of cysts and viruses into the distribution system on a continuous basis.

Any instantaneous failure represents a possible threat to public health. Micro-organisms (such as *cryptosporidium*) are extremely resistant to disinfection.

This necessitates optimizing physical removal as well as chemical inactivation of pathogens.

Chlorine cannot act as the only barrier to the passage of cysts and viruses.

Optimization Goals (cont'd)

To achieve optimized performance and to provide the maximum protection to public health, the following **goals** are required:

1. Minimum data monitoring requirements

- a. daily raw water turbidity
- b. settled water turbidity at 4-hour increments from sedimentation basin
- c. continuous on-line turbidimeter on individual filters
- d. a monthly filter post-backwash profile for each filter

2. Individual sedimentation basin performance goals

- a. settled water turbidity of < 1 NTU when annual average raw water turbidity is ≤ 10 NTU
- b. settled water turbidity of < 2 NTU when annual average raw water turbidity is > 10 NTU

Optimization Goals (cont'd)

To achieve optimized performance and to provide the maximum protection to public health, the following **goals** are required:

3. Individual filter performance goals

- a. filtered water turbidity of 0.10 NTU 95% of time (excluding 15-minute period following backwash) based on maximum values recorded during 4-hour time increments
- b. maximum filtered water turbidity of 0.3 NTU or less
- c. initiate filter backwash immediately after turbidity of any individual filter exceeds 0.10 NTU
- d. maximum filtered water turbidity following backwash of 0.3 NTU, returning to 0.10 NTU within 15 minutes

4. Disinfection

- a. CT values to achieve required log inactivation of *Giardia* and viruses

Progressive Corrective Action

- ❖ Filter Profile – analyzing individual filter effluent data through an entire backwash cycle**
- ❖ Filter Assessment – entering filter to evaluate media depth, type & consistency of captured floc, bed expansion during backwash**
- ❖ Comprehensive Performance Evaluation – investigation of entire administrative, design and O&M infrastructure of system**
- ❖ Voluntarily or by regulatory triggers if facility does not meet individual filter performance requirements**

Progressive Corrective Action Triggers

(1) > 1.0 NTU in 2 consecutive 15 minute measurements

- 1. Record filter number, turbidity value & date**
- 2. Produce filter profile w/in 7 days**
- 3. Report w/in 10 days after end of the month**

(2) > 0.5 NTU in 2 consecutive measurements at the end of 4 hours of operation after back-washing or taking offline (IFE, systems >10,000)

- 1. Record filter number, turbidity value & date**
- 2. Produce filter profile w/in 7 days**
- 3. Report w/in 10 days after end of the month**

Progressive Corrective Action (cont'd)

(3) > 1.0 NTU in 2 consecutive measurements in 3 consecutive months

- 1. Record filter number, turbidity value & dates**
- 2. Perform self-assessment of filter w/in 14 days**
 - a) Assessment of filter performance**
 - b) Prepare filter profile**
 - c) ID/prioritize factors limiting filter's performance**
 - d) Assessment of corrections**
 - e) Preparation of report**

(4) > 2.0 NTU in 2 consecutive measurements in 2 consecutive months

- 1. Record filter number, turbidity value & dates**
- 2. Comprehensive Performance Evaluation**
 - a) Scheduled w/in 30 days**
 - b) Completed & final report submitted to State w/in 90 days**

**Performance
Limiting
Factors
(PLFs)**

PLF Categories

❖ **A – Administration**

❖ **D – Design**

❖ **O – Operation**

❖ **M - Maintenance**

Administration PLFs

❖ Plant Administrators

- Policies - do existing policies or the lack of policies discourage staff members from making required operation, maintenance, and management decisions to support plant performance and reliability?
- Familiarity With Plant Needs - do administrators lack first-hand knowledge of plant needs?
- Supervision - do management styles, organizational capabilities, budgeting skills, or communication practices at any management level adversely impact the plant to the extent that performance is affected?
- Planning - does the lack of long range planning for facility replacement or alternative source water quantity or quality adversely impact performance?
- Complacency - does the presence of consistent, high quality source water result in complacency within the water utility?
- Reliability - do inadequate facilities or equipment, or the depth of staff capability, present a potential weak link within the water utility to achieve and sustain optimized performance?
- Source Water Protection - does the water utility lack an active source water protection program?

Administration PLFs cont'd

❖ Plant Staff

- **Number** - does a limited number of people employed have a detrimental effect on plant operations or maintenance?
- **Plant Coverage** - does the lack of plant coverage result in inadequate time to complete necessary operational activities?
- **Personnel Turnover** - does high personnel turnover cause operation and maintenance problems that affect process performance or reliability?
- **Compensation** - does a low pay scale or benefit package discourage more highly qualified persons from applying for operator positions or cause operators to leave after they are trained?
- **Work Environment** - does a poor work environment create a condition for “sloppy work habits” and lower operator morale?
- **Certification** - does the lack of certified personnel result in poor O & M decisions?

Administration PLFs cont'd

❖ Financial

- **Operating Ratio** - does the utility have adequate revenues to cover operation, maintenance, and replacement of necessary equipment (i.e., operating ratio less than 1.0)?
- **Coverage Ratio** - does the utility have adequate net operating profit to cover debt service requirements (i.e., coverage ratio less than 1.25)?
- **Reserves** - does the utility have adequate reserves to cover unexpected expenses or future facility replacement?

Design PLFs

❖ **Source Water Quality**

➤ **Microbial Contamination - does the presence of microbial contamination sources in close proximity to the water treatment plant intake impact the plant's ability to provide an adequate treatment barrier?**

Design PLFs cont'd

❖ Unit Process Adequacy

- **Intake Structure** - does the design of the intake structure result in excessive clogging of screens, buildup of silt, or passage of material that affects plant equipment?
- **Presedimentation Basin** - does the design of an existing presedimentation basin or the lack of a presedimentation basin contribute to degraded plant performance?
- **Raw Water Pumping** - does the use of constant speed pumps cause undesirable hydraulic loading on downstream unit processes?
- **Flow Measurement** - does the lack of flow measurement devices or their accuracy limit plant control or impact process control adjustments?
- **Chemical Storage and Feed Facilities** - do inadequate chemical storage and feed facilities limit process needs in a plant?

Design PLFs cont'd

❖ Unit Process Adequacy

- **Flash Mix** - does inadequate mixing result in excessive chemical use or insufficient coagulation to the extent that it impacts plant performance?
- **Flocculation** - does a lack of flocculation time, inadequate equipment, or lack of multiple flocculation stages result in poor floc formation and degrade plant performance?
- **Sedimentation** - does the sedimentation basin configuration or equipment cause inadequate solids removal that negatively impacts filter performance?
- **Filtration** - do filter or filter media characteristics limit the filtration process performance; do filter rate-of-flow control valves provide a consistent, controlled filtration rate; do inadequate surface wash or backwash facilities limit the ability to clean the filter beds?
- **Disinfection** - do the disinfection facilities have limitations, such as inadequate detention time, improper mixing, feed rates, proportional feeds, or baffling, that contribute to poor dis-infection?
- **Sludge/Backwash Water Treatment and Disposal** - do inadequate sludge or backwash water treatment facilities negatively influence plant performance?

Design PLFs cont'd

❖ Plant Operability

- **Process Flexibility** - does the lack of flexibility to feed chemicals at desired process locations or the lack of flexibility to operate equipment or processes in an optimized mode limit the plant's ability to achieve desired performance goals?
- **Process Controllability** - do existing process controls or lack of specific controls limit the adjustment and control of a process over the desired operating range?
- **Process Instrumentation/Automation** - does the lack of process instrumentation or automation cause excessive operator time for process control and monitoring?
- **Standby Units for Key Equipment** - does the lack of standby units for key equipment cause degraded process performance during breakdown or during necessary preventive maintenance activities?

Design PLFs cont'd

❖ Plant Operability cont'd

- **Flow Proportioning** - does inadequate flow splitting to parallel process units cause individual unit overloads that degrade process performance?
- **Alarm Systems** - does the absence or inadequacy of an alarm system for critical equipment or processes cause degraded process performance?
- **Alternate Power Source** - does the absence of an alternate power source cause reliability problems leading to degraded plant performance?
- **Laboratory Space and Equipment** - does the absence of an adequately equipped laboratory limit plant performance?
- **Sample Taps** - does the lack of sample taps on process flow streams prevent needed information from being obtained to optimize performance?

Operation PLFs

❖ Testing

- **Process Control Testing** - does the absence or wrong type of process control testing cause improper operational control decisions to be made?
- **Representative Sampling** - do monitoring results inaccurately represent plant performance or are samples collected improperly?

Operation PLFs cont'd

❖ Process Control

- **Time on the Job** - does staff's short time on the job and associated unfamiliarity with process control and plant needs result in inadequate or improper control adjustments?
- **Water Treatment Understanding** - does the operator's lack of basic water treatment understanding contribute to improper operational decisions and poor plant performance or reliability?
- **Application of Concepts and Testing to Process Control** - is the staff deficient in the application of their knowledge of water treatment and interpretation of process control testing such that improper process control adjustments are made?

Operation PLFs cont'd

❖ Operational Resources

- Training Program - does inadequate training result in improper process control decisions by plant staff?
- Technical Guidance - does inappropriate information received from a technical resource (e.g., design engineer, equipment representative, regulator, peer) cause improper decisions or priorities to be implemented?
- Operational Guidelines/Procedures - does the lack of plant-specific operating guidelines and procedures result in inconsistent operational decisions that impact performance?

Maintenance PLFs

❖ Maintenance Program

- Preventive - does the absence or lack of an effective preventive maintenance program cause unnecessary equipment failures or excessive downtime that results in plant performance or reliability problems?
- Corrective - does the lack of corrective maintenance procedures affect the completion of emergency equipment maintenance?
- Housekeeping - does a lack of good housekeeping procedures detract from the professional image of the water treatment plant?

Maintenance PLFs cont'd

❖ Maintenance Resources

- **Materials and Equipment** - does the lack of necessary materials and tools delay the response time to correct plant equipment problems?
- **Skills or Contract Services** - do plant maintenance staff have inadequate skills to correct equipment problems or do the maintenance staff have limited access to contract maintenance services?

PLF Rating and Ranking

❖ A

➤ major effect on long-term repetitive basis

❖ B

➤ moderate effect on a routine basis, or
➤ major effect on a periodic basis

❖ C

➤ minor effect

Performance-Based Training

- ❖ Follow-on from CPE
- ❖ Usually involves operations and management staff from several treatment facilities that have been through the CPE process
- ❖ Allows them the opportunity to review problem areas of treatment together, work collectively to determine solutions, and take this knowledge to their respective plants for implementation



ANY QUESTIONS?