SCADA Alarms for Treatment Plants

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Do you know what your alarm set points are in SCADA and the purpose they serve? Supervisory Control and Data Acquisition (SCADA) systems, help operations staff stay aware of treatment performance and avoid treatment failures and violations. Whether you operate a complex surface water filtration plant or a well with disinfection using chlorine, SCADA systems only work as well as their programming. Alarm set points can not only be programmed to help avoid problems, but can also help ensure you are meeting your own treatment optimization goals. Simply getting to know what your current alarm set points are can help you identify if they are adequate to avoid violating regulatory limits and to meet your internal treatment performance goals.

Start by asking yourself the following questions:

1) Are operators on site during all hours of plant operation? ☐ Yes ☐ No
2) If you answered no, are the following alarms in place:
   - Surface water plants: high combined filter effluent (CFE) turbidity? ☐ Yes ☐ No
   - Surface water plants: high individual filter effluent (IFE) turbidity? ☐ Yes ☐ No
   - High entry point (EP) chlorine residual? ☐ Yes ☐ No
   - Low EP chlorine residual? ☐ Yes ☐ No

The following alarms are required, and their absence would be considered a significant deficiency during a water system survey:

- A high combined filter effluent turbidity alarm (for conventional and direct filtration plants)
- A low EP chlorine alarm (for all surface water and ground water under the direct influence of surface water (GWUDI) systems serving more than 3,300 people).

A low entry point chlorine residual alarm needs to be set high enough to meet disinfection CT (**C**hlorine residual multiplied by contact **T**ime) requirements at all times, for all surface water and GWUDI systems. The low chlorine alarm needs to consider both higher demands, when a higher residual may be needed to obtain the same CT at a lower contact time, and cold water temperatures, when the CT requirements are greater.

> *Example:* A surface water system was experiencing high demands and greater disinfection requirements when filling a reservoir during cold weather. The achieved CT for a 1.76 mg/L chlorine residual at 29 minutes of contact time was 51 mg-min/L, but the required CT for the pH, temperature and residual conditions

was 58 mg-min/L. As a result of not meeting disinfection CT requirements, the water system raised the minimum chlorine residual level set point at the entry point to meet CTs at all times, including during critical conditions.

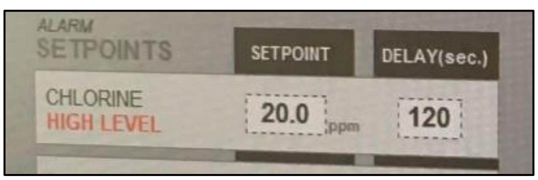
For ground water systems, the low EP chlorine alarm should consider the minimum chlorine residual level to meet any disinfection requirements for your source.

Low EP chlorine alarms can also help water systems that add chlorine meet the requirement to ensure a minimum detectable chlorine residual in the distribution system at all times.

Have you verified alarms will work when needed?
You can verify the alarm set points in SCADA, or in your turbidimeter or chlorine analyzer controller if you do not have SCADA. Periodically test the alarm function and be sure to document your findings in an alarm response Standard Operating Procedure (SOP). An example data table for verifying alarm set points is provided in Table 1 at the end of this article.

Do I really need to verify alarms? I never trigger an alarm.
Even if you have never triggered an alarm, these set points can be inadvertently changed. The photograph below (Figure 1) was taken during a water system survey in 2019:

Figure 1. High chlorine level alarm set at 20 ppm (very high)



Take the time to test the alarms to make sure they work. Figure 2 shows the set point for a surface water filtration plant at 0.15 NTU. The alarm was tested during a survey in 2016 by lifting the turbidimeter head off the sensor body to create an 8 NTU "spike" in turbidity. The alarm worked, but the test revealed that the SCADA system was incapable of recording higher than 1 NTU due to how the 4-20 milliamp (mA) input was configured in the Programmable Logic Controller (PLC).

Figure 2. High turbidity level alarm set at 0.15 NTU (SCADA was capping turbidity data at 1 NTU)

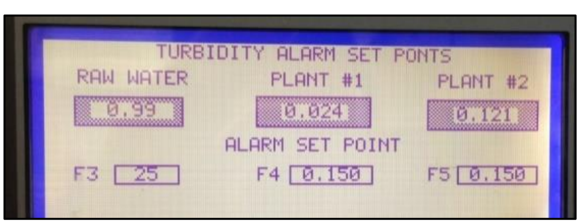
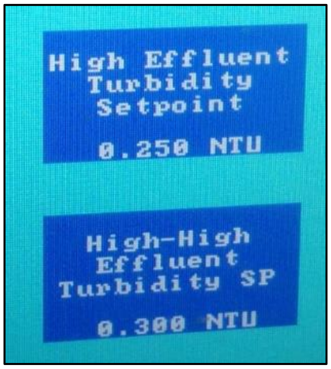


Figure 3 shows how high- and high-high set points should be configured to meet both regulatory limits and the water system's performance goal for a surface water filtration plant.

Figure 3. High turbidity level alarm set at 0.25 NTU as a performance goal set below the High-High regulatory limit of 0.3 NTU.



How can alarm set points help improve filtration plant performance?
In a survey of 33 small conventional and direct filtration water treatment plants in Washington State serving fewer than 3,300 people, the following correlations between high turbidity alarms and optimized performance were identified:

- 83% of nearly-optimized plants had some form of automatic plant shut down alarm for high filter effluent turbidity, with 90% of alarm set points in the 0.1 – 0.3 NTU range.
- Only 40% of lower performing plants had a high turbidity alarm, compared to 82% for optimized plants.
- 33% of optimized plants had a set point of $\leq$ 0.1 NTU while none of the lower performing plants had a set point less than 0.1 NTU.

In conclusion, verifying and testing alarm set points not only ensures they will work in the way they should, but also provides an opportunity to make sure they are appropriate for regulatory limits and performance goals. Developing SOPs ensures that staff will know what to do when one of these alarms is activated and improves contininuity of service to your customers. Remember, meeting regulatory limits and optimized performance is not an event, but a process that takes persistence and commitment. See the optimization goals for conventional and direct filtration plants and other information for surface water treatment at www.healthoregon.org/swt.

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Table 1. ***Alarm Set Point Verification***
(example regulatory limits and optimization goals for conventional filtration are shown)

Alarm	Intended Purpose		Set Points		Verified in SCADA or in meter controller	Tested Alarm & Auto Dialer
	Compliance	Optimization	Autodial	Shutdown		
	Applicable Regulatory Limit	Applicable Optimization Goal	Autodial Set Point & Phone #	Auto-Shutdown Set Point		
IFE NTU High ☐ N/A	1 NTU ☐ N/A	0.10 NTU ☐ N/A	___ NTU (___) ___-_____ ☐ N/A	___ NTU ☐ N/A	☐	☐
IFE NTU High-High ☐ N/A	2 NTU ☐ N/A	0.30 NTU ☐ N/A	____NTU (___) ___-_____ ☐ N/A	___ NTU ☐ N/A	☐	☐
CFE NTU High ☐ N/A	0.3 NTU ☐ N/A	0.10 NTU ☐ N/A	___ NTU (___) ___-_____ ☐ N/A	___ NTU ☐ N/A	☐	☐
CFE NTU High-High ☐ N/A	1 NTU ☐ N/A	0.30 NTU ☐ N/A	___ NTU (___) ___-_____ ☐ N/A	___ NTU ☐ N/A	☐	☐
EP Chlorine Low ☐ N/A	0.2 mg/l - High enough to meet required CT - High enough for detectable residual throughout distribution system ☐ N/A	0.2 mg/l - High enough to meet required CT - High enough to maintain 0.2 mg/l throughout distribution system ☐ N/A	___ mg/l (___) ___-_____ ☐ High enough to meet required CT ☐ High enough for detectable residual throughout distribution system ☐ N/A	___ mg/l ☐ High enough to meet required CT ☐ High enough to maintain 0.2 mg/l throughout distribution system ☐ N/A	☐	☐
EP Chorine High ☐ N/A	4.0 mg/l ☐ N/A	2.5 mg/l ☐ N/A	___ mg/l (___) ___-_____ ☐ N/A	___ mg/l ☐ N/A	☐	☐
Comments:						
Sign:				Date:		

N/A = Not applicable for intended purpose or not available for alarm and set points
NTU = Nephelometric turbidity units
IFE = Individual filter effluent
CFE= Combined filter effluent
EP = Entry point to the distribution system (after all treatment and prior to or at first customer)
CT = (chlorine Concentration in mg/l) x (contact Time in minutes)