Editor's Focus

By Richard Baril

Understanding Risks, Maintaining Security

Securing water distribution networks with continuous online water quality monitoring

Today's water plant managers understand the importance of a secure drinking water distribution system. They are taking seriously the threats to drinking water safety, and their security efforts are being spurred on by U.S. EPA requirements.

In March 2003, the EPA required that water systems serving more than 100,000 people submit vulnerability assessments to the agency and by June 2004 these vulnerability assessments were required from all water systems serving more than 3,300 people. The EPA is also requiring plants submit plans for securing their water distribution network. Plants today better understand the risks, but addressing all of the security concerns can be a complex and daunting task.

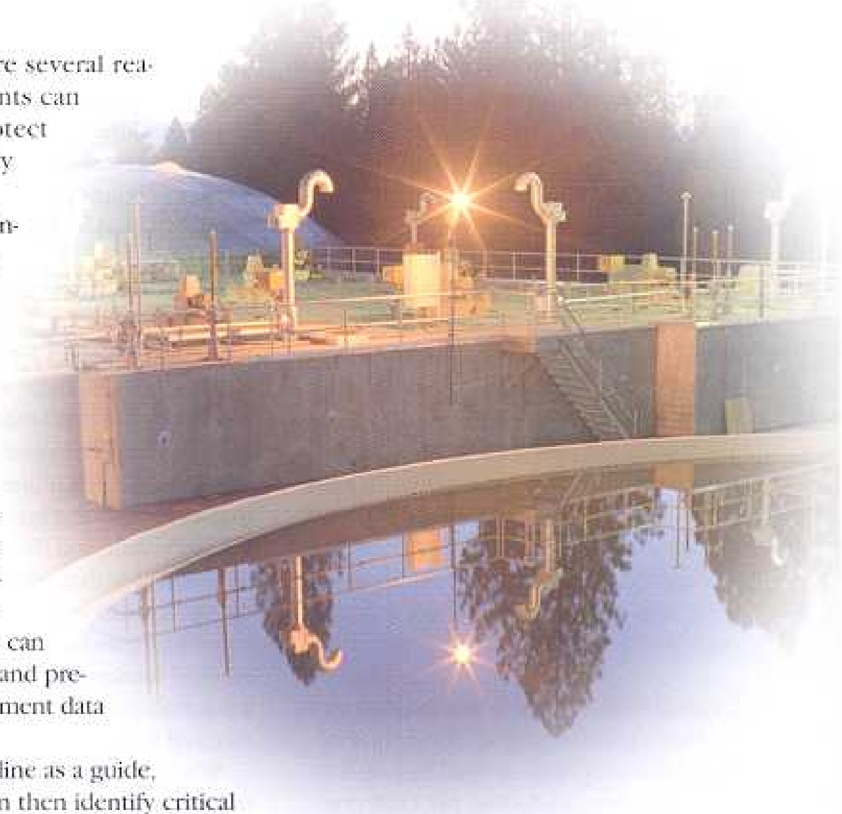
Identifying vulnerabilities

There can be numerous points of vulnerability in various locations throughout a municipal water system. In addition, the aging and outdated infrastructure that makes up much of the water distribution systems across the country is taking its toll. To complicate matters further, water systems are growing, but staff and budgets are shrinking, making monitoring difficult due to limited resources.

Testing for every conceivable contaminant is not possible. There are no tests for some contaminants and it would be beyond the scope and resources of any drinking water facility to test for every possible situation. In addition, the number of potential points of vulnerability in any distribution network could also be very large. It is not possible for a plant to upset the entire operation to protect against every conceivable parameter.

However, there are several reasonable steps plants can take to better protect their water quality and safety.

In fact, by continuously monitoring several critical water quality measurements online at strategic points in the distribution system, plant operators can develop a baseline for measurements that indicate normal water conditions, so they can better understand and predict what measurement data is appropriate.



Using that baseline as a guide, plant operators can then identify critical changes in the water composition that could indicate when a contamination event has occurred. If a change in the water composition is detected, the plant operator can take steps to analyze it further to determine whether or not the change poses a risk or indicates a problem in the water system. In order to develop an accurate baseline, it is generally recommended plants conduct and track continuous online measurements for at least a year, so that operators can understand the normal variances and identify unusual changes.

This kind of continuous, online, systematic monitoring makes up a critical early warning system that can often detect chemical or microbial risks, indicating to the plant the need for further water quality analysis at a particular point in the water system. The goal of an early warning monitoring system is to reliably identify low-probability, but high-impact contamination events in source water or distribution systems. An early warning system will include a variety of critical water quality measurements monitored continuously to provide real-time water quality data. An ideal early warning system must provide continuous measurements of the measured parameter and warn the operator in sufficient time for the plant to take action. The system must be affordable, require low skill and minimal training to operate, and incorporate robust, long-life sensors that require low maintenance. The early warning system should also provide for remote operation and offer sensor and instrument diagnostics to minimize false positive and negative responses.

Role of the EPA

The EPA is currently taking additional steps to help water plants develop effective safety and security systems. Through its Environmental Technology Verification (ETV) Program, the EPA develops testing protocols and verifies the performance of technologies that have the potential to improve protection of human health and the environment. The ETV was created to accelerate the introduction of new environmental technologies into the domestic and international market. In today's world, it also tests and verifies the performance of monitoring and treatment products that are relevant to homeland security. The ETV program aims to provide plants with an independent, objective and high-quality source of performance information on these technologies so that they can make informed decisions. The stakes have never been higher for plants to select the most effective solutions available to help protect the water quality and safety. The ETV is currently evaluating multiparameter water systems that can be used as early warning systems for water quality.

Critical water quality measurements

These multiparameter water quality systems incorporate several important measurements, including pH, ORP, conductivity, free chlorine, monochloramine, dissolved oxygen and turbidity. Early warning systems monitor pH to detect changes that impact the potential corrosion of the distribution network. ORP is continuously measured to determine the level of chemical reactivity. Conductivity provides an indication of the total dissolved solids, and turbidity indicates biological growth in suspended matter. Free chlorine and/or monochloramine is tracked to ensure the maintenance of optimum residual disinfection levels. In addition, dissolved oxygen is an important indicator of whether there is a healthy environment being maintained in the water distribution network. The continuous monitoring of all of these measurements is critical to understanding the proper composition of the water system at each stage of the distribution network, so plant operators are more likely to detect changes that could indicate a contamination event has taken place.

Continuous online measurement is the key to an effective early warning water quality system. But just as important is the appropriate placement of these systems. The first step a plant must take is to conduct, as the EPA has required, a vulnerability assessment to understand the primary points of risk throughout the water distribution network. Once the plant determines those locations, it is best to install a water quality monitoring system in each of these weakness points, or at least in as many of them as would be feasible and affordable.

Cost of ownership

When evaluating water quality monitoring technologies for use in an early warning system, there are several factors plant operators and managers should keep in mind. The plant should first understand there is not a one-size-fits-all water quality monitoring system that will work for each plant, and should be wary of any manufacturer that provides a standard off-the-shelf solution. Each plant has its own individual network with its own specific areas of weakness, and each plant requires a solution that's flexible enough to be customized to its needs.

When evaluating cost, it's important that plants look at both the initial investment cost and the total cost of ownership, including installation, training, maintenance and replacement costs.

For example, plants and municipalities have found it's important to select solutions built using robust long-life sensor technologies proven to withstand harsh process environments. Sensors that have provided long life in harsh applications, such as chemical and pulp and paper processing, will last even longer in the drinking water monitoring environment, requiring less maintenance and replacement costs than sensors built using more lab-oriented technologies. In addition, many long-life sensors require so little maintenance that the analysis systems require very little interaction with operators.

In addition, plants should look for solutions that are easy for their staff to implement and use, thus minimizing training and start-up time and avoiding disruptions in plant processing. Water quality monitoring solutions that include smart instruments, for instance, eliminate false positive alarms caused by instrument or sensor failures by providing predictive diagnostic information that can be accessed by the operator. With the instrument providing this diagnostic information in advance of a problem, plant operators can make minor maintenance adjustments without any unexpected breakdowns or process disruptions.

When evaluating installation processes, there are typically a couple of options a plant can select depending on its needs. A plant can choose a system that comes pre-integrated with a complete process control system, or if a plant already has an effective SCADA system in place, it can choose a system that can be integrated with that existing network.

Final assessment

Drinking water plants today understand the risks posed against their systems. Driven by both the security concerns and new requirements by the EPA, they are developing systems to help ensure water quality and safety. By monitoring a variety of measurements throughout the distribution system, plants can better understand normal patterns and detect unusual and potentially dangerous changes in the water quality. Continuous, online water quality monitoring technologies and processes can greatly reduce the risk that contamination events will be missed, enabling plants of all sizes to better protect the water quality in the communities they serve. WWD

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