However, driving the utility pickup truck around 380 sq mi (984 km²) of city water system weighs heavily on the schedule of operators and technicians for the city of Oklahoma City Water and Wastewater Utilities.

Looking to find a better way to keep tabs on the 2,600 mi (4,183 km) of water lines serving 500,000 people in Oklahoma City, Okla., and supplying 13 neighboring systems, utility managers installed several automated, water quality monitoring panels at key distribution network points. A supervisory control and data acquisition (SCADA) system scheduled for deployment this summer will collect data continuously from each panel, allowing comprehensive network surveillance 24/7 at a central location.

The real-time network data will signal—even predict—where and when remedial action is needed so that personnel can focus the utility’s resources efficiently. Further, the utility expects that full-time surveillance will yield significant security benefits.

AGING, EXPANDING SYSTEM PRESENTED CHALLENGES

Oklahoma City’s water system has unlined, cast-iron pipe that’s showing its age. Corrosion has resulted in periodic red water issues—a common occurrence in many distribution systems with aging infrastructure. Treatment with polyphosphates and frequent flushing are the traditional remedies that have helped the city control the effects of corrosion.

Further, system residual time for chloraminated water can vary widely during the year. “We treated a capacity 189 mil gal [715 ML] one day last July, yet our annual average is about 90 mgd [341 ML/d],” explained Water Quality Division Superintendent Monte Hannon. During the low-demand times, stratified water can reside in storage tanks for up to seven days, estimated Water Treatment Supervisor Stan Morris, expressing his concern about chlorine residual decay.

This situation creates the potential for waterborne disease that could result from incursion because of failing pipelines and tanks. Oklahoma City is heading off this potential by implementing a “fairly large rehabilitation and replacement program,” according to Hannon, who reported about 15 mi (24 km) of water lines have been replaced annually over the past few years. In 2004, the city expects to replace 34 mi (55 km) of water line.

Compounding these issues is the city’s continuing need to cover more territory and serve more people. Increasingly stringent groundwater regulations are expected to cause many well water users to convert to water supplied by Oklahoma City. Hannon estimated the utility has been adding an average of nearly 40 mi (64 km) of line each year.

A supervisory control and data acquisition system will collect data continuously from each panel, allowing comprehensive network surveillance 24/7 at a central location.
MULTIPLE WATER QUALITY PARAMETERS CAN BE MONITORED SIMULTANEOUSLY

The utility had relied on continuous-reading chlorine monitors, installed in 2000, to alleviate some of the operators’ burden. Explained Morris, “We positioned 10 chlorine analyzers—the same units we use in the treatment plants—at storage tanks to keep track of total chlorine residual. Operators checked the recorded readings once or twice a week and reviewed data monthly when reagent was replenished.”

Pleased with the efficiency of automated chlorine measurement, the city investigated the use of online turbidimeters to eliminate much of the operators’ manual turbidity monitoring load. Operators had been taking from 210 to 300 turbidity readings a month to identify and track systemwide water quality as the utility replaced aging portions of the network.

Hannon and Morris investigated online monitoring alternatives and found a water distribution monitoring panel that includes premounted, prewired, and preplumbed analyzers for not only free or total chlorine and turbidity but also conductivity and pH, along with a temperature sensor. A sensor on the panel also monitors water pressure delivered to the analyzers. Hannon and Morris saw this continuous monitoring panel—designed to transfer real-time data on several key water quality parameters to analog or digital communication systems—as the ideal complement to the SCADA system already planned to upgrade data management and network efficiency.

Installation. During the summer of 2003, treatment plant mechanics installed 19 units of the monitoring panel, mounting them on the walls of booster pumping stations and the control buildings serving storage tanks. Each panel required just a single line connection, and one sample port on the panel fed all the instruments on each panel.

Tom Mitchell, plant manager II and overseer of the entire distribution system, said installation was relatively uncomplicated. “You want to be able to sample from a flowing main, not a dead end or on the pump suction, so in a few instances we had to tap a main and run some drains. But all the locations had power, and the panels themselves were pretty easy to mount. Our own mechanics did all the necessary power and sample line connections. We had all the panels in place in about two months.” Mitchell noted that in one instance a panel positioned to monitor a 25 ft (8 m) above-and belowground tank had to be moved to a location with more delivery pressure. A service technician from the vendor assisted with startup and calibration after system mechanics finished installation.
REAL-TIME DATA KEY TO IMPROVED MANAGEMENT

The panels—which include the original chlorine analyzer—have now replaced the single-parameter instruments and provide continuous turbidity, conductivity, and pH surveillance, saving operators hours of sampling and testing time. The most remote panel is about 15 mi (24 km) from the nearest primary treatment plant, saving operators miles of driving time as well. The panels will ultimately send their encrypted data to the SCADA system targeted for completion in the summer of 2004.

“Our original application of the SCADA system was to watch the entire system from our control room and have real-time feedback on the condition of our water and system,” explained Hannon. “For example, we will be able to switch tanks while avoiding water pressure problems.”

Added Morris, “With the data from the panels coming in, we’ll be able to establish a baseline over varying demand periods, see how our chloramines hold up, and even watch for nitrification.”

Hannon likened the water quality data collection and interpretation to the statistical process control (SPC) manufacturers might apply to spot production problems and minimize product faults. Using the baseline established from data registered by the panels, his staff will be able to determine appropriate alarm set points that will alert operators when—or even before—an upset occurs. He recalled an instance when construction flushing resulted in high turbidity in a water storage tank. “We realized it after a customer notified us,” admitted Hannon. “This system will let us see when a problem is developing, ahead of a customer call.”

While evaluating instrumentation quotes, the utility found that the multi-parameter panels are less expensive to purchase and install than individual analyzers. They are also more cost-effective than having operators performing daily maintenance measurements and security monitoring.

Hannon believes, along with numerous water quality experts, that the concurrent measurement of several key parameters serves to correlate and confirm a deviation from the normal water quality baseline—the first signal that “something’s going on here.” Hannon is proud of the action taken by his utility: “Continuous, automated network monitoring gives us a lot more data than we could gather from manual testing, so we can establish a reliable database—a reference—for continuous surveillance. Our intention is to be able to identify a legitimate contamination event and to locate and isolate the contaminant as quickly and effectively as possible.”

Hannon explained his decision to implement automated distribution system monitoring: “It’s a perfect fit with our upcoming SCADA system: we have an eye throughout the network for turbidity that suggests red water, we have a better profile of chlorine residual, and we’re doing as much as we can to keep the water system safe.”

DISTRIBUTION MONITORING ENHANCES SECURITY

“Continuous monitoring has another purpose here,” acknowledged Hannon. “Our vulnerability assessment pointed to a need for more distribution water quality monitoring and more daily spot checks. Manual testing was our other option.”

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