Software Solutions Help Water, Wastewater Operations Hit Moving Environmental Compliance Targets

As drinking water standards and effluent discharge regulations get increasingly stringent, water-centric utilities are optimizing processes and recordkeeping with industry-specific software solutions.

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Introduction

Water and wastewater treatment plant managers, utility directors and consulting engineers are facing increasing state and federal regulatory pressures to produce the highest quality of drinking water or treated effluent. Environmental compliance is forcing many public and private utilities to adopt sophisticated treatment technologies that require tighter operational controls than traditional operations. Recordkeeping responsibilities also are becoming more complex as the utilities must demonstrate that all treatment measures were maintained around the clock.

This white paper will explore how regulatory compliance issues are continually changing the manner in which plants are operated, and how software solutions can assist both in operations and recordkeeping to achieve constant compliance with all environmental regulations.

The Ever-Changing Regulatory Environment

The modern era of water and wastewater treatment in the U.S. began in the 1970s with the passage of the Clean Water Act (CWA) in 1972 and the Safe Drinking Water Act (SDWA) two years later. These two acts, as well as subsequent amendments, radically changed the way that water and wastewater treatment was conducted in the U.S. and by default many other countries that look to the U.S. for environmental policy models as well as treatment technologies. This sea change was arguably most pronounced in the wastewater treatment arena. Where simple lagoon treatment may have been acceptable for many communities prior to 1972, the CWA and its National Pollution Discharge Elimination System (NPDES) permit process for discharges into streams or other bodies of water dramatically changed the complexity of wastewater treatment technologies.

State and federal water and wastewater regulations have continued to tighten since the 1970s. Today, water and wastewater treatment facility managers face tougher and tougher restrictions on individual contaminants, and these regulations often force the abandonment of previous treatment technologies in favor of more advanced technologies that have greater efficacy in treating target contaminants. In some instances, specialized treatment operations have been mandated at individual production well heads or in centralized treatment facilities to achieve compliance with a specific naturally occurring contaminant such as arsenic or uranium. In other cases, compliance with drinking water standards are achieved through the blending of compliant water with non-compliant supplies so that the end product does not exceed a target contaminant threshold, but such blending must be supported by rigorous documentation.

Regardless of how compliance is achieved, water systems have a newfound responsibility for the safe operation of new treatment technologies as well as a much higher degree of regulatory recordkeeping to maintain. Usually the filtration technology requires backwashing according to a set schedule, and the resulting residue may be considered hazardous waste. A list of contaminants of concern is always under review by U.S. Environmental Protection Agency, and additional water systems may be faced with the implementation of advanced treatment technologies to achieve compliance with particular contaminants of concern.

Similarly, the wastewater treatment industry has been under increasing pressures to discharge treated effluent that is quickly approaching drinking water quality standards. Recent regulatory focus has been on much lower levels of the biological nutrients nitrogen and phosphorus, which some municipal wastewater treatment plants (WWTPs) have been forced to take to incredibly low levels unachievable by conventional treatment methods. These pressures increase as many communities look to beneficial reuse of treated effluent either to replace potable water supplies with treated effluent in non-consumptive uses such as the irrigation of parks and ball fields or even direct recharge of aquifers with treated effluent. In such cases, EPA and state environmental agencies have been putting particular focus on the level of total nitrogen in the treated effluent. Achieving compliance with very stringent nitrogen levels requires sophisticated treatment technology. Such WWTPs are very capital-intensive to build, and require that operators attain the highest level of certification. Upsets in the operations of these facilities can be extremely costly and time-consuming to rectify, and penalties for noncompliance can be equally expensive.

With the myriad of constant regulatory changes facing water and wastewater facilities alike, plant managers can no longer be content to let the institutional knowledge of plant operations reside inside the heads of the most senior operators or on paper copies of environmental compliance records stuffed away in filing cabinets in plant laboratories. Instead, WTP and WWTP managers must turn to software solutions that provide traceable records of flows into and out of their plants, what process actions were taken in-process, and what operation and maintenance measures loom on the horizon.

Solutions for a higher level of operational control

As these varied external pressures put more demands on water and wastewater systems every year, the need for greater automation and data management rises accordingly. Even technology advances such as remote sensors, often tied into supervisory control and data acquisition (SCADA) telemetry systems, and in-house laboratory capabilities have added a new layer of data inputs begging for something more than a page in an operations log book.

The data inputs must be presented in real-time visual form at the human-machine interface (HMI) so that onsite operators can spot trending and be alerted to potential system upsets before they happen. This functionality is afforded by solutions such as GE's HMI/SCADA–iFIX or HMI/SCADA–CIMPLICITY, both of which allow for precise monitoring and control of treatment processes and equipment.

Water and wastewater operations have virtually no choice but to capture the wide array of disparate data being generated at their facilities, store it for historical reference or regulatory compliance, and interpret it for daily or emergency operations. Products such as GE Historian can tie both the plant and business functions together so that downstream applications such as GE Troubleshooter and GE Cause+ can be used to identify possible causes of process spikes and upsets, develop process fine-tuning opportunities and provide cause-based alarms if processes or operations begin to go out of control.

Offsite managers or engineers, in turn, need to have a web-based look into operations to make immediate decisions without traveling to the plant. With real-time operations data on a common web client and reporting application such as the GE Real-Time Information Portal, important decisions about processes and operations, including equipment issues, can be monitored and diagnosed with a minimum of travel and other overhead costs.

Even routine work instructions, standard operating procedures (SOPs), and corrective action plans can be automated for more efficient operator utilization by software solutions such as GE Workflow.

Letting water quality rise to the top

Providing the best possible water quality to residential, institutional and industrial customers is by far the primary goal of any water system. Most modern water systems have three-ring binders full of standard operating procedures, but no well-defined program for ensuring that those procedures are followed by all operators or for initiating corrective actions when noncompliance issues arise. Inefficiencies in daily treatment operations as well as unfocused corrective actions can be tremendous cost factors for cash-strapped water treatment facilities.

Such was the case for the waterworks at the City of Haverhill, Mass. This 12 MGD facility is accountable to roughly 52,000 homes and businesses each day, and the responsibility is not taken lightly. The facility had a strong set of written SOPs, but adherence to them varied among operators. Similarly, corrective actions varied operator-to-operator.

Therefore, plant management identified the need for a computerized quality control and quality assurance system that would standardize treatment operations and corrective actions. City officials chose GE's Workflow solution to provide an easy-to-use method for operators to track treatment and distribution processes, achieve consistent regulatory compliance, and react to upsets according to a proscribed sequence of actions. The implementation program leveraged the existing in-house treatment expertise to create eSOPs and thus achieve buy-in from the operators. This ease of development and deployment, in turn, facilitated the Workflow implementation.

GE Workflow was thus able to provide procedural guidance on typical operations such as monitoring the high and low chlorine and fluoride levels in the treatment and distribution systems, and high clear well level monitoring and clear well flushing. Instructions were also provided for infrequent events such as intrusions or chemical leaks, as were proactive advisories such as the emergency response and high-flow management plans. The end result for the City of Haverhill was a 15 percent reduction in annual costs for operator troubleshooting and corrective actions.

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Gaining control of fluctuating incoming streams

Not all water or wastewater is created equal. Water quality can change considerably depending on seasonal water level fluctuations of source streams or reservoirs. Heavy pumping of groundwater wells can also pull in greater contaminant loads, and rising water table levels during the spring can mobilize contaminants not encountered at other times of the year. Similarly, the influent to a WWTP may contain shock loads of biological oxygen demand (BOD), chemical oxygen demand (COD) or other critical parameters based on time of day or industrial process changes in the service district. Operators, therefore, must always be prepared to work with what is coming into the plant at any given time.

Such was the case at the Formellino WWTP at Faenza, Italy. The combination of residential, institutional and industrial influents to the facility varied day-by-day and even hour-by-hour, with industrial discharge quantities, qualities and periodicities being the largest unknown factors. This 6.4 million gallons per day (MGD) activated sludge WWTP depends on a nitrification/de-nitrification (N/dN) process based on treatment cell retention times before discharge into the biological nutrient-sensitive Lomone River. Shock loads of BOD or COD, especially from industrial dischargers, frequently threatened to upset the activated sludge process, especially at night when operators were not onsite. To deal with these shock loads, operators frequently turned up the power to the blower motors and thus inadvertently would over-oxygenate the treatment cells. As a result, the N/dN process became less efficient both for operational control and environmental protection.

During an engineering upgrade to the Formellino WWTP, managers placed plant automation high on their list of must-have technologies in order to provide the best level of service to all customers while protecting the river ecosystem. With a GE PACSystems RX3i control system connecting roughly 600 new and old sensors, engineers installed GE's HMI/SCADA CIMPLICITY operations software to monitor all processes, display the operational data to operators in trending or log forms, and maintain a historical database for operational and regulatory purposes. Alarms were established to alert operators of BOD or COD fluctuations in the influent, in-process dissolved oxygen levels, equipment maintenance issues and other real-time situations that threatened to upset the sensitive N/dN process.

The result is a WWTP that is fully automated around the clock. All plant data is constantly monitored and recorded. Equipment use, including the power-hungry blowers, has been optimized through the GE software's sensor data collection and interpretation as well as its predictive control capabilities. Less than two months after the WWTP was automated, its energy consumption had fallen 30 percent.

Conclusion

Environmental compliance is arguably the major concern for managers of water and wastewater treatment plants around the world. Failure to achieve compliance with regulatory mandates at the very least can result in punitive fines, while major process upsets can have negative consequences for human health and environmental protection. Increasingly, plant managers and engineers are leveraging the operational and recordkeeping safeguards afforded by technology solutions such as GE's family of GE solutions targeted toward the water and wastewater industries. Such products have been shown to increase ease of operations, maintain a steady state of quality control, and provide a historical record of operations both for operational review and compliance with state and federal recordkeeping requirements.

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