Water, Wastewater Treatment Plants Realize Operational Efficiencies with GE Workflow Solutions

Increased system complexities and rising operational costs drive the need for greater operation control and recordkeeping.

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Introduction

As service area populations rise and commercial, institutional and industrial needs become increasingly complex, water and wastewater service providers are constantly struggling to provide sufficient treatment throughput while meeting all customer and regulatory expectations. All of this comes at a time when traditional state and federal funding agencies have little or no grant or even loan monies for water and wastewater capital programs for capacity expansions, technology upgrades or plant replacements. Municipal and even private treatment facilities cannot easily raise water and sewer rates, so in many cases they are left to become as efficient as possible with the equipment and infrastructure already in place. Even service providers that have undergone recent improvements to their existing facilities or perhaps are starting up new facilities find that they need to change the ways in which these treatment plants traditionally have been managed to provide the best return on investments to taxpayers or private-sector investors.

This white paper will look at how the efficient capture and interpretation of operational data can be used by water and wastewater managers and engineers to maximize treatment capabilities to maintain water quality standards while minimizing power and chemical consumption as well as water system losses. The paper will also review the types of software solutions that are helping water and wastewater operations throughout the world.

Solutions for a higher level of operational control

Water and wastewater treatment facilities are by no means the static operations that the uninitiated might assume. The flow into any wastewater treatment plant varies widely on an hourly, daily or even annual basis as residential, commercial, institutional and industrial customers' usage patterns change. Even water systems experience changes in the quality of water coming into the treatment plant as fluctuations in reservoir levels and groundwater tables can have significant impacts on the water chemistry.

With water resources becoming increasingly scarce throughout the world, water systems also are under growing pressure to reduce the amount of water that is treated but never reaches a paying customer. These non-revenue water (NRW) losses include water that is treated at cost to the water authority, but either leaks out of the delivery system or never gets billed because of faulty meters, lack of meters on illegal connections, or internal consumptive uses. NRW is arguably the most costly financial drain on most water systems, as such losses result in unnecessary capital expenses due to the construction of oversized facilities as well as regular operating and maintenance (O&M) costs associated with the treatment of NRW.

These issues combine to put more and more pressure on water and wastewater systems to increase their levels of automation and data management. So, too, do advances in sensor technologies that are tied into supervisory control and data acquisition (SCADA) telemetry systems as well as the ability to perform greater levels of in-house testing due to analytical technology advances.

Applications optimize plant operations

At the heart of any operations management system is a central data repository that collects the huge amount of data streaming in from processes and operations throughout the water or wastewater treatment plant. Only with such a database can processes and operations be visualized in real time and also used as an "after action review" mechanism.

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 to provide a complete record of all processes, operations and business functions that can be used to lower production costs while eliminating avenues for lost revenues.

GE's Historian was designed to carry this concept further by providing visibility of data from disparate systems at extremely high speeds, apply context to that raw data, and compile related data sets wherever necessary to improve plant operations and cost-efficiency.

In a water or wastewater operation, such visibility and context is invaluable. For water treatment plants, this means a constant view and historic record of incoming streams from surface or groundwater sources, aquifer drawdowns, treatment processes and operations, blending rates, storage capacities and distribution operations. Wastewater treatment plants, whether using relatively straightforward activated sludge processes or state-of-the-art membrane bioreactors, can easily be adversely affected by sudden changes to influent characteristics from industrial dischargers or precipitation events. GE Historian, however, can merge data from influent flowmeters, laboratory analytical inputs, process basin sensors, blower motors, valves and other equipment to optimize plant operations. All of this data can be securely stored both as an operational history of each plant asset as well as for regulatory compliance documentation.

The data inputs must also 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 products, which allow for precise monitoring and control of treatment processes and equipment, GE Troubleshooter, which helps operators find likely causes of process upsets and variations, and GE Cause+, which carries forward the information gained in GE Troubleshooter to develop process improvement actions as well as establish caused-based alarms for any future upsets.

In addition, offsite managers or engineers 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.

Following are two examples of how water and wastewater operations have deployed various technology solutions to improve efficiency, better protect human health and the environment, and lower operational costs.

Tying together far-flung operations

Water is everywhere in Waterford Township, Michigan. In the 35-square-mile community are 34 lakes and several streams. Because of the ready availability of surface water, there are 13 small water treatment plants strategically located near population clusters. Wastewater is not treated within the township, but rather is piped 30 miles to Detroit. Although this business model saves the huge capital cost of constructing a WWTP plus the annual O&M costs of operating it, 62 pump stations are needed to get wastewater from various parts of the township at a variety of elevations to the wastewater main that will carry it to Detroit.

Having so many relatively small fixed assets scattered around the service area along with the usual assortment of manholes, vaults and other non-mechanical structures, places a tremendous O&M challenge for the Utility Department workers. The Department already had a Geospatial Information System (GIS), but no way to tie it to work orders when maintenance was required.

Starting with GE Historian as the central computing solu-tion, GE information technology specialists from GE's Advanced Manufacturing and Software Technology Center in Van Buren Township, Michigan helped Township officials and operators implement GE iFIX to tie all critical assets to the Historian database. Then, the work process management applica-tion GE Workflow was implemented to digitize both manual and automated processes within the water and wastewater systems. Workflow enabled operators to quickly develop electronic standard operating procedures, or eSOPs, for all routine and emergency O&M activities. The Workflow solution employs Alarm Response Management technology that not only monitors the receipt of an alarm by an operator, but also helps ensure that proper corrective action is taken in a timely manner. Out-of-spec conditions trigger alarms in Workflow, which then manages the distribution of the alarms based on criticality and field response time. Workflow also generates a work order tied to the GIS coordinates and the eSOP required to manage the operational or process upset.

For example, each of those 62 pump stations in Waterford Township contains three identical pumps to provide redundancy in the event of scheduled or emergency maintenance. To ensure that all pumps wear evenly, they are cycled on and off so that

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each pump only bears one-third of the total workload. When a pump station experiences a disruption of that automatic cycling or if a given pump begins to draw current at a rate that might indicate impending pump failure, GE iFIX will alert the operators and managers to the out-of-spec situation. Workflow will create a work order with GIS coordinates and perti-nent information such as when the condition began and under what conditions. Should operators need to access manholes near the affected pump station, they can query Workflow to get a listing of all manholes in the area.

The result of these software implementations is a highly auto-mated water and wastewater utility department that ties together what would otherwise be disparate systems. Such auto-mation provides the highest level of assurance of meeting water quality standards as well as maximizing the capital and O&M investments the Township has made in its many assets spread throughout the community.

Plugging the revenue drains

The biggest revenue drain for most water systems is NRW. While even the most diligent water systems may be expected to have at least 10 percent NRW, many older systems can have 50 percent water losses or even greater–meaning that half or more of the water that is treated never reaches a paying customer.

Such was the case with a major water system in Southeast Asia. NRW water losses were a major threat to the operations of this water system, which services more than a quarter of a million people in an urban environment. With water collection, treat-ment and distribution spread out over a wide area with multiple facilities, the water provider knew that much of the water it was collecting and treating at considerable cost was never making its way to customers.

The water provider created a detailed specification for an infor-mation technology system. GE was chosen to provide a suite of solutions to meet the benchmarks set by the customer's speci-fications. SCADA sensors were implemented at the reservoir and distribution system to monitor water levels and flows. The flows and pressures were also monitored in the pressure zones throughout the service area. This data was then fed back to a GE iFIX server in the operation center's server room. Using the GE iFIX, operators were able to monitor all flows and make control adjustments that would be carried out automatically through motorized valves or pressure reducing valves throughout the distribution system. The GE iFIX server system

also provided normal, warning and alarm status reports for all critical operations, as well as fault signals for malfunctioning equipment. Finally, the GE Real-Time Information Portal provided a web-based portal through which managers could view and analyze all aspects of the far-flung treatment operations.

To gain a similar level of insight into the business operations, all water billing data, service records, work orders and other management data were also captured by the water system. Thus connected, management had a complete picture of all aspects of the water system operations, from collection, treatment, and distribution to customer billing. Water system personnel away from the facilities were also afforded the opportunity to monitor conditions via the GE Real-Time Information Portal. All opera-tions and management information was archived by the GE Historian central data repository.

The wide network of data loggers, matched against billing records, proved to managers that there was a huge amount of NRW that was draining profits from the water system. Through the process and management visualization afforded by the GE iFIX system, company managers were able to compare water distribute with billing records to identify many NRW losses throughout the system. In fact, the water company realized a 33 percent reduction in NRW losses, representing a tremendous revenue savings to the water company.

Reducing the cost of doing business

Water and wastewater utilities throughout the world share the same budgetary crunch: Service populations are growing, indus-trial customers are demanding more clean water while giving back increasingly complex wastewater streams, government coffers have less to offer utilities, and residential, institutional and industrial customers do not understand the need to raise rates. Many utility managers are finding that the right mix of computing hardware and software can provide enough operational effi-ciency to not only meet short-term demands but also facilitate long-term growth programs.

Korea Water is the public-private corporation tasked with managing water and wastewater operations throughout South Korea. Known colloquially as K-Water, the company provides about 60 percent of South Korea's total water supply, with partic-ular focus on providing domestic and industrial water to major cities and industrial centers. K-water's stated goals are to fulfill its social responsibilities as a water and wastewater authority as well as to become a global leader in water resources.

To achieve these goals, K-water managers made the choice to implement a company-wide operations system that would tie each of the 12 regional operations to facilitate the transfer of best practices in operations and technology while also leveraging the economies of scale possible through a unified operation.

To effect this mammoth integration, K-water sought a technology partner with a large base of installations and a strong reputation in the water and wastewater industry. K-water chose to use GE's iFIX solution for the automa-tion of its disparate water and wastewater systems, and give the implemented automation system the OEM brand name of "Water-K" to play off the company's existing branding. One reason K-water managers cited for choosing the GE product family was its ease of integration with legacy multi-vendor hardware and software systems. The resulting implementation, which saved an estimated $58.5 million in anticipated implementation costs, provided online monitoring of the entire K-water opera-tions for the fastest possible response times to issues that might threaten operational upsets. The GE-based Water-K system also includes the robust GE Historian database necessary to provide a knowledge base for continuous improvement programs as well as regulatory compliance.

The GE solution has resulted in tremendous reductions in operating and maintenance costs. The implementation has helped the local and regional operation track costs and effect savings through improved procurement and logistics. These operations were also able to communicate which best practices could be shared throughout the system to achieve additional efficiencies. The bottom line was a 30 percent reduction in operations management costs, plus a 10 percent reduction of chemical and power use in the treatment processes. In addition, the partnership with GE is helping Korea Water to meet its goal of expanding its presence in international water markets.

Conclusions

Water and wastewater operations are, for the most part, unseen and out of mind from the majority of the customers they serve. The data these facilities generate, however, must be completely visible to operators, managers and engineers, both in the present and future. No longer can operator or laboratory technician logs suffice for the efficient operation of such vital infrastructure assets. As environmental regulations become increasingly more stringent and operating budgets stagnate or shrink, plant managers and engineers must utilize the considerable advantages afforded by technology solutions such as GE family of GE solutions targeted toward the water and wastewater industries. The need for such solutions rises accordingly with operations that are spread across a wide service area. These soft-ware products have been demonstrated to dramatically improve ease of operations, control energy and chemical costs, and provide a detailed historical record of all processes and operations for training and regulatory compliance purposes.