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smart urban solutions*



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Integrated control architecture paves the way to utility savings

Water and wastewater treatment facilities reach full potential with leading edge, integrated automation and control architecture, according to **Kyle Tracy** of Emerson Process Management.

Moving beyond programmable logic control-based systems to sophisticated and integrated automation, instrumentation, and control solutions opens up new areas of opportunities for municipalities and investor-owned utilities, even enabling them to integrate operations on a district-wide scale. The benefit of this advance cannot be underestimated; the ability of these systems to share information throughout the organization paves the way for easier and more efficient financial, environmental and regulatory reporting while also producing additional measurable results.

Traditionally standalone controls have been used in water and wastewater plants to monitor and control various plant processes, however their major drawback is that they prevent municipalities from realizing the true potential of their resources.

Making the step-change from basic process control to an integrated system begins with evaluating the options based on a strategic vision for the future development of automation technology. In addition, it's important to consider that the operational, regulatory, environmental and economic issues facing the water and wastewater industries will continue to evolve, so the ability to respond to this ever-changing landscape should be considered necessary in moving forward. Therefore, laying the right foundation is crucial.

Leveraging integrated control technologies allows municipalities to avoid the substantial disadvantages of relying on isolated islands of automation. These disadvantages include incompatibility among systems, lack of visibility into the process, difficulty in maintaining aging systems due to the scarcity and/or expense of spare parts, and an inability to expand systems to meet the needs of a growing population.

The integrated control system architecture for water/wastewater industries often incorporates a supervisory control and data

acquisition (SCADA) system for wide-area monitoring and control of operations from a single location. These operations may include remote pumping stations, wastewater collection systems, water distribution, sewer diversion, wet weather overflow protection, and weather monitoring. This integrated architecture ensures that operating parameters are adjusted according to changing situations, thereby helping the collection and distribution systems to run smoothly.

Within the plant a SCADA system can integrate skid-mounted auxiliary systems along with non-process systems – like HVAC, power monitoring, lighting control, access control, and fire protection – into the control system. Uniting this information into the control system allows the plant to be monitored as a whole system, and enables multiple plant installations to be monitored from a single centralized location.

For municipal authorities that are constructing new facilities or up-grading existing operations, adopting a digital bus-based control architecture takes monitoring and control to a whole new level. A digital plant architecture incorporates high-speed communications networks, intelligent field devices, and bus I/O technologies to offer unprecedented insight into operations at a single plant or across multiple plants within a municipality's operations.

This insight is further enhanced by incorporating asset management software applications into the control system to ensure critical equipment assets – including mechanical equipment, electrical systems, process equipment, and instruments and valves – are properly operating, thereby helping water and wastewater facilities meet environmental mandates and lower overall operations and maintenance costs.

Furthermore, the network of predictive intelligence that is offered by an integrated monitoring and control system enables municipalities to detect process

and equipment problems before they occur. This abnormal situation prevention makes it possible to be proactive rather than reactive, thereby translating into enhanced protection of assets as well as more efficient deployment of personnel.

Plant optimization software offers additional opportunities for cost savings and operational efficiencies. Incorporating model-based predictive controls, optimization software improves the economics, safety, and efficiency of water and wastewater treatment facilities. For example, by optimizing water treatment and waste-

water treatment processes it is possible to minimize costs, reduce equipment wear and tear, and balance tradeoffs, such as whether to start an additional pump during peak electricity demand periods. Plant optimization software can be applied to many key areas of operation within the plant and throughout the water system, including chemical use and pump and energy optimization. Lowering energy use reduces carbon emissions and costs.

An integrated system can enable municipalities to take proactive steps to minimize the impact of impending wet weather events,



Within the plant a SCADA system can integrate skid mounted auxiliary systems, along with non-process systems – like HVAC, power monitoring, lighting control, access control, and fire protection – into the control system. *Photo by Emerson Process Management*

which can wreak havoc on water and wastewater systems. Combined sewer systems can overflow untreated sewage into waterways during heavy rains, posing health, environmental, and regulatory consequences. Integrating weather monitoring capabilities into a control system enables municipalities to take proactive steps to minimize the impact of impending wet weather events. The control system alarms notify operators of approaching rain, enabling them to initiate wet weather containment measures, such as inflatable dams, basins, or tunnels to temporarily divert/hold excess water and eliminate or minimize undesirable overflows.

An integrated control system can also address security concerns. For example, some sophisticated control systems are equipped with embedded security features that enable customers to proactively address cyber security issues, such as system hacking, data integrity, and verification. In addition to cyber security, the control system can also augment a municipality's existing physical security efforts. Video security monitoring, access control, and intrusion detection, for example, can be integrated into the system to guard against potential sabotage at the plant and remote locations, such as pumping stations.

While they are diverse, evolving financial and environmental regulations have one thing in common: they all call for access to operational data to fulfill reporting requirements. In organizations where financial and operational information resides on separate – and often incompatible – systems, it is difficult and time consuming to obtain the necessary combination of information required for reporting. Standardizing on a single platform seamlessly integrates information not only at the plant level but also on a district-wide basis, streamlining the reporting process for additional, measurable benefits.

In this era of increased accountability, it's no surprise that one of the factors that makes integrated control systems appealing to municipalities is their use of widely recognized, commercially available hardware, software, networking, and communication interfaces. A major benefit of this open systems approach versus proprietary systems is that it allows organizations to easily and cost-



The integrated control system architecture for water/wastewater industries often incorporates a SCADA system for wide-area monitoring and control of operations from a single location. These operations may include remote pumping stations, wastewater collection systems, water distribution, sewer diversion, wet weather overflow protection, and weather monitoring. Photo by Emerson Process Management

effectively modify and expand the system without the risk of obsolescence. It also facilitates incorporation of the latest technologies as they become available.

Wireless technology is a great example of this benefit. Wireless technology can cost-effectively extend the full benefits of digital bus-based plant architecture to locations that were previously inaccessible or financially impractical because it reduces the time and expense required to install wired devices. For example, smart HART-based devices being used today have some level of diagnos-

tics capability. Unfortunately, many plants don't have the infrastructure to receive HART data into the appropriate system. Since only a fraction of these devices are digitally monitored, the potential gain from accessing such "stranded" diagnostics is significant. With wireless technology, the data doesn't have to be stranded anymore. Existing wired HART devices can be upgraded with a wireless adapter to transmit diagnostics information back to the control room where appropriate personnel can take corrective action as needed.



A digital plant architecture incorporates high-speed communications networks, intelligent field devices, and bus I/O technologies to offer unprecedented insight into operations at a single plant or across multiple plants within a municipality's operations. Photo by Emerson Process Management

The open system design of today's cutting-edge technologies also allows for integration with existing higher-level business systems for a comprehensive view of the entire organization that, in turn, facilitates more informed decision making.

Regional automation network underway in King County

In the US state of Washington, the King County Wastewater Treatment Division is in the midst of a multi-year project to automate its wastewater treatment plants, and in turn, improve operations serving more than 1.4 million people within the greater Seattle area. This project will network two wastewater treatment facilities and one new wastewater treatment plant under a regional supervisory process control.

The comprehensive solution is a critical element of King County's long-term master automation plan. Implementation, taking place in several phases, will enable King County to integrate real-time process and equipment data from its treatment plants and other remote facilities on a regional basis. It also will enable King County to integrate enterprise business systems with critical process data, environmental data, and asset information.

Integrating these information layers will ultimately provide greater insight into King County's processes, assets, and overall operations for greater operational flexibility, improved reliability, and efficiency. It will also improve the ability to reduce operations and maintenance costs, and maintain environmental and regulatory compliance in the ecologically conscious area.

The two existing plants – South Treatment Plant and West Point Treatment Plant – in addition to the new Brightwater Treatment Plant, are part of King County's regional wastewater treatment system serving approximately 1.4 million people across areas of King, Snohomish, and Pierce counties in Washington State. These plants average approximately 200 million gallons of water per day (MGD) (757 million megaliters (Mml)) of total wastewater treatment. The South Treatment Plant has a throughput capacity of 115 MGD (435 Mml) average wet weather flow, while the West Point Treatment Plant

has a throughput of 133 MGD (504 Mml). Brightwater will initially have a maximum capacity of 34 MGD (129 Mml); by 2040 the plant will be expanded to provide treatment capacity of 54 MGD (204 Mml).

It's worth noting that this project uses a new, high-value engineering and implementation model. From the beginning, King County established a process by which all parties – the County, its engineering consultants and automation partner, Emerson Process Management – work together to design, configure and install the county-wide, Ovation®-based automation, control, and information technology solution. Doing so helps to manage the scope, schedule, and budget of this large, complex project, while at the same time ensuring knowledge transfer takes place among the team members so that the County operations and maintenance staff gain critical expertise even before plant commissioning.

The digital automation solution for King County includes deployment of three (one per plant) Ovation wide-area systems to monitor and control a number of plant processes, including primary treatment and sludge handling.

For greater efficiency, the new Brightwater facility will be remotely controlled and monitored on nights and weekends from the South Plant using Ovation technology. In addition, each plant's Ovation solution will collect and integrate information about surrounding pump stations and treatment facilities via a combination of Emerson-supplied Bristol® RTUs (Remote Terminal Units) and PLCs. This will provide plant operators with vital information about influent and other variables from these remote facilities. In all, the Ovation systems will monitor and control approximately 20,000-25,000 I/O points.

King County's automation solution includes deployment of digital bus technology, using Foundation™ fieldbus and DeviceNet™ industry standard communication protocols to relay information to the Ovation systems from intelligent devices.

Emerson's AMS® Suite: Intelligent Device Manager is another important element of King County's customized automation solution. For new plant construction, AMS Device Manager streamlines device configuration, thereby contributing to more efficient plant startup. In addition, the AMS

Device Manager provides online access to instrument and valve process information, diagnostic status information, and automatic documentation of all field device maintenance information – all contributing to ongoing efficiency of plant operations and maintenance activities.

The first phase of the project, installation of the core Ovation process automation, control and information technology infrastructure, was installed and commissioned at South Treatment Plant early last year, while the first operating section retrofit of the South Plant is expected to be installed and commissioned later this year. Following the completion of this phase, over the next five to seven years additional phases at multiple facilities will take place concurrently until all retrofit and new construction is completed.

Sea change in automation

King County is not alone in embracing a sophisticated automation and control architecture. Such major US metropolitan areas as Chicago, Detroit, San Diego, and Washington, D.C., and in other large cities in the world including Vancouver, Canada, and Harbin,

China's seventh-largest city, are just a handful of the municipalities that rely on integrated automation and control solutions.

Implementing integrated control architecture as part of a multi-year automation master plan makes it possible for organizations to build on existing resources as circumstances dictate. For although the pressures in which the water and wastewater industries operate may be complex, the bottom line is simple: adopting an integrated monitoring and control approach improves the economics of water and wastewater organizations by delivering operational flexibility, improved reliability, increased operating efficiencies, the ability to meet operations and maintenance budgets, and maintain environmental and regulatory compliance.

Author's Note

Kyle Tracy, the program manager for water solutions at Emerson Process Management, has more than 17 years experience in program, project, and proposal management in addition to marketing, engineering, and field support on multi-million-dollar automation projects.



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