ESC engineering

project brief

City of Westminster Upgrades Water Utility's SCADA System

The City of Westminster, Colorado is a suburban community that is part of the Denver metropolitan area. The city's water utility serves a population of approximately 110,000 citizens and needed to be upgraded for improvement in operation, reliability and efficiency. The upgrades would consist of automated control system improvements and development of standards for treatment, raw water and distribution facilities as well as improvements for communications and security monitoring systems. The City desired to conduct a master plan to be followed by system implementation.

SUMMARY:

Water System Controls Modernization

GOALS:

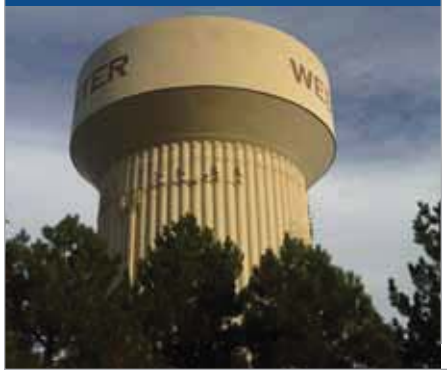
- Evaluate and determine best course of action with a master plan
- Replace obsolete and limited controls
- Create standard data object models
- Establish redundancy and reduce single point of failure

SYSTEM COMPONENTS:

- Distributed programmable logic controllers (PLCs)
- Object-oriented human machine interface (HMI)
- Integrated data historian
- Digital wireless communications

HIGHLIGHTS:

- Successful upgrades and cutovers with minimal downtime or impact
- Improved operations and maintenance and increased flexibility
- Redundancy of operator controls and communications paths



APPLICATION:

Westminster's Water Utility Supervisory Control and Data Acquisition (SCADA) system consists of one attended and one unattended water treatment facility and over two dozen remote sites, which includes pump stations, storage tanks and reservoirs.

The existing SCADA system was a centralized single source BIF software platform that was an obsolete and proprietary Human Machine Interface (HMI) and control package. The SCADA/HMI communicated with the field stations on a routine or polled basis and provided functionality for graphics displays, alarming, trending, and reporting.

ESC engineering (ESC) was awarded the initial Pre-Design phase of work, to perform an evaluation of the Water Utility's operations and determine upgrade options and any potential constraints or scheduling conflicts. The intent was to document the existing, discuss the possible, and design the relevant and prudent. A master plan was developed and primary deliverables included replacing the outdated BIF SCADA with a Wonderware Archestra-based system, decentralizing all controlled process functions by moving them to remote PLCs, and providing improved communications and security monitoring to the field stations.

Following the completion of the master plan, ESC was awarded the Design/Implementation phase, during which ESC finalized designs for the new control and communication equipment, developed software for the Wonderware Application Server platform and PLCs, developed standardized object/data models, orchestrated installation cutovers, and performed system startup. ESC also developed O&M manuals, conducted operations training for City personnel, and provided follow-up support.

REQUIREMENTS:

- Upgrade the water treatment facilities' control scheme from a centralized to a distributed system and install a new fully-integrated HMI.
- Design multiple data path/routing capabilities to eliminate or minimize single points of failure.
- Optimize the remote site communications for higher reliability and speed and minimal downtime yet provide flexibility, adaptability, and redundancy for immediate and future needs.
- Standardize remote site monitoring to improve information feedback and include future video surveillance capability in a fully integrated manner.
- Develop an implementation plan for achieving each of the budgeted deliverables and provide staging for project tasks that would be funded at a later date.

CHALLENGES:

Several noteworthy challenges were encountered over the course of this project. These include a high volume of work with a condensed and restrictive schedule; maintaining operations while cutovers were implemented; working with existing equipment that was not replaced; and limited PLC memory size. Committed funding would not cover all recommended improvements, so the master plan provided an opinion of costs for items slated for future funding.

The existing SCADA system was an obsolete and centralized software platform with single source support. In addition, much of the coding in the existing system was not documented and required a great deal of research to

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determine actual functionality and system impact. System designs needed to provide an open architecture to prevent dependence on a single vendor and provide the City with the greatest degree of flexibility for future growth. An open system approach would also enable the SCADA to interface with other enterprise level systems, including an existing Wonderware Archestra system already in use within the City's waste water utility.

Operational and historical data were not easily accessible beyond the control room environment and previous software changes did not appear to give adequate consideration to optimizing system capabilities.

The existing communication system was a mix of radio, hardwire, fiber optic serial and Ethernet Modbus. A licensed 900 MHz MAS radio system provided little redundancy although it was capable of higher data rates and improved signal stability.

This project demanded a substantial amount of resources for the first crucial months of the implementation phase to accommodate an aggressive conversion roll-out. It was necessary to finish the major aspects of the physical installation by early spring, which required a great deal of work in an abbreviated timeframe.

SOLUTION:

ESC assembled a diverse team of individuals specializing in various aspects of the project, with a project manager experienced in each of the domains addressed within the scope of work. Each project task was conducted in a sequential and methodical manner to ensure that all system aspects were thoroughly evaluated, feasible solutions considered, and the eventual results provided the best solution for the City.

Several workshops and onsite meetings were conducted with city staff to determine system requirements and any potential constraints and to also ensure that adequate staff input was received prior to beginning any design work. ESC's conversion plan minimized disruptions during the SCADA and radio system changeover phases. Migration milestones were developed to ensure that cutover installations were conducted as seamlessly as possible. Mission critical path elements were also identified and were executed in conjunction with other items to meet scheduling demands.

The new master radios were initially operated in analog mode to provide a burn-in period and were converted to digital mode once the installation was complete. Antenna upgrades improved signal strength and the field station PLC programming was modified to enhance communication with the new SCADA/HMI. The existing licensed MAS radio system was retained as a fallback in case of an infant equipment failure and was upgraded for higher throughput and better reliability.

Redundancy was incorporated into the SCADA system. The SCADA HMI was developed to present meaningful and consistent graphical representations of the system based on a standardized object/data model basis. Standardization of data arrangements were developed for the HMI objects and corresponding PLC programming to simplify maintenance and provide the ability to create consistent and repeatable data packets.

RESULTS:

Due to extensive project planning by ESC, the hardware and software upgrades software were installed without any significant issues. Once the new SCADA system was integrated within the City's network, historical data collection, trending and reporting options were greatly improved and the control system could be monitored seamlessly from multiple locations.

The initial radio system conversion was successfully implemented in a single day, greatly minimizing any communication outages. Field station radios were upgraded to permit digital mode operation with the result being a faster and more reliable communication system that provided a high bandwidth path to remote stations.

FOLLOW-UP:

ESC competed against three national engineering firms for this project's bid selection and provided a successful implementation with a personal approach. ESC has since become a preferred vendor with the City of Westminster for controls system projects. This has led to several subsequent assignments, including the design, control system programming, and startup for a number of utility facilities.

The communication system will be upgraded as additional funding becomes available to enhance redundancy, higher capacity data rates, and Ethernet and video security capability to the field stations.

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