

PRODUCTS IN ACTION

By Grant Van Hemert

Award-Winning Water

A well-planned electrical distribution system and data collection, trending and recording capabilities helped one plant win an award

ARTICLE SUMMARY

Challenge: Central Lake County Joint Action Water Agency's SCADA system was obsolete and required the agency to delete functions in order to prevent lock-ups.

Solution: A PC-based CitectSCADA software, which provides easy integration of historical and real-time data into spreadsheets and report generators.

Conclusion: With a total of 8,000 tags of its 15,000 tag licenses in use, the new SCADA system allowed the plant to double in size before requiring an upgrade.

CLCJAWA took a phased approach to its PLC migration. This hybrid control panel contains the newer Modicon Quantum processor communicating with the original SY/MAX I/O. The plant can convert the I/O to the Quantum platform as time and money permit.

In 2005, the Central Lake County Joint Action Water Agency (CLCJAWA) was awarded the Phase IV Drinking Water Excellence Award by the Partnership for Safe Water, identifying its staff and facilities as meeting the highest standards for quality in the production and distribution of drinking water. The transformation to an independent award-winning regional drinking water agency did not happen overnight, however. It took more than a decade of collaboration, planning, construction and upgrading to achieve this status.

Treatment Process

The CLCJAWA system consists of a raw water intake, a raw water pumping station, two miles of transmission pipeline to transport Lake Michigan water to the plant, a booster pump station to maintain water pressure to the outlying communities and more than 32 miles of finished water transmission pipeline.

Potassium permanganate is fed into the intake structure for zebra mussel control, and large debris is screened from the water at the raw water pumping station. The treatment facility, arranged in four parallel 12.5-million-gal-per-day processing trains, is entirely enclosed to allow for ease of operation and maintenance in all weather conditions. Once at the plant, the water is treated with ozone for disinfection, taste and odor control and enhancement of particulate removal. After ozonation, the water enters the rapid-mix basins, where a coagulant is added to facilitate the removal of suspended particulate matter. Following the rapid-mix basins, the water is stirred in a three-stage flocculation

process and then flows through inclined plate settlers to remove solids.

To remove fine particles that escape the sedimentation process, the water is treated through granulated activated carbon (GAC) filtration, and finally the filtered water is subjected to ultraviolet (UV) light, which inactivates bacteria in the filtered water without the use of any chemicals. From the ultraviolet reactors, the filtered water proceeds to the finished water clearwells and is pumped to the individual communities' distribution networks. The sludge gathered from the plate settlers and GAC filters is then thickened in clarifiers before being dewatered in centrifuges.

Upgrading the SCADA System

By 1998, CLCJAWA felt limited by its original SCADA system. The hardware of the UNIX-based proprietary system was obsolete and not upgradeable. In addition, the agency was using the system to its highest capacity, updating 6,000 data points every 10 seconds and storing up to 18 months of data. The agency even had to delete functions to prevent lock-ups. The SCADA software had information databases that were not easily imported into other applications, difficult historical database retrieval and limited options for report generation.

The CLCJAWA wanted to move to a PC-based SCADA structure to make expanding and upgrading simpler. The agency chose CitectSCADA software from Citect and installed it on PCs. The software met the agency's data storage, redundancy and speed requirements, while providing easy integration of historical and real-time data into spreadsheets, report generators and more. Furthermore, the agency liked that the system could integrate power monitoring data to provide energy-use reports, runtimes, number of starts, etc.

The system has a total of 8,000 tags of its 15,000 tag licenses in use, allowing the plant to almost double in size before requiring a SCADA upgrade. The system consists of two redundant input/output (I/O) servers to handle the critical I/O and another I/O server to handle noncritical I/O. It has 10 view licenses and two manager nodes that float as needed. The 8,000 points of data are scanned at a rate of 6,000 points every 10 seconds and enter the system through a variety of means.



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Optimizing Control

As CLCJAWA began the process of upgrading its SCADA system, it decided to also address challenges with the PLC portion of its control system. The agency decided to replace the SY/MAX PLCs with 23 Modicon Quantum processors while maintaining the same I/O. In some locations, a hot standby system was implemented. The new PLCs utilize IEC 61131-3 programming standards and communicate to the SCADA system via a Modbus Plus communication network. They are able to handle the communication speed required by the facility, providing a more detailed view into daily plant operations. The Quantum PLCs also can be directly interfaced to the existing I/O racks, reducing costs and providing a clear path for future migration.

The agency realized further benefits when it came to programming the new PLCs. According to CLCJAWA Systems Analyst Dave Thompson, "The upgrade of the chemical feed systems consolidated six separate PLCs into one. Because the PLCs were compliant with the IEC 61131-3 standard, we were able to create derived function blocks for the feed systems components. This dramatically reduced our development time."

More than 300 lines of ladder logic in one SY/MAX PLC were replaced with six derived function blocks that ran an entire feed system. Utilizing structured tag names allowed the balance of the five feed systems to be programmed in less than an hour by copying and pasting and then utilizing search and replace functions. CLCJAWA also replaced its limited logic and memory RTUs with compact Modicon Momentum PLCs.

"The Momentum family of PLCs is economical and more than powerful enough for our delivery structure application," Thompson said. "Communication failures due to problems with the phone lines are no longer the problem they used to be because the PLCs have been programmed to store two months of data-specific flow data that is accessible remotely. Creating a derived data type that included a date field as well as flow data also made the functions much easier to complete."

Improving the Electrical Distribution System

Power reliability is a major focus for the Paul M. Neal plant. In 2004, the agency decided to improve its overall electrical distribution system and power reliability by adding switching options and increasing redundancy. To maximize system reliability, the agency turned to several specific power distribution products and system designs.

Extensive coordination and engineering was needed during the upgrade since the system was a hybrid of previous and current methodologies and because an OEM supplied some of the equipment. The agency quickly realized that three technical challenges needed to be understood and resolved.

First, if the normal utility power was lost and the generators were required to supply plant power, then the 5,000 KVA 12.5 KV to 4160 VAC transformers would need to handle power in a reverse direction. Therefore, the transformers would serve as step-up transformers. Because the 4160 V generators had

to have the capability to handle the significant inrush currents associated with turning on a transformer from the secondary side in a "black start" scenario, Schneider Electric engineers performed calculations to confirm the suitability of this arrangement and the setting of the protective relays.

Second, when the CLCJAWA disconnects from the utility and runs on its backup generators, the agency loses its reference to ground because the 5,000 KVA transformers are 12.5 KV delta to 4160 wye connected. To resolve the issue, Square D recommended and then built two neutral deriving assemblies and put them on the high-voltage side of the 5,000 KVA transformers to create a reference to ground.

Reliability and quality of the finished water were the utmost concerns at all times. As a result, the third challenge was that the agency forbade the use of oil in transformers due to the remote possibility of water contamination. Therefore, all transformers, including the 12.5 KV to 4160 VAC Power-Cast II transformers, are air-cooled. In addition, the design of the resulting system and the tie-in to the existing system had to ensure that downtime was kept to a minimum. This downtime requirement was the impetus for the previously described design.

To ensure proper performance monitoring of the power distribution system, a power monitoring system was installed throughout the power distribution system. This equipment is integrated to the control system via a Modbus TCP/IP Ethernet connection.

"We chose Square D electrical distribution products for our upgrade because they were part of the plant's existing infrastructure and had proven their reliability," Thompson said. "The extra coordination and diligence of the Schneider Electric engineering staff during the project only enhanced our confidence in the company."

Exceeding Treatment Parameters

To qualify for an award from the Partnership for Safe Water, a facility must demonstrate to an independent team of water professionals that all aspects of operation are optimized and reliable. In addition, the plant must prove that it meets specific treatment parameters, requiring an exhaustive means to gather operations data to be in place. The program requires producing water with a turbidity that is five times lower than what current federal regulations require, which is 0.5 NTU.

"In practice, we produce water that is 10 times lower than current federal regulations require, typically below 0.05 NTU," said Burr Koepsel, the agency's director of operations. "Our goal has always been to optimize our water treatment process and to produce the best quality water with the equipment and techniques we have available to us." www

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