Siemens helps JEA keep the waters flowing in Northeast Florida

Electricity, water and sewer services for the residents and businesses of Northeast Florida are served by the municipal-owned utility called JEA. Established by the City of Jacksonville in 1895, JEA grew from a department of city government to an independent energy authority created by the consolidation of city and county governments in 1967. Thirty years later, the water and sewer systems operated by the city since 1880 also became part of JEA's service offerings.

Today, JEA is the largest community-owned utility in Florida and the eighth largest in the U.S. With a total generating capacity of about 3,050 megawatts, JEA serves more than 417,000 electric customers in Jacksonville and parts of three adjacent counties. JEA's water system serves more than 305,000 water customers and 230,000 sewer customers in Northeast Florida. Its water system consists of 134 artesian wells that tap the Floridian Aquifer, one of the world's most productive aquifers. Water is distributed through 35 water treatment plants and 4,208 miles of water lines. More than 3,760 miles of collection lines and seven regional and eight non-regional sewer treatment plants make up the JEA sewer system.

Case Study

Challenge:

Modernizing an outdated pumping control system for JEA's waste water collection system's lift stations and treatment centers

According to Darren Hollifield, JEA's manager of Access and Control Systems, the existing pumping control system for the 1,273 lift stations that keep waste water flowing through 14 treatment centers was simply outdated. "The current system was designed and engineered in the middle 1990s," he said, "and technology has changed a lot since."

JEA uses the lift stations throughout its sewage system to manage storm water flows and pump wastewater from homes and businesses to its treatment centers. Also, JEA continues to acquire adjacent water systems and work with current septic tank owners to connect to JEA's system. As a result, they will need to add more pumping capacity and communications capabilities in the future among its existing and any newly built remote lift stations.

Hollifield explained that JEA's current SCADA (Supervisory Control And Data Acquisition) pump control system consists of multiple operator interfaces; two input/output servers (primary and backup); seven data concentrators using Siemens S7 416-2 PLCs; and 32 master radio sites. Most of JEA's remote lift stations use Siemens S7 200-series PLCs, while about two dozen lift stations use the Siemens S7 300-series PLCs.

The data concentrators are Modbus master pollers, each featuring eight master channels. Each master channel, in turn, can poll up to 100 Modbus slaves. The communication path uses inverse multiplexing over fiber equipment on each end from JEA's Systems Operations Control Center (SOCC) to each remote station's master radio over narrowband, spread spectrum radio.

Pat Harwood, the control system's technician, explained that with the current system, verifying communication between the data concentrators and the remote lift stations is primitive. "We do it by checking a counter which is always changing and incrementing or resetting the counter, if a certain value changes or does not change."

Such limited, one-way communications prevents Pat and his team from conducting remote diagnostics or doing remote programming. As a result, each time a lift station has a problem or needs a software fix, patch or upgrade, a technician needs to be dispatched at a typical cost of several hundred dollars.

Pat Harwood also noted that communications are only updated when the Modbus polling device requests data and the more Remote Terminal Units (RTUs) on a channel, the slower the update times are. If communications with the RTU is lost, the RTU has no buffering capacity to hold its data until communication is restored.

Solution:

A Siemens SIMATIC S7-300 PLC with SINAUT Telecontrol and SIMOCODE pro motor management and WinCC HMI

Working both with its distributor AWC as well as with Hollifield, Pat Harwood and other JEA team members, Siemens developed an advanced and comprehensive solution based on the proven SIMATIC S7-300 PLC platform and the SINAUT ST7 telecontrol system using Profibus. Each lift station's PLC is also integrated with Siemens SIMOCODE pro intelligent motor management system.

The S7-300 PLC system provides local logic as well as data collection for the SINAUT ST7. It is also the PROFIBUS master for two SIMOCODE pro systems. The two SIMOCODE pro systems provide motor overload protection, local I/O to read in the analog well level and the digital floats' signals. If the PROFIBUS connection is lost between the SIMOCODE pro and the PLC, the SIMOCODE pro provides redundancy and can take over full control of the pumping operation until the network is restored. SIMOCODE pro also provides key diagnostic and operational data that is eventually sent to the control center. This includes power measurement data that is recorded and sent to the SCADA system, which is used to evaluate energy savings projects and control strategies.

The SINAUT ST7 extends the SIMATIC S7 automation system by integrating special hardware and software components that enable remote data transmission. This interconnects the SIMATIC S7 CPUs with one another through a Wide Area Network (WAN) and with the SINAUT ST7sc Control Center System that provides fully automatic monitoring and control of the lift stations from the master control center.

The SINAUT software in each lift station provides event-driven process data transmission between each lifting station PLC's CPU and with the control center. Now, for example, Harwood and his fellow technicians can see connection failures, disrupted CPUs or a disrupted control center on PC displays via the Siemens WinCC PC-based SCADA software. It updates data automatically after a problem is corrected or after an RTU's CPU or the control center is restarted.

Date and time throughout the network's CPUs and control center can be synchronized via a DCF77 radio clock or a GPS (Global Positioning System). Either way the systems always have the exact time of day. Also daylight-saving/standard time is switched automatically. Time stamped data messages or automatic scheduling of program starts are therefore standard features of the system.

A Siemens DC UPS system also provides backup power to retain communications to the lift station if 480VAC power is lost for example during storm conditions.

Results:

Much improved communications, lower operating costs and lots of scalability for the future

The Siemens SIMATIC S7 solution has helped Hollifield and Pat Harwood realize their goal of designing new control cabinets for the lift stations that cost the same or less as the old ones but with a lot more capabilities, especially communications. Their deployment plans involve migrating a lift station's cabinet controls to the new Siemens SIMATIC S7 platform when an existing unit fails; when upgrading selected stations; or when building new remote stations.

One of the most beneficial aspects of the solution comes from the SINAUT ST7 telecontrol system. "Now that we have two-way communications capabilities with the SINAUT ST7, we can get exception reports when something goes wrong," said Hollifield. "We also can do remote diagnostics, software upgrades and other fixes and maintenance that would otherwise have to be done onsite by a technician. And we can do it without losing communications with any other RTU on the system."

Energy savings is realized by optimizing hydraulic control. Pump stations are controlled so that they run in concert and not pumping against each other. SIMOCODE pro can measure motor current, voltage, apparent power(kVA), active power(kW), power factor(%) and power consumption(kWh).

The system automatically compiles complete diagnostic logs of all communications between the central control system and the remote lift station along with details of the type and time of any failures, which helps shorten troubleshooting times. Updating the remote PLCs is much improved because individual messages can be automatically triggered by an exception report or by a pre-determined event or time parameter.

He added that if a problem does require a technician's visit, remote diagnostics can provide a much better idea of what the problem is, so they can dispatch a technician with the right skill set and with the right parts and tools. This can save the monetary costs of "truck rolls" as well as the environmental costs of burning gasoline.

Inside JEA's remote stations, the intelligent SIMOCODE pro motor management system can keep the pumps working even if the PLC control network goes down. "SIMOCODE pro provides us with peace-of-mind because those pumps need to be working 24x7," said Pat Harwood. "With SIMOCODE pro, there's also a lot less wiring costs and its power management features can help us cut our energy usage up to 20 percent." In fact, less wiring brought down the overall project costs by 30 percent, almost enough to pay for the upgraded system.

Going forward, Hollifield and Pat Harwood are confident that the Siemens S7-300 platform's scalability will meet JEA's growing needs to build more remote lift stations and upgrading existing ones. At the same time, they both are excited about the potential to optimize their control system's operations to achieve greater efficiencies, lower costs and save energy.

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