

## Wireless Keeps Irrigation System Flowing

### Summary

- Energy Systems Engineering wanted to improve many processes in the irrigation system in Lindsay, California
- The company used Phoenix Contact TWE radios and PLCs as part of an extensive SCADA system upgrade
- The new system improved the water distribution control from both a logic standpoint and design standpoint, and Energy Systems anticipates much less maintenance



A Phoenix Contact radio and power supply mounted in a control cabinet.

### Customer Profile

Energy Systems Engineering ([www.ese-corp.com](http://www.ese-corp.com)) is an electrical engineering firm that specializes in the integration of automation, SCADA, instrumentation, energy, and electrical systems. Based in Bakersfield, Calif., they provide engineering services such as system design, PLC programming, panel fabrication, and instrument and electrical maintenance to water and irrigation districts along with other types of customers.

### Challenge

Energy Systems is currently working with the Lindmore Irrigation District in Lindsay, Calif. to upgrade its SCADA network. The Lindmore Irrigation District is located in the east central portion of California's San Joaquin Valley. The district serves the communities of Lindsay and Strathmore, Calif., as well as around 1,200 agricultural customers that grow citrus, olives, and almonds in a 100-square-mile area. It also provides supplemental irrigation capacity to Fresno, Tulare, and Kern counties.

The 10-mile by 10-mile area is a very large area to cover, but pumping is not required on the west side of the canal because these pipelines are gravity fed. The three gravity-fed bilateral pipelines (called "avenues") are approximately five miles apart. Each of the first two is about 10 miles long; the third is about eight miles long. These bilateral pipelines transport the water from the canal to the farmers.

The primary objective of the pumping plant is to maintain reservoir level and flow demand. When farmers call in with their water requirements, district operators select the number of pumps to operate. Each pump has a selectable setpoint at the reservoir level. Once the reservoir level reaches its setpoint, the pumps stop. Head pressure at the reservoir maintains the line pressure.

In the past, Lindmore Irrigation District relied on manual metering to provide water to its customers. When a customer needed water, a technician had to drive to the customer's site and manually open a valve. This process provided almost no flow rate or water volume data. The only way to measure how much water was delivered was to note how long the valve was open.

Not knowing exactly how much water each customer received made billing difficult and potentially inaccurate, the resource waste. Deviation between the amount of water actually provided and the estimated amounts could vary from 30 to 40 percent.

## Solution

Energy Systems installed flowmeters to measure how much water is flowing through each pump and what's being pumped back to the reservoirs. The district also knows the capacity of each reservoir, and measures their water levels. They included those measurements in the SCADA system as well.

Lindmore Irrigation District's SCADA upgrade included implementing PLCs, VFDs at pump stations, motor-driven valves, and wireless communication technology to link all local automation to various Human Machine Interface (HMI) platforms. Converting the district's SCADA system communications to a wireless platform greatly improved its accuracy and data collection throughput.

Energy Systems advised Lindmore Irrigation District to upgrade to a wireless system because of inefficiencies in the communications among the PLCs within the SCADA system. A wireless system with Ethernet connection at each site would allow remote administration capabilities. This would provide more bandwidth to enable us to perform instant remote diagnostics from our office. Energy Systems also knew wireless technology would provide very reliable operation.



**Irrigation pumps deliver water to customers in the higher elevations to the east of the canal.**

Lindmore Irrigation District chose Phoenix Contact's TWE radios because of product availability, Phoenix Contact's superior technical support, superior product quality, and terms of warranty. Energy Systems tested the radios and had no communication failures over an 11 month period.

Prior to implementation, the Phoenix Contact engineering team examined the radio signal path. Based on the survey information, they have added new functions to the radios such as network filtering to reduce multicasting and blocking certain frequencies.

The engineering firm has installed six TWE radios so far. To provide district-wide radio coverage, they erected a 60-foot antenna tower at the district's central office. Around 28 additional radios will be installed and integrated during the next 12 to 18 months on all reservoirs, pump stations, and main trunk lines. The total number of radios to be installed could reach as many as 1,200 over a period of several years. A total of four master radios are planned for the entire project.

A PLC at each reservoir site transmits data to the pumping plant to control the pumps. The junction box and the radios at the pumping plant transmit the data to the district's office SCADA computer. There is one PC with web client access used as the SCADA server. The district's other PC is at the district office where the operators can access the Internet, if necessary.

The PLCs use the EtherNet/IP multicast protocol, and the ability of the wireless system to transmit this protocol reliably and quickly contributed significantly to the success of the upgrade project.

PLCs use messaging blocks to read and write to registers. It also passes alarm status (including high and low levels, high and low pressures, UPS battery status and more) in message blocks. The radios transmit these data to the SCADA system.

The PLCs connect to the radios through Ethernet connections. This scenario allows them to program and maintain PLC programs via a secure VPN to the office.

The district's original radios used serial data and were limited in terms of bandwidth and data. However, the new wireless system uses Ethernet, which allows Energy Systems to connect to each site via the Internet. The flexibility and web connectivity of the TWE radios allows the district to connect to most any device at any site.

The new radios offer the ability to configure a single radio as a master, slave, or slave/repeater via built-in web-based management pages. Having this configuration software built into the radio also simplifies installation.

Compatibility with third-party control protocols was another important decision criterion. The ability of the TWE radio to wirelessly transmit the PLC's EtherNet/IP multicast protocol in a quick and reliable manner was a big factor contributing to the success of the upgrade.

The wireless system allows Energy Systems to connect to each PLC remotely to diagnose potential problems. The system is also expandable to multipoint communication. There is more bandwidth available to expand communications to farmers' fields to collect data such as flow, pressure, and motor run status. The Ethernet radios also monitor reservoir levels, and update the PLCs and the SCADA system to control the pumping plant.

## Results

Before the upgrades began, the district's water delivery and measurement system wasn't very accurate or efficient. Now, the district is measuring and monitoring water use. The operators record exactly how much water is flowing and where it's going, and the database keeps track of water use and billing.

The upgrade greatly reduced personnel requirements. Technicians will no longer be required to initiate water distribution. Water



**A 60-foot antenna tower helps provide district-wide radio coverage.**

conservation is improved through more accurate water monitoring, and Lindmore Irrigation District customers can rest assured their water bills will be accurate.

Necmi Sanli, PE, vice president of engineering at Energy Systems Engineering, said, "Phoenix Contact technical support office was always there for us—even on weekends. Also, Phoenix Contact offered a five-year warranty on the radios if we used their power supplies and surge arrestors."

Because of the reliability of the TWE radios, service calls to the district sites have been virtually eliminated. Reduced service calls translate directly to less travel time.

"We believe we'll achieve better water distribution control both from a logic standpoint as well as a control system design standpoint, and we anticipate much less maintenance," says Lindmore Irrigation District general manager Michael Hagman.