IMPLEMENTATION OF MODERATELY PRICED SCADA FOR THE RIVERSIDE IRRIGATION DISTRICT

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ABSTRACT

In northeastern Colorado, water resources are under tremendous pressures brought about by drought conditions experienced over the past seven years. Some mutual irrigation companies and irrigation districts have implemented SCADA as a means of collecting and recording accurate and timely information for water surface levels, canal flows, and recharge structure deliveries throughout the service area.

Fortunately, the cost of SCADA implementation is less than it used to be in the past and software, hardware, and communication advances have allowed new installations to be accomplished with low to moderate investments. Hardware and software is increasing in function, decreasing in cost, and becoming much more affordable for these private enterprise situations. SCADA implementation by the Riverside Irrigation District is described in which low-cost RTUs and a satellite uplink is used for communications to keep costs reasonable to the District.

INTRODUCTION

The Riverside Irrigation District (Riverside) service canal is approximately 90 miles in length stretching from the Riverside Reservoir in southern Weld County to the eastern edge of Morgan County in Colorado. The District serves about 150 farm owners utilizing 114 turn outs. The District also provides and manages recharge water for six augmentation plans using another 25 turnouts. The canal is used for delivery of irrigation water and filling of Vancil Reservoir, about 75 miles downstream.

The long lag time between reservoir releases and the turnouts ordering release make for ongoing flow management challenges. Ditch loss variability, storm inflows and flow measurement handicaps also contribute to make delivery precision elusive. The various main canal flumes and weirs are visited and recorded only once per day by the district's ditch riders. This provides the superintendent with a spot measurement of the flow with which to base reservoir release requirements for the ensuing three-day lag. As total deliveries change

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during the day with some users coming in and others going out, perhaps above and below the various gaging stations and those daily changes registering after the daily ditch rider visit, some uncertainty was always present concerning the exact amount of water available and if any corrective action was necessary. A SCADA system was conceptualized because it would allow for continuous flow monitoring, and help to account for many of the variables that have plagued the system.

ORIGINAL SCADA SYSTEM

In early 2004, Riverside Irrigation District asked Aqua Engineering to help develop SCADA system concepts and costs for the requirements that Riverside envisioned. There was need to measure and report the flow at five critical points on the system it was also desirable to log the level in one reservoir without reporting the values on the SCADA network. See Figures 1 and 2. A system was designed to meet these requirements. Initially the concept was to utilize spread spectrum radios to link the stations together and feed directly to the Riverside

Figure 1. This installation of an RTU is on a rated section of the main canal. A small generator was used for incidental power needs during installation. A fence protects the equipment from grazing cattle.

Figure 2. Riverside Irrigation District has several rated sections with wet wells available for WSL sensors.

office in Fort Morgan. After radio signal testing, it was concluded that spread spectrum radios were insufficient in power to see one another over the distances and topography. This left the option of more powerful, licensed radios or satellite links. Riverside opted for the satellite based communications system. This would entail a greater annual cost, but a reduced up front cost. It would also enable us to easily have our data available on the internet from any location without having to develop and maintain a permanent web site. This is important as more than one user has a need for the real-time data and neither may be in the office to see it when decisions are to be made.

The initially installed equipment consisted of Automata mini-station loggers, Automata level watch submersible sensors, satellite radios, solar charged deep cycle batteries and the required software. The average installed cost per site was about $3,700.00. See Figure 3.

Figure 3. In several cases, the existing Stevens recorder was replaced with a SCADA RTU with the replacement electronics costing less, by comparison, than a new replacement Stevens recorder.

EXPERIENCE

Installation of the stations, sensors and radios was performed by Aqua Engineering working together with Riverside staff.

The sensors have adjustments that must be made from time to time to stay in calibration. These adjustments tend to be more frequent during times of the year when the water temperature change is greatest (spring and autumn). Silting in wet wells also can cause sensor drift. If these adjustments are not made, the reported data from the sensors becomes useless. In some circumstances calibration must occur daily. This was noted most often by the first generation of sensors that we installed, which were all ceramic submersible transducers. Because we were not always able to fine tune as often as needed, the data became less reliable.

Within about one year of installation all of the ceramic sensors had failed. Some failed for unknown reasons, while the demise of three was believed to be caused by nearby lightning strikes. We were careful to adequately ground all equipment in accordance with the manufacturer's instructions. Automata provided replacements at no cost to us for some of the sensors. The replacements were a much heartier metal submersible transducer. These proved more accurate and much less prone to drift.

During 2006, Riverside's accumulated data was moved to Automata's new web site. This move greatly enhanced our ability to access the data and plotted data can now graphed in a more useful manner. We could now easily tune the sensors from any location, provided that we had a spot visual measurement from a particular station at a known time. We could also now have a better graphical representation of the levels being measured by the sensors and any trends.

Our experience with lightning made us leery of the continued use of submersible transducers in our system, especially in close proximity to a reservoir. Therefore, we replaced one lost sensor with a Stage Discharge Recorder (SDR) made by Sutron. See Figure 4. The SDR was connected to the Mini-Station using an SDI interface card that converts the digital output of the SDR to analog use for the Mini-Station's logger and radio. The SDR has a plastic float in contact with the water, which should provide increased isolation from stray voltage associated with nearby lightning strikes. The SDR also has an easy method to download data quickly using a hand held computer. This is useful because outside in the glare of the sun a laptop computer is very difficult to see and not tolerant of the elements. The download time of a comparable data set from the SDR is dramatically less than that from the Mini-Stations. The sensor drift is also very easy to correct at the site by pressing a few buttons, but unlike a Mini-Sat correction cannot be accomplished remotely.

Figure 4. Several WSL sensors were tried before focusing on a float and wheel arrangement that has proved to meet expectations for accuracy.

CONCLUSIONS

Real time water flow data is invaluable to us and we have become reliant on the continued use of our SCADA equipment. We sometimes wonder how we operated without it. Our daily water delivery is less prone to error. When the skies open up and pour rain (as they rarely do) causing uncontrolled inflows into a full ditch it is very useful to be able to monitor the progress of the swell and its accompanying affects as they migrate downstream on the canal. We can now detect and repair "holes" in the ditch flow a day sooner due to the SCADA monitoring. We can now process flow data and update accounting on our schedule rather than being dependent on others.

Our advice to ditch companies seeking to wade into the SCADA pool is to prioritize carefully your requirements and to be realistic with your expectations. This is a long term relationship, so assess your level of commitment. Can you devote the additional time and resources to maintaining and operating the SCADA system? What level of measurement precision does your SCADA network need? Can you tolerate periods of no data when sensors have been lost or malfunctioned. How frequently will you be able to calibrate and verify the reporting accuracy? Do you have the technical competence to swap out sensors, make minor modifications and troubleshoot the system?

Our SCADA requirements and expectations were probably unrealistic. The sensors, loggers and communications devices are not plug and play, nor are they install and forget. These are sensitive devices placed in an inhospitable environment.

Ditch companies operate in a different environment than most other water users. We have a real need for this technology, but we lack in-house IT departments that can keep them functioning reliably at a low cost. Riverside's IT department consists of me, the superintendent, and a voltmeter. This should inspire confidence in only the most desperate. We also lack deep pockets to afford the finest equipment that requires less maintenance. This explains why agriculture has been slow to come to the SCADA table. Fortunately, there are some vendors like Automata and Aqua Engineering that are aggressively trying to meet our needs.