WIRELESS WELL MONITORING SYSTEM

Industry: Water Well Monitoring | Product: Spectre 3G WiFi Cellular Router

A Simple Solution for a Tough Problem

By William H. Conley III

Introduction

The water well location is one of 12 located on a 600-acre rural development in Southern Arizona. There are many communities using well water, which is quite typical in the area. And, whether well systems are large or small, you can't take them for granted when you live in the desert. The consequences of a malfunction anywhere in the system can, quite literally, be life threatening. At the very least, the kids won't be swimming and nobody will be taking showers.

Our well system isn't new. Increasing demand, aging components and extreme desert temperatures put a strain on our motors, cause fuses to blow and force breakers to open. A large holding tank provides reserve capacity, but it also masks problems. It can take as long as two days for the tank to drain and for the water to stop flowing. We needed a sure-fire way to monitor every part of the well system so that problems could be headed off before they became catastrophic.

THE CHALLENGE

A tank farm in Arizona provides water for rural homes far outside the city limits. Increasing demand, aging components, and extreme desert temperatures were putting a strain on the pump motors. This blew fuses, tripped circuit breakers and interrupted service. The problem forced maintenance staff to return to the tank farm again and again.

The system includes a 15,000 gallon holding tank, a 1,000 gallon pressure tank, a well pump, and a pressure pump. A control panel mounted on the holding tank distributes power to the pumps, and controls turn the pumps on and off as needed. The large holding tank provides reserve capacity, but that can mask problems. It can take as long as two days for the tank to drain and for the water to stop flowing. This called for remote monitoring and control.

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Well System Overview

This well site consists of a well pump located at a depth of 700 feet and submerged in 20 feet of water; a 15,000 gallon holding tank, a pressure pump, and a 1,000 gallon pressure tank that provides water pressure. A control panel distributes power to the pumps and houses a very simple control system. The controls turn the well pump and the pressure pump on or off as necessary to fill the holding tank and to pressurize the pressure tank.

Float switches monitor the water level in the holding tank. When the level drops about 3,000 gallons, an internal contact closes in the float switches. This energizes the well pump, which refills the holding tank. Meanwhile, a pressure switch monitors the pressure tank. The pressure pump forces water from the holding tank into the pressure tank. The pressure in this tank is a relative indication of how much water is pressurized and how much water pressure is available to each of the connected homes.

I wanted to monitor all of the important pieces. This included water level in the holding tank, AC current drawn from the well and pressure pumps, and the pressure in the pressure tank.

Wherever practical, I like to use sensors with a conditioned current output (4-20mA). A current type sensor eliminates most induced noise and can easily support longer connection lengths. And, it is best to use a sensor/transmitter with a full scale measurement greater than what is being monitored. In other words, if you plan on measuring a motor with a max current draw of 20 Amps, you want to select a current sensor with a full scale of 50 Amps. While you sacrifice some resolution, my experience has been that it lets you catch potential failure modes that you would miss if the sensor maxed out at rated load. So I chose 50 Amp current sensors, placing one on each leg of the incoming 220V power cable. Large current draw is an excellent indicator of Start or Run capacitors going bad. For monitoring the holding tank water level, make sure you are using a level 'Transmitter', not a level switch or other device. Sometimes the difference can be confusing. I chose Flowline's LU12-5001 Level Transmitter because of the low cost and the fact that it provides a 4-20 mA output signal with respect to a 4" to 40' depth detection. Mounting the level sensor was one of the most difficult parts of the project, as it required mounting the sensor as well as running conduit to install the wiring. The pressure sensor outputs a 4-20 mA current signal with respect to its full scale measurement of 0-100 psi. It took the place of an older pressure gauge.

The Remote Monitoring System

I needed the ability to remotely monitor and control my system. But my home is located across a road and over 800 feet from the well. If I wanted to get readouts in the comfort of my living room, I was going to have to design a system that could network the remote sensors at the well site and get the data to the computer in my home. One option would have been to hard wire everything, put some cable up on poles, and carry the data over the road and to my back door.

But a much cheaper, easier alternative was available. I went wireless. I connected my sensors to Zlinx™ Xtreme ZZ9D-NA-LR I/O modules, which are outdoor rated RF-enabled data acquisition devices and I/O radios. The Zlinx™ wireless I/O system is modular, allowing you to simply snap on additional I/O to add more analog and digital inputs and outputs any time you wish to increase monitoring capabilities. The system provides connectivity to almost any type of sensor, and even supports Modbus. The I/O radios transmit their data to the Zlinx™ Xtreme ZP9D-115RMLR wireless modem, which is connected to the heart of the system, a Spectre 3G cellular router.

The Spectre 3G cellular router connects to my Zlinx™ Xtreme radio modem, as well as a security camera. Designed to provide Internet connection for remote equipment and remote LANs via the cellular telephone network, and equipped with multiple 10/100 Ethernet ports, a USB host port, one binary input/output (I/O) port and dual SIM card holders, the Spectre 3G collects data from disparate sources and makes all of it available to me anywhere that I can establish an Internet connection.

(The second SIM card holder provides network redundancy, as the router can automatically switch between cellular service providers if one connection fails.)

The Spectre 3G supports the creation of VPN tunnels using IPsec, OpenVPN and L2TP. It supports DHCP, NAT, NAT-T, DynDNS, NTP, VRRP, control by SMS, and numerous other functions, as well as additional software like SmartCluster, VPN Server and R-SeeNet. A password-protected Web interface allows users to configure and manage the Spectre 3G from remote locations. The router can automatically upgrade its configuration and firmware from the operator's central server, allowing for simultaneous mass reconfiguration of multiple routers on a network. Users may insert Linux scripts and they can create up to four different configurations for the same router. Examples would include the SMS and binary input configurations. Users may switch from one configuration to another at any time.

WHY B&B ELECTRONICS?

- Spectre 3G cellular routers eliminate the cost of running wires and are much easier to install.
- The Spectre 3G supports the creation of VPN tunnels using IPsec, OpenVPN and L2TP.
- A password-protected Web interface allows users to configure and manage the Spectre 3G from remote locations.
- Modbus connectivity offers easy monitoring and reset faults without visiting the tank farm, saving trips and delays.
- B&B Electronics' technical support and solution assistance is always free.

THE PRODUCT

Spectre 3G Cellular Router

- Designed for M2M applications
- Wide temperature range: -30 to 60°C
- Advanced security
- Easy plug-and-play installation
- Versatile power 10 to 30 VDC
- Modbus connectivity, Ethernet 10/100, RS-232/422/485
  (Model RT3G-300-W option adds Wi-Fi)

About the Author *Bill Conley is an Engineer at B&B Electronics and is in charge of our Southwest U.S. Regional Office. He is the focal point of our Spectre 3G cellular product line as well as many other innovative products.*