Keeping the Flow

Changing out a control system when you just can't turn it off

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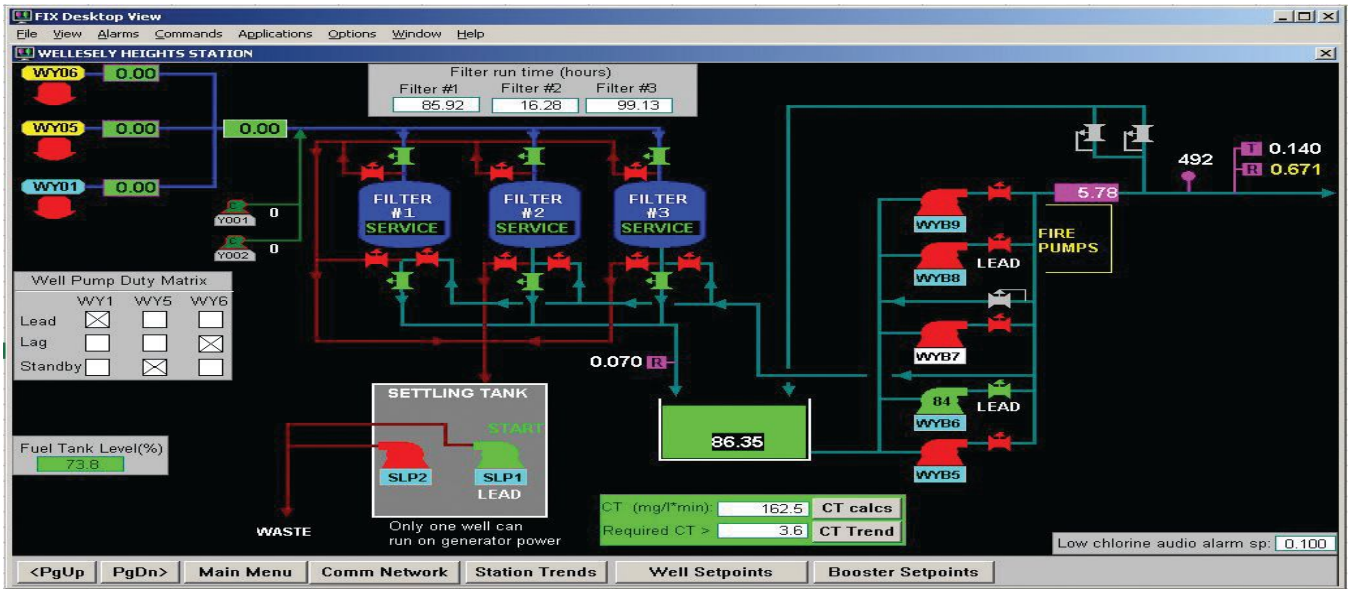

Supervisory Control and Data Acquisition (SCADA) on screen.

Most of us are so accustomed to water being there whenever we turn on a tap that we could scarcely conceive of functioning without running water for six weeks straight during a system upgrade. Municipalities across the province know this is not a reasonable proposition for consumers and have tactics in place to prevent service disruption during repairs, including water storage, such as tanks and reservoirs, and redundancy, such as multiple facilities within the treatment and distribution systems. In many small towns, however, these options are not available. The question then becomes, what happens now? What can be done when a remote processing unit (RPU) for such a town, a vital component of the Supervisory Control and Data Acquisition (SCADA) system that monitors and controls the wider water treatment and distribution system, requires replacement?

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The Region of Waterloo recently faced this very situation. A blend of the major urban centres of Cambridge, Kitchener and Waterloo as well as the rural Townships of North Dumfries, Wellesley, Wilmot and Woolwich, the region is responsible for the treatment and distribution of safe drinking water to a large geographical area and population base of approximately 570,000.The water system is comprised of both surface and ground water treatment systems through a distributed network and individual systems consisting of over 120 facilities, with an average daily production of 160,000 m^3. While the vast urban distribution system within the cities contains multiple storage reservoirs, treatment plants and booster stations, the small rural-based water system in the community of Wellesley does not, which presented the region with a challenge.

The region relies on a SCADA system to manage its massive water distribution system. Through the use of computers, wide area networks and RPUs, the system provides the ability to automatically control water operations. From their operations centre at the Mannheim Water Treatment Plant (WTP), operators are able to remotely observe what is happening at any facility and make control changes when necessary. The RPUs provide the fundamental control and monitoring of the pumping and process equipment at over 180 units throughout their system. Typically, RPUs contain custom software that is intended to provide a specific function such as turning a

Exterior and interior views of the new remote processing unit (RPU) panel.

well pump on or off to pump water out of the ground.

The Wellesley WTP is a typical ground water treatment plant consisting of ground water extracted from numerous wells, sand filtration system, chlorination to provide overall disinfection, an onsite treated water reservoir and multiple booster pumps to maintain adequate pressure within the distribution system. The facility is controlled by an RPU that, through its custom software, determines when well pumps are to start and stop, how much chlorine is to be injected and how many booster pumps are to operate so that the community always has safe drinking water and adequate pressures. The RPU is critical to this operation of the facility as it is not manned and is remotely located from the operations centre at the Mannheim WTP.

The RPU had reached the end of its useful life. Typically, RPUs are located within enclosures that protect the electrical components from the environment that it is in. The humidity and chlorine vapours found in the air in water plants can often damage equipment. The enclosure itself can go through many upgrades through its life cycle resulting in multiple changes. The original RPU enclosure at the Wellesley WTP was installed in the 1990s and had been through an upgrade previously. Over time the enclosure had equipment added into it and thus was becoming tight for space.

Many factors are considered when determining the plan for replacing an RPU, including the current condition of its enclosure, whether the system can operate for an extended period of time without the RPU, and what opportunities might exist for improvements. The region looked at these options and, due to the age and condition of the enclosure and the need for the facility to remain operational 24/7 given its status as sole source of water for the community, a brand new RPU panel in a new location within the facility was identified as the path forward.

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The upgrades followed a traditional design, bid, build process. The consulting team and the region reviewed the facility to find a new location for the RPU enclosure. As with most controls and automation upgrades, nothing was straightforward, and the best location for a new RPU panel just happened to be in the same location as an existing floor drain and instrumentation. The design took this into account, and the floor drain system was reworked by the contractor prior to installing the new enclosure. The instruments that monitored the chlorine residuals in the water and the turbidity had to be relocated. A new instrumentation mounting system was supplied and installed by the contractor along with new sample lines. With these process and building systems addressed, the installation of the new RPU enclosure could begin.

During construction the new RPU enclosure was fabricated by the contractor based upon the overall design requirements. A brand new Schneider Electric SCADAPack357 field controller and the necessary expansion input and output (I/O) modules were built into a new

New conduits to route control systems back to the RPU.

The floor drain was relocated to make room for the new RPU panel.

enclosure. The region also took advantage of this upgrade opportunity to migrate the facility to their new fibre optic communication network instead of reusing the legacy serial-based leased lines. With the facility still being fully monitored and controlled through the existing system, the new RPU enclosure was installed on site. Brand new conduit and wiring was routed from the enclosure to all of the instruments, well pump starters, booster pump variable frequency drives, which control the speed of the pump and thus the pressure in the distribution system, and other equipment. With that in place, the changeover was ready to begin.

Not only does the region operate the plant, but they also have regulatory responsibilities to report information from the facility to the Ministry of the Environment and Climate Change. Without the SCADA system, and in particular the RPU, this is a manual labour activity as operators must note and record this information as frequently as every five minutes. A systematic plan was developed by the project team that was intended to minimize the impact on day-to-day operations. The plan proposed placing the new RPU online and communicating back to the SCADA system. One by one, each I/O point was relocated to the new RPU and tested jointly by the contractor, consultant/system integrator and operations.

The complete changeover was broken up into multiple days with goals at the end of each day set to be achieved with a commitment by all to stay until they were completed. The first system to swing over to the new control system was the booster pumps and was scheduled for the middle of the morning when demand typically is lower. Once this was complete, the changeover progressed by moving into the disinfection system, followed by the filters and, lastly, the wells. While there are always moments of excitement and uncovering issues along the way, by the end of the week the entire changeover was completed as planned and the contractor could remove the old equipment. There were no disruptions to the water supply for the community, and the region met all of their regulatory requirements at all times.

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The success of the project was grounded in tried-and-true methods of developing an overall plan, effective communication with respect for the needs of all parties involved, and working closely to execute the plan. No one person could operate a facility while testing software and wiring equipment all at the same time and, as a result, a true team effort must come together. With the project completed on time and on budget while water kept flowing, it was an impressive achievement. Moving forward the region now has a brand new RPU panel that they can fully support and rely upon. Time to move on to the next replacement!

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