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Improve Power Monitoring at Remote Water Facilities

For any water utility, a reliable electricity supply is essential to keeping the water on and ensuring regulatory compliance. One utility is using advanced communication protocols to help it respond better to power interruptions at remote sites. **BY KEVIN STEWART AND GRAHAM NASBY**

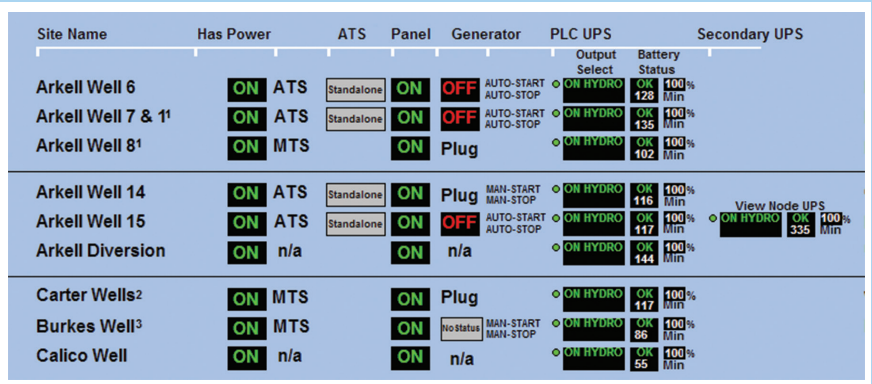
CONTRARY TO common belief, electricity and water do mix! For water systems, power is a critical input to operations. Pumps require electricity to operate, and supervisory control and data acquisition (SCADA) systems need electricity to monitor and control process equipment and log critical compliance data. But effectively monitoring the electricity supply to water facilities is challenging. For example, Guelph Water Services (Ontario, Canada) has 30 remote facilities, all unmanned, each of which has its own power feeds.

Thus, when a storm occurs or there are problems in the water utility's power lines, it's imperative that operators know which sites have power and which don't. Furthermore, remote monitoring is needed to check the status of generators, automatic transfer switches, and uninterruptible power supplies (UPSs). The operations team can use such power status information to effectively determine when, and in what order, to check on facilities—or make process adjustments—during power outages.

At Guelph Water Services, each of 35 SCADA programmable logic controllers (PLCs) distributed throughout the city's water facilities is equipped with a UPS, as shown in the photo on page 30. The UPSs keep the PLCs online during power outages, so the SCADA system can continue logging process data and providing monitoring and control connectivity to the centralized SCADA system. The UPS units are sized to provide at least 30 minutes of runtime for each PLC, which is enough time to cover more than 95 percent of power outages. As part of this setup, the PLCs also look after shutting off process equipment at the start of a power outage and restarting facilities once stable power returns.

Status Screen

A single status screen was added to the SCADA system so operators could check the power status of all the city's remote water facilities at a glance.



MONITORING POWER STATUS

To ensure power-supply security, Guelph Water Services embarked on a project in 2017 to enhance the monitoring of electrical power at all its sites. This included adding power status relays to PLC panels, improving generator status monitoring, monitoring automatic transfer switches, and adding communication cards to monitor UPS units. The project also included monitoring small PLC-panel UPSs and large-facility UPSs.

In 2013, Guelph Water Services had already started on a project to standardize the typical UPS units it uses. For PLC panels, a standardized 1,500-VA UPS from a reputable manufacturer was selected, so only one set of spare units and spare batteries had to be stocked. For larger UPS units, the utility selected

PHOTOGRAPHS: CITY OF GUELPH WATER SERVICES

Using a new power status screen, Guelph Water Services' staff can quickly see the power status of any of the utility's 30 remote facilities at any time.

units that closely matched individual site requirements while ensuring appropriate vendor-support agreements were in place.

UPS COMMUNICATIONS

Part of the UPS selection process was to go with enterprise-grade UPS units. This meant ensuring each UPS would have certain core technical features, including the ability to add a network communications card. The city went with an Ethernet UPS network card that leverages the existing SCADA network, uses standardized Ethernet-based protocols, and allows access to a diagnostic webpage for each UPS.

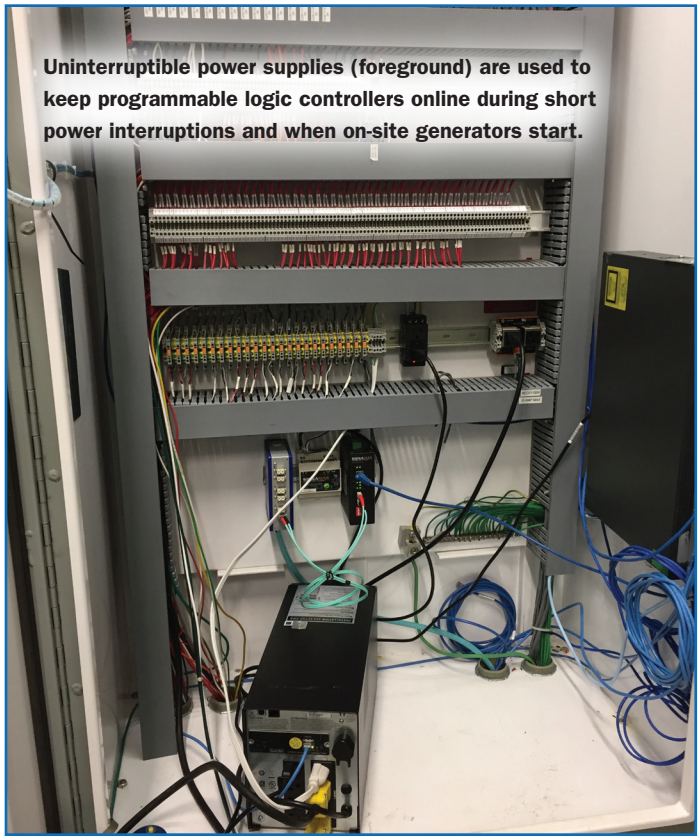
For the PLC-panel UPSs, the city selected units with advanced network management capabilities based on the number of existing UPS units and available technical features. A comparison of UPS vendors will show product lines offering similar configurations. For large-facility UPS units, the city installed the corresponding Ethernet network cards. The city avoided using serial protocols and relay-based UPS interfaces to ensure each UPS would have a built-in diagnostic webpage accessible for troubleshooting via the SCADA network.

Connecting the UPSs to the SCADA system posed some challenges. The original plan was to connect using the Modbus TCP protocol, as the city already had a Modbus driver installed in its SCADA software. However, the UPS network cards' Modbus interface didn't include all the status monitoring points desired. Instead, the city elected to use simple network management protocol (SNMP), a widely used communications protocol from the IT sector. All the city's UPS units, including the PLC-panel UPSs and the large-facility UPSs, also supported the SNMP protocol.

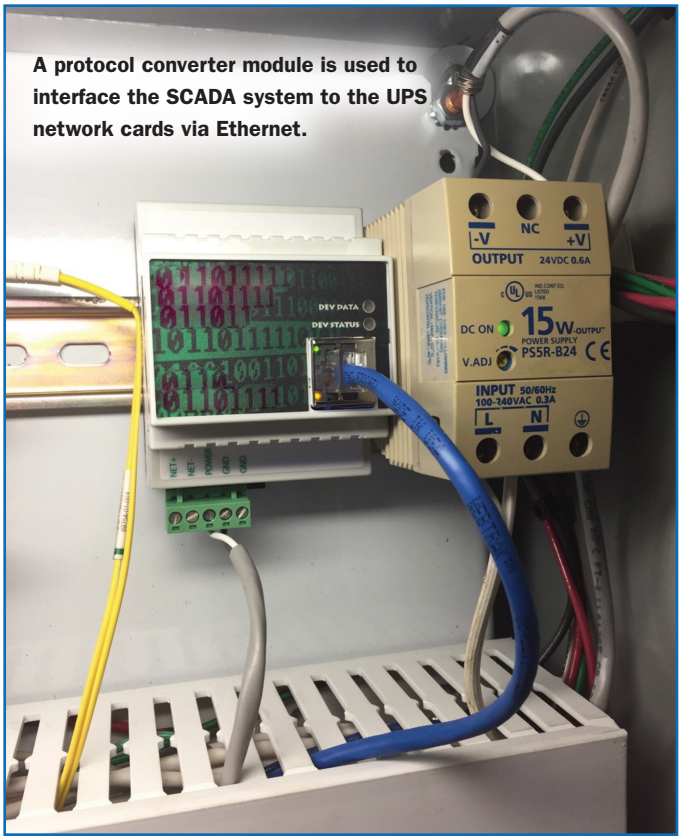
Because SCADA systems don't readily speak SNMP, the city used a centralized Ethernet-to-Ethernet protocol converter module, as shown in the photo on page 30. The city selected a device for this role from among several modules available on the market and used the device to convert the SNMP protocol's object identifiers into Modbus holding registers that could be read by the SCADA system. The device also provided a web-based setup utility that used XML configuration files that can be readily uploaded or downloaded via its web interface.

USING THE UPS DATA

Once the city could read the UPS status data into the SCADA system, the next step was to put the data into a format that could be used by the operations team. This was accomplished by designing a power status screen that provided power feed, generator, automatic transfer switch, and UPS status for all sites on one human-machine interface (HMI) screen.



Uninterruptible power supplies (foreground) are used to keep programmable logic controllers online during short power interruptions and when on-site generators start.



A protocol converter module is used to interface the SCADA system to the UPS network cards via Ethernet.

The intent was to have a single HMI screen that operators could use to get an overview of the power status across the entire water utility at a glance. Part of this screen is shown in the figure on page 28.

The screen features a standardized status row for each site. Each status row shows the site's overall power status; if there's an automatic or manual transfer switch (ATS or MTS) fitted; the type and status of on-site generator, if one is present; the status of power feeding the PLC panel; the status of any UPSs on-site; the percent of battery left; and remaining UPS runtime. An on-screen legend is provided for reading the compactly arranged UPS status indicators. Also, if legacy equipment is used (e.g., older stand-alone ATS units) that isn't yet monitored by SCADA, this information is also provided to operators.

The ability to remotely read the real-time battery status and remaining runtime for the PLC panel UPS units, in particular, has proved to be an extremely useful tool for Guelph Water Services. Since most of the utility's remote water facilities use live water tower level readings to automatically start and stop pumps, maintaining power to the PLC panel and communications at the water towers is vital. Hence, it's important for the operations team to know the power status for these facilities.

Now that operators have real-time data about the power status and number of minutes of UPS battery runtime left for each water tower, they no longer have to immediately visit each water tower after a power disruption. Armed with detailed information about how much UPS runtime is left at a site, operators can now decide if (and when) a site needs to be visited or not.

Moreover, because many power outages are often 5 minutes or less, many unnecessary site visits have been eliminated. The UPS unit in the PLC panel always keeps each water tower's level measurement online. Additionally, for sites with large pumps that the PLC has automatically shut down because of a power outage, the operators can see if there's enough UPS runtime left for the PLC to seamlessly restart the station once power is restored.

Using the SCADA system's new power status screen, operators can quickly see the power status of any of Guelph Water Services' 30 remote facilities at any time. The screen is available at all SCADA terminals and is now used extensively whenever storms or other problems affect the power feeds to the utility's facilities. Equipped with this knowledge, the operations team can make better decisions based on real-time data as to which sites to visit, including when and in what order, during a power interruption.