WATER OPERATIONS: SECURITY OF SUPPLY – MONITORING POWER STATUS OF REMOTE WATER FACILITIES

BY KEVIN STEWART AND GRAHAM NASBY

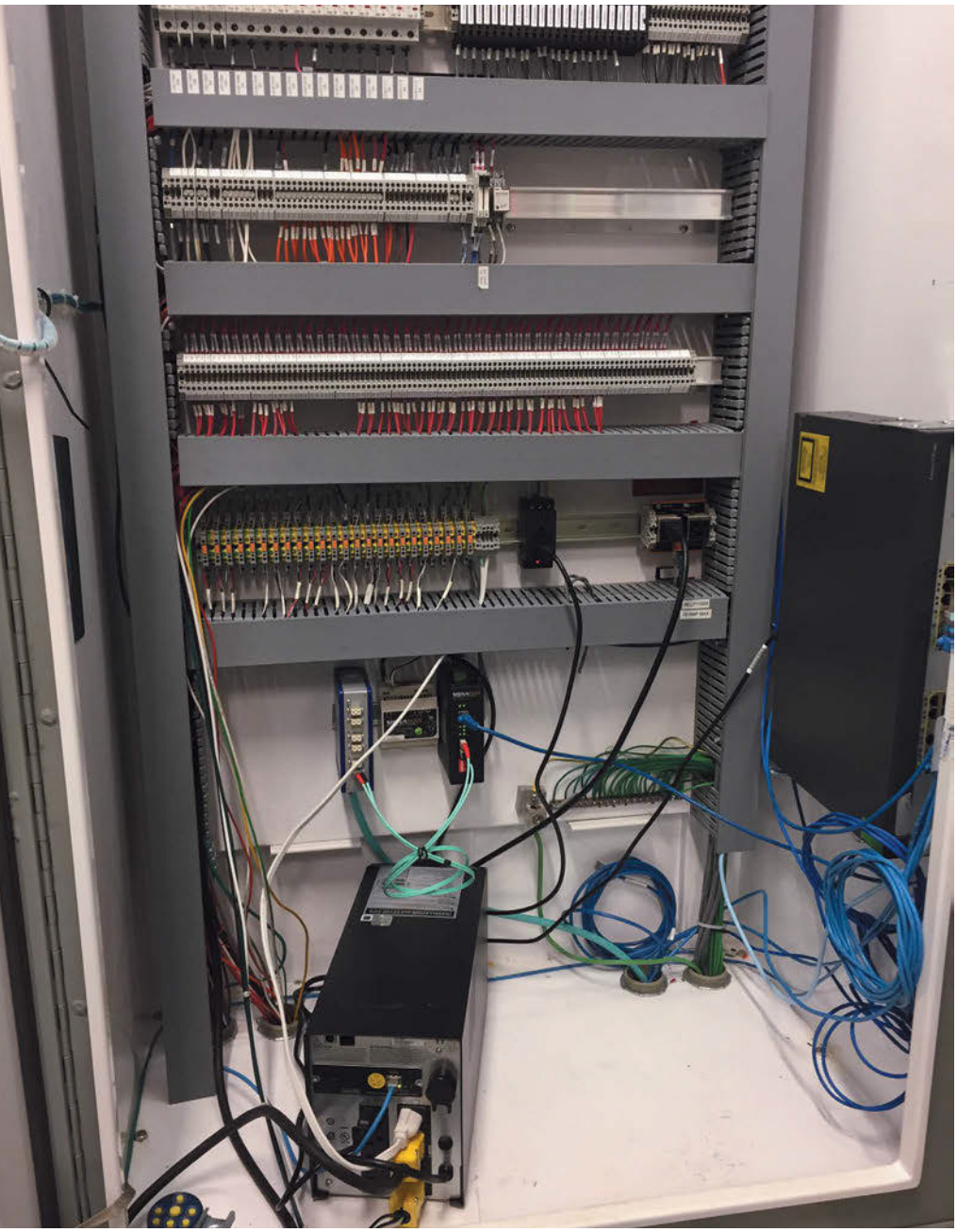

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Figure 1 – UPS (interruptible power supplies) are used to keep PLC panels online during short power interruptions and to keep PLC panels online while on-site generators are starting up. Notice the communications network card in the back of the UPS.

Contrary to what your parents said, electricity and water *do* mix! In fact, for any water utility, a reliable electricity supply is essential to keeping the water on and ensuring regulatory compliance. Pumps require electricity to operate, and the SCADA (supervisory control and data acquisition) system needs electricity to monitor/control process equipment and log critical compliance data. However, effectively monitoring the electricity supply to water facilities is challenging. For example, Guelph Water has 30 remote facilities, all unstaffed, with each having its own individual power feeds.

Thus, when there is a storm, or there are problems in the hydro utility's power lines, it is imperative that operators know which sites have power and which do not. Furthermore remote monitoring is needed to check on the status of generators, automatic transfer switches, and uninterruptable power supplies (UPSs). Using this power status information, the operations team can then effectively determine when, and in what order, to check on facilities – or make process adjustments – during power outages.

At Guelph Water, each of the 35 SCADA programmable logic controllers (PLCs) that are distributed through our water facilities is equipped with a UPS. The UPSs keep the PLCs online during power outages, so the SCADA system can continue logging process data and providing monitoring/control connectivity to the centralized SCADA system. The UPS units are sized to provide at least 30 minutes of runtime for the PLC, which is enough time to cover over 95 per cent 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 re-starting facilities once stable power returns.

Monitoring Power Statuses

To ensure security of supply, Guelph Water embarked on a project in 2017 to enhance the monitoring of electrical power at all of its sites. This included the addition of power status relays to PLC panels, improved generator status monitoring, monitoring of (electrical) Automatic Transfer Switches, and adding communication cards to monitor the status of UPS units. Monitoring both small PLC panel UPSs and large facility UPSs was also included in the project.

Starting in 2013, Guelph Water had already started on a project to standardize the typical UPS units it uses. For PLC panels, a standardized 1500 VA UPS from a reputable manufacturer was selected, so that only one set of spare units and spare batteries had to be stocked. For larger UPS units, a process of selecting units closely matched to individual site requirements was used, while ensuring the 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 that each UPS would have certain core technical features and the capability of having a network communications card added. In our case, we went with an Ethernet UPS network card so we could leverage the existing SCADA network, use standardized Ethernet-based protocols, and have access to a diagnostic webpage for each UPS.

For our PLC panel UPSs, we selected APC Smart UPS 1500 units with AP9630 network management cards. This selection was made based on our count of existing UPS units plus available technical features. It should be noted that other UPS vendors also have similar configurations available in their product lines. For our larger facility UPS units we installed the corresponding Ethernet network cards for those units. We avoided the use of serial protocols and relay-based UPS interfaces as we wanted to ensure that each UPS would have a built-in diagnostic webpage accessible for trouble-shooting via the SCADA network.

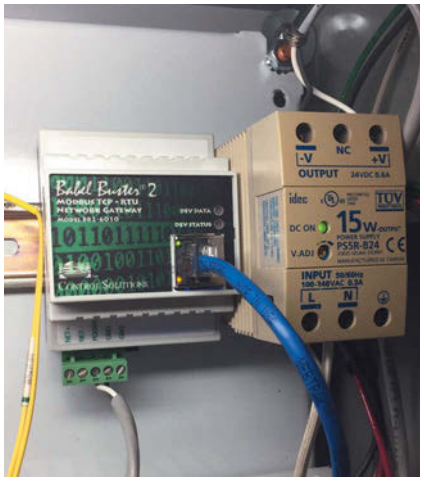

Figure 2 – Protocol Converter Module which was used to interface the SCADA system to the UPSs network cards via Ethernet.

Connecting the UPSs to the SCADA system did involve some challenges. We originally wanted to connect using the Modbus TCP protocol, as we already had a Modbus driver installed in our SCADA software. However, we discovered the Modbus interface of the UPS network cards did not include all the status monitoring points we wanted. Instead, we elected to use SNMP (simple network management protocol), which is a communications protocol widely used in the IT sector. All of our UPS units, including both the PLC panel UPSs and the large facility UPSs, also supported the SNMP protocol.

Since SCADA systems do not readily speak SNMP, we used a centralized Ethernet-to-Ethernet protocol converter module. For our system we used a device called a "Babel Buster" for this role, though it should be noted there are a several modules available from variety of vendors that could be used. We used the Babel Buster to convert the SNMP protocol's OID (object Identifiers) into Modbus holding registers that the SCADA system could read. The Babel Buster also provided a web-based setup utility that used XML configuration files that can be readily uploaded/downloaded via its web interface.

Using the UPS Data

Once we could read the UPS status data into the SCADA system, the next step was to put it into a format that could be used by the Operations Team. This was accomplished by designing a power status screen that provided the power feed, generator, ATS and UPS statuses for all sites on one HMI (human-machine interface) screen. The intent was to have a single HMI screen that operators could use to get an overview view of the power status across the entire

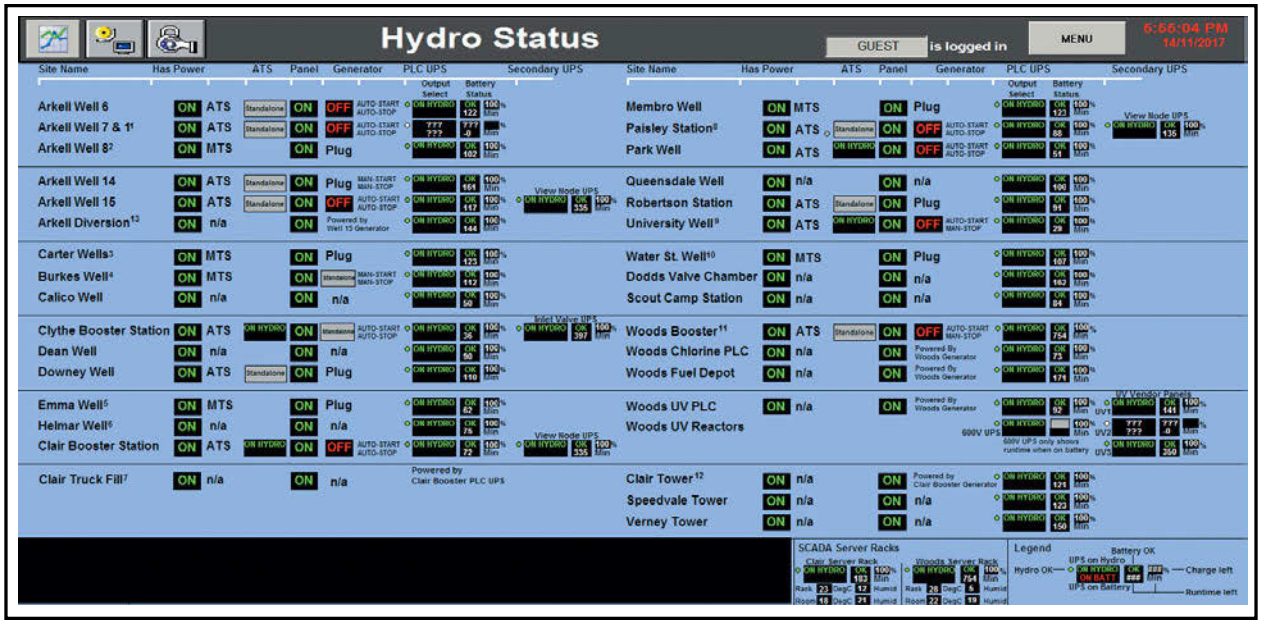

Figure 3 – A single status screen was added to the SCADA system so operators could see power status of all water facilities at a glance.

water utility at a glance. Part of this screen is shown in Figure 3.

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

Using the new Power Status screen in the SCADA system, operators now can quickly achieve situational awareness of the power status of Guelph Water's facilities at any time. This screen is available at all SCADA terminals, and is now used extensively whenever storms or hydro utility problems are affecting the power feeds to Guelph Water's 30 remote facilities. Armed with this knowledge, the operation team can now make better decisions based on real-time data as to which sites to visit, including when and in what order, during a power interruption event.

Kevin Stewart is a third-year engineering student at the University of Guelph in Guelph, Ontario. He recently completed a SCADA developer co-op placement at Guelph Water Services. Kevin, originally from Kingston Ontario, is enrolled in the UofG's B.Sc.(Eng.) Engineering Systems and Computing program. kstewa11@uoguelph.ca

Graham Nasby, P.Eng, PMP, CAP holds the position of Water SCADA & Security Specialist at City of Guelph Water Services, a publicly-owned water utility located in Guelph, Ontario, Canada. He is a member of both OWWA and WEAO, and currently sits on the OWWA Automation Committee. Graham is also co-chair of the ISA112 SCADA Systems Standards committee. graham.nasby@guelph.ca