Georgian College – Load Management

A critical failure occurred on Georgian College Campus in Barrie, Ontario at 3:15 a.m. on August 29, 2004 - a week before the new fall year was scheduled to begin. The 5 MVA transformer, replaced two years before as part of a campus expansion, suffered a primary fault to ground. Fortunately, the building services department had systems in place and the necessary personnel to minimize the downtime and return the college to full operating levels within days of the initial failure. The following article is an outline of what happened and the measures taken to maintain limited functionality on campus and an important study on the necessity of being prepared for supply crises in large facilities.

Jeff Choma, Manager of Electrical and Mechanical Services at the college, was on site soon after the failure occurred and with his experience with the campus network understood the problems that were about to occur. "Many of our critical systems are on UPS backup, but at best they were good for a single hour," said Choma. The Barrie site acts as the hub for the Owen Sound and Midland campuses along with other smaller satellite sites, connecting the college computer system, building automation and security systems.

Additional security were called in to patrol the buildings once the UPS back up ran out, in case of fire or a problem resulting from the power outage since they had no idea of the damage that might have occurred during the fault. There was also the issue of thousands of dollars of equipment and computer labs that were now completely without surveillance.

With the security and safety issues addressed, the problem began of finding replacement power. Three years prior, the original 2 MVA transformer had been upgraded to 5 MVA, and the old 1968 Wooden had been kept in storage. With the options of diesel generators and rental transformers both being cost prohibitive, Choma opted to temporarily replace the 5 MVA transformer with the old 2 MVA. After some rudimentary tests, the 2MVA transformer was re-installed in its original place. The only problem was the campus load had increased significantly since the upgrade and there was no way the old Wooden would be able to carry the full campus load. The campus normally operates between 2500-2700 kW and while leaving enough head room for unexpected draws, the 1968 transformer would be operating at a maximum of 900 kW or 1/3 the normal capacity.

While the old transformer was being installed, a separate crew had tested the main high voltage lines running to each building for faults caused by the possible spikes that might have occurred during the failure. All had survived except for one, the line supplying building F, the location of the building services offices and the main automation control room. The crew found, excavated and repaired the 3 phase fault to ground that had occurred in the line.

With the transformer in place, a whole new set of problems arose. Each building had to be brought on-line separately in order to maintain the overall load below 900kW. Without the main control room, there was no way to monitor the kW consumption. “I needed to create a path back to building F so that I could regain access to the control room and be able to see what was going on,” said Choma. The main metering room is located in building B, adjacent to the transformer, and whether or not they could see the meters on their systems; they needed the meters to be logging data as soon as possible. Building B was brought on line first, allowed to stabilize, and then every non-critical load in the building was shut down. Initially, lighting was the only load allowed to remain. The second building to come on line was building C, where the main computer room is located and the hub of the fibre optic network that connects the entire campus. With only lighting loads allowed to stay on, building C was brought up and once stabilized, building F was finally activated.

In the initial design of the automation systems, Electrical Services had specifically maintained separate control systems so that in the event that one failed, the others would still be in operation. It proved to be a good strategy since one of the control systems is connected through a RS485 data loop that failed when a spike went down the line. The other systems were connected by fibre optics and were still intact. With most of the control room back in operation, the staff could now use both the Power Measurement ION Enterprise power monitoring system and the Siemens and Carrier automation systems to monitor what was happening on campus. “Using the energy monitoring system we could see the power factor, the kilowatt load, frequency and to see how the system was reacting as each building was brought on line.” Each system had to be turned on, stabilized and then turned off so that the building automation systems could recognize it and then control it. “The combination of the power monitoring and the two building automation systems gave us hard data with feedback, a cause and effect relationship so that we could operate within known parameters.”

It was at 4:00 a.m. on Monday, August 30, 24 hours after the failure, that the campus was stable enough for the team to go home for a much needed rest. At 8:00 a.m. that same day, they were back on campus. With 7,000 students arriving in a week, approximately 3,000 staff showed up to get ready for the start of the new school year. With only 900 kW available, many of them were asked to work from home if possible and if they did stay, not to turn anything on.

Using the power monitoring system, each building was flagged at a specified consumption level to be able to identify which building was the cause in the case of an overall rise in kW usage. If consumption rose above the flagged level, the entire building would simply be shut down. “The 2 MVA transformer was the only one I had left. I wasn’t about to risk having it go down,” said Choma. By establishing load trends for each building, they were able to predict load fluctuations and prevent buildings from exceeding their allotted kilowatts. They spent four days closely monitoring the whole campus, shedding loads when required and manually disconnecting pop machines, computer labs, hand-dryers, anything non-essential that could be taken off-line. “The in-house staff switched the loads that could not be changed remotely from the central control room, without their efforts we would not have accomplished what we did,” said Ron Howden of Langford & Associates who spent several days in the control room monitoring the fluctuating loads. The student resident had been put on diesel generation on the first day after the failure since students had already begun arriving and there was too much possibility for demand overrun.

Ventilating the campus proved to be one of the biggest challenges. All the buildings had been without ventilation for over 24 hours by the time they could evaluate their ventilating options. Fortunately, the weather co-operated. With mean outside temperatures around 15°C, they were able to cool using outside air for most of the day and only reached first stage cooling at the mid-day peak time and never resorted to second stage. CO_2 levels from the Siemens building automation system allowed them to juggle cooling between buildings. When one building reached a pre-determined zone temperature, the cooling was disabled and the kilowatts made available to another area for ventilation. The process required a good deal of hands-on monitoring but it allowed them to keep inside temperatures, in all buildings, from exceeding 23° C.

On Thursday, the replacement transformer arrived, a second 5 MVA transformer with capacity enough to carry the entire campus to start the year. So once again the team of contractors came together to replace a transformer in the dark hours of the night. “On Friday, once the transformer had been installed, we turned everything on. I wanted to make sure that if it was going to fail, it failed then and not the first week of school,” said Choma. Everything held and they were able to bring the student residence back on line.

With full power to all systems, they were able to see the extent of the damage. Along with the building control system, fire alarm modules, breakers, contactors, ballasts, control transformers, fuses, motors and compressors had all failed.

Choma estimates the damage at over $200,000 but without the combination of control systems and power monitoring, it would have been a lot worse. “If we had had to hire someone to come in and manage the situation for us, it could easily have been over $500,000. By using our own in-house staff and our existing systems we got the campus back on-line faster and at a much lower cost.”

Choma plans to install a second transformer on a pad next to the existing in case of future failures, bringing him up to a back-up level usually reserved for larger power consumers. “We were fortunate,” he stated, “we had an extra one. This time we’ll do scheduled maintenance on the back up transformer.” He also plans to use what he’s learned to increase the energy management of the campus. With the Power Measurement, Siemens and Carrier systems in place, the campus is set for load shedding and much more intensive energy management. “We’ve seen what we can do in an emergency, now I’d like to implement that day-to-day.”

ION Enterprise Vista screen allows operators at Georgian College to track all loads across campus to ensure the transformer is not over-loaded.