Energy Monitoring Aids University's Energy Usage and Cost Reduction

Photo courtesy of the University at Buffalo

Electro Industries/GaugeTech
The Leader in Power Monitoring and Smart Grid Solutions

Case Study - University at Buffalo State University of New York

- **Lower Energy Usage Costs with Real Time Monitoring, Campus-wide**
- **Reduce Energy Consumption through Awareness of Energy Use**
- **Analyze Power Quality Problems to Improve System Reliability**
- **Meet Campus Energy Goals and Carbon Footprint Reduction**

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The University at Buffalo (UB) is the largest campus of the 64-campus State University of New York (SUNY) system. It is a community of approximately 30,000 students and a faculty and staff numbering nearly 7,000. The university is spread across three campuses: North Campus, South Campus and Downtown Campus.

- The North Campus has 146 buildings containing over 6,700,000 square feet with an average demand of 30MW.
- The South Campus has 53 buildings containing over 3,000,000 square feet with an average demand of 5MW.
- The Downtown Campus has 43 buildings including shared leased space containing over 588,000 square feet with an average demand of 2.5MW.

Like all Universities, UB was faced with energy management challenges.

➤ Main Challenges

Lower Energy Usage Costs and Reduce Energy Consumption
UB needed to lower cost and energy usage, but to do so they needed to be able to monitor their actual energy use. As the University's need for more energy usage data grew, UB started to investigate replacing their existing subscription-based monitoring system with a more extensive web-based monitoring system. Their existing system monitored energy and demand for several dozen buildings on campus. Since the data from this system was not real time monitoring, it could not be used with their building automation systems for control purposes.

➤ Main Goal

Use Advanced Metering to Gain Information to Address the Challenge
One key goal in implementing a campus-wide monitoring system was to monitor every building on campus, giving management detailed real time accounting of when and where energy was being consumed. This information would be used for:

- Benchmarking
- Cost Allocation
- Control
- Demand Response Programs

Analysis of this data would aid in:

- Identifying Inefficiencies
- Identifying Performance Related Issues
- Load Planning
- Helping to identify energy related projects with the greatest return on investment

➤ Main Considerations

In the process of developing the requirements for a campus-wide monitoring system a number of things needed to be considered:

1. Data Integrity
2. Real Time Monitoring
3. Security
4. Ease of Use
5. Scalability
6. System Provider

1. For **data integrity** it was imperative that the meters be revenue grade and have an accuracy of ±0.1% for Volts and Amps, and ±0.2% for power and energy, In addition the meters had to have internal memory with a minimum of 90 days of data retention as a backup to the campus monitoring software.
2. **Real time monitoring** was required in order to supply real time data to several different building automation systems on the various campuses.
3. **For security**, the meters needed the capability to be password protected in order to prevent unauthorized resetting of the demand and energy readings as well as reconfiguration of the meter's profile. Security was also important as power meters would be supplying data to the control and DDC systems. For this reason, the power meters needed to have separate isolated outputs and communication ports. These outputs needed the capability of a second Ethernet port, a serial port, and analog and pulse outputs.
4. Regarding **ease of use**, the power meters had to be easy to configure in the field or over a network, and have the ability to be upgraded to add additional features and capabilities without the need of replacing hardware. It was required that the campus-wide power monitoring system be web-based, with no applications needing to be installed or maintained on any individual PC. The monitoring system needed to be easy to use and intuitive to navigate, in order to see real time data from the entire campus on down to the building level. Historical data and trends had to be updated in real time and be easily accessible as well as automatically exported to the university's Energy Cap energy management reporting software.
5. **Scalability** was necessary as the university continued to grow and more metering points were required to quantify campus demand and consumption. With ongoing new construction projects, the addition of renewable energy projects and the need for more finite analytical data, it was important that the campus monitoring system be able to grow while protecting the university's initial investment.
6. The **system provider** needed to have a proven track record in providing metering hardware and software and to offer an extended warranty. The provider needed to be able to demonstrate that they had successfully installed similar systems, utilizing their standard product offerings, for a minimum of five years.

➤ Preparing the Project

The University at Buffalo worked with M/E Engineering to develop a detailed specification for a campus-wide monitoring system.

The turnkey solution called for the installation and commissioning of meters, their associated hardware and a graphical web interface.

In the development of the project's specifications, numerous parties were involved from the earliest onset. These included UB facilities, IT, Project manager Pres Services, Contractors, and Vendors

Each of the 237 metering locations were surveyed and detailed with hardware and network considerations.

- ✓ Metering locations included new metering points as well as replacing existing electro-mechanical, analog and electronic meters.
- ✓ Detailed information included: CT sizing for new installations and the re-use of CTs for existing meter locations.
- ✓ Network infrastructure and support, server requirements, and location of data drops were also documented.

Meters: For standardization and ease of installation, the final specification called for each location's meter to be mounted in one of three pre-wired UL-listed assemblies, which would include the meter, CT shorting blocks, fusing, disconnect switches, control power transformer where required and terminals for inputs and outputs. The meter assemblies were as follows:

- ✓ Meter Exterior Enclosure: Steel weatherproof NEMA 4 enclosure with padlock provisions and the meter mounted on an internal hinged panel.
- ✓ Meter Interior Enclosure: Steel NEMA 12 surface mount enclosure with padlock provisions and the meter mounted on the front door of the enclosure.
- ✓ Flat Panel Assembly for Existing Switchgear: Custom steel plate assembly to be mounted over the opening of existing switchgear.

Communication Software: The power monitoring communication system was to be web-based with SCADA capability through a graphical interface.

- ✓ The system needed to give simultaneous users the ability to monitor and manage the power system through a web browser.
- ✓ The system needed to provide real-time data as well as historical logs, charts, graphs and reports.
- ✓ The monitoring system needed to be able to monitor power quality events and offer comprehensive data analysis.
- ✓ The interface needed to display meter geographical locations on a campus map, along with campus and all campuses total usage, with the ability to zoom down to the building level.

- ✓ The monitoring system had to export/data transfer information to the university's existing Campus Energy Accounting System.
- ✓ The system needed to use standard Modbus TCP architecture and to be scalable to 400,000 points without modifying existing software.
- ✓ Data security and backup would be required of the system.

Project funding: Funding and incentives for the implementation of a campus-wide monitoring system were provided by New York Power Authority (NYPA) and New York Energy Research and Development Authority (NYSERDA).

Project Awarded to Electro Industries/GaugeTech (EIG): Bid proposals were evaluated by the project's team which ultimately chose the EIG solution with Ferguson Electric of Buffalo, NY as the prime contractor.

Shark® 200 Meter in Internal Enclosure

➤ Project Implementation

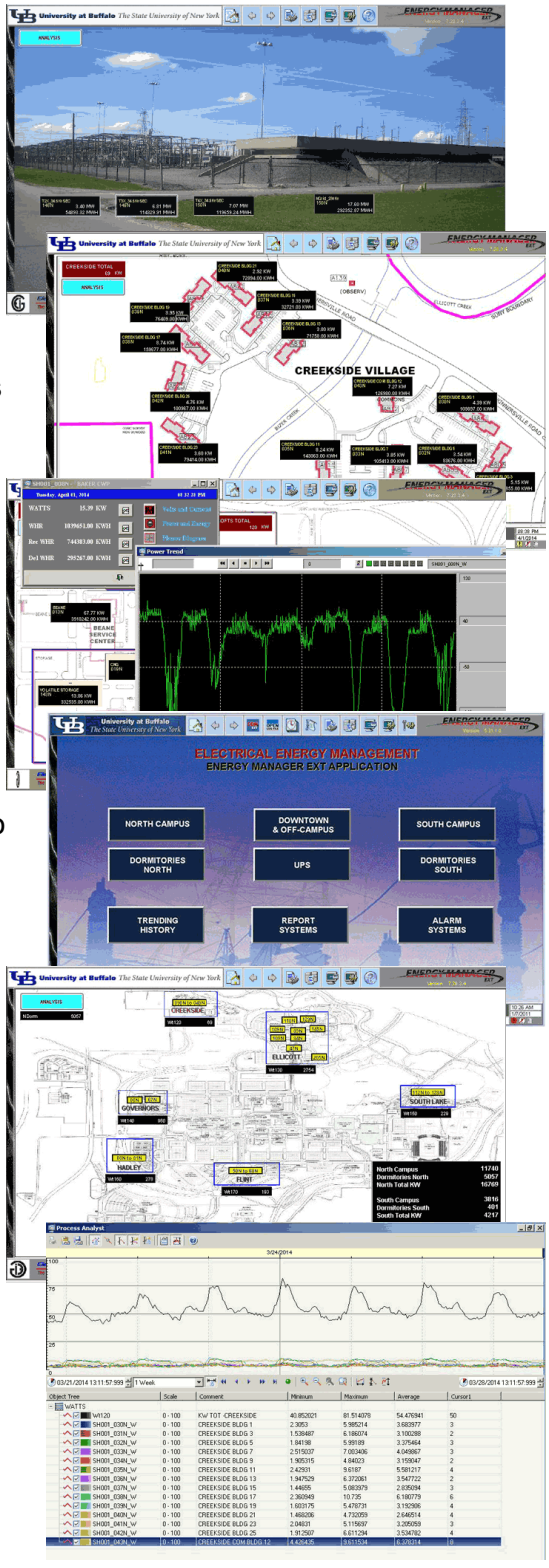
EIG supplied a turnkey campus monitoring system which included:

- ✓ 237 revenue grade Shark® 200 meters with internal data logging, Ethernet and serial ports.
- ✓ Some meters had additional features for their specific locations, such as analog outputs, pulse inputs and power quality with harmonic analysis capability.
- ✓ The meter enclosure assemblies were fabricated by Volland Electric in their panel shop located in Buffalo, NY.
- ✓ Prior to delivering completed assemblies to the installing contractor, Electro Industries programmed all of the meters with a pre-determined standard meter profile along with the specific IP address, meter name, CT ratio and any required scaling of outputs for each installation. An engraved nameplate was applied to each meter assembly with its meter name/location and IP address. The meter assemblies were then shipped to the contractor, plug-and-play ready.

Meter Installation: Electro Industries worked in concert with Ferguson Electric and Pres Services supporting the installation efforts. All work was performed in compliance with all applicable codes and standards. Due to required shutdowns, many of the installations were performed during evening hours to minimize any inconvenience. Because meters were pre-programmed and Electro Industries was given remote access to the campus power monitoring vpn, meter installations were verified as they were completed to ensure valid communication to the meter on the network, that wiring of the installed meter assembly was correct (no reversed polarity of CTs or cross phasing), and that the data was accurate.

Software Integration: In parallel with the installation of the meters, Electro Industries performed the integration of the meters and inputs into its graphical HMI EXT™ SCADA software.

- ✓ The Energy Manager EXT™ software suite would allow users to connect to a graphical Human Machine Interface consisting of the Energy Manager™ Software applications.
- ✓ Using HMI EXT™ software, the university would graphically view all data through a Local Area Network (LAN) or the Internet, and compile energy usage reports easily and quickly.
- ✓ At the building level, discreet critical loads such as UPS, and net metering for renewable energy sources the HMI EXT™ application would graphically display real time voltage, current, power and energy readings.
- ✓ The historical log files could be accessed either through the interface graphically, or as csv files. The logs would include energy readings, interval energy, demand and max demand with a time and date stamp. Graphs would allow users to zoom in and out, pan or define a window of time to be viewed.
- ✓ Demand totals and historical totals for the entire campus, including the North, South and Downtown campuses, substations and groupings of buildings, such as Creekside Village (a residence complex comprising of 14 buildings), would be displayed and plotted.
- ✓ In the substations, transformers were monitored and totalized. Pulses from the utility meters were accumulated through an IO card on the Shark® 200 meter. Totalized energy and demand from the substation meters could then be tracked against the utility pulse data.
- ✓ The power monitoring system had alarm functionality whereby users would be notified via email of any alarm condition. For example, meters going offline would generate an email to alarm recipients. Other alarms could be set based on exceeding programmed set points, such as demand limits.



Example Screens from UB's HMI EXT™ Application

- ✓ Log files and reports would be stored in designated folders easily accessible by system users. Monthly energy and demand reports to be exported to the university's Energy accounting software would be automatically generated.

➤ Results

The entire system was commissioned in April of 2012, and positive results were realized by UB almost immediately, including:

1. Immediate access to accurate real time readings campus-wide
2. Ability to analyze usage for the entire campus on down to specific locations and buildings
3. Immediate access to historical and trending data for analysis
4. Ability to identify power quality and performance issues
5. Ability to add additional metering points to the system as the need for more data grows
6. Support for a dashboard providing real time utility data to the UB community, increasing their awareness and commitment to reducing their consumption and carbon footprint

➤ Continuing Plans

- The power monitoring system will continue to be a vital tool as the university strives to meet NY Energy Efficiency Executive Order EO88, which has been signed into law and which requires a collective 20% reduction in energy use by April 1, 2020 relative to fiscal 2010/2011. This mandate requires benchmarking and energy reporting for all standalone state buildings greater than 20,000 square feet, and all multi-building campuses. Measurement of energy on multi-building campuses includes all energy consuming buildings, regardless of size.
- The University at Buffalo is committed to becoming climate neutral by 2030, per the university's Climate Action Plan. The power monitoring system supplied by EIG will play an integral part in helping the university attain its goals.

Bill of Materials for Similar Projects:

Shark® 200 Revenue Grade Data-Logging Energy Meter for Load Profiling

Ordering Part #: Shark200-60-10-V2-D2-INP100S-PO1S,
Shark200-60-10-V4-D2-INP100S-PO1S

Option Card: PO1S (Pulse Input/Output)

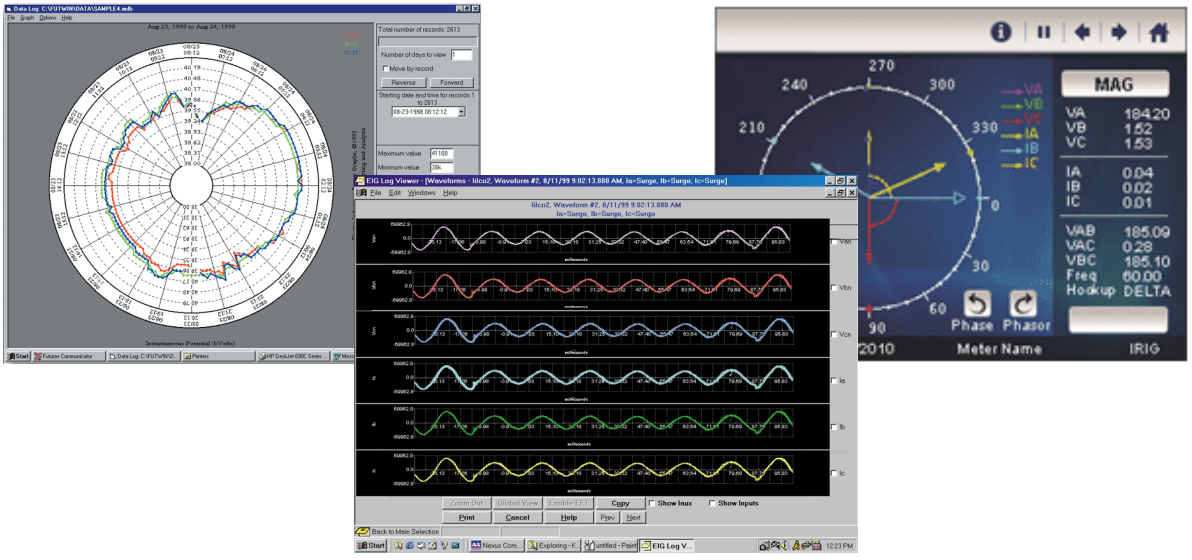
Option Card: 20mAOS (4-20mA Analog Output)

Communicator EXT™ Software Application for Meter Polling, Logging, and Configuration

Ordering Part #: COMEXT3

HMI EXT™ - Modular, Enterprise-wide Energy Management Monitoring System

Ordering Part #: HMIEXTC



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