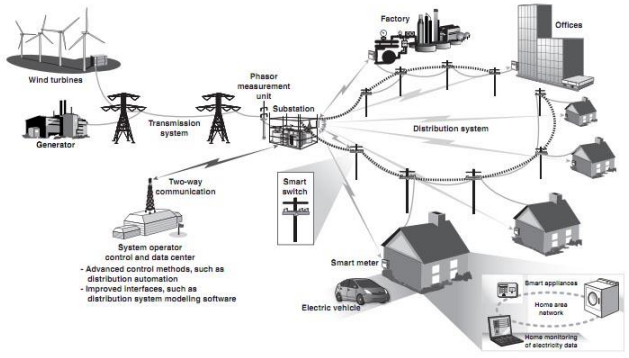

ADVANCED METERS AT ELECTRIC UTILITIES

Opportunities for cost savings and adding value for your commercial/industrial customers

SUMMARY

This article is a discussion of some of the benefits that may be realized by employing advanced meters at various levels of utility operations. All the examples given come from 17 years of personal experience as a Senior Engineer in the Metering Technology group at We Energies (WEC Energy Group) in Wisconsin. The document is meant to provide a general overview of why we chose to make the strategic decision to invest in advanced meters, and to discuss how the utility and our C&I customers benefitted.

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

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What are "Advanced Meters"?

There are various descriptions out there for what an "advanced meter" is. In some cases, AMI/AMR meters are placed in this category; however some of these automated meters have hardly more capability than old style mechanical meters. When I describe a meter as "advanced," I am referring to a measurement device that goes far beyond basic measurements used in utility billing.

The meters I consider advanced have the additional capability to measure and record power quality events (e.g., voltage sags, current surges), record voltage and current waveforms based upon a power quality event trigger, measure harmonic energy, accept various inputs from sources outside the meter, provide control outputs to external devices based on measurements made by the meter, while measuring real and reactive power and energy in all four quadrants (forward/reverse power and energy). In addition, an advanced meter will have superior data communication capability. There will be multiple types of ports to interface with a variety of devices, and the meter will be capable of handling multiple communication sessions, simultaneously.

Why Consider Advanced Meters?

The utility industry is very different from any other industry. Many investor owned utilities (IOUs) operate under some degree of regulation from state governments, as well as the federal government. With business operations, rates and profits being regulated to varying degrees, the only logical way for IOUs to insure profitability is to control costs. Generally, most IOUs will focus on the Operating and Maintenance (O&M) budget for their cost cutting, since those costs, like the Capital budget, are not supported by their rate paying customers. O&M expenditures are ultimately paid by the stockholders, so they directly affect profitability and stock value. Investing in technology such as Advanced Meter upgrades can result in substantial reduction in the O&M budget, over time.

Municipal utilities are non-profit entities, so their business dynamic is different from that of IOUs; however their goal should be to provide enhanced service while maintaining the lowest rates for their customers. More and more, these utilities are deploying Advanced Meters as one method to help control costs.

I mentioned budgets, costs, and profits first, because these are of primary importance in the successful operation of any business (obviously). However, I would argue that customer goodwill is at the core of a utility's continued success. Whether a utility does business in a completely regulated environment where operation parameters are very rigidly defined as part of a state's administrative code (e.g., Wisconsin), or exists in an environment where energy prices are determined by the marketplace, being valued by your customers is still the most important variable in the equation for success.

Integrating advanced meters into a utility's operation will have a number of benefits:

- Ability to provide special services to your C&I customers.
- Monitoring of power quality on the distribution system.
- Reducing or eliminating manual meter reads.

Leveraging Advanced Meters

1. Special Services for Customers
    - Allowing a customer to connect directly to a serial port or Ethernet port of an advanced utility meter will provide them with a much larger array of data than just contact closures that represent energy quantities. There will be many additional quantities available that can then be sent to a customer's energy management system, allowing them much better control and monitoring of their facility.
    - The utility meter can be used to provide a relay contact change of state, based on a number of varying conditions, so that a customer can improve control of some plant operation or provide a visual/audible notification of a specific condition (e.g., loss of a phase voltage).
    - A customer can be notified via email directly from the meter when a power quality event occurs. This is useful if there is an event that causes the shutdown/failure of a plant system, which needs to be attended to quickly to minimize damage and loss of revenue.
    - Providing hyper accurate control of a meter's clock can provide enhanced control of a customer's on-peak/off-peak energy management. Using the meter's IRIG-B port and a satellite-controlled time source, the meter's clock will be synchronized with millisecond accuracy against UTC time.
2. Distribution System Monitoring
    - Employing advanced power quality meters on C&I accounts is quite useful for identifying issues on the electric distribution system. Thoughtful placement of these meters can provide extremely valuable data to help identify problematic feeders and equipment. Email can be sent directly from the meter to distribution engineers whenever meters log events, providing a proactive element to distribution system maintenance.
    - Monitoring harmonic energy has not become a high priority for most utilities at this point, however an advanced meter placed at large C&I customer locations can provide valuable information regarding harmonic energy being generated. This information can help a utility monitor for conditions that may be causing excessive transformer heating or damage to nearby distribution equipment, such as capacitor banks.

3. Reduce or Eliminate Manual Meter Reads
    - Since advanced meters also have robust communication capability, a telemetry system using public networks (e.g., cellular) can provide all necessary data for billing customers. When paired with a cellular modem or router, an advanced meter is able to provide interval, register, TOU, and power quality data to the data collection/validation/billing system as often as necessary, without a site visit.

Experiences with Advanced Meters

In November 2004, my responsibilities in the Metering Technology group changed from all electric metering below 600 V to all metering above 600 V. I went from supporting about 1.2 million electric customers to supporting about 700 primary rate customers, as well as Balancing Authority metering and power plant metering. There were a total of about 1100 metering points that I would be responsible for as the Primary Metering Engineer. When I was made aware that the 700 primary rate customers accounted for more than 50% of the total electric revenue at the company, I realized I needed to start evaluating meters with more capability than the 1990 era models we had. I wasn't even certain how much revenue was moving across the 60 Balancing Authority metering points, but I figured it was huge.

In early 2005, I began searching for four quadrant meters with advanced capabilities, using the meters we had deployed at the time as a standard. I was interested in socket and switchboard meters in forms 9, and 5 (or 45) with blade power and external power. I wanted a meter with better than 0.1% accuracy, a full range of power quality measurements and logging, harmonic energy measurement (>25th order), THD measurement, waveform capture capability, energy values or pulse count interval data configuration, 10/100MB Ethernet, two or more configurable RS485 serial ports, large display with front panel controls, Test LED, IRIG-B port, Optical port, easy to use and maintain meter communication software, and MV90 capability, from a company with a proven successful history with advanced metering, and in a case with as low a profile as possible, to facilitate easy installation in as wide a range of switchgear metering bays as possible.

After evaluating several very capable meters over a two-year period, I chose the Electro Industries/GuageTech Nexus® meter. Overall, the features were superior, and the software was much easier to use than the other two companies' meter communication software. I was also given access to all their engineering resources when I needed a question answered. I found that refreshing. I had reviewed the history of the company and since they had been around since the 1970s, producing cutting edge advanced meters, I felt comfortable selecting them to provide meters to We Energies. The deployment of Nexus® 1272 meters, beginning in 2007, has resulted in some valuable improvements to services provided to key accounts at We Energies. According to several Key Account managers at the company, the improvement in ranking in the Key Account National Benchmark was partially

due to the customers' favorable view of the Nexus® 1272 meters that were installed at their facilities and the improved services that came with them. We also saw improvements in our distribution maintenance with the access to extensive power quality data from the Nexus® 1272 meters deployed at key accounts across the We Energies service territory. Rather than having to install a PQ meter or chart recorder temporarily on a problematic feeder at one of our largest customers and then hoping that an event would occur, a permanent installation of a Nexus® 1272 meter provided continuous monitoring and access to PQ data. The root causes of many distribution system and customer equipment issues were discovered and resolved. We Energies has won the ReliabilityOne Excellence award for a number of years, and the use of Nexus® 1272 meters definitely plays a part in that.

- Providing Information to Customers via Modbus Interface

Utility C&I customers have been able to acquire interval energy and End-Of-Interval pulse data from their meter for quite some time. It works, but it's limited in scope. Based upon the capabilities of the Nexus® meters that were being deployed at We Energies, I developed a plan to have the company offer a direct connection from the customer's energy management system to the COM4 serial port, using Modbus RTU protocol. This would be offered as Option B in the existing pulse output tariff. I modified the tariff language and got the changes approved in 2012, and the tariff took effect on 1/1/2013. Customers were required to pay an installation fee, but there were no monthly service fees. When compared to using KYZ data pulses, the main advantage is the lower cost to the utility, due to the use of a low cost RS485 hub providing 2500 V DC isolation, versus the high cost mercury whetted isolation relays used in KYZ output installations.

- Veterans Administration Hospital – Milwaukee, WI:

This was the first location to install a direct connection from the Nexus® 1272 utility meters to their energy management system. The VA was in the midst of an energy control initiative, and they were looking at an expenditure of around $300k (as told to me by the facility manager) to install equipment to monitor energy consumption and provide data to their EMS. When I suggested that we could facilitate a connection to our meters that would supply data beyond just energy information, and at 1 second polling intervals, they agreed. A hardwired connection was made to the meters through an RS485 hub (for isolation), and the EMS was configured to access 26 data points. The total cost to the VA was $260, including labor.

➢ Aurora St. Luke's Hospital – Milwaukee, WI

Aurora Medical Group was also trying to get a handle on their energy costs and improve efficiency. The St. Luke's Hospital facility was chosen as the initial site. I met with the facility manager to discuss the option of connecting the EMS to the Nexus® 1272 meters at the site. The only issue here was that the EMS did not speak Modbus. It was a BACnet system, and adding a module to the EMS was apparently not a simple integration. I suggested that a BACnet ProtoCom protocol converter be purchased from Electro Industries for each metering point. This solution provided for a clean install, where the converters detected the Nexus® 1272 meters and automatically configured the data points to be accessed in the meter. The EMS just had to accept the data and process it. The total cost for this installation was under $1500, based upon the standard We Energies charge of $130 per metering point and the purchase of two ProtoCom converters.

- **Providing Control for Customer Generators**

The rates for customer owned generation (COGEN) accounts can be somewhat complex. When a COGEN customer is also on a primary rate with a firm load commitment, it can be even more complicated – especially for the customer. If a COGEN customer has a contract where they are committed to pay for 200 kW of load and they don't get paid to sell excess energy to the utility, then they won't want to over-generate, even if the generator has the capacity. If they have to pay for 200 kW of load, then they will want to try and consume 200 kW of utility energy whenever possible. If the plant load ever drops close to 200 kW, the generator should not be running.

➢ Brookfield Wastewater Treatment Plant – Brookfield, WI

Brookfield Wastewater Treatment Plant is part of the Brookfield Water Utility in Brookfield, WI. In 2015, the utility installed a generator that was fueled from methane produced during the treatment process. Traditionally, the plant had taken energy pulses in 15 minute intervals for general energy control at the facility, but the addition of the generator and their firm load contract complicated the situation. During meetings with the wastewater utility, I decided that it would be possible to use the ElectroLogic Relay Control in the Nexus® 1272 meters installed at the plant to provide a control signal to the generator control system. I set up OR logic to open the normally closed contact of a remote relay when the plant load reached 202 kW, or if one or more phase voltages dropped to less than 30% of nominal. There was a 3-minute hysteresis set to prevent the control relay contact from making abrupt state changes if voltage or power fluctuations were occurring. This solution allowed the customer to run the generator for load reduction while maintaining a 200 kW firm load.

- **Email Sent by Nexus 1272® Meter for Power Quality Event Notification**

➢ We Energies Group Mailbox

In order to provide a medium for quick notification of power quality events that were affecting key accounts, I worked with IT to create a group mailbox for all Nexus® 1272 meters to send email to, whenever a power quality event occurred. The subject line of the email was specific to the account name, which allowed key account managers to scan the mailbox each day to check on their accounts. The idea was to try to be as proactive as possible in dealing with these events, and to initiate action by the line crews, troubleshooters, or underground crews before the customer had time to complain. Cost to implement this was almost nothing, but it created a lot of goodwill with We Energies' largest accounts.

Summary

My experiences with Nexus® 1272 meters as tools for providing valuable power quality information to a utility and creating customer goodwill have proven to me that a relatively small capital expenditure by a utility can have a large impact. It's not always easy to try and change how a company does business, or to convince people to think outside the box and embrace more advanced technology. I found that it was worth it. Once I approved these meters for use at We Energies, and people began to see the benefits for analyzing problematic feeders and providing enhanced services to our customers, I was constantly getting requests to install Nexus® meters at key accounts. Take my advice and investigate the many benefits of adopting the Nexus® series meters at your utility.