COMMERCIAL AND INDUSTRIAL USES OF POWER MONITORING – A PRIMER

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OVERVIEW

Power Monitoring – or Sub-Metering, as it is sometimes called - is a rapidly growing industry, which, to the uninitiated, can appear to be overwhelmingly complex. Just a few years ago, little information about energy usage and power quality was available without using very expensive lab-grade analysis equipment. Recently, however, the adoption of utility deregulation combined with volatile energy costs has driven energy consumers to find methods to actively manage their power systems. Today, with product choices ranging from basic 'stand-alone' energy (kWh) meters to extremely powerful, networked power management systems, there are solutions available to suit the needs of almost every energy consumer. The wide variety of available equipment and services can leave a potential user all but unable to define and select a cost-effective system to meet his/her needs. This article will attempt to explain some of the available solutions and required equipment, and hopefully help potential users to better define their needs and select the best approach for their application.

APPLICATIONS

COST ALLOCATION & SUB-BILLING

Cost allocation and/or sub-billing is the most basic of power monitoring applications. The goal of this type of installation is to allow the user, usually a property or plant manager, to determine the specific energy usage for one or more specific sections of the managed facility.

A good example application would be a commercial complex with provisions for multiple, reconfigurable leased spaces. Due to the expense of re-configuring utility meters with every tenant shift, it is often preferable for the entire property to receive a single utility bill. The property manager can then allocate this bill to the individual tenants. Prior to the availability of cost-effective monitoring equipment, the manager would often allocate the cost based on square footage. Clearly, however, this can result in significant inequities, due to differing usage patterns between businesses. As shown in the illustration below, a small welding and machining operation can be expected to use significantly more power than a much larger warehouse space.

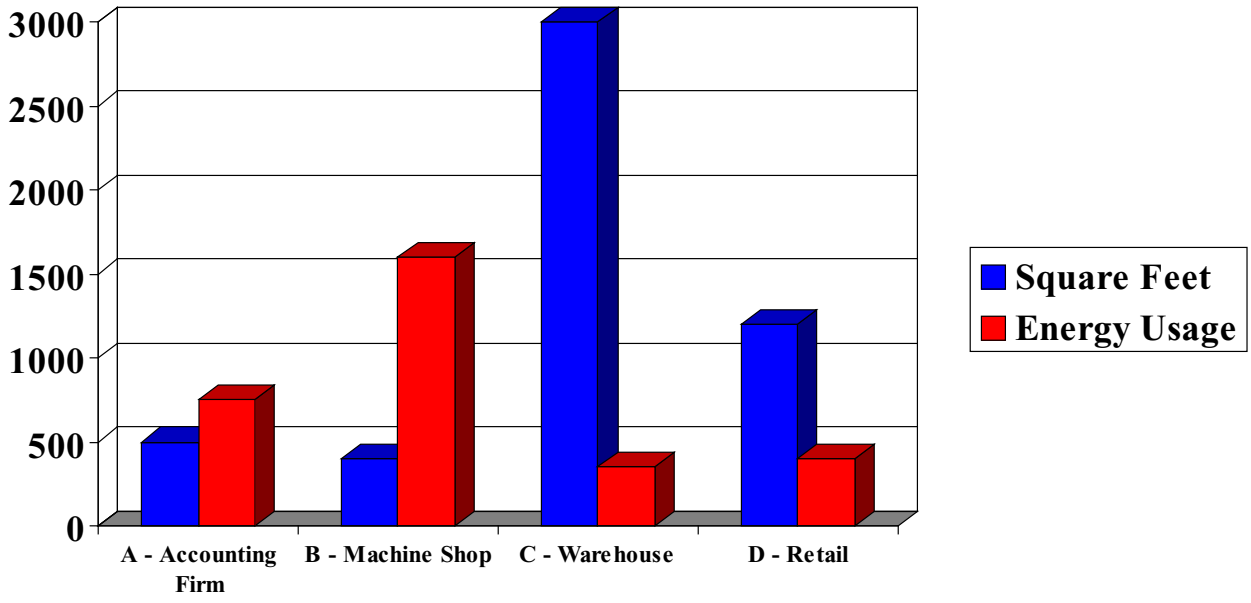

Figure 1 – Energy Usage vs. Square Footage comparison

A size-based allocation method also provides no incentive for any of the tenants to conserve or manage their energy usage. With the advent of cost-effective energy metering equipment, however, facility managers have multiple usage-based energy cost allocation solutions at their disposal.

The equipment used for Cost Allocation normally includes basic kW/kWh Demand meters and some sort of logging solution, although reproducing utility bill values may require more detailed information such as Power Factor, kVAr, or

kVA. The system may be as simple as a display and clipboard, or as complex as a network application involving logging meters, gateways, and complex billing calculation software.

ENERGY MANAGEMENT

Energy Management generally refers to applications where the energy usage is monitored with the intent of using the resulting information to reduce energy costs for a facility or operation. In many cases, this approach is coupled with intelligent process, lighting, or HVAC control systems. Demand management actions that can be coupled with these systems include load shedding, load shifting, and peak shaving.
The equipment used for energy management is highly dependent on the specific application, but generally requires multi-variable meters connected to some sort of control network to allow collection of real-time information.

POWER QUALITY

General PQ

General power quality applications involve monitoring the power service to detect various types of **conditions** or **events**.
Conditions can include:

- Poor power factor
- High levels of harmonic distortion
- Steady-state under- or over-voltage
- Phase imbalance

Events can include

- Sags
- Swells
- Surges
- Flicker
- Transients
- Phase Loss

This information can be used for process control, proactive maintenance, equipment monitoring, and/or utility feedback. Equipment used for power quality monitoring almost always includes fairly sophisticated metering hardware coupled with a medium- to high-speed communications network. In general, sophisticated analysis software will also be required to take full advantage of the information provided by this type of equipment.

Disturbance Monitoring

Disturbance monitoring refers to systems designed to detect events having a very short duration and a wide range of frequency. Many of these events – such as a nearby lightning strike or capacitive switching transients - have effects that can be very costly and difficult to trace to their origin. Information gathered by this type of system can be used for failure analysis, system fault detection, and equipment damage prevention.

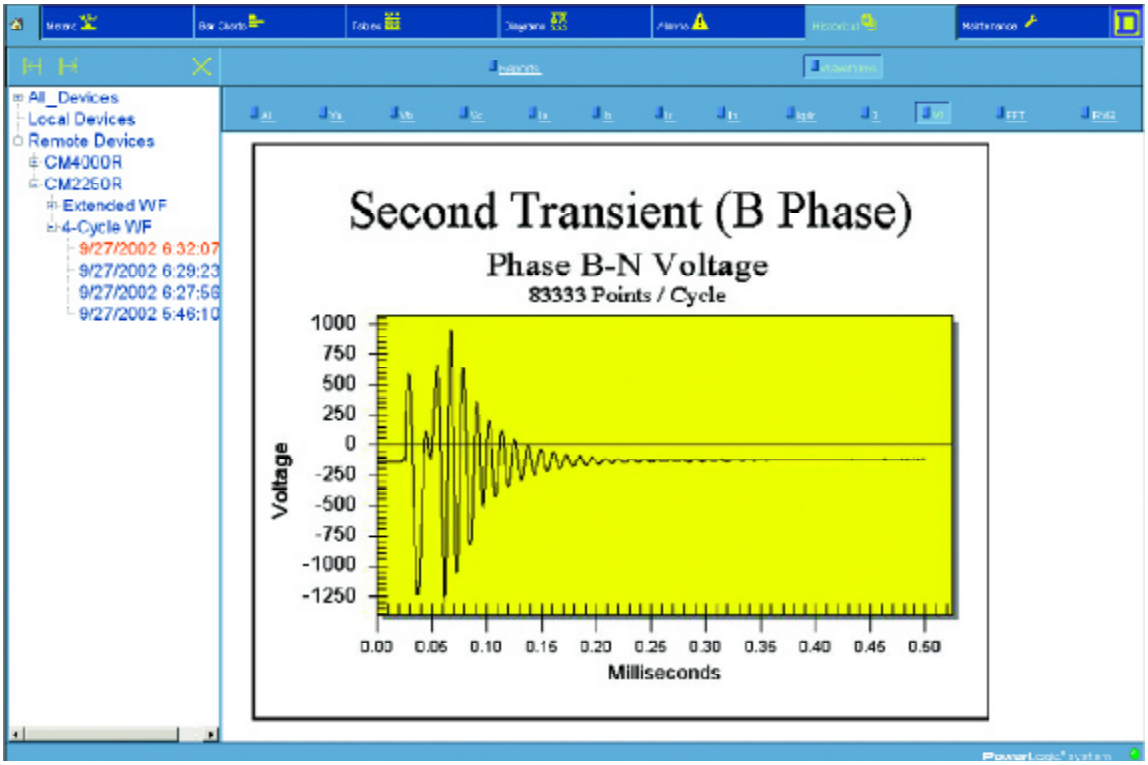

Figure 2 - Example of transient analysis software

Equipment used for disturbance monitoring generally includes a high-speed transient detection monitor and some sort of logging and analysis software. In many cases, these monitors are installed for a finite period of time to capture the event of interest and are subsequently removed. Some of the newer power quality meters also have transient detection capabilities, and are very useful in applications with highly sensitive loads, where continuous long-term event detection capability is desired.

CRITICAL POWER MONITORING

Critical Power Monitoring is a relatively new concept that is applied to loads where power quality is not necessarily an issue, but the reliability of the supply is crucial. This would include applications such as:

- Data centers
- Long-cycle, high-cost industrial processes
- Financial institutions
- Public safety systems
- Transportation controls

The goal of a critical power monitoring system is to monitor the distribution system loads at multiple protection levels. This allows the control system to manage loads across the system to predict and avoid overloads in any given portion of the electrical network. This, in turn, helps prevent costly outages and downtime due to ‘nuisance’ breaker trips and other types of system failures.

Figure 3 – CTs installed in a panelboard for branch circuit monitoring

Equipment used for this type of monitoring generally includes one or more networked multi-circuit metering devices, which may collect data ranging from current alone to a full set of power quality data. A centralized alarm annunciator is a requirement for these applications, although it may range in complexity from a local alarm light at a panel to a tightly integrated facility management system.

SUMMARY

It is apparent that there is no single, 'one-size-fits-all' solution for power monitoring applications. In order to select the proper equipment and metering strategy, one must first determine the specific goals of the system, as well as characterizing the loads to be monitored. This allows the specifier to select the general type of solution to be installed, thus avoiding the potential pitfall of installing a perfectly good monitoring system that fails to address the targeted issue. Once this is done, it then becomes a matter of selecting the best available products meeting the specific needs of the application.