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Metering Your Way to Better Demand Side Power Quality

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Introduction

Power quality problems, such as voltage sags, transients, and system harmonics, can have a big impact on facility owners' bottom lines through lost productivity and equipment repairs and replacement. Research shows that most of these power quality issues are caused by problems within the facilities themselves rather than by the utility-supplied power. As a result, it makes good financial sense for owners and managers to be proactive in identifying and addressing power quality shortfalls before they cause damage.

Today's advanced power-metering technology offers new, accessible options for monitoring local electrical systems to ensure power irregularities don't get out of hand. Such meters also can provide the data needed to implement continuous improvement efforts that can bring a facility's performance up to the next level, not just spot problem conditions as they occur.

In this eGuide, Schneider Electric power quality experts Vanya Ignatova and Michael Reed offer background and guidance on the importance of ongoing power quality monitoring and the metering equipment that can make such programs possible. This information can provide a foundation for initiating a power quality improvement process in your facility's operations for bottom-line improvements and greater peace of mind.

Owners and managers must be proactive in identifying and addressing power quality shortfalls before damage can be done.

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Where Do Power Quality Meters Fit in Your Energy Management Strategy?

Author: Michael Reed

I have often wondered why companies that wanted help with their energy projects wanted to skip the most essential part of the project. I have seen it many times when a customer said "we already have a BMS (Building Management System), I don't need any other meters." The point of this article is not to bash BMS systems. Those systems serve an important purpose in energy management strategies. The focus of this is to show how metering with power quality functions is the true backbone of successful energy projects and energy security.

Advanced metering infrastructure (AMI) systems are typically installed and commissioned after a building has been in use. Almost all commercial buildings have BMS systems that are commissioned when the building is turned over to the tenant. So why is there this need for two separate systems?

I once received a phone call from an Air National Guard base that was having an AMI system installed next to their BMS. The energy manager from the base called me to ask why he needed two systems. Before I was able to answer, the installer, who was also on the call, spoke up about how this system would help them make their BMS more efficient. This call was a moment of clarity about metering projects. The two systems are complimentary rather than overlapping. The installer proceeded to explain that the information gathered in the AMI meters gave the base a roadmap for their energy plans.

This roadmap was the key to properly tuning the BMS because it showed how power quality was affecting the BMS performance. The energy manager remembered that a particular building had "never performed" well no matter how many timed the BMS system was tuned or reprogrammed.

The AMI system was able to give him the information to diagnose the problems within a day of commissioning power quality meters.

A few months later, the installer on this job made a trip to one of Schneider Electric's power quality training classes. He told me that AMI systems not only compliment BMS systems but also generate more successful work for his business. He explained that at every site he has installed AMI with a BMS because it generates three times the work on the BMS system than those customers who don't know their power quality. When I asked him about his customers' energy savings and overall satisfaction with their two systems, he responded "night and day." The customers who utilized power quality data to tune and commission their BMS system see far more savings in their energy bills and fewer maintenance problems.

It is important to understand how much energy your facility consumes. Either a BMS or an AMI system can measure consumption. AMI is the only way to capture power quality which is the roadmap to a successful energy plan.

Metering with power quality function is the true backbone of successful energy projects and energy security.

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Power Quality: Measuring to Manage

Author: Vanya Ignatova

It's a classic business adage that you can't manage what you haven't measured, and that principle certainly holds true for power quality – but exactly what aspects of power quality should facility personnel be tracking, and how should they go about the process? While every location has its own unique profile of installed loads and grid-supplied power issues, Schneider Electric has some general recommendations.

The results from a number of power quality studies in the United States and Europe have identified a number of common and expensive power quality disturbances, drawing from a range of end users. Voltage sags and swells and harmonics are, by far, the most common issues facing U.S. companies (Figure 1), and Europeans see high economic impact from transients and surges, voltage dips and short interruptions (Figure 2), according to the Leonardo Power Quality Initiative.

Based on these results and the experience of Schneider Electric power professionals in conducting hundreds of power quality audits and analyses every year, all around the globe, we recommend systematic monitoring of the following power quality problems:

- Harmonics
- Power factor
- Voltage dips and interruptions
- Transients
- Imbalance (specifically in motor applications)

How should these issues be monitored? Targeted, short-term measurement of known problem locations over, say, a two-week period is one option. However, such a tactical effort will miss any events happening outside the study period, and it won't support ongoing continuous-improvement goals. Instead, we recommend installing a permanent power quality monitoring system to detect and record all disturbances on an ongoing basis.

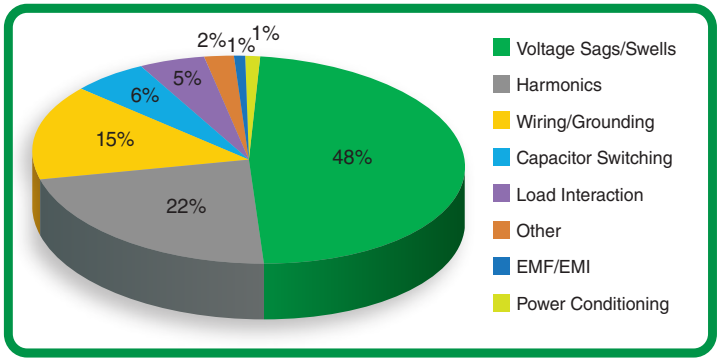

Figure 1-Most common power quality issues (U.S.).

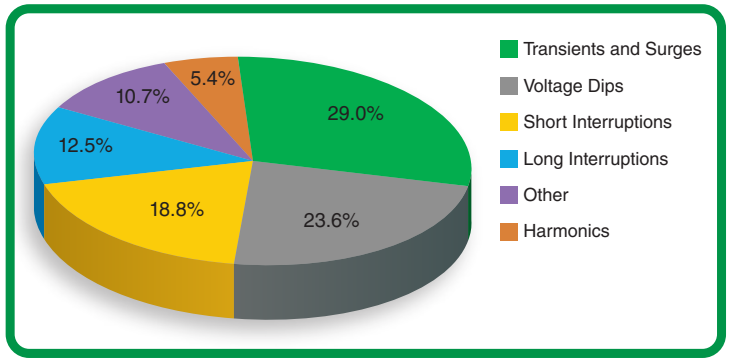

Figure 2-Power quality disturbances with highest economic impact in EU-25 countries.

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Power Quality: Measuring to Manage (cont.)

With continuous monitoring comes the possibility of making continuous improvements to your system's power quality and sustainability.

Where should measurement happen?

Continuous improvement is a strategy, not a tactic. Meters that can provide ongoing monitoring of both short-term and ongoing power quality issues cost more than those that simply monitor usage and time of use, so they should be installed where they add the most value. One good option: at a facility's main service-entry point, where the equipment can help managers determine if disturbances are coming from the energy supply or are being generated onsite.

With continuous monitoring comes the possibility of making continuous improvements to power quality and sustainability.

Additional Resources

For more information about how to approach continuous power quality improvement, you can read this white paper: "A Framework for Implementing Continuous, Iterative Power Quality Management."

Learn more about products that support continuous power quality improvement programs:

- PowerLogic PM8000
- EcoStruxure™ Power Monitoring Expert

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How Today's Monitoring Systems Make Power Quality Data Easier To Understand

Author: Vanya Ignatova

Today's power quality metering devices can capture data on issues ranging from transients and surges to harmonics and power interruptions – but that raw data, alone, might not be useful to the personnel charged with maintaining a facility's electrical system. New products address this challenge with embedded intelligence to show trends and alerts, with at-a-glance displays designed to meet the needs of many different staff members.

Continuous power quality monitoring is the best way to both maintain current equipment performance and support a facility's continuous improvement efforts. The new displays make such programs easier in a number of ways. For example, a trend graph, as illustrated in Figure 1, can provide clear indication of many long-term, steady-state power quality disturbances over time. Facility staff can easily see if recommended limits on harmonics, power factor or other potential problem areas have been exceeded.

Short-term disturbances, such as voltage sags, swells, transients and interruptions are represented in a more snapshot fashion, using a variety of statistical widgets, charts and counters, as shown in Figure 2.

Such a presentation can offer a range of views – from a pie-chart-style breakdown of the kinds of power quality events a facility might be experiencing to bar charts comparing the impact of events either upstream or downstream of the measured location.

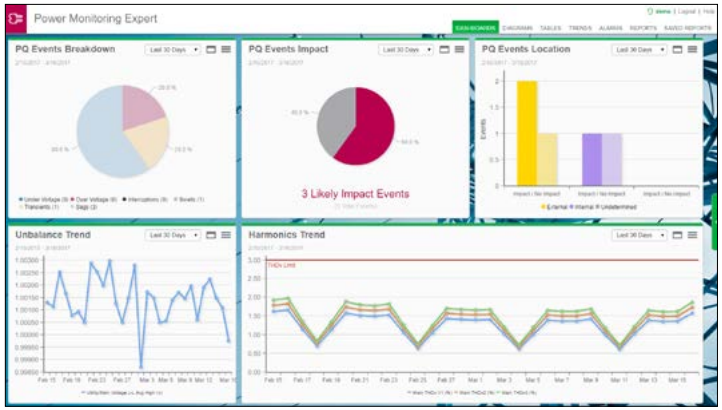

Figure 1-Analysis of continuous power quality disturbances.

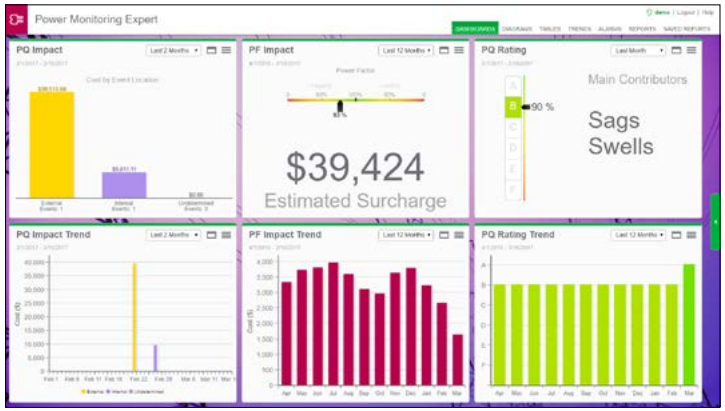

Figure 2-Analysis of power quality events.

Several new-to-market monitoring systems are taking this graphical approach a step further. The systems feature a simplified user interface that uses the green/yellow/red visual metaphor familiar to just about any automobile driver to indicate both short- and long-term power quality issues. In this application, green obviously indicates no critical issues with the characteristic being measured,

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How Today's Monitoring Systems Make Power Quality Data Easier To Understand (cont.)

while yellow and red indicators suggest performance is approaching or exceeding limits outlined in related electrical codes and standards.

The green/yellow/red approach solves a common problem of those whose job it is to monitor and maintain power systems: the wide diversity of potential power quality problems and their related metrics and applicable standards can be overwhelming. This methodology converts this multitude of taxonomies into meaningful, unified and easy-to-understand indicators for each specific power quality characteristic.

The new systems also are able to calculate an overall power quality index that amalgamates the data on individual measured characteristics into a 0%-100% rating – kind of like a report card for a single metered connection or an entire facility.

The green/yellow/red approach solves a common problem of those whose job it is to monitor and maintain power systems.

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Power Quality Improvements for Today – And Tomorrow

Author: Vanya Ignatova

Measurement and analysis are the critical first steps in any power quality improvement program. Putting what you've learned to use, though, means knowing the best solutions for the problems you've identified. Here, I'll cover corrective-equipment options, and then offer some suggestions for how to implement a continuous-improvement process to take a facility's power quality performance to the next level.

Equipment to solve power quality problems

Manufacturers have developed a range of equipment to help consulting engineers and facility personnel address specific power quality issues. In some cases, the options are pretty cut and dried, while other situations may require a bit more thought.

- **Transients.** Transient voltage surge suppressors are the best option for protecting against transients in a power system.
- **Voltage sags and interruptions.** The best choice here depends on extent of any interruption. Uninterruptible power supplies and other energy-storage options could do well with shorter-term sags or interruptions, but back-up generators or self-generation equipment is needed when longer outages are encountered. Other solutions could include static transfer switches and dynamic voltage restorers with energy storage.
- **Harmonics.** Active filters are the recommended solution for harmonic mitigation, thanks to their flexibility and high correction performance. Alternative approaches could involve passive filters, multi-pulse arrangement transformers or harmonic correction at the equipment level (for example, by integrating harmonic filtering into variable speed drives).
- **Power factor.** Reducing power factor requires producing reactive energy as close as possible to connected loads. Installing capacitors on the network.

With all these approaches, remote monitoring capabilities have become a standard customer request. Today's end users want to be able to verify the efficiency of any applied corrective actions – possibly through a dashboard-style interface, as shown in Figure 1.

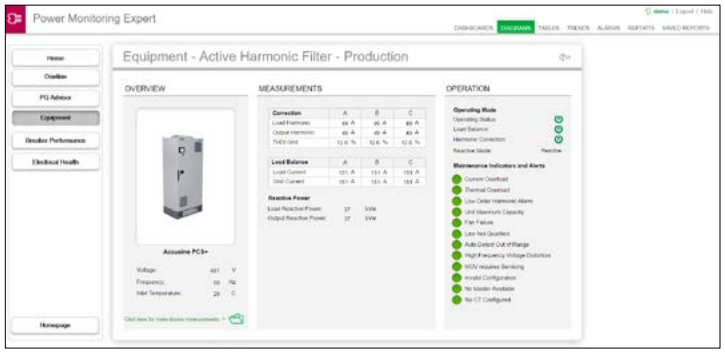

Figure 1 - Dashboard.

Taking power quality to the next level

Addressing power quality issues is often a reactive process – a response to a problem that has already occurred. But by implementing a more proactive process of continuous power quality improvement, facility managers can minimize the risk of future problems and interruptions and maximize both operational efficiency and equipment lifespans.
The following short- and long-term steps can help facility managers improve their uptime, energy efficiency and asset management:

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Power Quality Improvements for Today – And Tomorrow (cont.)

- **Within the next few weeks:** Plan a project roadmap. As a starting point consider monitoring the power quality at plant level, or at critical areas with sensitive loads.
- **Within the next 6 months:** Analyze the results of your monitoring and their impact on your equipment and installation. Assess the power quality correction technologies. Identify an initial project with reasonable investment that can result in positive results over a relatively short period of time (for example, an immediate opportunity to deploy power quality equipment for a particular device or process).
- **Within the next 12 months:** Plan methods for expanding power quality more broadly throughout your organization. Collaborate with internal stakeholders and/or seek out expert services organizations that have the technical expertise and global presence to support a long-term infrastructure integration project.

To learn more about how you can ensure power quality improvement, please read the following white papers and visit our product solutions.

A Framework for Implementing Continuous, Iterative Power Quality Management.

Using Color Codes to Simplify Power Quality Analysis.

- Metering: PowerLogic PM8000 Series
- Software: EcoStruxure™ Power Monitoring Expert
- Transients: Commercial/Industrial Surge Suppression
- Voltage sags and interruptions: Voltage Regulators
- Harmonics: AccuSine PCS+
- Power factor: VarSet LV capacitor banks

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