Energy waste and power quality management

Saving energy and minimising energy waste are critical in all industries. But looking for energy savings means looking at power consumption rates and developing a power quality management and energy-saving plan. This article from COMTEST outlines how this can be done using Fluke 1770 series analysers.

The first step in developing a power quality management program is benchmarking current electrical energy consumption across the facility. Through that initial survey, quick and easy solutions can be identified to start with, such as areas that are typically closed on the weekends and can be shut down. Areas that contribute to energy usage outside significant assets, such as supplementary electrical heating, lighting being left on, and computers not being switched off should also be looked for and tracked.

Once those quick wins have been identified and implemented, more detailed studies throughout the building or campus can follow by running load studies on assets throughout the area using the Fluke 1777 Three-Phase Power Quality Analyser, for example. These measurements can quickly highlight the significant energy-saving opportunities from switching some systems off during the night at non-operating times.

Finding energy waste with FLUKE's Power Quality Management Energy Saving Plan.

Advanced power quality considerations

As current flows, some generated energy will inevitably be wasted as heat. The next step in reducing energy consumption is to look at where energy waste arises. One area to focus on is losses in conductors. As current flows through conductors, some energy generated will turn into wasted energy as heat. Figuring out how to level this issue returns to the fundamental I2R equation indicating the power delivered. This leaves two possible solutions: reduce the current flow (I) so that fewer kW of energy are flowing, or reduce the resistance (R). Both leave you with a problem:

- Lower current (I) and the load will not operate correctly.
- Reduce resistance (R) can cost more because it requires the installation of new copper or aluminium conductors.

So, what is the best solution? Consider the conductor sizing. Following the National Electric Code (NFPA 70 or NEC 100) gives a lot of guidance towards the size of a conductor, describing the ideal conductor size for almost any circumstance. The primary consideration for conductor sizing is ensuring the safe operation of the conductors with the most appropriate insulation. This depends on the length, cross-sectional area and anticipated current rating required. This can minimise energy losses, typically 2% or less, and an acceptable voltage drop in the conductor.

Some additional possibilities would be installing higher efficiency loads and checking to see if the motors being powered might be oversized for the current application.

Wasted power

The NFPA and NEC codes and guidelines are great when installing new work, but don't always work out ideally once the cabling installation is completed and the loads installed. Over time, the equipment may change with additions or adjustments; moves and age can significantly affect waste energy. Key areas where energy waste may occur are also related to power quality: voltage regulation, harmonics, power factor and unbalanced loads.

Voltage regulation works to reduce energy consumption in voltage-dependent loads. It reduces or controls the voltage levels within the equipment manufacturer's specifications to return energy savings. As more efficient loads are installed at a transformer, the voltage in the system may rise or be incorrectly controlled.

To identify voltage regulation issues, a Fluke 1777 Power Quality Analyser can be used to look for transient voltages and voltage imbalance. Both issues can lead to failure, unplanned downtime, and expensive repairs. Harmonics distort the voltage and current so the ideal sine wave for voltage is not maintained. One of the most recognised effects of harmonics in electrical systems is the excess heat they create in the conductors carrying them. This results in overheating in phase and neutral conductors, and is known as "triplen harmonics". The additional heat causes cable runs, motor windings and transformer issues. The overheating can cause significant damage or complete failure, either of which could lead to unplanned downtime and expensive repairs. To measure and diagnose harmonics, a Fluke 1770 Series Three-Phase Power Quality Analyser can again be used.

The benefits of power quality studies

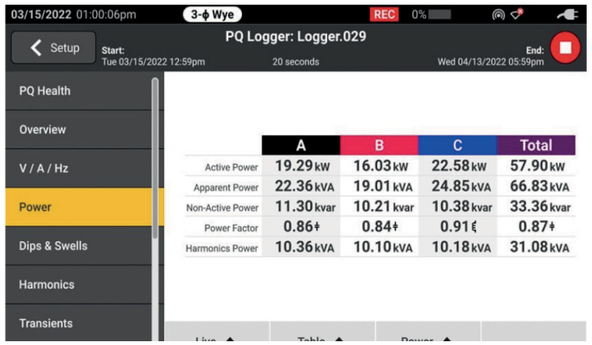
Once power quality studies have revealed areas where energy is being wasted, the following steps can be taken to fix the issues:

- Establish a preventive maintenance routine to continue to measure the power quality against the benchmark and to catch issues as they arise.
- Install harmonic filters on any loads that add to the facility's harmonic distortion.
- Address the sources of unbalance. This may mean setting up a repair or replacement schedule for large motors with mechanical unbalance issues.
- Mitigate unbalanced load issues. In some cases, this may mean adjusting single-phase loads to be more equally distributed across the phases.
- Replace blown fuses where necessary. A blown fuse on a bank of three-phase power factor improvement capacitors could also cause the problem; simply replacing the fuse can resolve a major unbalance.

Power quality studies highlight much of what can be done to save energy, reduce energy losses due to issues throughout a facility, and lower energy costs. And power quality monitoring can show where the issues are coming from and how to fix them. Beyond the energy savings, power quality studies have been shown to lead to some additional benefits, including predicting potential failure points in assets that can cause major disruption; reducing the variability of temperature across the facility; and finding improperly installed breakers prone to accidental tripping.

More information on how to apply power quality management can be found via the Campaign Pages on the COMTEST website.

https://comtest.co.za



Left: The Fluke 1770 Series is an automatic measurement capture system that can be used to identify more than 500 power quality parameters. Power and harmonics parameters are being identified here. Right: The Fluke 1777 Three-Phase Power Quality Analyzer.