For most facilities -
Huge cost savings available through
Reducing harmonic distortion

As Variable Speed Drives (VFD's) continue to proliferate throughout industry and institutional buildings, as well as many diverse applications such as pumps, factory automation, and process equipment, the problem of Harmonic Distortion increases directly with the number of VFD's being used.

Idaho Power began a program in the spring and summer of 2007, testing its largest customers' facilities in a week-long harmonic distortion monitoring session. They report that "the results to-date show that between 20 and 25 percent of customers tested were out of compliance with the standard" (IEEE-519) for the control of harmonic distortion.

A recent study by IBM showed that power quality problems cost U.S. businesses more than $15 billion a year. That's an (estimated) average of $79,000 for each company according to the article. Obviously, the larger energy users would share proportionately larger shares of those losses thus pointing to the great need to identify and solve the causal power quality issues, which often include harmonic distortion.

Alliant Energy reports that "approximately 8o percent of electrical disturbances originate within a business facility. Potential culprits may include large equipment start-up or shut-down, improper wiring and grounding, overloaded circuits or harmonics.

Idaho Power offers its customers the following advice: "As a note of caution, it is important that any piece of non-linear load equipment has all the necessary filtering in place as part of its electrical connection configuration. A load center where non-linear loads exceed 30 percent of the total load will require harmonic filtering. Line reactors will not be sufficient to maintain compliance."

Harmonic Distortion may or may not cause a problem in a facility. The facility may have harmonics present, but experience no adverse effects if the levels are low enough. However, as harmonic levels increase, the likelihood of experiencing problems also increases. Typical problems include malfunctioning of microprocessor-based equipment, overheating in neutral conductors, transformers or induction motors, deterioration or failure of power factor correction capacitors, erratic operation of breakers and relays, including nuisance tripping, and pronounced magnetic fields near transformers in switchgear.

Further, harmonic distortion can be transmitted from one facility back through the utilities' equipment to neighboring businesses, especially if they share a common transformer. This means harmonic distortion generated within a facility can stress utility equipment or cause problems in neighboring facilities in any direction.

For this reason, the IEEE–519–1992 standard was designed to protect both businesses and utilities by defining the allowable levels of harmonic distortion at customer service entrances, the Point of Common Coupling (PCC).

While the ideal time to analyze harmonic mitigation strategies is at the design stage of the facility or at the time of the addition or upgrade of equipment, most facility

managers aren't aware of the harmonic distortion levels within their facilities until one or more of the above mentioned symptoms begin to appear. To make matters worse, a drive shut-down or an overheating motor or transformer may often be misdiagnosed because a simple re-setting of the VFD may appear to return the equipment to "normal" operation. However, the harmonic distortion problem is still present, but is simply waiting for more non-linear loads to accumulate on the load side, until serious or major shut-down problems finally demand a corrective solution.

While there are many ways to deal with harmonic distortion, there is often one solution that offers the best cost/benefit ratio while providing a permanent solution to the problem.

As mentioned earlier, Line/Load reactors can often reduce harmonic distortion to acceptable levels in situations where distortion levels are light to moderate, but higher levels of distortion are normally best addressed by passive harmonic filters that are rated for the size of the motor and the drive controlling it.

MTE Series D Matrix Filters meet the most stringent IEEE 519 requirements (5% THID) for removing harmonic current distortion on virtually any kind of six pulse rectifier supply commonly found in three phase electronic equipment such as adjustable speed motor drives used in air conditioning/heating equipment, servo drives, or in any switching power supply used to convert AC to DC. In combination with the economical six pulse drives the MTE Series D Matrix Filters actually outperform other harmonic mitigation techniques such as 18 pulse drives, while reducing installation costs and increasing equipment reliability. The MTE solution results in a smaller overall physical package saving the facility valuable space. Thus, MTE Matrix Filters both increase drive performance and eliminate harmonic distortion problems for line-side applications.

For load-side applications, MTE Corporation Sine Wave filters are designed to protect AC motors from the destructive effects of harmonics and insulation failure caused by voltage spikes in long cable runs up to 15,000 feet between an inverter and motor. These 2 - 8 kHz sine wave filters are designed to convert a PWM inverter output wave form to a sinusoidal wave form. As a result these filters eliminate issues of motor over-heating, insulation failure, switching noise, terminal over voltage and damaging dV/dT associated with long cable lengths between the motor and inverter. These filters have been designed to meet motor current requirements based on NEC motor current ratings.

A topic pertinent to the discussion of harmonics is cable protection, but it is not often discussed with facility managers using drives, so seldom do they recognize cable/voltage problems, but ironically, they usually attribute the associated nuisance tripping as a "quirky drive problem". What the facilities usually experience is a nuisance drive shut down because of a voltage spike through the cable insulation. Since the cable is self-healing, the drive will operate normally after re-start – making a correct diagnosis very difficult.

There are a number of manufacturers who sell VFD cable which is meant to be used between the drive and motor. The cable is four-conductor, has high voltage insulation and is shielded. The cable is also large in diameter, very stiff and difficult to install and very expensive. It is usually not practical and sometimes impossible, to install especially on existing applications where a drive has replaced an across-the-line starter and the application is using cable in conduit. A typical cable between drive and motor is

rated at 600 volts but the high voltage spikes produced by the drive will exceed 600 volts, notably near the motor termination.

MTE's Motor Protection Filters offer superior load-side harmonic protection as compared to their competitors, but in addition MTE's Sine Wave Filters will eliminate the need for the costly VFD cable. The Sine Wave Filter solution is a more cost effective means to solve the cable problem with the added benefit of motor protection, which the VFD cable can not do.

For companies wishing to analyze their facility for harmonic distortion and other power quality problems, their provider utility is usually an excellent place to start. Many utilities now offer Power Quality (PQ) committees that can arrange a PQ audit to determine any PQ problems you may have.

The typical power quality audit may include measurement of critical PQ characteristics including voltage, current, harmonic distortion and disturbance events, analysis and reporting of recorded data, identification of PQ concerns and possible implications to the operation, and an evaluation of mitigation options for harmonic distortion, load balancing and surge or sag problems.

If the utility does not offer such services contact your nearest MTE Distributor www.mtecorp.com or search out an independent PQ Consulting firm.

MTE offers a full line of PQ and Harmonic distortion solutions that will help you solve critical PQ problems with a cost-effective and comprehensive solution. Many of the MTE Harmonic Filter solutions offer a guaranteed performance *without* a system analysis. For more information go to www.mtecorp.com or call 800-455-4683

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