By Domenic Capobianco

Domenic Capobianco, B.Sc. is a product specialist at Carlo Gavazzi (Canada) Inc. He can be reached at dcapobianco@carlogavazzi.com.

The hidden costs of installing

ENERGY EFFICIENT MOTORS

As we strive to be more energy conscious, it is not unusual to look around a facility to find ways to reduce energy consumption. A common action is to take a look at motor loads throughout the facility and consider upgrading them to more energy efficient models.

Just installing a motor that is energy efficient will not necessarily reduce the monthly energy bill, however. There are a few points to consider when installing a new motor. It is imperative to ensure that the motor is 1, properly sized for the application, and 2, properly started.

In industrial settings, motors make up a large percentage of the total electricity bill. Electrical motors will not only affect the electricity bill directly by increasing the amount of energy (kWh) used during the day, but if the motors are improperly sized, they will also negatively affect the bill by causing a poor power factor (PF). This increases the poor power factor penalties, something that the facility owner will have to pay for.

Another negative effect that's felt on the energy bill can happen if motors are started incorrectly. This could greatly influence the power demand charge (DMD).

Motor loads make up a large portion of electrical equipment used in all types of settings from residential to industrial. By analyzing the motors we have, and taking such steps as upgrading them or changing our behaviors on how and when we start them, we can reduce the amount of energy we are consuming.

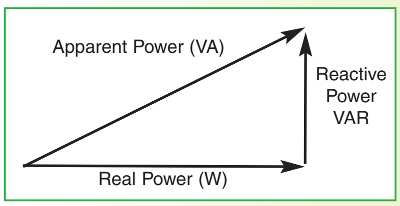
These changes will drastically reduce maintenance and costly downtime and, at the end of the day, save a bit of money.

continued on page 72

THE POWER FACTOR

Under-loaded motors are one of the key reasons for a poor power factor in industrial environments. Power factor (PF) is the ratio between the amount of energy supplied (VA) to the actual amount of energy used (W). The result is known as reactive power (VAR), and is essentially wasted energy capacity.

Power factor is defined as a number between 0 and 1. Typically, heaters or resistive loads will have a power factor of 1. The more motor or inductive loads on a system, the greater the likelihood that this figure will be below 1.0.



For a motor to operate, two types of power are required, both W "real" and VAR "Imaginary" power. In the diagram, "apparent power" is what is supplied from the utility.

The windings inside the motor need to be magnetized in order for the motor to operate. This magnetic field does not do any useful work, but is necessary, that is why this portion of the energy used is called "imaginary power."

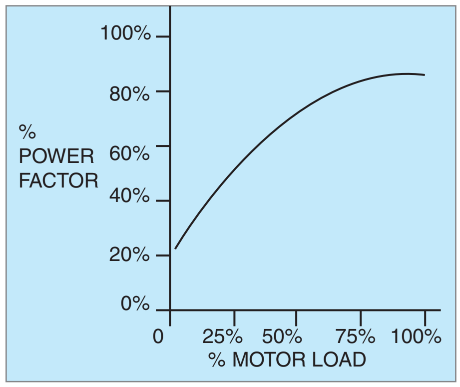
If the motor is over-sized for an application, this can drastically reduce the quality of the power in the entire facility. The larger the motor, the more imaginary power required to drive that motor.

continued from page 70

POWER FACTOR PENALTIES

Many utilities charge a power factor penalty as power factor decreases.

Power Factor	*Surcharge*
0.9+	*Nil*
0.88 - 0.9	*2%*
0.85 - 0.88	*4%*
0.80 - 0.85	*9%*
0.75 - 0.80	*16%*
0.70 - 0.75	*24%*
0.65 - 0.70	*34%*
0.60 - 0.65	*44%*
0.55 - 0.60	*57%*
0.50 - 0.55	*72%*
0.50 or less	*80%*



The graph above illustrates the reduction in power factor as the load is reduced on the motor.

A GOOD START

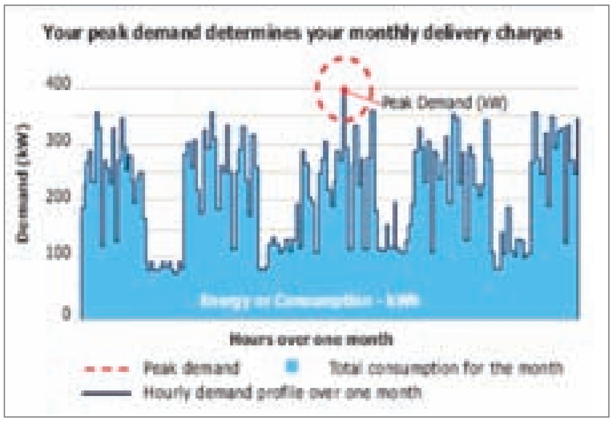
The most basic way to start a motor is by applying full voltage to the motor terminals. This is known as a direct online start (DOL). Performing a DOL on a motor will have many negative effects on the system, including causing voltage drops on the supply system, due to the high inrush of currents created when initiating the DOL.

New high-efficiency motors can have an inrush of up 15 times the motor's normal running current. Even on standard motors, the inrush can be in the range of six to seven times the normal current.

This means every time power is applied to a pump, compressor, fan, etc., the facility could experience voltage dips, light flickering, breaker trips, and the pitting and burning of contacts, all due to the current draws that can be many times the motor full load current. This can result in continuous maintenance of equipment, and a greater chance of unscheduled shutdowns, and increased costs due to the need to oversize mechanical and electrical components to cater to the power surges at start up.

SPIKING THE BILL

With every start of the motor, the current will spike. For a motor controlling a pump or a fan that turns on and off multiple times a day, this can translate into quite a few spikes.
So what? Well, the second-largest charge on a monthly energy bill is for the peak electrical demand (kWdmd).



So, it may be possible to significantly reduce the total charge for electricity simply by reducing the peak demand charge, even if the total electricity use during the billing period remains the same.

This charge occurs on the bill because the utility needs to be able to provide enough energy to sustain these spikes. If they don't, we risk having brown out conditions. This is sometimes seen on the first hot day of summer when everyone in a neighbourhood turns on the air conditioning at the same time. All these large spikes at one time are too much for the utility to supply, and we end up with a brown out.

The demand charge is calculated over a 15 minute window, so if the motor is started a few times in that time period, the spikes that occur are sensed and included in the calculation.

The more spikes, the higher the demand, and therefore, the higher the energy bill.

Start softly

A sure-fire way to drastically reduce power spikes is by correctly starting motors. A soft start is the best way to achieve this.

A soft start works by varying the voltage by starting from an adjustable point and gradually increasing to the rated voltage in an adjustable period of time.

Benefits of starting this way include eliminating water hammering in water pumps, reduced break downs, eliminating sudden stress on mechanical parts, and no more light flickering or the false tripping of breakers.

With a soft start the spikes induced on a system at motor start up are reduced, which in turn eliminates the costly demand charges.

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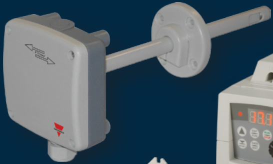

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