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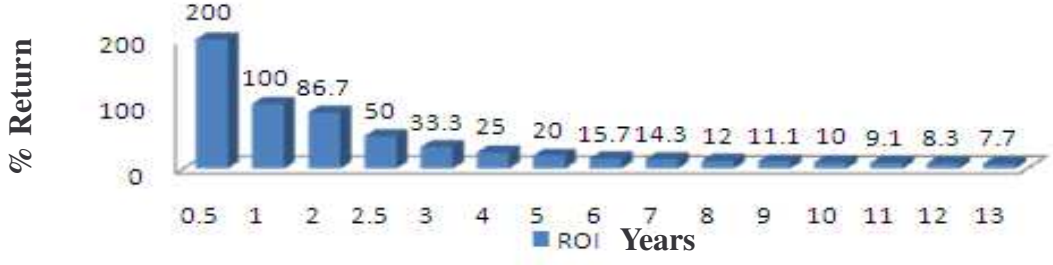
Installation Of A Reliable Motor Control System

Motor systems consume approximately 63 percent of the $33 billion spent each year on electricity by domestic manufacturers. More than half of these motors are used in either fan or pump applications. This is why so many manufacturers are looking at VFD's to reduce the power consumed in fan and pump applications. In fact, the physical size and, more importantly, the cost of variable frequency drives have been reduced to levels where the payback in many instances is quite often one year or less!

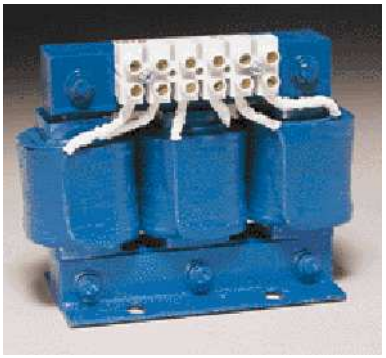
Are you currently controlling the air flow within your existing Air Handling Units (AHU) with inlet or outlet dampers? Are you currently controlling the flow of water or other fluids by adjusting valve position? If your answer to either of these questions is "YES", then your facility is an ideal candidate for the use of VFD's. VFD's or Variable Frequency Drives, are one of the most overlooked devices for providing energy savings within your facility. Did you know that an electric motor running at 50% speed on the type of system described above only requires approximately 12.5% of the energy required to run it at full speed? With the rebates now being offered by many of the utility companies for the installation of energy saving devices, the payback for the entire installation including labor is quite compelling. On many systems the payback for the VFD is less than a year!

Take a look at the chart below. A one year payback is the equivalent of a 100% return on investment!



Energy savings, which can be substantial, is not the only benefit of the installation of VFD's, there are also additional savings realized in the reduction on wear and tear on the equipment. This savings, also significant, is not taken into consideration in the payback period described above.

While VFD's can provide your facility with substantial energy savings, they do present some special considerations to insure reliable and trouble free installation. While drives inherently correct bad power factor, they are a switching power supply and can induce harmonics into your system. Variable frequency drives take Alternating Current (AC) and convert it to a pulse width modulated DC output. These are pulses of DC of varying duration that the motor interprets as AC. Any equipment that switches from AC to DC such as the power supply on your laptop, ballasts in fluorescent light fixtures, UPS systems and the VFD can cause stray voltages and/or currents called transients or harmonics to be fed back into the voltage supply. These stray voltages can lead to problems with other electronic equipment as well as the VFD itself. Motor and conductor overheating and bearing damage are some symptoms of transients. Newer VFD's utilizing the latest electronic components induce far less than their predecessors but precautions should still be taken to reduce the likelihood of induced harmonics. VFD's are also susceptible to existing harmonics that may already be in your electrical system. To help prevent the VFD from creating these transients, there are



some precautions that should be taken. The installation of an appropriately sized line reactor installed on the input side of the VFD can help prevent transients formed within the VFD from being fed back into the incoming power feed as well as blocking any transients on the incoming feed from entering the VFD. These are relatively inexpensive one-to-one transformers rated by load and impedance.

On the output side of the VFD are three possible areas of concern. The first lies within the motor itself. The windings in older motors, those not inverter duty rated, were insulated with a varnish that may not react favorably to the pulses and voltage spikes created by the VFD. These voltage spikes may be of a magnitude that will eventually break down the insulation on the windings within the motor. The motor will overheat and eventually fail. Higher efficiency, inverter duty rated motors have windings insulated to accept these voltage spikes without breaking down.

These transient voltages within the motor need to go somewhere and the natural path is through the shaft, into the bearings and then to ground through the motor casing. Here lies the second possible problem area at the motor. As these voltages and currents pass from the motor shaft to ground, they have to pass through the bearings inside the bearing races.

Once these voltages exceed the resistance of the bearing lubricant, they discharge through the motor's bearings causing pitting, fluting damage, excessive bearing noise and eventual bearing failure. Grounding rings are available for installation on the motor shaft which prevent electrical bearing damage by safely channeling harmful shaft voltages away from the bearing to ground. These rings provide the path of least resistance to ground and dramatically extend motor life.

This brings us to the third potential area of concern, long lead length between the VFD and the motor. As a rule of thumb, the distance between the VFD and the motor should not exceed 75 to 100 feet. Greater distance can cause reflected or standing wave phenomenon and capacitive coupling.

This phenomenon has a voltage doubling effect at the motor terminals. In fact, the voltage spikes mentioned earlier created by the VFD can reach the 1300V range causing motor deterioration and eventual failure.

The voltage build up caused by the capacitive effect of these long lead lengths can also have an adverse effect on the VFD and can cause nuisance tripping within the VFD and cause overheating in both the VFD and the motor significantly reducing the life of either or both. There are a couple of precautions that can be taken to help prevent these issues. First, a load reactor, can be installed on the output side of the VFD. Just as the line reactor on the input side helps prevent transients from entering or exiting the VFD on the line side, the load reactor provides the same results on the output side of the VFD. Specialized cable is also available to help counteract these problems as well as reduce the introduction of stray voltages and currents into these conductors from external sources.

As mentioned in the beginning, as long as they are properly installed and the appropriate precautions taken, VFDs are and excellent way to save energy, reduce maintenance and downtime on pump and fan installations.

If you would like more information, help with sizing and selecting the appropriate VFD for your application or help with the precautionary equipment described, please contact your local Springfield Electric representative.

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