Don’t Bypass The Savings

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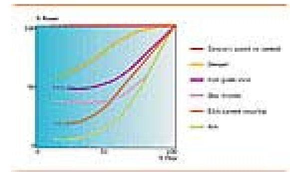

FIGURE 1. Achieve energy optimization via an audit that will get your drives usage back on track.

You went with VFDs to save money. That’s great. But if you’re letting even 10% of those drives operate in bypass mode on an ongoing basis, then you could be using up to 56% more energy. Here are four steps to protecting your air-handling investment and your bottom line.

Despite the economic advantages and significant energy savings available by using AC VFDs in HVAC applications, many building operators do not repair or replace drives when they fail; this is because the motors easily can continue to run through a bypass contactor. While this is a great solution for short-term outages, continued operation in this mode quickly becomes a very expensive way of operating a fan.

THE CHALLENGE

Budget cuts and competitive pressures have reduced building maintenance staffs in many public and private enterprises. This frequently results in a reprioritization of activities, forcing concentration on addressing issues that are required to be fixed at the moment. Repair items such as an HVAC drive system operating in bypass mode may be considered only a nuisance, to be dealt with as time permits. And of course, time seldom permits.

HISTORICAL PERSPECTIVE

Consider the rationale for installing VFDs over the past 10 to 15 years to control the airflow in buildings. These drives were originally installed to replace the throttling systems designed to regulate airflow in the system. While throttling reduced the flow, the motor still ran at nearly full-load speed and, in some cases, worked even harder to overcome the added system restriction. By reducing the speed of the motor, the VSD ensures no more energy than necessary is used to achieve the required flow.

For example, in theory, a fan running at half speed consumes only $1/8^{th}$ of the energy compared to one running at full speed. Field experience has shown that when the effect of static backpressure is factored in, the relationship is somewhere between $¼^{th}$ and $1/8^{th}$ of the energy consumed at full speed, depending on the mechanical application.

BYPASS FAILURES

Recent studies indicate that 8% to 12% of HVAC drive systems are running in a bypass mode due to a drive fault. A bypass contactor is intended to be used in the case of a drive failure for temporary emergency service. It was never intended to be a long-term solution to a drive malfunction. While the misapplication of long-term use is understandable due to increased pressures on typically undermanned building maintenance organizations, there are proven approaches to solving this pressing problem.

WHY WORRY? BECAUSE ENERGY COSTS SOAR!

Why worry about this now? Energy costs continue to soar. Between 1999 and 2004, electricity costs increased by nearly 15% (source DOE). When VFDs were purchased for the application, the additional costs were justified based on saving money and improving profitability by using less energy for HVAC air handling in the building. Here’s an example of how long-term use of bypass contactors affects energy costs: if 10% of the drives are in bypass mode, up to 56% more energy can be consumed by the HVAC air-handling system. This is based on the assumption that all motors being operated are the same size, and all HVAC systems are operating on average at 50% flow.

FOUR STEPS TO ACHIEVING ENERGY SAVINGS

The path forward presents two clear choices. First, do nothing and continue to lose increasing amounts of money every day as additional VFD systems periodically fail and go into bypass operation. Second, develop a program that will change the way drives are proactively maintained. To develop such a program, it’s useful to detail how a typical PM program is centered on the following activities:

Review your situation. Utilize either an outside or internal resource person to inventory the drives in the building/complex to gather the following information:

- The number of installed drives and the make and model of each unit
- Age of the drives and how long they actually have been in service
- The hp of each drive
- The duty cycle of each drive. Note that load-level vs. length-of-time data may be difficult to determine, so this will often be an estimate
- The number of drives operating in the bypass mode
- Existing replacement drive inventory and on-hand spare parts to support downtime.

Replace or repair all of the drives operating in the bypass mode, to begin realizing the original energy savings. It is important to work with a supplier who demonstrates the capability to replace or repair drives easily. Select one who will assist in the maintenance and support on an ongoing basis.

Create or contract a PM program that focuses on the specific issues of drives and how to keep them up and running. These activities typically include, but are not limited to the following:

With the VFD de-energized

- Inspection of the environmental conditions on each drive
- Inspection of power components and circuit boards for deterioration
- Inspection for loose connections
- Cleaning interior components of the drives.

With the VFD re-energized

- Simulation or variation of signals from the control system to verify that the VSD is responding properly
- Calibration of the drive to original factory settings
- Review of the drive application for possible upgrades and operational enhancements.

Replace older and highly critical drives before they fail. When a drive is over 10 years old and/or in a demanding and highly critical application, consideration should be given to replacing it before failure. Even with the cost of a new drive and installation, the benefits will include lower operating costs and improved client comfort. Simple-payback, 10-year life-cycle-costing, or other financial analysis techniques may be performed to formally evaluate the economics for drive changeout.

CONCLUSION

VFD systems installed in the facility have a proven track record of reducing energy costs and improving client comfort. The ability to keep drives running as designed will ensure continued savings and comfortable clients.

A number of significant improvements have been made to present-day VFD systems compared to what was available 10 years ago. Drive sizes and parts counts have been reduced along with cost, while performance, quality, and warranty periods have increased. Commonly available features include embedded PI control functions that eliminate the need for closed loop output signals from the BAS. The PI controller typically includes feedback inverse, square root, and differential control functions on board which lower your costs of HVAC control system installation and wiring.

VFD units now typically combine sophisticated IGBT power switching with advanced microprocessor logic to reduce audible motor noise and meet accepted power quality standards. A number of communication options are available which can be tailored to a wide variety of BAS data and control formats. On-board metering of electrical kW and kWh information provides data useful in efficiency and billing calculations.

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Walter is a U.S. Air Force veteran and attended the University of Wisconsin before beginning his civilian career. He initially worked as a field service engineer at Eaton Corporation. There, he also served as senior engineer, Application Engineering. In 1998, he joined ABB. He has held multiple positions, including field service manager, product specialist, and product manager. He is currently a market manager, HVAC and an ASHRAE member. His areas of experience include AC drives, HVAC drive applications, power quality, and ancillary drive application topics including harmonics, EMC, and short circuit ratings.