Variable-frequency drives spin up energy savings for data centers

Finding ways to reduce costs when planning a new data center or expanding an existing one, ensuring that the new facilities can manage larger loads as demand grows, and keeping operations up and running are essential objectives of data center designs. Often, owners, contractors and operators focus on the largest, most visible systems when looking for ways to reduce expenses without sacrificing performance. But in data center operations, little things can mean a lot.

For example, with electricity ranking as the largest operational expense for data centers, a significant way to keep costs down is to capitalize on the capabilities of variable-frequency drives, or VFDs. These drives are employed to regulate the speed of motors that power fans, pumps, air handlers and other devices across the center. Motors account for a substantial amount of the mechanical power consumption in a data center. By varying the frequency of electricity supplied to motors, VFDs can alter the speed of cooling devices, thereby conserving and optimizing electricity consumption. The cumulative cost-saving effect across the data center can be significant.

“A large data center may house fifty or more VFDs, optimizing its cooling operations,” says ABB Commercial Marketing Manager Peter Walter. “When new data centers are built, owners want to get working sections up and running quickly, commissioning only a portion of the much larger planned facility to start operations sooner. VFDs can play an important cost-efficiency role in these circumstances, providing essential flexibility. At the outset, VFDs can scale back the power consumed by fans that have been designed for the full-sized facility. Then, as more capacity comes online, the same VFDs can increase fan speeds for additional cooling.”

In this way, VFDs allow data centers to right-size their cooling systems and provide continuous adjustment for optimum energy input under varying operating conditions. Energy savings from VFDs can range from 20 to as much as 80 percent.

At the same time, maintenance costs drop because seals and bearings last longer when cooling systems are not constantly running at full speed.

Reliability virtually eliminates bypass mode

Just as with UPS devices and other critical systems, VFDs often are planned with “spares” for backup. For example, an area may have two drives running two pumps and a third drive that can tie into either of the pumps in case of a VFD failure. Or the layout may consist of two drives, two pumps and a third drive with a third pump. In other instances, two drives will have a common connection point. If the primary drive goes out of service, the system automatically transfers to the second drive without interruption.

Traditionally, as a backup, the drive system would switch to bypass mode, and the driven devices would run at full power without the capability to vary their speed and without some functionality. Modern bypass systems duplicate nearly all the logic and control capabilities, such as opening and closing dampers and operating solenoid valves, only the variable speed control is absent. In today’s redundant drive systems, the redundant drive effectively replaces the bypass. In practice, VFD reliability is so great that operation of the bypass or the redundant drive normally is limited to a monthly manual test.

Another aspect of VFD design is its resistance to seismic events. The best VFDs carry a seismic certification earned by a robust design and verified by shaker-table tests that ensure the drive remains completely functional even under difficult conditions.

Top-quality VFDs also are designed to limit electrical interference that may be produced by the drive. They will automatically filter out unwanted harmonics and eliminate electromagnetic and radio-frequency interference. Top-of-the-line ultra-low harmonic drives reduce the harmonics to imperceptible levels, avoiding the harmonic generation in the first place.

To gain maximum efficiencies, VFDs in a data center should be integrated and interoperable with the building management and automation systems, such as Data Center Infrastructure Management (DCIM). These smart drives can provide a wide range of information that can be used for better decision-making on operations throughout the building.

Combining VFDs and direct drives

For large-scale data center operations, VFDs may be combined with direct-drive motors for additional cost savings. In cooling towers, the traditional equipment includes a gearbox that is filled with oil. That gearbox requires an oil change periodically, and the entire device degrades over time. The replacement of a gearbox can be an ordeal.

“Direct-drive motors, based on permanent magnets, eliminate the gearbox, gearbox cooling system, driveshaft, couplings and bearings,” observes Richard Kirkpatrick, Baldor Electric product manager at ABB. “This does away with gearbox maintenance, as well as oil leaks, cooling water contamination and long lead times for replacement parts.”

Combined with a variable speed drive, the motor often can be run at the slowest appropriate speed to reduce energy consumption by more than 40 percent.

“Every architect needs to incorporate variable frequency drives in commercial buildings and data centers for energy efficiency and LEED certification,” Walter advises. “VFDs will improve the efficiency of the building’s systems.” In pursing optimal performance, a holistic view of all equipment and systems – both big and small – is key to little technologies can truly make big contributions.

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