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Side-by-Side Test Program Verifies Variable Frequency Energy Savings

Provides documentation for county's drive retrofit

A county government in the southeastern United States was convinced that updating its HVAC installations with variable frequency AC drives would save energy and lower maintenance costs. Its own regulations, however, required proof of the drives' ability to deliver significant energy savings.

Working with Capital City Mechanical and Electronic Maintenance Associates (EMA), both of Norcross, Ga., Yaskawa Drives devised a testing program that would provide all of the energy-savings evidence the county would need.

TESTS CONDUCTED IN BUSY, FULLY OCCUPIED SPACES

The test sites were the seventh and eighth floors of one of the county's most active facilities, where cooling was required around the clock seven days a week.

The test floors featured similar layouts and circulation patterns. They were cooled by identical variable-air-volume (VAV) air-handling units (AHUs) powered by identical constant-speed, 25-hp AC motors.

A combination starter ran each motor at 100-percent power. Airflow was modulated with mechanical inlet guide vanes pneumatically controlled through an aging building-automation system.

VFD INSTALLED ON SEVENTH FLOOR

A Yaskawa E7 HVAC-specific variable frequency drive (VFD) was installed on the seventh-floor AHU, while the air handler on the eighth floor continued to operate using the constant-speed VAV system.

EMA provided installation materials and labor and handled the integration of existing controls into the drive wiring. Installation and start-up was completed in less than a day.

The county wanted the drive to maintain static pressure in the supply duct. A pressure transducer was installed in the ductwork to provide feedback to the drive's PI control loop, with a setpoint of 1 in. programmed into the drive.

The inlet guide vanes on the seventh-floor AHU were locked open, leaving the E7 in control of supply-air-volume flow.

Inlet guide vanes	
Eighth-floor energy calculation	
Weekday average KWH	316
Weekend/holiday average KWH	298
Total weekday KWH	74,323
Total weekend KWH	33,585
Total annual KWH	107,908

Variable-frequency drive	
Seventh-floor energy calculation	
Weekday average KWH	98
Weekend/holiday average KWH	56
Total weekday KWH	23,520
Total weekend KWH	6,440
Total annual KWH	29,960
Annual KWH reduction	**77,948**

TABLE 1. Comparison of inlet-guide-vane and variable frequency-drive energy usage.

INDEPENDENT MONITORING

Integrated Services Group, an independent energy consulting firm based in Atlanta, was contracted to monitor, measure, and compare energy usage.

Return-air temperature and AHU power usage for each floor were logged at 5-min intervals for 13 days—Aug. 30 through Sept. 11, 2002.

72-PERCENT ENERGY SAVINGS

The data showed a 72-percent reduction in energy consumption on the seventh floor.

Cooling the seventh floor utilizing the VFD required an annualized total of 29,960 KWH (Table 1). Maintaining the same cooling levels on the eighth floor using the existing constant-air-volume system required 107,908 KWH.

PAYBACK

Electrical rates paid by the county average 4.45 cents per kilowatt-hour. At that rate, based on an estimated $5,000 installed-drive price, the payback on this variable-speed drive is 1.44 year.

Calculated at the average cost of electricity in the United States—6.93 cents[1]—the drive installation would provide annual savings of slightly more than $5,400 and a payback of less than a year.

REDUCED MAINTENANCE COSTS

VFDs can help lower maintenance costs by delivering "soft" starts and stops, which cuts down on mechanical stress and wear and tear that occurs when starting directly across line power.

REFERENCE

1) U.S. DOE. (2001, August). *Electric power monthly annual.* Washington, DC: U.S. DOE Energy Information Administration.