YASKAWA

AC Drive Retrofit Saves $93,000, Year

The installation of energy efficient motors, drives, and controls on a condenser water pumping network at Miami Center is expected to lower the office building's annual energy consumption by 1,131,000 kwh and trim demand by 196 kilowatts.

Originally undertaken to correct condenser water pipe leaks, the $275,000 project will yield a payback of just under three years based on annual energy savings of $92,882, according to Bill Allen, chief engineer for Lincoln Property Co., the building owner. He stated that most of the utility savings come from the conversion of the facility's 2,100-ton, constant-volume condenser water system to variable-volume pumping.

The project started when building management noticed that pipes carrying condenser water from shutoff valves to condenser units in the building's 68 packaged air conditioners were leaking excessively. The original horizontal-branch piping system was a patchwork of dissimilar metals, including iron, steel, copper, and brass. This arrangement encouraged the formation of electric currents that attacked the weaker metals and caused leaks. The company determined that the pipes needed to be replaced.

It was decided to undertake the pump conversion at the same time. It included retrofitting two centrifugal condenser pumps and three cooling tower fans with efficient motors and variable frequency drives; installing a new standalone direct digital control system to supervise flow control; replacing manually operated condenser water shutoff valves with automatic valves; and revamping the leaky pipe network.

Prior to the retrofit, the common loop condenser water system would operate at full flow regardless of demand. Flow control was usually achieved by positioning manually operated butterfly valves to regulate certain portions of the system. The worn-out branch network was replaced with copper piping and nonelectrolytic fittings, while the old valves were replaced with electrically operated butterfly valves.

Had the valve project been undertaken separately, Miami Center would have paid an additional $100,000 in construction costs to cut into the piping system, according to Owen Nevader, existing building services engineer with South Florida Trane Service.

While the new valves are not energy efficient, they were necessary to effect the variable flow control strategy, Nevader explained. They will open only when air conditioners are running, reducing pumping requirements. The HCFC-22-charged air conditioners are self-contained, vertical-mount variable air volume units manufactured by The Trane Co, LaCrosse, Wisc.

Because all of the cooling units rely on the same condenser water loop for heat rejection, the loop must remain charged at all times, he explained. During periods of low occupancy, project planners and engineers predicted that having a system regulated by variable frequency drives could result in a 90 percent decrease in fan and pump horsepower.

Condenser pump system efficiency gains were realized with the installation of two Yaskawa variable-speed drives and two premium efficiency motors . The pulse-width-modulated, wall-mounted drives are NEMA-1 enclosed and feature input circuit breakers, emergency bypass capability, overload protection, indicator lights, and LED displays. The 95.4-percent efficient motors are rated for heavy-duty service and have a power factor of .86. The programmable Tracer controller, also by Trane, has 20 points of control and operates independently of existing building automation equipment.

The motors and drives were added to two of the three 100-horsepower (hp) condenser water pumps. Now the two energy-efficient pumps run continuously, while the third pump is relegated to backup duty.

With the addition of the Yaskawa drives, pump speed is controlled based on information sent via loop differential pressure transducers. As individual valves close, the resulting pressure increase is routed from the transducers through the Tracer panel back to the drives, which then throttle back the pumps accordingly.

A 50 HP Yaskawa variable speed drive and a 50 HP motor were also installed on each of the three fans that serve the building's three 900-ton cooling towers. These drives almost the same technical characteristics as the new pump drives, while the motors are rated 94.1 % efficient with a .89 power factor.

Before the retrofit, the cooling tower fan was controlled with the aim of maintaining a supply water temperature of 83 degrees. Lacking a precise way to match fan speed to the tower's outlet temperature requirements, the strategy proved inefficient, according to Nevader. He said it resulted in either one motor running continuously or frequent short-cycling.

When motors operate in this manner, the wear on belts and starter contacts can shorten their life, according to Yaskawa's Florida regional service marketing manager. In fact, one of the cooling tower fans failed just prior to the retrofit, Nevader observed.

"It's like trying to maintain 60 miles per hour up a hill in your car—you give it more gas. On the way down, you let up on the gas," Nevader explained. "The one thing you don't do is start and stop the engine."

In addition to wasting energy, this method of maintaining condenser water temperature resulted in large deviations from the desired setpoint and increased cooling tower water consumption. Working with the variable speed drives and the direct digital control system, the new condenser water temperature sensors are capable of maintaining temperature within 0.5 degrees, ensuring that a constant supply water temperature is maintained, Nevader observed.

Annualized savings from water conservation weren't calculated, but Allen said they could be around $1,000 a month, based on an actual three-month water bill reduction of close to $3,000.

Another element of the controls system project was the addition of a personal computer that allows the building's maintenance and engineering staff to monitor changing conditions.

"In South Florida, air conditioning is critical. We wanted to finish the job and get good baseline performance data under our belts," Nevader stated. "This way we could go back and make the necessary month-to-month changes."