Flagler's New Wave Of Technology

We usually consider being close to the ocean a good thing, but such a location is no day at the beach for mechanical equipment. Ready for some retrofits and looking for new design options, this Florida college embraced a frictionless chiller and upgraded its piping and cooling towers. The result? A sea change in noise and performance.

BY JOANNA R. TURPIN

Flagler College in St. Augustine, FL is located on 19 acres and is one of the most historic campuses in the nation. The college offers state-of-the-art facilities, including computer labs and wired residence halls, as well as historic buildings such as the grand Ponce de Léon Hall, a former luxury resort hotel built in the 1880s that is now listed on the National Register of Historic Places.

Since its founding in 1968, the college has spent more than $43 million restoring the historic campus and adding new buildings. A recent renovation project involved a chiller retrofit for Kenan Hall, which is the main academic building on campus. Built in 1888, the 50,000-sq-ft building houses classrooms, lecture halls, and faculty offices. While the existing chiller could keep the building comfortable, it was inefficient and noisy. (An auditorium was located above the equipment room, so chiller noise was unacceptable.)

As part of an energy retrofit, the seven-year-old screw chiller was set as a standby chiller to be used in case of an emergency, and a new 150-ton frictionless, magnetic bearing compressor chiller was installed to deliver both energy savings and ultraquiet operation. The college was so happy with the results that months later, it chose to install the same type of chiller for the campus's new Art Building.

OUT WITH THE (NOT VERY) OLD

Colleges are notorious for keeping heating and cooling equipment long past its expected lifespan. Replacing a perfectly good chiller for energy and noise reasons is extraordinarily rare, so David Hardesty, HVAC project manager with W.W. Gay Mechanical Contractor, Inc., Jacksonville, FL, was excited when the college approached him in 2005 and asked what could be done to improve the energy efficiency of its facilities. "We had previously replaced some of their pneumatic controls with DDC to improve their energy efficiency, so we were familiar with the equipment on campus," said Hardesty.

Frank Riggle, the owner's representative for new construction at the college, noted, "The existing chiller was doing a decent job, but it was consuming a lot of power. That was a big factor in deciding to replace it. In addition, the renovation involved enlarging the facilities, and the existing chiller wasn't large enough to handle the new load."

In addition to the noise and efficiency issues, there were humidity problems in historic Kenan Hall, and the renovation would have to address this as well. Many furnishings and paintings in the building had recently been restored, and the college did not want to lose its investment to high humidity. However, the school did not want to see a large increase in its energy consumption to control the humidity.

Hardesty suggested that the college might want to consider replacing the existing chiller with one utilizing Turbocor compressors, which use magnetic bearings and are oil-free. The new chiller would meet the requirements for higher energy efficiency and low noise and

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Historic Flagler College enjoyed quiet operation and energy savings after it installed frictionless, magnetic-bearing compressor chillers in two of its buildings.

would also control humidity problems.

Since the technology was relatively new, there was concern as to whether or not the chiller would be reliable. "The college president was concerned about the life cycle costs and dependability, while the maintenance engineer was concerned about reliability and ease of maintenance," said Larry Estrella, P.E., president of Estrella Engineering, Orange Park, FL.

After much discussion as to whether or not the new technology could work, a decision was made to install a McQuay 150-ton frictionless chiller with two 80-ton magnetic bearing compressors. "This was the first frictionless chiller to be installed in northeast Florida and only the second in the entire state," said Clarke Story of Brooks Air Systems, the McQuay representative firm in Jacksonville.

The magnetic bearings of the frictionless chiller's compressor eliminate bearing lubrication and the need for oil heaters, oil coolers, oil pumps, and oil pumping. Eliminating the oil support system results in increased chiller reliability and lower maintenance costs than would be associated with a negative pressure centrifugal chiller.

"The oil-free issue was a big deal for the college," said Story. "Most problems you have with chillers revolve around oil, oil maintenance, and bearing failures. When you don't have anything touching anything else, it's a big deal on the maintenance side. The college also liked the fact that the chiller used environmentally friendly R-134a."

The magnetic bearings of the frictionless compressor also eliminate the metal-to-metal contact noise of conventional bearings. The direct-drive design means inherently quieter operation because there is no gear noise. The overall result is sound pressure ratings for the frictionless chiller as low as 77 dBA per ARI Standard 575.

As for energy savings, the frictionless chiller provides high-energy efficiency with part load performance as low as .375 kW/ton by eliminating the high friction losses of typical centrifugal compressors. VFDs and digital controls further improve efficiency through the entire operating range.

Riggle noted that while the old chiller regularly pulled 175 amps, the most he's ever seen pulled by the new chiller is 80 amps. "Usually, it's in the 30 to 50 amp range," he said. "The power consumption is significantly less."

Using the McQuay Energy Analyzer™ analysis program, the projected annual energy savings for Flagler College was $25,000 a year compared to the air cooled reciprocating chiller that the frictionless chiller replaced. "In the first 20 years of operation, that would mean more than $500,000 in savings. Considering that chillers can operate 30 years or more if properly maintained, the college's energy savings could be even more significant over the life of the chiller," said Story.

WATER VS. AIR

Many years of expansion around campus had involved numerous air cooled chillers with primary loops. The air cooled coils would be ruined after 10 to 15 years due to the college's proximity to saltwater. For this reason, they decided that the new McQuay chiller would be water cooled.

In addition to the chiller being replaced, Hardesty advised that the pumping configuration needed to be changed. "We suggested to the college that first and foremost, they needed primary/secondary pumping in their chiller plant," said Hardesty. "There were two primary loops in the chiller plant, so we built a new primary for the new chiller and tied the existing primaries together to develop the secondary. Then we were able to eliminate the air cooled machines."

The new design expanded the mechanical room and re-used the existing chilled water piping to the extent that it was feasible. "New piping was installed progressively, and the plant was shut down for the connection of new piping to existing," said Estrella. The team changed out existing pumps and motors and added VFDs. Due to space constraints, the old skid-mounted pumps were replaced with vertical pumps.

Estrella added that the installation was challenging due to the minimal space available for new piping and equipment. Clearance issues with the new piping, insulation, and the height of the chiller, along with getting around the equipment, made the work difficult. In addition, the chiller plant is housed in a historic building, and any new work needed to be engineered so as not to affect the appearance of the historic building, he noted.

The 13 existing air handlers are gradually yielding to replacements, as most are at least 25 years old. While those AHUs received repeated cleanings, they are no longer efficient. Hardesty noted that the units have preheat coils, so the distance between the cooling coils and the preheat coils is about 2 in., making it very difficult to maintain and keep clean. In addition, the drain pans are starting to rust, so new equipment will be necessary.

"It's a VAV system, but we're making some modifications," said Hardesty. "The existing air handlers have discharge dampers to control the static, and we are doing away with that and going back to VFDs on the fans when we replace them." The chilled water control valves have also been changed from three-way to two-way valves in order to facilitate variable flow in the secondary chilled water loop.

The existing cooling tower was undersized and noisy, so two, low-noise, stainless steel cooling towers replaced it. Riggle noted that quiet towers were necessary, because new classrooms are located right next to the equipment, and the old, noisy tower was a big problem.

"The new cooling towers also required a diverter on the discharge to avoid moisture depositing on the adjacent historic structure, and to avoid mold growth on the same," said Estrella. This had been a problem with the previous cooling tower installation.

The college utilized pneumatic controls and did not have a central BAS, so a DDC system from KMC was installed as part of the renovation. "We retrofitted all the VAVs with DDC, so now they actually have a front end. They can monitor the temperatures, do trending, remote adjustment, remote alarm, and we're looking to expand that around the campus."

The electrical service also needed upgrades as part of the renovation. One of the selling points of the magnetic bearing compressors is that they have a 2-amp in-rush current, but that power surge can also require new

Because of the salt air, water cooled chillers along with a new primary loop were specified for Flagler College.

electrical service. "The electrical service had to be changed from 208V to 460V to be able to accommodate the chiller, because these chillers are only available in 460V," said Story.

SECOND CHILLER NEEDED

The first frictionless chiller was a definite success, both from an energy saving and a noise standpoint. "It's shocking to me how quiet the chiller is," said Story. "The pumps are louder than the chiller. You're standing there talking in front of a machine, and you have to put your hand on the compressor to make sure it's running."

The college was so happy with the first chiller that a second one was purchased and installed next to the first one, making space in the equipment room even tighter. The second 150-ton chiller serves the new Art Building, which was built next to Kenan Hall. The new art facility was originally designed for rooftop package units, but due to the energy savings experienced with the first chiller, the college decided to expand the chiller plant and add a second frictionless chiller.

"With the identical machine, there are 300 tons of cooling in the plant, which ensures they'll never need the screw chiller that's been retained as backup," said Hardesty. "The new DDC system also controls the second chiller."

The total cost of the chiller plant renovation including the new chillers, DDC system, primary/secondary, VSDs, and cooling towers, came to approximately $750,000. The job had to be completed over the Christmas holiday in 2005, which gave Hardesty and his crew about one month to complete it.

"The time frame was a challenge, and basically, I didn't have a holiday last year," said Hardesty. "But we had the college up and running when the students came back after their break, and that was the important part. We probably worked another month to get all the bugs worked out, but there were very few problems."

Since the installation has been finished, Hardesty has had other customers interested in frictionless chillers as well. "I've taken several people to see and hear the frictionless chiller operating in Kenan Hall. Customers from schools, government buildings, and commercial offices have all been impressed by the chiller," he said. "As a result, we've been able to value engineer several other projects." **ES**

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