JOINT VENTURE / SINGLE PURPOSE

When the City of Tallahassee and Leon County collaborated on a consolidated public safety complex to deal with local emergencies, the stakes were high and the need for robust yet adaptable HVAC was, too. Another collaboration within the design — chilled beams and pump technology — represented a key component of the mechanical system as it stands ready for severe swings in occupancy and weather alike.

By William Dalhoff, LEED AP

Public safety complexes (PSC) are the nerve centers for municipalities and their citizens. As contained within a PSC, an emergency communications center's (ECC) ability to quickly process incoming calls of an emergency nature and rapidly dispatch public safety resources can be a matter of life and death. In community-wide emergencies, whether natural or man-made, an emergency operating center plays a critical role in assessing the nature and extent of a disaster or unfolding threat and in coordinating/marshaling local, state, and even federal responses to protect the public.

Obviously, because there are many agencies involved that have to be coordinated, the more centralized the functions of a PSC/ECC can be, right down to physical co-location and sharing of services within the same complex, the more efficient and effective this vital public service can become. The Communications Security, Reliability and Interoperability Council (CSRIC) called for such consolidation in its 2010 final report on Key Findings and Effective Practices for Public Safety Consolidation:

"Public safety radio systems and communications dispatch centers were historically built and operated by single agencies for their own users. Systems were designed to meet unique local requirements, but often led to incompatibility, inefficient use of scarce resources, and higher costs for specialized equipment and procedures with little opportunity to benefit from economies of scale. There has been a clear trend over the last two decades towards public safety system consolidation, with radio networks developed to cover counties, regions, and even states. Similarly, jurisdictions have merged their communication dispatch centers across agencies and political boundaries."

THE TALLAHASSEE-LEON COUNTY PSC EXAMPLE

A model for successful integration of a PSC-ECC along with other functions (EMS, fire department, transportation management) into a single complex with integrated functions is the Tallahassee-Leon County Public Safety Complex in Tallahassee, FL. This $47 million complex, which opened in the spring of 2013, combines both city of Tallahassee and Leon County public safety communication functions along with an emergency operations center and other emergency functions under a single cohesive emergency service operating structure. The city and county share the costs of operating the facility. An award-winning project (American Public Works Association and Associated Builders' Building Contractors Awards), the Leon County PSC is seen as a benchmark for how mission critical facilities can be consolidated and their functions seamlessly integrated to better serve the public.

The project was the vision of the city of Tallahassee and County Commissions. It came together as a result of years of hard work and leadership on the part of the two political subdivisions, with the sole objective of improving the delivery of emergency services to the community. Architect Carl Morgan, a longtime Leon County facility and construction manager, oversaw the programming, design,

FIGURE 1. Objectives for the facility included the ability to function if entirely severed from public utilities, and to provide full parallel redundancy in supporting systems.

and construction of the facility in a multi-year project he likens to a labor of love. The Tallahassee-Leon County PSC provided the opportunity to build a state-of-the-art public safety building specifically designed to facilitate the collaboration of city and county agencies, include the county sheriff's department, and integrate cutting-edge technologies to make the facility energy efficient, sustainable, and able to smoothly handle cooling needs with changing occupancy rates.

"We developed a set of significant objectives associated with the initial design process for this building," he relates. They included:

- A building threat hardened against both natural and man-made disasters;
- A fully sustainable facility, able to function independently from public utilities should those connections be severed;
- Redundancy in all supporting systems to achieve N+1(also known as "parallel redundancy" —— power supply components (N) have at least one independent backup component);
- Ability to withstand wind forces of an F4 tornado (12-ft thick insulated walls to the building and laminated glass windows that can absorb the impact of a 15-ft 2x4 piece of lumber traveling at 100 mph);
- Built-in long-term flexibility so that the building can respond to whatever changing needs might be;
- Building design to facilitate collaboration between all the occupying entities.

DRASTICALLY DIFFERING OCCUPANCY

Because the building has changing occupancy levels based on workday staffing, evenings and weekends, and full activation in an exercise or real-situation mode, design and selection of the HVAC system was an especially critical step.

One of those mechanical challenges was that the building had to be able to deal effectively with a very broad heat load extraction. To illustrate, whereas the building has a normal daytime occupancy of around 150 people, and an overnight average occupancy of 35-40, the occupancy rate can balloon quickly to up to 400 in the event of activation of the EOC.

H2 Engineering of Tallahassee, the prime engineering consultant to the architectural design firm of Clemons, Rutherford & Associates (Tallahassee), was elected as the consulting engineers on the project. In business since 1977 and currently with approximately 20 employees, H2 Engineering focuses on K-12 and university, correctional, and EOC facilities. Daniel Henderson, P.E. was lead engineer on the Leon County PSC, backed up by H2 Engineering part-owner and President Matt Scaringe, P.E.

THE HYDRONIC HVAC SYSTEM

"The HVAC system for the building is a chilled water system," says Henderson, "with three 250-ton Trane supplied centrifugal chillers (CenTraVac™ chillers) piped in a variable primary flow. It uses ground source condenser wells (bored down to 450 ft) for cooling water. It has three primary chilled water pumps (Taco FI Series) that pump water throughout the facility. It also has two boilers (Harsco Patterson Kelley Modu-Fire) in a primary-secondary arrangement with both primary dedicated pumps and secondary distribution pumps. Everything is redundant so that a failure of any single piece of equipment will not render the system inoperable."

"The way we deal with the varying loads," explains Henderson, "is with the three Trane chillers piped in series: the first chiller handles the everyday load; when we go into activation mode, we then need two chillers, and the third is our N+1 redundant unit."

Vital information stored on the servers in the facility's dual-powered equipment racks in the 2,600-sq-ft data center is cooled through in-row cooling units with hot aisle containment, in lieu of conventional CRAC units. Variable speed fans with chilled water coils in between the racks provide pinpoint cooling across the servers and can be adjusted for flow rate and temperature. Chilled water to the in-row cooling units is supplied by the house system, not an independent unit. This allows chiller power consumption for all refrigeration requirements to be optimized and maintenance costs to be reduced. The constant temperature in the data center is maintained at around 68°F. Its functions are controlled by a backbone Alerton BAS that rides on the back of the HVAC system employing WebTalk.

BACKUP POWER

As a building that must continue to function should power be lost, the facility has an N+1 standby power system consisting of diesel generators, fuel storage tanks, parallel switchgear, and two 1-megawatt uninterruptible power supplies (UPS). The power generation system includes three 1-megawatt diesel engine-driven standby generators housed within an exterior, hardened mechanical enclosure that is rated to withstand 200-mph winds. Diesel fuel storage capacity is maintained at over 17,000 gallons, held within two 8,000-gal above-ground tanks along with one 450-gal base-mounted tank at each of the three generators. This allows the facility to function on generator power at the current electrical demand for approximately 10 days, including five days at the maximum rated load.

CHILLED BEAM BENEFITS

Separate from the data center, approximately 90% of the occupied space of the building is quietly cooled by a chilled beam system (Trox active chilled beams supported by Taco LoadMatch circulators and LOFlo mixing blocks). There are over 300 chilled beams

FIGURE 1. While the building has a normal daytime occupancy of around 150 people and overnight average of 35-40, that can balloon to 400 in the event of an emergency.

throughout the building. The chilled beams come with their own controls and are kept at 2% above dew point, with Daikin McQuay air handlers providing dry air to the beams in what is essentially a constant volume system supplying fresh air to the building and removing the latent heat from the exterior air.

Use of a chilled beam system allowed the engineers to reduce the size of the mechanical rooms and the air handlers. The beams have also helped reduce energy consumption, which continues to drop each month because there is less air to move around the spaces.

"It's much cheaper to move water than air," says Morgan. "And we don't have a hot-cold complaint log for the building because we don't have hot-cold complaints."

However, chilled beams were not originally intended for use in the Leon County PSC.

"Early on in the design phase, we looked at an underfloor air distribution system in the hopes that it would provide us with long-term flexibility for the various space utilizations," Morgan explains. "But the more we worked on that with the H2 Engineering team, the more we realized that such a system did not provide the functionality and flexibility we required. We then looked at other alternatives, including chilled beams. It is a system I was not 100% acquainted with, as I had not used them before."

Few building owners, engineers, or contractors in the Tallahassee area had worked with chilled beams at that time.

"The use of chilled beams for a public building here in the south is pretty unique," says Jay Smith II, vice president of Ajax Building Corp. (Midway, FL), the construction at risk management firm on the project. "It's fairly new technology here, and we're just starting to see it employed, as in the Leon County PSC project and the University of Florida's College of Journalism building. People have concern about using chilled beams because of our climate's high humidity factor, which can produce sweating and potential leaks."

Scaringe's firm had experience with chilled beams and had suggested them to Morgan. "One of concerns with chilled beams, especially in a climate like we have here, is condensation forming on the surface of the beams. It's a real concern and requires us as engineers to properly design the system and for the owner to properly operate the system. One of the things we rely on is using the Taco LOFlo injection pumps to make sure we're maintaining a water temperature above the dew point in the space and using highly accurate dew point sensors throughout the space to make sure we're measuring it correctly."

The team reports that the company's circulators and mixing block work well in a setting involving radiant cooling and chilled beams. Self-balancing technology has eliminated the need for most balancing valves or control valves, while the mixing block provides only the flow and temperature needed to adapt to the facility's potentially wide swings in zone load.

Installation of the overall LoadMatch system and the Trox chilled beams proved to be an easy install. "This was a first time use of these components for our firm," says Bobby Kelly, president of Kelly Brothers, the installing contractor on the project. "Chilled beams are easy to install, save space above the ceiling, and are very energy-efficient."

The team saw another advantage with regard to managing occupant space.

"Overhead chilled beams in the spaces solved our concerns over flexibility, especially with regard to turning the workstations over the life of the building," adds Scaringe. "We felt that chilled beams were the right application for this project, and it's turned out to be a great success. This is very comfortable environment for the occupants."

THE MECHANICAL ROOM

Because engineering considerations came first in terms of design, the mechanical room space and layout were a priority.

"Most times, mechanical rooms are very limited," says Kelly, "and we struggle to fit everything in. In this case, there's plenty of room for maintenance after the fact and room for any future expansion that might occur."

"Use of (Danfoss) variable-speed drives on the Taco pumps (47 total) allow us to handle the varying load conditions by varying the water flow to each piece of equipment," says Henderson.

Scaringe adds: "One of the other applications we had for the pumps on this project is that we eliminated control valves on our cooling coils and actually pump to every coil in the building. This way, we can vary the speed with the drives on those pumps to match the temperature conditions we need coming off the coils. It also allowed us to eliminate the pressure drops in the system typically associated with control valves on cooling coils."

"The building itself is designed with a complete variable speed system. Each piece of mechanical equipment works no harder than it actually has to," says Morgan.

Additional equipment from the same manufacturer in the mechanical room includes frame-mounted pumps, KV vertical pumps for AHUs, air/dirt separators, multi-purpose valves, and expansion tanks — equipment typically seen in Southeastern U.S. mechanical rooms where hydronics dominate.

The hydronic system design for the building was laid out using Taco's Hydronic Systems Solution® (HS2) software program, which H2 Engineering is well acquainted with, having been one of the first engineering firms in the country to use it.

"This project was our largest HS2 file yet," reported Henderson.

The team considers the tool a real asset in terms of clear communication to the contractor and owner about what is being provided.

CONCLUSION

Morgan spends a bit of his time each week showing off the facility and its features to fellow public safety professionals, and he's proud of what the new facility delivers to the citizens of Tallahassee and Leon County in terms of fast and efficient public safety response, and also what the building means to the future of public safety complex design and construction.

"Building a mission critical facility requires taking into account a lot of different considerations to make it successful, from the design to the construction, and then at the end of the day to how do the occupants use the facility," said Morgan. "Each agency in this building is acoustically isolated, yet they're all connected via the common use spaces, the common cores. There's a tremendous amount of glass in the building to give them a sense of visual connections with their counterparts. As the agencies work together, they become more like a collective than independent functioning entities occupying the same space, and that integration holds great promise for our ability to provide the very best emergency management services to our community.

"Thanks to the vision of the county and the city working together, we were able to incorporate a lot of exciting new technologies into a tried-and-true mission critical facility. This building will set the standard for years to come."

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