District Energy

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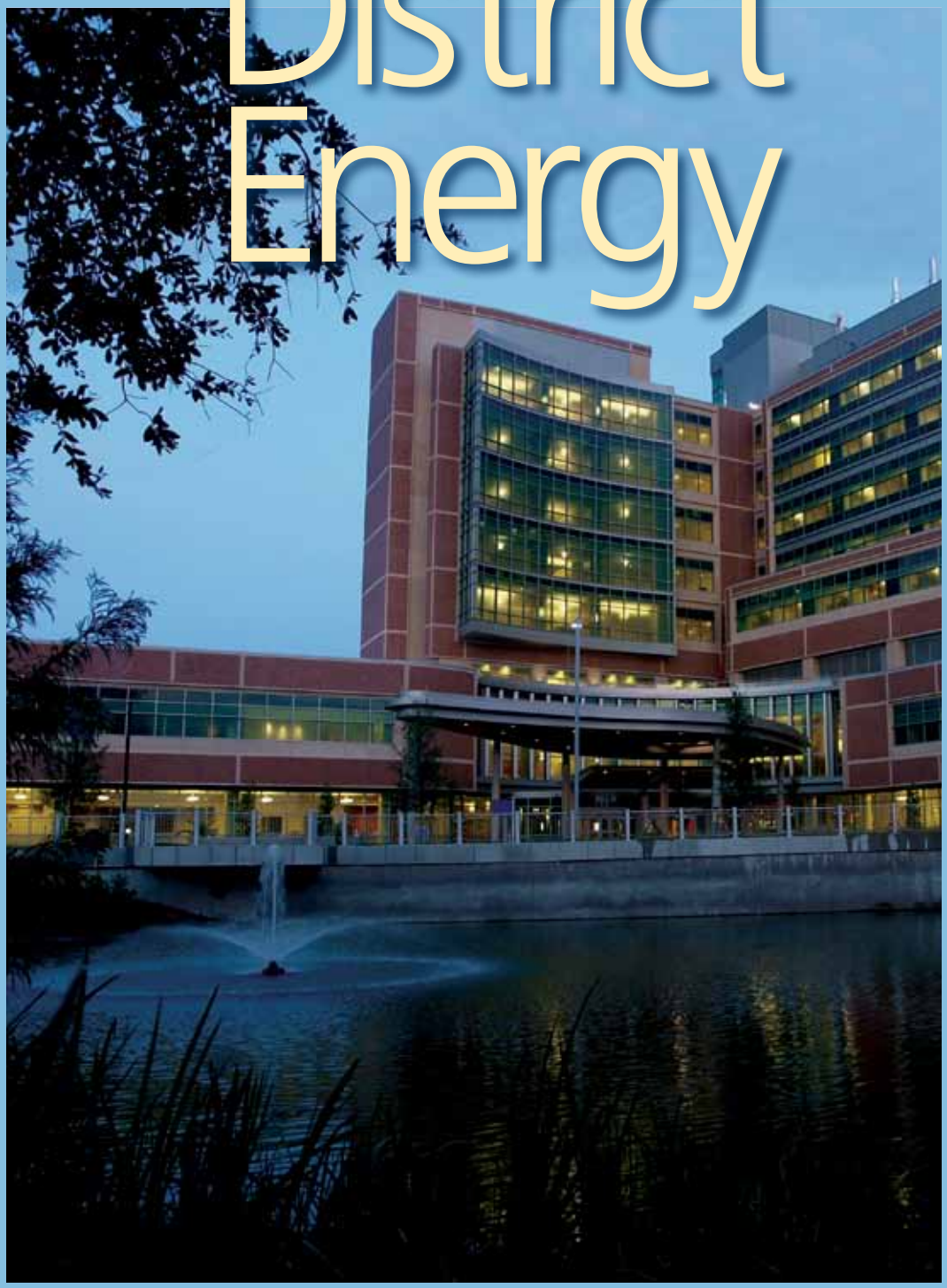
Shands HealthCare, Florida Utility Partner on Unique Energy Center



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Cover Story

Outsourced and On Site:

Hospital, utility team up on innovative energy center

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Chuck S. Heidt, Asset Manager, South Energy Center, Gainesville Regional Utilities;
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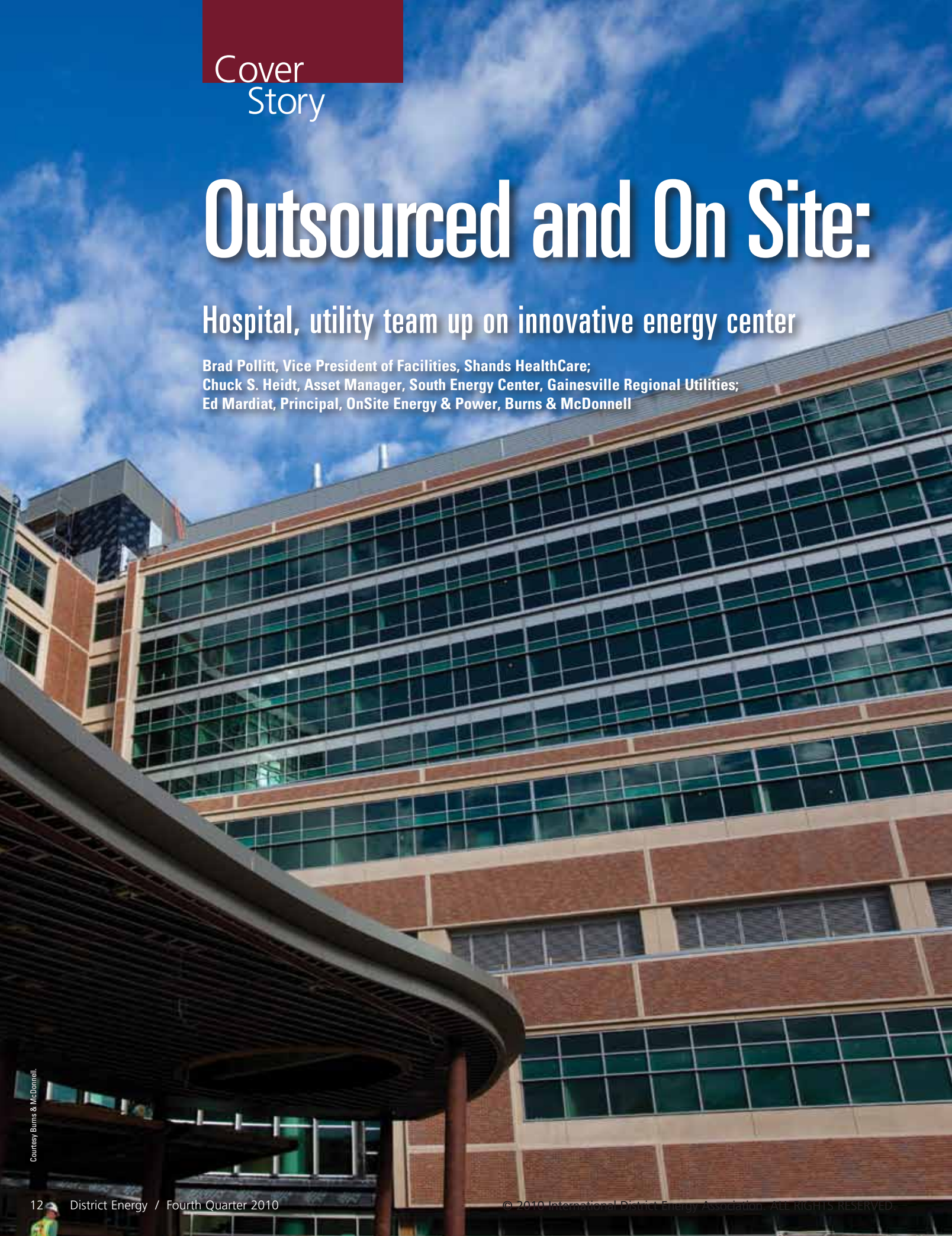

Courtesy Burns & McDonnell.

As Shands HealthCare administrators began planning a new cancer hospital in Gainesville, Fla., one question kept coming up in discussions: How can this project become uniquely Shands'?

A leading health care system in the southeastern United States, Shands is a private, not-for-profit medical network affiliated with the University of Florida (UF). The company designed its new Shands Cancer Hospital at UF to be a 500,000-sq-ft facility offering advanced resources for a wide range of oncology, surgery, critical care and emergency/trauma patients. It would incorporate 192 private rooms, a tranquil healing garden and other features reflecting the Shands tradition of quality, patient-centered care.

Shands also envisioned that the hospital would be supplied with steam and chilled water from its own district energy system – a system that the company planned to outsource to an energy partner. The partner that Shands chose, Gainesville Regional Utilities (GRU), delivered even more economic and operational benefits than hospital leaders may have anticipated. Its plan for the hospital's South Energy Center, which included combined heat and power, has set new industry standards for partnership and energy efficiency.

The Shands-GRU collaboration is the first national model of a not-for-profit hospital and municipal utility partnering to create an on-site energy center that meets all the health care facility's power, heating and cooling needs. It is an innovative partnership that can be instructive for other large public institutions facing a similar combination of environmental, energy security and operational imperatives.

Outsourcing Energy

In the mid-2000s, as Shands developed its master plan for the cancer hospital campus, hospital leaders concluded that turning their vision into reality required them to turn over areas outside their core mission – like improving power quality and energy security – to key partners. In short, Shands 'didn't want to own a backhoe.'

When GRU realized that Shands, one of its largest customers, was planning to solicit proposals for an energy partner to finance, design, build, own, operate and maintain a new district energy system to serve the hospital campus, it knew it was about to face a test. Others were planning to go after the energy outsourcing project.

Owned by the city of Gainesville, GRU provides electric generation and distribution, water, wastewater, natural gas and telecommunications services. Although, as a multi-service municipal utility, GRU was uniquely vested in the overall success of the Shands project, hospital planners were not convinced that it had the expertise to design and build a power facility that would deliver the energy security and power quality it needed.

The South Energy Center serving the Shands Cancer Hospital at the University of Florida is housed in a steel-frame, precast concrete structure designed to withstand hurricane force winds. The three-story structure was built with space to expand as the hospital's master plan continues to evolve.

GRU decided to convince the hospital otherwise. It was not about to stand aside and watch a major customer leave its system without a fight.

The Case for Innovation

Though municipal utilities typically have fewer reasons to object to distributed generation facilities than investor-owned utilities, all utilities integrating on-site CHP face challenges to their load growth planning and future resource development. For this reason, along with many other challenges, few utilities have experience owning and operating CHP systems located at a customer's site.

Despite those obstacles, GRU chose to view Shands' decision to become independent of the grid as an opportunity to create a win-win partnership. GRU's first step was to identify its competitive advantages and disadvantages.

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With its AA bond rating, one of GRU's biggest strengths was its access to low-cost financing. The ability to finance the $45 million energy center over 50 years at a municipal bond rate turned out

The South Energy Center provides ample cooling capacity for the hospital via two 1,500-ton electrical centrifugal chillers and one 1,200-ton steam turbine centrifugal chiller.

to be a significant advantage over private finance alternatives. Another big advantage was that, as the local utility, GRU could export power to the grid. This helped drive the economics of an on-site CHP system to a level that was competitive with the economies of scale typically achieved by much larger generating assets. Another significant advantage was GRU's pool of qualified staff with significant experience operating and maintaining a fleet of central station gas turbine generators.

GRU Builds Its Team

Shands' request for proposal for the energy center, issued in 2006, required respondents to have a proven track record of design and construction of similar CHP facilities; so it was apparent to GRU that it needed to bring on a team member with relevant experience.

Shands also had a very aggressive schedule: The energy center needed to be operational 12 months prior to the November 2009 hospital opening, to provide cooling and heating for dry-out during hospital construction. Because of the need to minimize schedule risk, among other conditions, GRU had decided that a design-build project delivery approach was needed.

After evaluating the qualifications of a number of design and construction firms, GRU selected Burns & McDonnell because of its recent design-build experience on a similar CHP project for Austin Energy at Dell Children's Medical Center in Austin, Texas. There Burns & McDonnell had installed a CHP system as part of a packaged, modular plant that helped the hospital become the first LEED® (Leadership in Energy and Environmental Design) Platinum-certified hospital in the world.

Making the Numbers Work

Next GRU turned its attention to project financing. Shands was interested in pursuing a 50-year contract in which the energy partner would own and operate the plant. GRU's strong credit and ability to utilize tax-exempt municipal bond financing would help differentiate the utility's proposal from those of other for-profit entities bidding the project.

Burns & McDonnell worked closely with GRU to evaluate how to incorporate CHP as part of Shands' district energy system. The partners developed an innovative financial and technical proposal that suggested a state-of-the-art combustion turbine with a competitive heat rate efficiency. The proposal allowed both Shands and GRU to achieve specific business and operational objectives. GRU's proposal, submitted in fall 2006, was the only one Shands received that incorporated CHP.

Early in 2007, Shands selected GRU as its energy center partner. Shands would agree to pay all capital costs as part of monthly capital cost recovery over the term of the agreement; production costs for electricity, chilled water and steam; pass-through costs for fuel (natural gas, electricity and diesel) and medical gas; and operations and maintenance costs incurred by GRU.

For its part, GRU would gain by retaining one of its largest customers and by helping that customer create and sustain hundreds of new jobs in the community as it implemented future phases of its master plan. GRU would also gain an additional highly efficient, reliable source of power capacity that would help diversify its revenue stream.

While GRU could not sell electricity at rates below its tariff for large commercial energy customers, it did have other options for passing along savings. As part of the agreement, GRU offered Shands its power generation natural gas price, which is the cost charged to its fleet of large central station generating plants. This rate is significantly lower than its local distribution system natural gas rate structure.

Additionally, all power generated is purchased by GRU according to a pricing formula providing a credit to Shands. An operating committee consisting of Shands and GRU representatives approves the budget and resolves other operational issues. Budgets are developed and reviewed by an operations committee, and any savings are split on a 50-50 basis.

The capital savings resulting from outsourcing the central utility plant allowed Shands to focus limited capital funding on a needed parking garage, aesthetic enhancements and energy efficiency improvements. This has directly improved Shands' ability to provide a quality environment of care for its patients. That and other features of this unique open-book contract make it one of the most trendsetting in the district energy industry in many years.

State-of-the-Art Inside and Out

Construction on the South Energy Center began in 2007. During the first half

of 2008, it started phasing in service to the Shands Cancer Hospital, which was still under construction; and it began providing full service to the hospital in 2009. The hospital opened its doors in November 2009.

The South Energy Center is the only CHP facility of its size in the southeastern U.S. capable of providing 100 percent of its host institution's electric and thermal energy needs. It provides normal and standby essential steam for space heating and sterilization, chilled water for cooling, plus medical gas. (See "System Snapshot.") The center is housed in a three-story, 43,000-sq-ft, steel-frame, precast concrete structure designed to withstand 100 mph wind speeds resulting from a Category 3-4 hurricane.

> The South Energy Center meets 100 percent of its host institution's electric and thermal energy needs.

Electric Power

The energy center has a state-of-the-art 4.3 MW natural gas recuperated combustion turbine, with a simple-cycle heat rate efficiency of 38 percent and guaranteed nitrogen oxide emissions of 5 ppm without after-treatment. This ultra-high-efficiency generator is designed to run 24/7 and is normally operated in parallel with one of the two utility feeds that come from separate substations in GRU's network. The energy center can generate all of the hospital's normal, essential and emergency power on-site as well as all of the power necessary to run the energy center itself.

Thermal Energy

Two 1,500-ton electrical centrifugal chillers and one 1,200-ton steam turbine centrifugal chiller more than meet the challenges posed by central Florida's heat and humidity. The exhaust from the combustion turbine generator is directed through a waste heat recovery boiler to produce 14,500 lb/hr of steam without any additional fuel. The steam is used to provide building reheat, cooking and sterilization and hot water for the hospital.

Courtesy Burns & McDonnell.

Chilled-water cooling is supplied to the Shands Cancer Hospital at UF as well as to an employee fitness center also located on the medical campus.

Redundancy

Duct burners provide an additional 30,000 lb/hr of steam at a nominal 98 percent thermal efficiency. The energy center also includes a 30,000-lb/hr dual-fuel standby boiler, for use on those rare occasions when the CHP system is out for scheduled maintenance. The steam can also be used to produce 1,200 tons of chilled water by using the steam to drive a steam turbine centrifugal chiller. This blend of technology results in a 75 percent efficiency rate for the CHP unit.

Controls

The South Energy Center has a programmable logic controller-based control system that allows remote monitoring and operation throughout the building. Still, highly trained operators are crucial. The South Energy Center was fortunate to be able to draw a highly qualified and motivated staff from GRU's other power generation facilities.

As part of the Shands project, GRU also extended a new reclaimed water line approximately 1 mile to the site to provide water for hospital campus irrigation and cooling tower makeup.

The South Energy Center facility has been constructed to accommodate the equipment for Phases 1 and 2 of Shands' four-phase campus master plan, a blueprint for the next 20 years. With Phase 1 completed, Phase 2 will require adding a second CHP system and two more centrifugal chillers within 5-10 years. The facility can also be expanded to meet expanded campus loads under Phases 3 and 4.

At final buildout, the medical campus will comprise approximately 3 million sq ft of building space. This will require the addition of 15 MW of on-site electrical power generation; 16,000 tons of chilled water; and 120,000 lb/hr of steam production.

Improved Reliability

During normal operations, the South Energy Center runs at full capacity contributing power to the hospital and to the grid via two independent GRU interconnections from separate substations (fig.1). Should one utility source fail, the energy center automatically detaches from that source and operates as a power island. It then seamlessly synchronizes and connects to the alternate utility source, returning to parallel operation.

Facility operators can also intentionally 'island' the energy center in the event of severe weather that could affect the electrical system integrity.

Should both grid interconnections and the energy center fail simultaneously, the energy center has a 2,225 kW essential power diesel generator that is automatically started within 10 seconds to supply the life safety and essential loads until one of the three primary power sources is restored. The energy center also has its own dedicated 500 kW diesel generator available to black start the combustion turbine generator or to provide power to assist in re-establishing any of the four power sources to the campus. Shands has enough fuel storage on site

for emergency generators to meet essential and life safety loads without disruption.

Hospitals must perform monthly and annual load tests on their on-site generators in order to prove that they will be ready for operation when an emergency occurs. This is typically done by running the generator with whatever load is available from the hospital, which is usually much less than the generator's rating, since the generator is sized for the worst-case scenario.

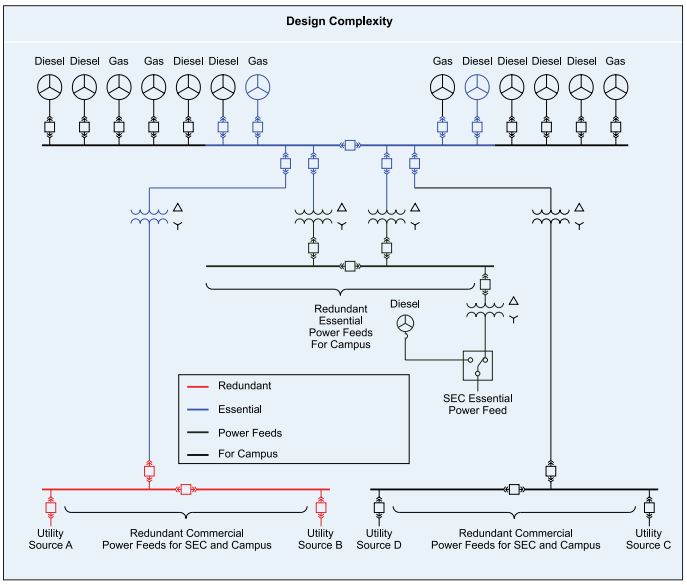
This is an inefficient operating point for the generator and does not prove that it will be ready for the real demand when the time comes. To address this, many hospitals provide a dedicated load bank for their generator tests. This is like a very large toaster oven that takes the generator's output and converts it to heat, which is vented to the atmosphere.

The South Energy Center provides an optimal solution by allowing the site's emergency generator output to be fully utilized by the site's normal power demand or exported to GRU's distribution grid. Thus, the generator can be tested at any desired output and duration with no waste of power.

Given the importance of on-site power generation to the entire Shands facility, the generation bus is isolated from both the normal and essential distribution systems via delta/wye transformers. This allows the generators to utilize high-resistance grounding to minimize damage while providing enough fault current to the distribution systems to activate the overcurrent devices. Thus, a fault in the distribution system can be quickly identified and isolated by the protective relays without unnecessarily interrupting on-site generation.

Though it has yet to be tested by an actual hurricane, the South Energy Center has operated in island mode several times during inclement weather. Though Shands is located inland, it was designed with capability to operate independent of the grid indefinitely, far surpassing Federal Emergency Management Agency requirements. If a hurricane is imminent, Shands will go 'island' long before the worst of the storm moves in.

Figure 1. South Energy Center: Reliability Through Redundancy. Grid interconnect diagram.



Source: Burns & McDonnell.

Environmental Benefits

The South Energy Center is proving to be one of the cleanest CHP units in the country. It is currently producing .003 lb/MWh of sulfur dioxide, .043 lb/MWh of nitrogen oxide and 615 lb/MWh of carbon dioxide. These standards exceed guaranteed performance

System Snapshot: South Energy Center
System Owner: Gainesville Regional Utilities
Location: Shands Cancer Hospital at the University of Florida, Gainesville, Fla.

	Steam/Combined Heat and Power System	Chilled-Water System
Startup Year	2009	2008
Number of Buildings Served	1	2 (hospital plus employee fitness center)
Total Square Footage Served	500,000 sq ft	500,000+ sq ft
Plant Capacity	72,000 lb/hr steam; 4.3 MW electricity	4,200 tons chilled water
Number of Boilers/Chillers	2	3
Fuel Types	Natural gas and diesel	Electricity and steam
Distribution Network Length	¼ mile	¼ mile
Piping Type	Carbon steel insulated, direct-buried	Carbon steel insulated, direct-buried
Piping Diameters	10-inch supply, 6-inch condensate	18 inches, supply and return
System Pressure	110 psig	N/A
System Temperatures	180 F condensate return	42 F supply/58 F return
System Water Volume	N/A	100,000 gal

Source: Gainesville Regional Utilities.

thresholds and are well above current federal and state clean air standards for the southeastern United States.

The combination of energy efficiency provided by the CHP system, hospital energy efficiency measures and sustainable construction techniques have helped the hospital achieve LEED Gold certification in the New Construction rating category. This achievement exceeded initial project objectives of LEED Silver.

The Shands-GRU partnership structure is an attractive one for municipal-owned utilities serving community mission-critical facilities. As the South Energy Center gains a track record of performance, more and more publicly owned utilities will look at district energy and the integration of CHP as a proven means to meet community, economic and environmental objectives.

This energy partnership is achieving success because of the qualifications, competence and commitment of each partner. It's a partnership that offers significant opportunities and benefits to each entity. There are challenges from the CFO office because of traditional accounting methods. There are complications with local AHJs due to introduction of new codes from differing industries and novel design approaches. There are challenges due to traditional utility industry barriers and dated business models. But for groups that are willing to put forth the extra effort to overcome these obstacles, the rewards are significant.

Brad Pollitt, AIA, is vice president of facilities for Shands HealthCare and its seven-hospital network. During his 10-year tenure in this position, Shands has implemented more than $450 million of construction, renovation and capital improvements. With the company since 1989, Pollitt has also served as hospital architect and directed major construction projects, facilities planning and facilities development. A licensed architect in the state of Florida, Pollitt holds bachelor's and master's degrees in architecture from the University of Florida College of Architecture.

Chuck S. Heidt, PE, is asset manager for the South Energy Center, a business unit of Gainesville Regional Utilities (GRU). Employed by GRU for 25 years, he served as project manager during the development and commissioning of the South Energy Center. Heidt holds a bachelor's degree in environmental engineering from the University of Florida and is a licensed professional engineer in the state of Florida. His email address is heidtcs@gru.com.

Ed Mardiat is principal of Burns & McDonnell's OnSite Energy & Power group. He was principal in charge for the South Energy Center project. With more than 25 years' experience in design and project management, Mardiat has focused his efforts over the past 14 years on project development of on-site energy projects. Mardiat can be contacted at emardiat@burnsmcd.com.

Changing Standards

Health care facilities everywhere are under increasing pressure to remain up and running, even during natural disasters that may interrupt power service on the surrounding grid. Though Florida has long had experience with hurricane contingency planning, requirements for grid independence came to the fore only in the early 1990s, in the wake of statewide devastation caused by Hurricane Andrew.

Today, hospitals are required by state and local Authorities Having Jurisdiction (AHJ) and the Joint Commission, an independent body that accredits and certifies U.S. health care organizations and programs, to plan for 96 hours of continuous operations in the event of a utility outage. (That requirement extends to 168 hours, or seven days, for Veterans Administration facilities located within 10 miles of the Gulf of Mexico or the Atlantic or Pacific Ocean.)

Hospitals are required by AHJs to have essential power. The Florida Agency for Health Care Administration (AHCA) had not previously approved the outsourcing of this function. For Shands' new cancer center project, however, the AHJ gave its approval because the owner of the energy center would be the local municipal utility and because of contract provisions ensuring the AHJ would have access, approval and authority.

All hospitals are required to have a diesel generator as essential backup for life safety systems, though these have proven to be unreliable. On-site storage of large quantities of diesel fuel for extended periods of time presents fuel quality and quantity issues. According to one study of the 2003 blackout in the northeast, most diesel emergency generators at affected facilities started within the required 10 seconds, but 67 percent failed to operate for prolonged periods of time.

Shands set out to meet and exceed the 96-hour requirement by developing a power resource that could give the health care center an unprecedented level of energy security and improved reliability to ensure a fully functional hospital under all operating conditions.

Courtesy Burns & McDonnell.