BY SAMUEL G. TOUB, GEORGE C. HAMMONS AND RICHARD NORRIS

Efficient (and safe) BY DESIGN

Electrical/mechanical upgrades ensure patient safety and operating efficiency now and in the future

Healthcare leaders continually strive to improve the services and quality of care they provide. As they expand their facilities in size and scope of services and incorporate new technology to meet their mission, they encounter difficult infrastructure challenges. In particular, it becomes a challenge to ensure that the emergency power generation system meets current standards of patient safety, and that the mechanical system meets current capacity needs and expectations of energy efficiency.

These challenges are compounded by the myriad of changes that have taken place in these systems over the years, often without adequate documentation to as-built drawings. Moreover, these systems must be upgraded and new components installed without impact on day-to-day hospital operations.

It is little wonder that healthcare leaders often approach these types of projects with concern. However, with careful planning, design and execution, electrical and mechanical upgrades can be accomplished smoothly with the best possible outcome for the institution.

Cooling towers were replaced with high efficiency units at Methodist Charlton Hospital in Dallas.

Reliable emergency power

Many earlier healthcare campuses were designed with the electrical distribution system comprising normal power and emergency power. Under the new code, however, the emergency electrical system must be designed as a three-branch system to provide for critical, equipment and life safety branches, in addition to the normal branch.

A major renovation or addition requires that these systems be brought up to code compliance. Moreover, from a patient safety perspective, prudent and thoughtful healthcare leaders will not settle for less.

A typical situation was faced by leaders of a medical center in the Southern U.S. The original hospital was completed in 1975 with one emergency generator. By the 1990s, the hospital grew to include 232 beds and was more than four times its original size.

As the hospital expanded over the years, two additional emergency generators were added to meet the emergency power generation needs of the campus. Generator No. 1 served the main hospital, including the original bed tower and surgical suites; generator No. 2 served a second bed tower; generator No. 3 served the cancer center and phase 2. However, each of the three generators operated independently.

By the late 1990s, hospital leaders were concerned about the age of the units, capacity, and lack of redundancy for current and projected facility needs. This is a common problem among older healthcare institutions.

The mechanical/electrical consulting engineers proposed a solution involving a computer-controlled paralleling system, which allows the generators to work as one unit and to provide redundancy in case any one of them fails. The paralleling system comprises an input bus and an output bus. The input bus has a solid state, draw-out circuit breaker for each generator, that is, three input circuit breakers. If one of the generators fails, its circuit breaker automatically opens to protect the other two generators.

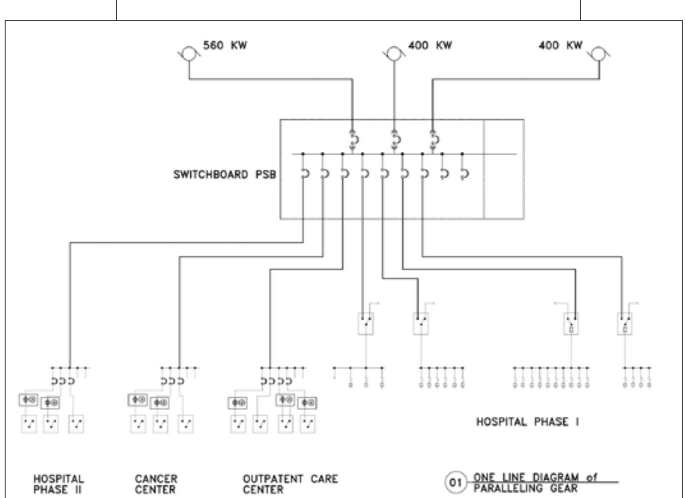
Similarly, on the output bus are roughly 10 circuit breakers, each of which feeds a transfer switch or distribution panelboard. At the time of the upgrade, there were 14 emergency transfer switches strategically placed throughout the hospital. The engineers designed the system with each of these switches wired to the system's computer controller and a circuit breaker for each transfer switch on the output bus.

For example, if one generator fails, the monitoring system detects that the emergency generator system has lost 33 percent of its capacity and assesses the remaining two generators for potential overload. If an overload situation is detected, the system automatically starts turning off individual transfer switches according to the priority list programmed by the engineers, according to which non-essential loads are disconnected first, although no more than necessary to compensate for the overload. In essence, the system monitors outgoing power to ensure that it is no greater than the generators' capacity.

The consultants also recommended that the hospital plan to replace the oldest generator, which was approaching 30 years old. This was performed approximately two years later where a 400 kw generator was replaced with a new 1,000 kw unit, further increasing the hospital's emergency power capacity.

In sizing the emergency power system, the consultants considered the health system's 10-year facility plan and designed the system to allow for the hospital to double the

An additional high efficiency centrifugal chiller was added to meet the growing load.



One Line Diagram of the Paralleling Switchgear (some of the detail has been removed for clarity).

PHOTOS: S. TOUB & ASSOCIATES, INC.

load. Hospital code requires a 25 percent excess capacity.

The project was carried out seamlessly without impact on the hospital's existing emergency power capacity. The vast majority of the installation was accomplished in the hospital campus central plant and the adjacent yard, where rented trailer-mounted, standby emergency generators were set up to power the emergency system while the new gear was installed.

The system has been in place since 2001, operating effectively during power outages.

Improved mechanical efficiency

Similarly, the campus and its associated clinical technology had outgrown the capacity of its central plant chiller system. The health system had added the appropriate sizes of pumps over the years to accommodate growth, and they had maintained the three existing 7-kw per ton chillers. However, the older chillers were not efficient, and the diameter of the existing piping in the central plant was inadequate for the increased mechanical load, resulting in high operational costs to pump chilled water through the system.

The solution was the addition of an efficient 4-kw per ton, 1,250-ton chiller installed in a bay addition to the building. The consulting engineers reconfigured the chiller system with primary and secondary piping loops and direct digital controls, enabling any one of the four chillers to function as the lead chiller, although the new, most efficient chiller normally operates as the lead. The diameter of new piping was increased to accommodate the new chilled water tonnage. In addition, the two existing wood cooling towers were replaced with stainless-steel towers, which more efficiently transfer heat. Moreover, with the new configuration, a new chiller can be added in the future if necessary, and the existing chillers easily can be removed and replaced. A structural engineer was consulted to ensure that the existing structure could handle the increased weight.

Typical chilled water piping that was replaced in the central plant at Methodist Charlton Hospital in Dallas.

PHOTO: S. TOUB & ASSOCIATES, INC.

The consulting engineers devised an installation plan to take the central plant chilled water system out of operation during the winter, when demand was lowest. Rented trailer-mounted air cooled chillers were set up in the adjacent yard and connected to the central plant through high-pressure hoses to handle the load. The piping was stripped out of the central plant and replaced. The project was completed before the summer.

The new system provides redundancy, increased capacity to accommodate growth under the hospital's 10-year facility plan and, thanks to its enhanced efficiency, reduced energy consumption. Based on the American Society of Heating, Refrigerating and Air-Conditioning Engineers energy estimating methods, there are 1,600 equivalent rated full load hours per year. This equates to a savings of approximately $75,000 per year.

In the spring of 2007, the hospital leaders began a $116 million renovation project on their campus, which was accommodated by the new emergency power and chiller systems.

Well-designed upgrades of existing electrical and mechanical systems assure that a growing medical center remains safe and efficient — by design — well into the future. ■

Samuel G. Toub, P.E., is principal of S. Toub & Associates, Inc., Dallas, Texas. A mechanical engineer with more than 40 years of consulting engineering experience, Toub is registered in 35 states. A fellow of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, he has served ASHRAE in various local, regional and national leadership roles. He can be reached at sgtoub@stoubandassociates.com.

George C. Hammons is vice president-electrical of S. Toub & Associates, with more than 40 years of experience in electrical system design and consulting. He can be reached at ghammons@stoubandassociates.com.

Richard Norris, P.E., is principal of S. Toub & Associates. He is an electrical engineer with seven years of consulting experience. He can be reached at rnorris@stoubandassociates.com.