

Modernizing Emergency Power

One of Montana's Largest Health Centers Centralizes, Automates Its System

Totally modernizing a hospital's emergency power system doesn't have to be a big pill to swallow. The work can be completed in small doses, without unpleasant budgetary side effects. That's exactly the prescription that Benefis Healthcare in Great Falls, Mont., is following for its East Campus.

The campus occupies 15 square blocks in Great Falls and includes the state's largest hospital, a skilled nursing center, medical office buildings, and the main location of the Great Falls Clinic—the region's largest physician practice. Together, with the eight-block West Campus, Benefis is licensed for 347 acute beds and 144 skilled nursing beds.

Rebuilding Emergency Power in Phases

"Benefis is deep into a multi-phase project that is overhauling a decades-old emergency power system," said Allen Meadors, an electrical engineer with CTA Architects Engineers in Great Falls, Mont. And it's accomplishing that feat without interrupting its 24/7 operations.

The healthcare organization's emergency power system has a huge responsibility. Not only must it keep NFPA 110-mandated life safety loads, chillers and critical-service departments like radiology powered, it must do so through frequent utility outages.

Benefis Facilities Manager Dawn Willey explained: "High winds coming down from the eastern front of the Rockies during the fall and into December can affect the lines from Butte [Mont.].

"The power fades enough to make the generators kick in two or three times a week. It only lasts a few seconds, but we run the generators for up to half an hour each time to make sure the episode is over," Willey said.

Benefis' precautionary procedure reflects the center's scope of responsibility. The center provides tertiary services for more than a quarter-million residents in north-central Montana. Outreach services cover the region's 45,000 square miles.

"It's not like being in a major metropolitan area with other large hospitals that might help care for patients," said Pete Haugan, Benefis' head electrician. "If something goes wrong here, we're by ourselves and in deep trouble if the emergency power system doesn't operate."

The old power system had followed Benefis' growth over the last quarter-century. Every time the center built an addition, another automatic transfer switch to service the addition's loads became part of the emergency power system.

Willey recognized that the de-



Exterior view, Benefis Healthcare's East Campus, Great Falls, Mont.

PHASE ONE: Centralizing the System

The first phase encompassed the generator building and the first of four 1500 kW engine-generators. This phase also included a basic engine-generator control system comprising master, engine-generator and two distribution sections, and one automatic transfer switch—all manufactured by ASCO Power Technologies.

The 3600-square-foot plant allows the emergency power system adequate room to grow through each phase.

The master control section initiates automatic system operation. It integrates AC metering of volts, amps, kilowatts, frequency and synchroscope, visual annunciation and control circuitry. It adds and sheds loads in the priority established by Benefis.

Power Control customized the section's operation to Benefis' specific requirements using the section's built-in, microprocessor-based programmable logic controller.

As the healthcare center's requirements evolve, an operator interface terminal will enable authorized personnel to change operational variables, such as time delays and set points.

A manual control station on the master section allows personnel to control the entire system with a combination of selector switches and push buttons. Paralleling, bus-under-frequency resetting, and alarm silence priority load shedding/load adding can be controlled from the station. Operation also can be monitored and controlled remotely.

centralized and over-taxed system would not be able to sustain the center and the planned additions looming on the horizon. She also wanted to reduce the amount of manpower required to maintain, test, monitor and control the system.

However, the cost of installing a total emergency power system was overwhelming. The solution? Completing the modernization in phases.

Meadors and CTA designed a system that would centralize equipment and operations, supply current loads and provide for ongoing expansion. Work started about six years ago with a review of the center's normal power supply.

The Power Picture

At least three normal 15 kV feeds are stepped down from two 15 kV substations. Power is distributed throughout the campus at 480V, with

numerous feeders serving separate transformers.

The mains connect with a normally open automated tie switch. Each transformer has a switch in the primary compartment that enables personnel to take the circuit off-line for maintenance.

The new 480V emergency power network uses the existing infrastructure throughout the campus. The emergency network splits into 480V circuits that feed approximately five emergency power centers. These centers feed approximately 30 automatic power-transfer switches. Emergency power centers are composed of a distribution panelboard at 480V that feeds the transfer switches.

"Because we knew what the eventual system capacity was going to be, we designed the first phase with a 10,000-ampere bus," Meadors said.

Seven Differentiating Points

Seven points of design differentiate the transfer switches. Differences include how the switches transfer power, ensure contact integrity and performance, extinguish arcing, and withstand and close-on on fault currents. Others are how they transfer motor loads, control emergency power system operation and can be tested, maintained and serviced.

The closed transition transfer switches feature overlapping main contacts that make before they break. This eliminates power interruptions during system testing, providing both sources are within plus or minus 5 percent voltage, plus or minus 0.2 Hz, and five electrical degrees. The transfer switch accomplishes this without controlling the engine-generator.

Each bypass-isolation transfer switch includes a closed transition transfer switch for regular operation and a bypass switch that allows the closed transition transfer switch to be inspected, tested and maintained without interrupting power to the load.

The transfer switch easily draws out from the enclosure for safe access to its components. Bypass and transfer switches, of course, have identical ratings.

PHASE TWO: A Real-Life Test

Phase two included the second 1500 kW engine-generator, an engine-generator section, and a supervisory and data acquisition system.

No sooner had the second phase been commissioned than the emergency power system got a real-life, extended test of its capabilities.

In addition to adding the new emergency power system, Benefis also had been constructing new operating room suites, which required digging in an open-air courtyard. The hoe found, and pulled, a 1200A, 480V feed from the normal source to a large switchboard in the heart of the hospital. The main had not appeared in a comprehensive search of blueprints prior to construction.

When the main experienced a bolted fault, the new emergency power system got its first test. It operated continuously for two weeks while Benefis replaced electrical equipment, repaired the electrical room and ran new wiring.

The two generators ran alternately, allowing the other to be maintained over the two-week period.

"It worked seamlessly," Willey remembered. "We were thankful for deciding to build a new emergency power system. It was a good plan."

The system's overall load includes almost all the campus' facilities. Besides life-safety loads, a good part of radiology, the heart catheter lab, air conditioning and the dialysis department all are protected by emergency power.

And what wasn't protected became obvious in a hurry. The elevator for the dialysis department, which is on the second floor of one of the buildings, was added to the



When it came time to update their power generation, Benefis Healthcare opted to do the work in phases.

system so patients needing treatment do not have to climb stairs. Cooling equipment in radiology is also now on the system.

The experience underscores the complexity of rebuilding a hospital's emergency power system.

Noted Meadors, "It's difficult to coordinate work around the 24-hour schedule of a healthcare center, which can't tolerate any shutdown for extended time periods."



PHASE THREE: Life-Saving Redundancy

After the episode with the main, Benefis installed phase three. Like phase two, phase three included a 1500 kW engine-generator and another engine-generator section. Although two gensets can easily support the campus at peak hours, Benefis considered its responsibilities and geography, and decided to add the life-saving redundancy of a

third genset.

"Redundancy is critical," Willey said. "I want to avoid having to close our doors because of power failures, which has happened in several places around the country."

To help manage the sophisticated emergency power system with minimum manpower, the healthcare center installed a PC-based automated monitoring and control system.

Haugan said, "It's an ASCO system and still brand new, so we're still experimenting with it." It communicates with the three engine-generators and the newer 27 transfer switches. The number of transfer switches will jump as older transfer switches are upgraded or replaced.

What Haugan likes about the automated system is that the desktop PC can be located anywhere and the status of the emergency power system can be monitored from anywhere. If power system operating conditions exceed set points for selected system alarms that they have established, Haugan is automatically alerted via email or pager.

Benefis also wants to monitor and control the power system from the West Campus, according to Meadors, and the automated control system will be able to do that.

It delivers detailed information on the status of all power transfer settings for all buildings. Operators know at a glance normal and emergency voltages and frequency, transfer switch position (normal, emergency or maintenance) and

source availability, logged transfer switch events and transfer switch test schedule.

Once the older transfer switches are replaced or upgraded, Benefis will have one of the most sophisticated and reliable emergency power systems in Montana.

PHASE FOUR: Preparing for the Future

Finally, a fourth 1500 kW engine-generator—and the corollary switch-gear—could join the trio of gensets to accommodate continued expansion.

Because the emergency power system is new, powerful and sophisticated, a natural question is whether Benefis plans to use it as a distributed generation resource.

"Not at this point," explained Willey. "We looked at several scenarios, but anything the engineers penciled out was borderline on whether it would save money on utility bills."

While the question may be considered in the future, she said a major issue is wear and tear on the engine-generators, which reduces the gensets' lifespans. If the benefits prove out, the system can easily be reprogrammed to provide for distributed generation operation.

Haugan said, "I had my doubts about the old system, whether it would run and keep running. But now I'm more comfortable than I've been in the last 15 years. It's really improved the whole hospital."

And that's a powerful statement for an emergency power system. ■