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UNDERSTANDING JOINT COMMISSION STANDARDS FOR HEALTHCARE EMERGENCY POWER SYSTEMS

Hospitals, nursing homes, clinics and other healthcare facilities are required by state, local and national electrical codes to have adequate emergency standby power systems that can be online within seconds of a utility outage to supply critical loads.

The Joint Commission's Environment of Care standard associated with emergency power systems was among the top ten standards cited for non-compliance during critical access hospital surveys in the first half of 2011.[i] In order to enhance the performance, capacity and reliability of emergency standby power systems, new recommendations encourage healthcare organizations to go beyond basic code-driven requirements.

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When the power goes out, having a backup power system is vital for patient safety and for preventing loss of life. Beyond electrical codes, numerous organizations are involved in setting standards and overseeing patient safety in healthcare facilities. These groups include the National Fire Prevention Association (NFPA), The Joint Commission (formerly known as JCAHO, The Joint Commission on Accreditation of Healthcare Organizations) and the American Society of Healthcare Engineers (ASHE). Some states also have their own standards organization; California's OSHPD (Office of Statewide Health Planning and Development) is one example.

While the scope of these organizations' oversight ranges widely, they all have specific rules and recommendations for emergency standby power systems. Rules specify that emergency standby power is vital for patients in operating rooms, obstetrical delivery rooms, nurseries and urgent care areas. It is also critical for life-support systems, blood, bone and tissue storage systems, medical air compressors and vacuum systems, as well as communication systems, elevators and egress lighting.[ii]

Recently, The Joint Commission issued a "top 10" list of the most frequently cited standards in surveys for its healthcare accreditation program. This list included observed deficiencies in emergency standby power systems in a large percentage of the healthcare facilities surveyed. Deficiencies included both equipment problems and procedural problems having to do with planning, testing, maintenance and documentation of standby power systems. This paper will examine the recommendations of the various sanctioning agencies, along with the recommendations of generator set manufacturers, to help healthcare facilities plan, install and maintain adequate and reliable emergency standby power systems that reflect today's risks and realities.

EVENTS FOCUS ATTENTION ON DEFICIENCIES

The majority of utility outages in North America tend to be infrequent and of short duration. However, in the past decade, there have been a number of region-wide events that severely taxed existing emergency standby power systems or exposed a significant system design flaw that led to catastrophic failure of the backup power system. Examples include the Houston floods of 2001, the 2003 utility blackouts in the northeast U.S. and the 2005 hurricanes in Florida, Louisiana and Mississippi. These and more recent disasters have repeatedly shown that a small proportion of emergency power systems may fail when most needed—due to inadequate system design or poor maintenance procedures. Some power systems failed due to design, such as systems housed in the basement or on the main floor of hospitals located in a flood zone. Others failed to start due to fuel contamination or weak starting batteries, the results of poor maintenance. Still others ran out of fuel before utility power was restored due to poor contingency planning. The Joint Commission reported that these incidents ranged from "single unit failures to entire large medical centers and each was associated with one or more patient deaths."[iii] Other natural disasters in recent years include events in Fukushima, Japan and Washington, D.C., where seismic activity renewed awareness of the International Building Code (IBC) for emergency standby generator systems and related equipment.

JOINT COMMISSION RECOMMENDATIONS

In the wake of the incidents cited above, The Joint Commission issued a list of recommendations that went beyond the current NFPA testing requirements and electrical codes. Aimed at reducing emergency standby power system failures, those additional recommendations are outlined below.

// *Perform a "gap analysis" on the emergency power system that compares critical equipment and systems needed in the event of an extended outage with the equipment and systems actually connected to the emergency power system.*

The emphasis here is on preparing for extended outages and verifying that the standby power system is actually connected to and powering the facility's most critical loads. This is especially important if the healthcare facility is older and may have several independent emergency standby power systems located in different areas that were added as the facility grew. At some point, it is prudent to consolidate all of the emergency standby power into one modern system and eliminate functioning but obsolete equipment.

In new facilities or during major expansions, it is also a good idea to evaluate whether to add enough generating capacity to supply non-critical loads in addition to critical loads required for life-safety purposes. Often loads that are considered non-critical in short power outages—such as HVAC—become critical loads when the focus is on preparing for an extended outage. Overall, the trend in system design is for the emergency standby power system to supply the total peak load of the facility, not only for life safety, patient comfort and convenience, but also for business continuity. Planning for extended outages also focuses attention on having adequate onsite fuel storage and a procedure for re-supply. NFPA 110, Paragraph 5.1.2 requires many mission-critical hospitals (specifically, those with an IBC seismic design Equipment Importance Factor of 1.5) to have 96 hours of fuel storage on site.

// *Maintain a complete labeled inventory of all emergency power systems and the loads they serve.*

This recommendation is part of a much larger requirement for complete documentation of the power system(s), including records of testing dates, duration, loads and notes on any performance issues. Modern digital generator sets have numerous built-in functions that facilitate data collection and recording that greatly ease compliance with this guideline. Also, keeping track of how loads grow and change over time can help ensure that the standby power system has adequate capacity to supply them.

// *Provide competent training and testing of all operators responsible for operating or maintaining the emergency power system.*

A standby power system is only as reliable as the people responsible for operating and maintaining it. In addition to providing operator training and testing, large healthcare facilities should consider engaging the generator set distributor or other service organization to perform the periodic maintenance on the standby power units. Not only does this ensure that the maintenance is done in accordance with the manufacturer's recommendations, it makes sure that it is performed on a regular schedule and fully documented. Generator set manufacturers and their distributors can also assist with operator training. It should also be emphasized that the importance of maintenance extends to the entire power distribution system, not just the engine generator. For example, switchgear needs to be opened for cleaning, calibration, thermal scanning, and other critical preventative maintenance as required by industry codes, standards, and generally accepted practices.

// *Regularly test diesel fuel in the storage tank and replace fuel not consumed before the end of its storage life.*

Diesel fuel has a limited shelf life, and one of the reasons for regular generator set exercise is to consume and replenish fuel before it becomes old and affects generator set starting or operation. The recommendation for regular testing of fuel quality is even more important in light of rules to keep 96 hours of fuel onsite for extended outages. With larger-capacity fuel tanks onsite, it is unlikely that regular generator set exercise will consume all the stored fuel in a single year. To ensure reliable starting and prevent fuel filters from clogging, fuel supplies need to be replenished with fresh fuel and fuel quality needs to be tested regularly. Also, as more states mandate bio-content in some fuels, it is even more critical that the fuel supply has a robust maintenance program.

// *Provide for communication between the operators of the emergency power system and the organization's management and clinical leaders.*

Utility outages occur without warning and usually at the worst possible time. It is therefore critical to have direct communication channels between the power system operators and management and clinical leaders. State-of-the-art standby power systems with digital control systems offer expanded communication with multiple parties and help facilitate coordination during outages. Remote-monitoring capabilities allow both management and clinicians to know, in real time, the status of the standby power system. This recommendation for healthcare clinicians is based on the remote possibility that the standby power system may fail to start or start and then fail to run reliably. In other words, there needs to be a plan in place for protecting patient safety in the absolute worst-case scenario where there might be no utility power and no standby power.

IMPROVING RELIABILITY IS A CENTRAL THEME

The overall goal of The Joint Commission's recommendations is to help maximize the reliability of the emergency standby power system. To a great extent, reliability can be designed into generator sets, transfer switches, switchgear and control systems to increase the likelihood that they function as intended. One major area that affects reliability is the IBC certification for systems designated with an Equipment Importance Factor of 1.5. Manufacturers are working to certify their equipment through robust designs, finite element analysis, and actual shaker-table testing to ensure that equipment not only withstands a seismic event, but will function immediately after to supply critical loads.

Other factors in reliability are maintenance, testing and support—all human activities that must be carried out as part of an overall plan to make sure the system works as intended. Simple design enhancements such as scanning portals (peep holes) to allow thermal scanning of critical power distribution equipment without opening cabinets, can make tasks easier while gathering data under real-world conditions. Such design enhancements eliminate safety concerns that would have limited this kind of preventative maintenance in the past.

For healthcare facilities that face life-safety risks if their standby power system fails, it is often prudent to invest more in the equipment to attain the highest possible measure of reliability. In multiple-generator systems, having at least one redundant generator also enables periodic equipment maintenance to be carried out without affecting the availability or capacity of the standby power system.

After determining what level of reliability may be acceptable and affordable, an organization must turn to the selection of equipment and suppliers.

SELECTING RELIABLE EQUIPMENT

While usually out of the scope of the healthcare facilities' managers, the selection of the specific equipment used in a healthcare facility's standby power system can have a major impact on overall costs, reliability and functionality. For the highest reliability, look for generator sets with engines that have some measure of reserve horsepower capacity at the alternator's nameplate kW rating and a low "brake mean effective pressure" (BMEP). Engines with larger cylinder displacement and lower BMEP have a greater ability to accept load without an undue drop in output voltage and frequency. Engine manufacturers vary in their approach to this issue. Therefore, when one-step load acceptance is called for in life-safety and mission-critical applications, select a manufacturer that can provide a generator-drive engine with the highest cylinder displacement and lowest BMEP relative to nameplate kW rating.

Appropriately sizing generator sets for the specific application has a major impact on power system reliability. Some generator sets that are required to pick up a load equal or close to their nameplate rating may not perform as intended. While the generator set may start and run, it may not be able to assume the facility load in one step as required by NFPA 110, or it may take longer than the required 10 seconds for life-safety applications. Unless all critical loads are properly supplied within the 10 seconds as required by NFPA 110, the standby power system cannot be considered to be suitable for life-safety applications. Some manufacturers offer to demonstrate this capability in their factory test bays; witness testing of a system prior to installation is an excellent way to prove load acceptance performance. At a minimum, measuring performance with a power quality analyzer will verify that equipment is appropriate for use in these applications.

MAINTENANCE AND TESTING

Once a power system has been properly designed and commissioned, the most important factor in its long-term reliability is regular maintenance and system exercise. Preventive maintenance of generator sets should include the following operations:

- Inspections
- Oil changes
- Cooling system service
- Fuel system service
- Testing starting batteries
- Regular engine exercise under load

Like regular maintenance, periodic testing is required by code in all healthcare applications. It is common for healthcare facilities to perform regular generator set testing during off-peak times when loads are at their lowest. While this practice prevents the possibility of serious interruptions to large and/or critical loads, it does not adequately test the generator set under worst-case conditions. When operated with the actual building load, the entire power system can be tested—including the automatic transfer switches and switchgear. It is very important that the engine be loaded to at least 30 percent of its nameplate capacity so it can reach operating temperature during tests and drive off any accumulated moisture. Another factor that makes testing under higher loads important is the growing use of specific types of diesel exhaust aftertreatment, namely diesel particulate filters (DPF). In order for the engine exhaust to reach DPF regeneration temperatures, generators need to have test runs on even higher loads than the 30 percent minimum. At least once every three years, all healthcare facilities are required to exercise the power system for at least four hours to verify that the system will start, run and accept the rated load.

CONCLUSION

All healthcare facilities are required by local and national electrical codes to have emergency standby power for supplying power to building loads critical for life safety and building egress. In addition to those basic requirements, The Joint Commission has developed recommendations that encourage healthcare facilities to go beyond basic code requirements whenever possible. These recommendations encourage better power system planning, better operator training, more detailed equipment record keeping and proper generator set exercise and maintenance in an effort to maximize power system reliability and patient safety.

Footnotes:

i. "Standard issues: Avoiding frequent Joint Commission deficiencies," Susan B. McLaughlin, FASHE, CHFM, CHSP, Health Facilities Management, January 2012.

ii. "Standards revisions related to the Centers for Medicare & Medicaid services CoPs," The Joint Commission EC.02.05.03, 2011.

iii. "Preventing adverse events caused by emergency electrical power system failures," The Joint Commission's Sentinel Event Alert #37, September 6, 2006.

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