

Maintenance and Testing for the Healthcare Industry — Essential Electrical Systems



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The electrical maintenance and testing requirements for a healthcare facility vary significantly within the overall electrical infrastructure. In this discussion, we will present maintenance and testing requirements associated with essential electrical systems (EES).

Those functions of patient care that depend on lighting or appliances connected to the EES can be divided into two mandatory branches: the life safety branch and the critical branch. The life safety branch of the system supplies power for the following lighting, receptacles, and equipment:

- Illumination of means of egress
- Exit signs
- Alarm and alerting systems
- Communications systems
- Generator set location
- Elevators
- Automatic doors

The critical branch supplies power for task illumination, fixed equipment, selected receptacles, and special power circuits that serve the following areas and functions related to patient care:

- Critical care areas that use anesthetizing gases
- Isolated power systems in special environments
- Patient care areas
- Nurse call systems
- Blood, bone, and tissue banks
- Telephone equipment rooms and closets
- Angiographic labs, cardiac catheterization labs, coronary care units, hemodialysis rooms or areas, and selected emergency room treatment areas.

To ensure that the EES is operational when called upon during an emergency, periodic maintenance and testing is required by the applicable codes and standards. Specific electrical requirements for clinics, medical and dental offices, outpatient facilities, nursing homes, limited-care facilities, hospitals, and other health-care facilities can be found in NFPA 70, *National Electrical Code*, (Section 517), NFPA 110, *Standard for Emergency and Standby Power Systems* (Chapter 8), and NFPA 99, *Standard for Healthcare Facilities* (Chapter 4).

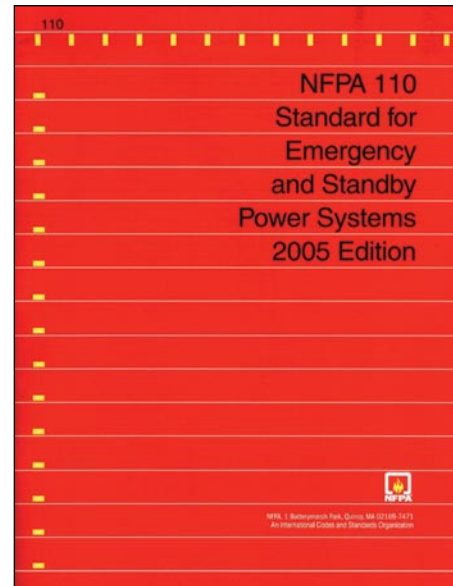


NFPA 99 is the benchmark for information and guidelines for the application and performance monitoring of EES for healthcare facilities. Here are some highlights from NFPA 99 associated with ESS:

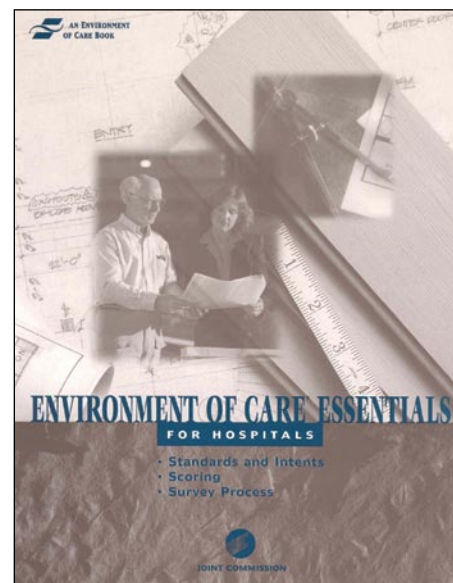
- Alternate power sources (i.e., generation systems) are to be tested every 12 months and must respond to a loss of the normal source within a 10-second interval.
- Stored energy power sources (i.e., UPSs) are to be tested every 12 months and must respond within a 10-second interval.
- Main and feeder circuit breakers are to be inspected every 12 months and periodically tested.
- Receptacles in patient care areas are to be tested every 12 months for physical integrity, polarity, continuity of the grounding circuit, and grounding blade retention force (not less than 4 oz.).
- The grounding system in patient care areas is to be acceptance tested, as well as retested following system modification, by voltage and impedance measurement. The measurement accuracy should be within at least ± 20 percent of nominal. The voltage measurements shall be made under no-fault conditions between a ground reference point and various exposed conductive surfaces. The impedance measurements shall be made between a ground reference point and at least 10 percent of associated receptacles. The impedance measurement is determined using the ratio of the voltage measured and current applied between the associated measurement points.
- Written records of all inspections and testing are to be maintained and available for inspection.

NFPA 110 provides guidance and requirements for all types of emergency and standby systems including those in healthcare facilities. Following are some highlights from NFPA 110 associated with maintenance and testing of emergency and standby power systems:

- Emergency power sources are to be tested every month with available system loads.
- Diesel generator sets shall be tested monthly at not less than 30 percent of the rating. If 30 percent of the rating can not be achieved with the available system loads, a test shall be performed annually with supplemental loads at 25 percent of rated for 30 minutes, followed by 50 percent of rated for 30 minutes, followed by 75 percent of rated for 60 minutes for a total of two hours of continuous operation.
- Transfer switches and paralleling switchgear shall be subject to inspection, testing, and a maintenance program. Recommended electrical PMs should include regular cleaning and connection inspection.




- For systems whose failure could result in serious injury or loss of life, the main and feeder circuit breakers between the emergency power system and transfer switch loads are to be exercised annually. Additionally, the main and feeder breakers in excess of 600 volts are to be exercised every six months and are to be tested under simulated overload conditions every two years. Further, the systems shall be tested for at least a four-hour duration at least once every three years.
- Main feeder insulation resistance tests shall be performed during acceptance and repeated whenever damage is suspected.
- Lead-acid batteries in support of EES shall be tested monthly for specific gravity and defective batteries shall be replaced immediately.
- Written records of all inspections and testing are to be maintained and available for inspection.



Additional guidance for EES testing and maintenance is provided in Joint Commission on Accreditation of Healthcare Organizations (JCAHO) standards. To comply with the JCAHO standards, EC.2.14 requires that critical operating components of utility systems be maintained, tested, and inspected. Further, record keeping is required for demonstrating compliance. With regard to the critical operating components of the electrical system, the following testing and documentation is required:

- Performance and safety testing of each critical electrical component prior to initial use and at least annually thereafter
- Preventive maintenance and inspection of utility systems according to a schedule based on current organization experience and ongoing monitoring and evaluation
- Demonstration of the emergency power system's reliability by conducting:
 - o Monthly testing of each generator for at least 30 minutes under a dynamic load.
 - o Monthly testing of all automatic transfer switches.
 - o Periodic testing of stored emergency power supply systems (SEPSS).
 - o Testing of all battery-powered lights required for egress.

In conclusion, essential electrical systems are used extensively within the healthcare industry. These systems include generation and UPS subsystems as well as the electrical infrastructure which supports these systems such as automatic transfer switches, main and feeder breakers, the grounding system, and receptacles. To meet NFPA and JCAHO standards, acceptance testing and periodic maintenance and testing are required for the associated equipment. 

As Operations Manager of ESCO Energy Services Company, Lynn brings over 25 years of working knowledge in design, permitting, construction, and startup of mechanical, electrical, and instrumentation and controls projects as well as experience in the operation and maintenance of facilities. Lynn is a Professional Engineer, Certified Energy Manager and has a BS in Nuclear Engineering from the University of Tennessee.

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