ASCO Power Technologies™

Load Testing for Healthcare Compliance

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Load Testing for Healthcare Compliance

Power availability is essential to providing services at healthcare facilities. Regular testing of emergency power equipment is necessary to ensure that it will function when utility outages occur, and is required by industry codes and standards. This document summarizes testing requirements and explains how load banks support testing compliance.

TESTING REQUIREMENTS

Emergency power systems for healthcare facilities are regulated by multiple industry codes. An important reference is the *Hospital Accreditation Standards* issued by The Joint Commission.[1] This document defines standards for auditing hospital operations and facilities to provide for the well-being of patients, staff, and visitors. Addressing areas from nursing practices to infection control, emergency management, and medical records, hospitals must comply with a broad range of requirements to obtain and maintain Joint Commission accreditation. Many hospitals must be accredited by the Joint Commission as a condition for receiving operating licenses and/or certain reimbursements for services.

Figure 1: Load banks such as this ASCO 4000 SERIES are commonly used for load tests at medical facilities.

The portion of the standard that primarily addresses backup power systems is entitled *Environment of Care (EC)*. Like the other sections, it contains statements, or *Standards*, that specify a state of compliance. For example, referencing infection control measures, Standard EC.03.01.01 states, "The hospital evaluates the effectiveness of its infection prevention and control plan." This is followed by a list of compliance indicators related to the standard, termed *Elements of Performance*. In this instance, three elements specify that a hospital must evaluate effectiveness, communicate findings, and use the findings when revising its infection control plan. An auditor can review evidence of these activities to assess whether a hospital is compliant with the standard.

The *Environment of Care* Section specifies one standard that particularly affects compliance testing for hospital backup power systems. *Standard EC.02.05.07* simply states, "The hospital inspects, tests, and maintains emergency power systems."[2] It then lists elements of performance that an auditor could review.[3] ASCO summarizes these as follows:

1. At least monthly, the hospital tests each emergency generator under load for at least 30 continuous minutes, with a dynamic load of at least 30% of the generators' nameplate rating or otherwise sufficient to meet manufacturer-specified minimum exhaust temperature.

[1] The Joint Commission. *2019 Hospital Accreditation Standards*. Joint Commission Resources, Inc. Oak Brook, IL, USA. 2019.
[2] Ibid. p. EC-35.
[3] Ibid. p. EC-35-37.

2. If a test does not meet the criteria above, then the emergency generator must be tested every 12 months at 50% and 75% of the nameplate rating for 30 minutes and 60 minutes, respectively.
3. At least monthly, the hospital tests all automatic and manual transfer switches.
4. At least once every 36 months, the hospital tests each emergency generator for a minimum of 4 hours using a dynamic or static load that is 30% of nameplate rating.

For additional detail, each Element of Performance in EC.02.05.07 refers readers to specific provisions of 2012 Edition of *NFPA 99 – Healthcare Facilities Code* and the 2010 Edition of *NFPA 110 – Standard for Emergency and Standby Power Systems.*[4,5] In particular, NFPA 110 required monthly testing of components in a facility's Emergency Power Supply System.[6]

For backup power equipment tests, the Joint Commission standard requires applying minimum amounts of load for minimum durations. To prove compliance, the test data and conclusions must be documented.

ACHIEVING SUFFICIENT LOAD DURING TESTING

To conduct compliant testing, sufficient load must be applied to the emergency power system for a specific minimum amount of time. The options available for applying load include (1) using building load during testing, and (2) using load banks to provide supplemental load to ensure testing compliance, and (3) using load banks to supply sufficient alternate load while the building load remains on utility power.

Advantages and Disadvantages of Using Building Load

Building load can be used to test emergency power systems. Upon initial consideration, this option can appear to offer ease of implementation, because little additional equipment is needed beyond the power equipment already in place. Consequently, this type of testing can be undertaken with relatively little capital cost.

Further consideration reveals that the timing of load tests could result in insufficient building load to satisfy testing requirements. For instance, the highest demand for power may be experienced on a hot summer afternoon, when all hospital departments and their equipment as well as its mechanical systems could be working near their maximum capacity. While the load could be sufficient to exceed the 30% minimum criteria for monthly testing, the impacts of any problems that occur during the test would be maximized if testing resulted in a power problem or equipment failure. For this reason, a facility may elect to test during the middle of a night, when fewer critical services are provided and the impact of problems is presumably reduced. However, at these times, cooling loads are low and loads from hospital activities are reduced. In that case, there is a greater chance that the building load would be insufficient to meet Joint Commission and NFPA test requirements.

Insufficient Load

An inability to apply sufficient load could become evident during a test in two ways: (1) The building load may not reach or exceed 30% of generator nameplate rating, and (2) the load may not remain above the minimum threshold for the prescribed duration. Not only would these outcomes be noncompliant, they could result in generator "wet-stacking", where unburned fuel residues accumulate in a diesel engine's exhaust system. This condition can impact the performance of engine-generators and reduce their service life. For additional information about wet stacking, please review the ASCO document entitled Adverse Effects of Low Load Operation on Diesel Generating Sets.

[4] National Fire Protection Agency, *NFPA® 99 – Health Care Facilities Code*. 2012 Edition. Quincy, MA. 2012.
[5] National Fire Protection Agency, *NFPA® 110 – Standard for Emergency and Standby Power Systems*. 2010 Edition. Quincy, MA 2010.
[6] Ibid. Article 8.3.2.1. p. 110-19.

Insufficient Control and Resolution

One characteristic of building load is that it changes moment-to-moment with electrical demand. Because the amount of load is a function of facility equipment usage, and is not an operator-controlled parameter, options for adjusting the amount of load are limited. Available options include operating specific transfer switches to attempt to approximate the necessary amount of load, and (2) powering or depowering circuits and/or equipment to provide additional load resolution. Where stepwise loading is necessary, these methods may result in block loading or block shedding, where large loads are added and removed suddenly. These control methods could impact hospital operations and could result in failing test results if load drops below the minimum testing threshold, even for a short amount of time. In addition, these methods usually do not afford opportunities to make small incremental changes to the amount of load.

Advantages and Disadvantages of Using Load Banks

Performing hospital backup power tests using load banks can offer advantages that streamline compliance testing. Doing so requires one or more load banks, plus the equipment needed to control them. Although there are capital costs associated with this approach, it's benefits support regulatory compliance and promote reliability.

Sufficient Load

Load banks can supply sufficient load at any time. As a result, compliance testing can be scheduled to occur at any time, including times when building load is insufficient to comply with testing standards. Because testing can occur independent of hospital high-load periods, the feasibility of scheduling tests during low-load periods increases, reducing potential impacts to hospital operations.

Advanced Load Control and Resolution

Load banks commonly feature controls that allow for addition and subtraction of load in step-wise increments. Because the amount of load can be automatically controlled, loads can be adjusted to match testing needs regardless of real-time building load. When loads are large, load can be added and removed incrementally to avoid potential block loading and unloading effects. Furthermore, transfer switch controls offer load adjustment resolution that can be adjusted to account for temporal changes in building demand. This helps ensure sufficient load throughout the duration of a power system load test.

STREAMLINING LOAD TEST OPERATIONS

For diesel-powered generators, the most frequent hospital critical power equipment load test requires a minimum of 30 minutes of continuous operation at load equaling 30 percent of generator nameplate rating or the engine manufacturer's minimum exhaust gas temperature.[7] To document the results, the data must be recorded for subsequent evaluation.

Controlling Load Banks and Recording Data

Market-leading load bank control systems feature automated control and data recording capabilities. Their programs can be used to add and remove loads in steps that conform to testing requirements and in increments that avoid undesirable block loading and unloading effects. The duration of each step is programmable to ensure that load is applied for sufficient time. For applications where building load comprises some part of the test load, controllers can be configured to adjust load banks in real-time to maintain a nominal total load. These capabilities streamline test administration and ensure that testing is consistent and repeatable from event to event.

Load bank controls, such as the ASCO SIGMA Digital Control Platform, automatically record data to digital memory. These recorded data typically include timestamps as well as voltage and amperage for each phase of an ac circuit. Because market-leading control systems can often network multiple load banks together, this information can be recorded and retained from test event to test event.

Test Compliance Reporting

To comply with applicable standards, the data from load tests must be documented, evaluated for compliance, and retained. These functions can be accomplished directly through load bank control systems and through power and building management systems that interact with additional types of power devices.

Controller-Based Reporting

The simplest option for reporting load test results is to export data to spreadsheets for evaluation and archiving. For example, using comma delimited data, voltage and amperage values for each phase of an AC circuit can be exported to a spreadsheet program for charting and reporting. Graphing the results enables rapid visual evaluation of whether the equipment under test performed as required, specifically whether it complied with load and duration specifications. Controller-based load test reporting programs can often compile a report

[7] The Joint Commission. *2019 Hospital Accreditation Standards*. Joint Commission Resources, Inc. Oak Brook, Il, USA. 2019. p. EC-37.

presenting data and summarizing its compliance status. Figure 2 shows load testing data from a report generated by a SIGMA Digital Control platform. Figure 3 presents graphs summarizing the data from the test. In this instance, the data show that the power sources under test provided more than 30% of total generator nameplate capacity for more than 30 seconds.

Load bank control systems may also export data using protocols such as CAN Bus and ModBus that can communicate with other devices. ASCO systems can provide real-time data to displays on handheld load bank controllers, and to power and building management systems.

Power Monitoring System-Based Reporting

In hospitals, critical power equipment includes more than generators. Hospitals typically rely on backup power systems comprised of generators, paralleling switchgear, transfer switches, load banks, and more. The Joint Commission requires regular testing of both generators and transfer switches.[8,9] NFPA 99 goes further, requiring monthly testing of a facility's Emergency Power Supply System. In large hospitals, compliance testing and reporting activities can constitute a significant and complex work effort.

Load Test - 4000kW System								
	Voltage				Active Current			
Time	L1-L2	L2-L3	L3-L1	Frequency	L1-L2	L2-L3	L3-L1	kW
3:36:46 PM	416	415	415	60	0	0	1	0
3:37:46 PM	416	415	415	60	1	0	1	0
3:38:46 PM	413	412	411	60	618	619	619	442
3:39:46 PM	412	412	412	60	616	617	618	440
3:40:46 PM	413	412	411	60	616	617	618	440
3:41:46 PM	413	412	412	60	618	617	618	441
3:42:46 PM	401	403	403	60	2400	2404	2417	1678
3:43:46 PM	401	404	403	60	2371	2375	2386	1659
3:44:46 PM	405	407	406	60	1701	1703	1711	1197
3:45:46 PM	406	407	406	59.9	1702	1706	1712	1200
3:46:46 PM	405	407	406	59.9	1702	1704	1711	1199
3:47:46 PM	406	407	406	60	1697	1706	1712	1198
3:48:46 PM	405	406	406	60	1692	1703	1710	1193
3:49:46 PM	404	405	407	60	167	1704	1712	1198
3:50:46 PM	405	405	407	60	1698	1703	1709	1196
3:51:46 PM	405	406	407	60	1687	1703	1710	1193
3:52:46 PM	405	405	407	60	1686	1704	1710	1191
3:53:46 PM	405	405	407	60	1686	1704	1710	1193
3:54:46 PM	404	405	407	60	1678	1701	1708	1187
3:55:46 PM	404	405	407	60	1648	1707	1712	1182
3:56:46 PM	404	405	407	60	1656	1703	1710	1181
3:57:46 PM	404	405	406	60	1685	1704	1710	1192
3:58:46 PM	404	405	406	60	1683	1704	1708	1187
3:59:46 PM	404	405	406	60	1687	1705	1713	1194
4:00:46 PM	405	407	406	60	1701	1703	1711	1197
4:01:46 PM	406	407	406	60	1702	1706	1712	1200
4:02:46 PM	405	407	406	60	1702	1704	1711	1199
4:03:46 PM	406	407	406	60	1697	1706	1712	1198
4:04:46 PM	405	406	406	60	1692	1703	1710	1193
4:05:46 PM	404	405	407	60	167	1704	1712	1198
4:06:46 PM	405	405	407	60	1698	1703	1709	1196
4:07:46 PM	405	406	407	60	1687	1703	1710	1193
4:08:46 PM	405	405	407	60	1686	1704	1710	1191
4:09:46 PM	405	405	407	60	1686	1704	1710	1193
4:10:46 PM	404	405	407	60	1678	1701	1708	1187
4:11:46 PM	404	405	407	60	1648	1707	1712	1182
4:12:46 PM	404	405	407	60	1656	1703	1710	1181
4:13:46 PM	404	405	406	60	1685	1704	1710	1192
4:14:46 PM	404	405	406	60	1683	1704	1708	1187
4:15:46 PM	404	405	406	60	1687	1705	1713	1194
4:16:46 PM	411	411	411	60	37	36	38	26
4:17:46 PM	412	411	412	60	0	0	1	0
4:18:46 PM	412	411	412	60	0	0	1	0
4:19:46 PM	412	411	412	60	0	0	1	0
4:20:46 PM	412	411	412	60	0	0	1	0
4:21:46 PM	412	411	412	60	0	0	1	0

Figure 2: ASCO SIGMA Digital Control platform load test data, records voltage, current, frequency and power data.

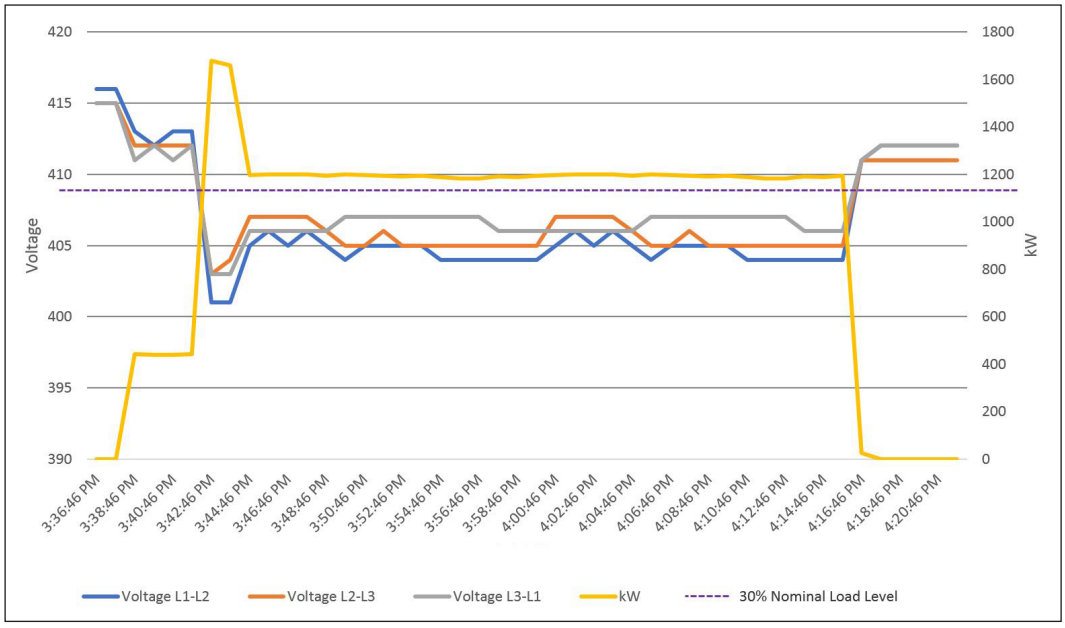

Figure 3: This graph shows that the generator provided more than 30% of the total nameplate rating for more than 30 minutes.

[8] Ibid. p. EC-35.
[9] Ibid.

In some facilities, all of this equipment is connected to a power or building management system. Examples of these systems include the ASCO Critical Power Management System (CPMS), the Schneider EcoStruxure platform, and the other commercial power and building monitoring solutions. These systems monitor, record, process, and archive data collected from devices across emergency power systems. Market-leading systems, such as the ASCO CPMS, are capable of automating power system test sequences, recording power system test data from all required devices, and automatically compiling and producing reports that present the necessary data and state whether the test results comply with requirements. These types of solutions streamline compliance activities and enhance compliance outcomes.

For additional information on system-based reporting solutions, review the ASCO document entitled Automated Reporting for Emergency Power Systems.

SUMMARY

Emergency power systems in healthcare facilities are regulated by the *Hospital Accreditation Standards* issued by The Joint Commission as well as NFPA 110 and NFPA 99. These codes specify that hospitals test Emergency Power Supply Systems on monthly and annual bases to ensure availability. The standards require that alternate power sources to supply at least 30 percent of their nameplate rating for at least 30 minutes.

To demonstrate compliance, load must be applied to the backup power system for testing. Building load can be used. However, its variable nature can compromise test results if the minimum required amount of power is not applied for the minimum required time. Using load banks provides greater predictability for load testing. Using load bank control systems, load banks can be networked for application flexibility, and the load test data can be automatically recorded and archived. Using solutions such as the ASCO Critical Power Management System for hospital load testing further streamlines compliance testing by collecting data from additional equipment such as transfer switches, then producing reports that presenting test data and assessing whether compliance was achieved.

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