White Paper

Automated Reporting for Emergency Power Systems

ASCO Power Technologies®

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Automatic Reporting Increases Compliance While Reducing Costs

A regional power outage impacts a 60-bed public hospital. Its single emergency engine-generator comes online and then supplies power to critical circuits, but fails a short time later. The facility remains dark for hours until repairs are made and the generator returns to service. A subsequent investigation shows that inadequate maintenance and testing contributed to the failure of the emergency power system.

Sound far-fetched? Unfortunately, similar events have occurred, and they underscore the need for proactive measures that include adequate maintenance and testing. For hospitals, data centers, and other mission-critical facilities, a regular program of generator testing is essential to verify the availability and reliability of emergency and legally required power systems. For this reason, government agencies and industry organizations specify that testing should be completed in accordance with recognized codes. This document describes how the automated data recording and reporting capabilities of the ASCO Critical Power Management System (CPMS) can support reliable operation and streamline regulatory compliance.

REASONS TO TEST

There are two primary reasons to exercise engine-generators and emergency power systems. The first is to ensure that the equipment can be relied upon in case of emergency. The second is to comply with laws, regulations, and industry standards that are designed to mitigate power outage risks at mission-critical facilities.

In order to ensure availability and reliability, engine-generators and backup power systems must be routinely exercised and tested to ensure that they will reliably start, connect, and supply the necessary amount of power. An adequate program involves testing at a frequency that is sufficient to verify continued operability. It also involves applying sufficient load to demonstrate that the equipment can meet demand during an outage.

By conducting testing in accordance with standards and regulations, facility managers can be confident that its engine-generators and associated emergency power equipment will be available and sufficient when needed. By performing tests, facility staff become adept at monitoring and controlling the equipment, and can become aware of potential reliability and performance issues before they result in operational difficulties or backup power outages. Because these benefits are important to public safety, industry organizations and public agencies may require evidence that adequate testing has been completed.

TESTING REQUIREMENTS IN CODES

Requirements for testing engine-generators are specified or referenced by several industry codes. Certain elements are performance-based, such as requirements to power specific loads within prescribed timeframes. Article 700.12 of NFPA 70, the **National Fire Protection Agency's** (NFPA) National Electrical Code® (NEC®), requires backup systems to apply power to life safety circuits within 10 seconds of the occurrence of an outage. Article 701.12 of that standard requires backup systems to supply power to legally required loads in 60 seconds.[2] To do so, generators must start, reach operating speed, and synchronize to bus, then transfer switches must successfully transfer loads from Normal to Emergency sources, all within the specified timeframes.

The 2016 Edition of *NFPA 110 - Standard for Emergency and Standby Power Systems* is a key standard that requires such testing. Article 8.4.1 of that standard specifies that Emergency Power Supply Systems, as defined in the code, should be "exercised under load at least monthly."[3] In addition, Article 8.4.2 requires that diesel generator sets powering these systems be exercised for at least 30 minutes at the exhaust gas temperature specified by the manufacturer, or at 30% or more of the Emergency Power System standby nameplate kilowatt (kW) capacity.[4]

The test requirements in NFPA 110 are incorporated by reference in the 2018 Edition of *NFPA 99 – Health Care Facilities Code*, which is the primary standard for infrastructure at facilities such as hospitals. Article 6.7.4.1.1.5(A) states the following:

> *"**Test Criteria**. Generator sets shall be tested 12 times a year.... Generator sets serving essential electrical systems shall be tested in accordance with Chapter 8 of NFPA 110."*[5]

Line (B) of the Article states that that tests should include *"... a complete simulated cold start and appropriate automatic and manual transfer of all essential electrical systems loads."* Elsewhere, the standard requires tests to be initiated from an automatic transfer switch. For all of the testing, NFPA 99 - Article 6.3.4.1 *et seq* stipulates that *"... a record shall be maintained of tests required by this chapter …"*

The cited NFPA documents are not the only standards that require generator testing in healthcare facilities. The **Joint Commission**, formerly known as the Joint Commission on Accreditation of Healthcare Organizations, audits and accredits tens of thousands of health care organizations and programs in the United States. Similar organizations fulfill this role internationally. In many US states, accreditation from The Joint Commission is required for a hospital to receive an operating license. Section 02.05.0.07 of The Joint Commission's *Environment of Care* guidelines requires generator testing and provides specifications. Likewise, the **Centers for Medicare & Medicaid Services** (CMS) and other health care payers may require Joint Commission accreditation as a prerequisite to reimbursing medical costs under government or insurance programs. Nevertheless, CMS guidance also refers to NFPA 110 regarding the performance of generator testing. Consequently, health care organizations maintain significant interests in effectively executing and documenting compliant generator test programs.

[1] *National Fire Protection Association, "NFPA 70 – National Electrical Code – 2017," Quincy, Massachusetts, 2017.*
[2] *Ibid.*
[3] *National Fire Protection Association, "NFPA 110 – Standard for Emergency and Standby Power Systems," 2016 Edition. Quincy, Massachusetts, 2017.*
[4] *Ibid.*
[5] *National Fire Protection Association, "NFPA 99 – Health Care Facilities Code – 2018," Quincy, Massachusetts, 2017*

Medical facilities are not the only organizations subject to generator testing requirements. Data centers and other mission-critical facilities are subject to NFPA 110 provisions. In addition, law enforcement agencies that rely on communications to provide public safety functions must also test generators. The Commission on Accreditation for Law Enforcement Agencies (CALEA®) credentials public safety programs and organizations, and maintains standards for preparedness. In this context, it is easy to understand the importance of adequate generator testing. During a public safety event or natural disaster, the implications of failed backup power systems at an emergency call center or a detention center housing prisoners could be profound.

EXECUTING TESTS

As previously noted, Article 8.3.2.1 of NFPA 110 states that operational testing of emergency power systems shall be initiated at an automatic transfer switch. As a test progresses, salient information must be recorded, including the time that Normal power was disrupted, the time that a generator start signal was issued, the time that the transfer switch(es) successfully transferred to Emergency, and the time of retransfer(s) to the Normal source. In addition, the load must be recorded as a percentage of rated generator capacity. The standard specifies a minimum loading of 30%, which is amount of load typically needed to avoid a buildup of products of incomplete combustion in the engine's exhaust system, a condition known as *wet stacking*. If this metric drops below 30% at any time during the event, the test is invalid and must be repeated. Integrating one or more load banks into a backup power system can provide capability for maintaining the necessary amount of load.

Historically, tests were carried out manually by personnel using timing devices and paper forms. Although simple, this approach presents several disadvantages. First, it requires that personnel be dedicated to the task of watching instrumentation and recording information for the duration of the test. Second, because data is physically observed and manually recorded, it can be subject to human error, or to omission through inattention. In addition, outage events that could otherwise demonstrate compliance cannot be utilized because there is no way to know when dedicated personnel should be scheduled to observe and record the necessary data.

Modern, automated, emergency power management solutions such as the ASCO CPMS make backup power testing easier and more accurate. Tests are initiated when scheduled and the resulting information is automatically recorded by devices serving the power system. Collecting data in this way eliminates the need for dedicated personnel to record measurements and avoids opportunities for human error. If a test is nonconforming – perhaps because a system fails to continually provide 30% loading to a generator – a CPMS system can ensure that the testing is continued until there is sufficient continuous operating time to meet requirements. Alternatively, the CPMS can terminate a test and alert personnel to avoid wasting further resources.


ASCO POWERQUEST Power Monitoring & Control

TEST REPORT

Saint Dismas University Hospital

160 Park Avenue, Florham Park, NJ 07932

Automatically Generated

Created: Jan 13, 2018 05:34:29 AM

Period: Jan 13, 2018 to Jan 20, 2018

Software Part Number : 1016418-003.06 Software Release Date : Dec 14 2015


ASCO | Generator Run Summary | POWERQUEST Power Monitoring & Control

Name	Location	Load Type	Power Rating (kW)	Current Rating (Amps)
Gen 3	Gen Paralleling System	-	2500	434

Total Run Time	Total Duration (hh:mm:ss)	Minimum Required Test Time
Start: 01/13/2018 04:00:02 AM Stop: 01/13/2016 05:32:11 AM	01:26:09	30 Mins

Run Time Greater Than 30% Nameplate kW	Duration Above 30% (hh:mm:ss)	Minimum Required kW Threshold	kW Result
Start: 1/13/2018 4:17:25 AM Stop: 1/13/2018 4:51:59 AM	00:34:34	750 kW	Pass

Generator Loading Graph

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Period: Jan 13, 2016 to Jan 20, 2016 Test Report


ASCO | Summary of Results | POWERQUEST Power Monitoring & Control

Generator's engine start was triggered by: ATS 35 L at 1/13/2016 4:05:59 AM

Name	Load Type	Total Transfer Time	Calculated Transfer Time	In Emergency (hh:mm:ss)	Transfer Inhibit Conditions	Maximum Passable Time	Result
ATS 35 L	-	10 sec	-	01:20:33	-	Level 1 (10 sec.)	Pass

All Transfer Switches

Name	Load Type	Total Transfer Time	Calculated Transfer Time	In Emergency (hh:mm:ss)	Transfer Inhibit Conditions	Maximum Passable Time	Result
ATS 02 C	Critical	8 sec	-	01:08:22	-	Level 2 (10 sec.)	Pass
ATS 03 L	Life Safety	8 sec	-	01:10:44	-	Level 1 (10 sec.)	Pass
ATS 04 Q	Equipment	27 sec	-	01:08:00	-	Level 3 (30 sec.)	Pass
ATS 07 C	Critical	9 sec	-	01:09:57	-	Level 2 (10 sec.)	Pass
ATS 08 L	Life Safety	10 sec	-	01:09:19	-	Level 1 (10 sec.)	Pass
ATS 09 C	Critical	9 sec	-	01:09:11	-	Level 2 (10 sec.)	Pass
ATS 10 Q	Equipment	284 sec	-	01:08:00	Load Shed	Level 3 (30 sec.)	Fail
ATS 12 L	Life Safety	7 sec	-	01:09:49	-	Level 1 (10 sec.)	Pass
ATS 13 Q	Equipment	30 sec	-	01:08:13	-	Level 3 (30 sec.)	Pass
ATS 14 C	Critical	10 sec	-	01:08:51	-	Level 2 (10 sec.)	Pass
ATS 15 E	Mechanical	29 sec	-	01:04:52	-	Level 4 (40 sec.)	Pass
ATS 16 E	Mechanical	30 sec	-	01:04:53	-	Level 4 (40 sec.)	Pass
ATS 17 L	Life Safety	9 sec	-	01:10:23	-	Level 1 (10 sec.)	Pass
ATS 18 C	Critical	10 sec	-	01:09:19	-	Level 2 (10 sec.)	Pass
ATS 19 Q	Equipment	14 sec	-	01:08:01	-	Level 3 (30 sec.)	Pass
ATS 20 E	Mechanical	7 sec	-	01:07:06	-	Level 4 (40 sec.)	Pass
ATS 21 E	Mechanical	7 sec.*	-	01:07:07	-	Level 4 (40 sec.)	Pass
ATS 22 E	Mechanical	7 sec	-	01:07:06	-	Level 4 (40 sec.)	Pass
ATS 23 C	Critical	10 sec	-	01:09:19	-	Level 2 (10 sec.)	Pass
ATS 24 E	Mechanical	6 sec	-	01:07:07	-	Level 4 (40 sec.)	Pass

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Automatic data collection can also streamline mandatory testing. NFPA 110 calls for testing generators by routinely applying a minimum 30% load for 30 minutes. If an unscheduled outage occurs, a CPMS will automatically record the associated data. If the outage spans a sufficient timeframe, the event will meet the criteria for generator testing and obviate the need to conduct and fund a separate dedicated test. Facilities can thus avoid the some of the planning and logistics associated with conducting generator tests, reduce equipment wear-and-tear, and reduce or avoid associated costs.

PROCESSING DATA

Following adequate testing, a CPMS can compile test data automatically and compare it to operating requirements such as those stipulated by NFPA 110. These systems can automatically populate a report template with the necessary information, and indicate whether the data meet the test criteria. Once compiled, the report can be stored and distributed automatically to recipients and destinations specified by the user. In this way, stakeholders receive reliable and timely notice about the compliance status of an emergency power system. In addition, test records are available for audit, when needed.

REPORT CONTENT

The data presented in test reports must be sufficient to demonstrate compliance with Joint Commission requirements and other codes that may apply to a particular facility. Reports should present the following information:

- The identity of the automatic transfer switch that first issued an engine start signal, together with a timestamp for the event
- A list of generators, their respective start and stop times, and an indication of whether they ran for a sufficient duration
- An indication of whether each unit met minimum load requirements throughout the required timeframe
- The status of each automatic transfer switch and its elapsed time for transferring to the Emergency source
- A log of the corresponding device events

To present the necessary information, a CPMS can populate the data into a report template developed for this purpose.

SUMMARY

NFPA 110 provides guidance for testing emergency power systems. To demonstrate compliance with the standard, engine-generators must be tested at regular intervals for prescribed durations to show that they can run reliably, and must be run at a minimum load to avoid wet stacking.

The most efficient method for documenting emergency power system tests is to equip power monitoring systems with an electronic reporting program that compiles and evaluates operating data and prepares a corresponding report. This strategy reduces opportunity for human error, reduces logistical preparations for test events, and allows allocation of resources to other tasks. It also enables facilities to use data from outages to fulfill testing requirements. For these reasons, automated reporting eases compliance with industry standards while reducing costs associated with testing and reporting activities.

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