

UNDERSTANDING NFPA 110:

The National Code for the Installation and Maintenance of your Emergency Power System

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CK Power, MO

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INTRODUCTION

Power outages can be devastating. For many facilities, an outage of even a minute can result in the loss of millions of dollars, or worse, put human lives at risk. In emergency and legally required applications, where an outage would pose a life safety risk, National Fire Protection Association standard 110 is the standard for emergency and standby power systems. It outlines requirements for the installation and performance of backup power systems. In this guide, we'll explore what NFPA 110 is, and what you should consider when implementing and maintaining your facility's emergency power system.

WHAT IS NFPA 110: A BRIEF OVERVIEW

The 2016 edition of NFPA 110 is split up into eight chapters and three annexes. It codifies the performance of emergency and standby power systems during installation, maintenance, operation and testing. Before outlining what NFPA 110 is and how it should be used by facility managers, installers and engineers, we need to define the terms used in the standard.

Emergency Power Supply (EPS)

Essentially, the emergency power supply (EPS) is the source of electrical power (i.e., generator) used in your backup power system (3.3.3). It is independent of your primary source of power and ready to start in case of a power failure. When this guide refers to an EPS, it refers to a standby generator.

Emergency Power Supply System (EPSS)

Your emergency power supply system (EPSS) refers to your backup power system in its entirety. It includes the EPS, transfer switches, load terminals and all the equipment required to provide a safe and reliable alternative source of power for your facility (3.3.4).

Authority Having Jurisdiction (AHJ)

Authority having jurisdiction (AHJ) is a broad term referring to the agency, or agencies, responsible for enforcing code compliance in your particular city or region (3.2.2).

Approved

NFPA 110 defines something as approved when it's "acceptable to the AHJ" (3.2.2).

Note: The NFPA doesn't approve any equipment or installations as being "compliant" with NFPA 110 (A.3.2.1).

The only way to guarantee your installation, procedures or equipment are compliant is to work with your AHJ to ensure all applicable standards, policies and codes have been met.

These terms are at the core of NFPA 110. The standard provides requirements and best practices for the setup and ongoing performance of EPSS, to ensure they are able to provide prompt and reliable power in the event of the failure of your primary power source, which minimizes the risk to human life.



THE KEYS TO UNDERSTANDING NFPA 110: LEVEL, CLASS AND TYPE

The key to understanding the requirements outlined in NFPA 110 lies in understanding the way emergency power supply systems (EPSS) are classified:



Level

Dictates performance standards your system needs to follow.



Class

Duration your system must be able to run without refueling.



Type

Time your generator has to be operational after a power failure.

These categories dictate decisions including (but not limited to) what equipment to use, where to store the system and how much fuel to keep on site as required by your facility's application, location, proximity to fuel and level of life safety risk.

Level

There are two EPSS levels defined in the standard: Level 1 and Level 2. They're distinguished by the types of loads they carry and they have different equipment and installation standards.

Level 1 EPSS systems provide power where failure would result in "loss of human life or serious injuries" (4.4.1).

Level 2 EPSS systems carry loads "less critical to human life and safety" (4.4.2).

As you can imagine, Level 1 EPSS systems are subject to stricter design guidelines. Most equipment is designed for Level 1 requirements and can be used for the less strictly regulated Level 2 loads.

It's important to note that NFPA 110 does not state which applications, qualify as Level 1 or Level 2; that is up to the AHJ's interpretation (1.1.5). They do, however, provide some examples of situations where a Level 1 or 2 EPSS might be required.

Possible NFPA 110 Level 1 applications

Life safety illumination, public safety communication systems, fire pumps and ventilation equipment (A.4.4.1).

Possible NFPA 110 Level 2 applications

Heating and refrigeration systems, sewage disposal and some industrial processes (A.4.4.2).

NFPA 110 only defines systems with a direct impact on life safety, even though the failure of a Level 2 system would have significant impact on occupants if it failed (1.1.3). Due to the effect of Level 1 and 2 loads on life safety, an NFPA EPSS system must be permanently installed to ensure it starts if your primary power source fails.

There are also non-essential applications (i.e., data centers, research facilities) where failure could result in the loss of millions of dollars. These types of loads should be served by optional standby generators, which aren't defined in NFPA 110 because they aren't essential to life safety.

Facility managers looking for compliance guidance for a necessary (but not legally required) unit should turn to NFPA 70, more commonly referred to as the National Electrical Code®. Article 702 contains helpful information regarding the design and installation of optional standby power systems. There is significant overlap between the NEC® and NFPA 110. NFPA Level 1 roughly equates to Article 700 for "emergency systems," and Level 2 to Article 701 for "legally required standby systems."

 **Class**

Your EPSS Class is the duration (in hours) your system must be able to run at its full-rated output without refueling (4.2).

For example, Class 2 requires your generator run for 2 hours without adding fuel, Class 48 requires 48 hours and so on. Although some AHJ's define "Class X" differently, it generally translates to 96 hours of rated output.

Table 4.1(A) Types of EPSSs

CLASS	MINIMUM TIME
Class 0.083	0.083 hr (5 mins)
Class 0.25	0.25 hr (15 mins)
Class 2	2 hr
Class 6	6 hr
Class 48	48 hr
Class X	Other time, in hrs, as required by the application, code or user

Source: NFPA 110

Higher Classes pose a challenge for system designers, especially designers of larger systems, as enough fuel must be stored on site to satisfy the generator's fuel consumption for the duration as defined by your Class. For example: you require 18,000 gallons of fuel to run your EPS for 96 hours because you have a Class X EPSS installation. According to the 133% rule, you need to store almost 24,000 gallons on site.

You'll need to carefully size your fuel tanks and perform regular fuel maintenance to ensure compliance (7.9). You should also consider fuel supplier delivery logistics. If you're in a rural area where it's going to take time to get more fuel if you run out, you should consider oversizing your tank even further.

You should work closely with your generator manufacturer to create a fuel storage and maintenance plan that complies with this standard and all applicable codes, without being cost prohibitive.

Type

Type refers to the time in seconds for all Level 1 and Level 2 loads to be supplied with alternate power. For emergency power – defined as Level 1 in NFPA 110 – 10 seconds is the standard. That means all Level 1 loads need to be transferred to your EPSS in 10 seconds, no matter how large or small your system is.

To prevent nuisance starts, there's usually a time delay of about 1 to 3 seconds on the transfer, leaving even less time to move the load. With bigger units, the time delay is sometimes reduced to create more time for the transfer. For instance, a time delay of 3 seconds gives 7 seconds for the transfer. Reducing the delay to 1 second gives 2 more seconds to transfer the load, which could be critical for larger applications.

You need your EPSS to be available within a reasonable timeframe after power failure, and you need it to fulfill your load requirements in full until your primary power source comes back on. .

And that's what NFPA 110's classification method was designed to do - ensure your EPSS system will provide a "source of electrical power of required capacity, reliability and quality" for the timeframe your application requires (4.1).

Table 4.1(B) Types of EPSSs

DESIGNATION	POWER RESTORATION
Type U	Basically Uninterruptible (UPS system)
Type 10	10 sec
Type 60	60 sec
Type 120	120 sec
Type M	Manual stationary or non-automatic-no time limit

Source: NFPA 110

A FEW IMPORTANT CAVEATS ABOUT NFPA 110

While it provides guidance to design engineers, manufacturers and governing agencies, NFPA 110 is not an all-encompassing manual for the design and implementation of emergency power systems. In fact, NFPA 110 dedicates a whole chapter to listing out referenced publications and standards "considered part of the requirements of [the] document." The publications listed on the next page might be useful in your continued research regarding compliance for your emergency power systems for your facility.

- NFPA 1 – Fire code
- NFPA 30 – Flammable and combustible liquids code
- NFPA 37 – Standard for the installation and use of stationary combustion engines and gas turbines

- NFPA 54 – National fuel gas code
- NFPA 58 – Liquefied petroleum gas code
- NFPA 70® – National electrical code®
- NFPA 72® – National fire alarm and signaling code
- NFPA 99 (if applicable) – Health care facilities code
- NFPA 780 – Standard for the installation of lightning protection systems
- ASCE / SEI 7 – Minimum design loads for buildings and other structures

To ensure your system is compliant, all applicable codes and standards for your industry should be referenced and you should work closely with all AHJ's. By familiarizing yourself with the necessary codes and working with the appropriate state and federal authorities to certify your emergency power system, you can be sure your backup emergency power will kick on when you need it most.

ACHIEVING NFPA COMPLIANCE-WHAT YOU NEED TO KNOW

Emergency power systems aren't called upon in ideal situations, so your EPSS needs to be designed to operate in flood, earthquake, fire and storm conditions (A.5.1.1).

NFPA 110 outlines ways to prevent the disruption of life safety critical loads in case of emergency, and it outlines the tests required to prove compliance with your AHJ. However, your EPSS will ultimately be installed, tested and maintained by your preferred generator service provider and "approved" by your AHJ. As your particular AHJ will vary, depending on your location, there's no cut-and-paste way to achieve compliance. Read NFPA 110 and talk with your AHJ to ensure your EPSS installation is compliant with all applicable standards and codes.



INSTALLATION ACCEPTANCE TESTING

Your EPSS is not considered compliant upon installation. You must prove its function and ability to carry all emergency loads (7.13.1) through a series of on-site installation acceptance tests and a two-hour load test (7.13.4.3).

Along with assistance from your preferred generator service provider, you'll test your EPSS installation and ensure it both follows NFPA guidelines and is acceptable to your AHJ. After passing the tests, your equipment will be warranted and commissioned by your AHJ for use as an emergency power system.

INSTALLATION

**ACCEPTANCE
TESTS**

**TWO-HOUR
LOAD TEST**

**WARRANTED &
COMISSIONED BY
YOUR AHJ**

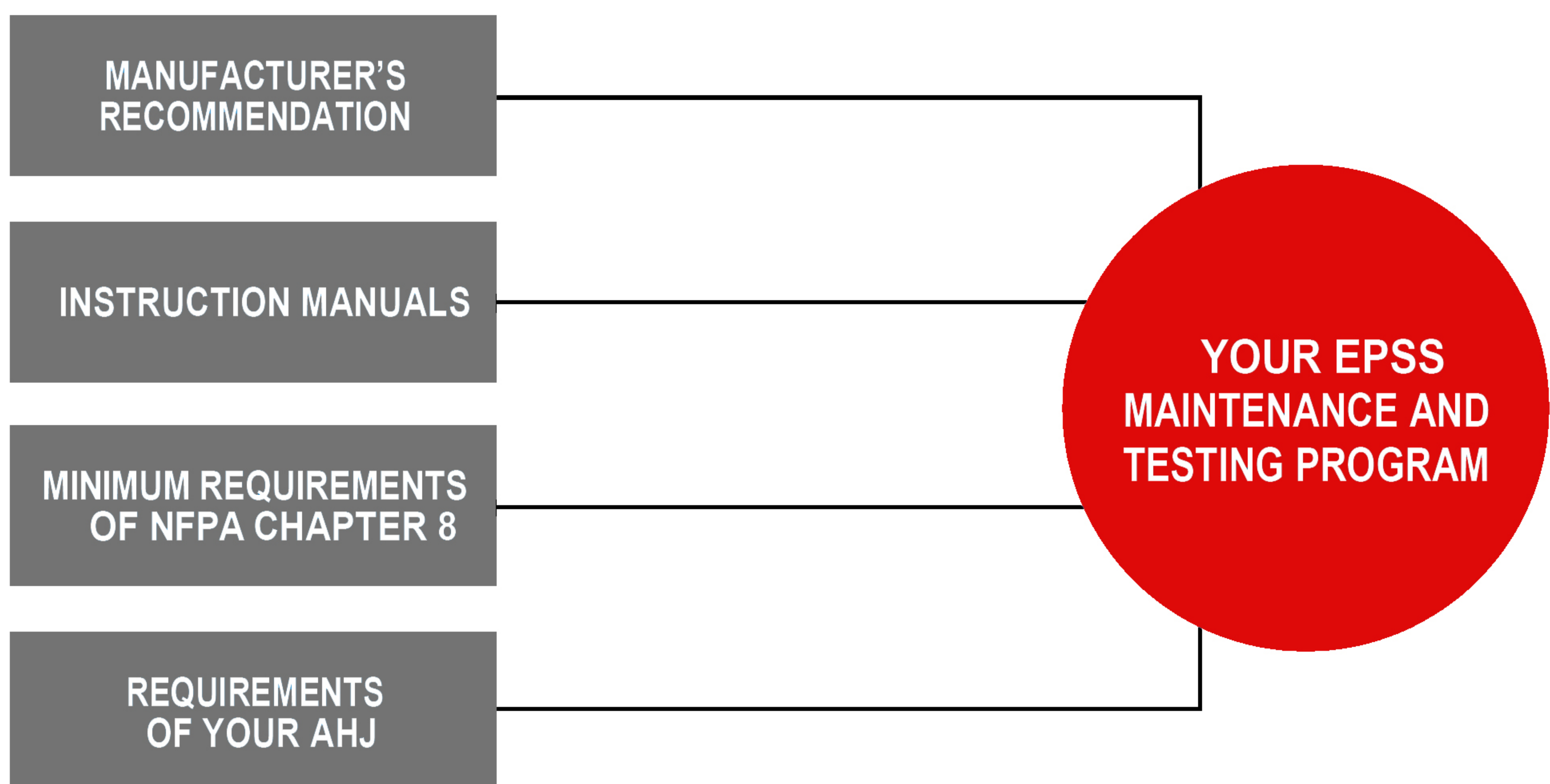
ROUTINE MAINTENANCE ACCORDING TO NFPA CHAPTER 8

Your EPSS must provide reliable power at a moment's notice. And since you can't predict when you'll need to call upon your emergency power system, routine maintenance and testing is the only way to make sure the system is functioning and available at all times.

NFPA 110 Chapter 8 suggests you follow your manufacturer's maintenance recommendations, but it outlines an alternate maintenance program if no manufacturer-given guidelines are available (A.8.3.1).

Their recommendations are helpful in visualizing the weekly, quarterly, monthly and annual inspection / maintenance items you'll have to perform. However, it isn't necessarily an exact replica of what your plan will look like. And following it won't guarantee compliance— the NFPA only provides the sample plan for informational purposes. Your particular system's maintenance program will depend largely on your manufacturer's recommendations and your AHJ's requirements.

Core elements of an EPSS maintenance Program



ONGOING EMERGENCY POWER SYSTEM TESTING

A weekly inspection and a monthly load test should be performed on your EPSS (8.4.1). And every 36 months, you'll need to run Level 1 EPSS for the amount of time specified in your application's class up to four hours of runtime (8.4.9.1-2). The purpose of these tests are to periodically verify the function of the system against the standard.

To achieve compliance, however, you'll need to consult your AHJ and manufacturer to develop an acceptable testing program for your system. If you're trying to achieve compliance for your facility's emergency power system, closely reading NFPA 110 is a good place to start. From there, you'll need to work with the governmental agencies responsible for code enforcement in your area. And, along the way, your generator manufacturer or preferred generator service provider should be able to answer any questions you might have regarding the installation, maintenance, operation and testing of a compliant NFPA EPSS.

CHOOSING YOUR PREFERRED GENERATOR INSTALLATION & SERVICE PROVIDER

From designing your EPSS to ongoing maintenance, there's a lot to consider when complying with NFPA 110. The aim of this guide is to give you a basic understanding, so you can ask the right questions when developing a code compliant EPSS with your generator manufacturer or preferred generator service provider.

Your preferred generator provider will be the main source of information and guidance, so ensure you have absolute confidence in the team that will maintain your vital emergency power equipment.

ACF STANDBY SYSTEMS

ACF is a leading supplier of generators for both prime and standby applications. Our staff of engineers and compliance specialist helps our customers choose and maintain the equipment that's right for them – and helps facility managers achieve compliance. With NFPA 110 compliance specialists on staff, CK Power can design, install and maintain even the most complex emergency power systems within code.

Visit our maintenance programs page for more information on what goes into a planned service agreement, or get in touch with ACF today to discuss your emergency power needs.



ACF Standby Systems
Power Generation

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