



NFPA 110 Overview

Part 1: Key Requirements for Emergency
and Standby Power Systems

White Paper 125

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NFPA 110 Overview

Part 1: Key Requirements for Emergency and Standby Power Systems

NFPA 110 – Standard for Emergency and Standby Power Systems provides basic requirements for the performance of backup power systems.¹ Often referenced by other standards and regulations, a useful understanding of NFPA 110 is essential for professionals engaged in the installation and operation of critical power equipment. The first of a two-part series, this document summarizes key highlights from the standard.

PURPOSE, SCOPE, AND APPLICABILITY

The purpose of NFPA 110 is to provide performance standards for Emergency Power Supply Systems (EPSS). It addresses the installation, maintenance, operation and testing of emergency and standby power systems. With the exception of *Section 8*, the standard applies to newly installed systems. The requirements in *Section 8 - Routine Maintenance and Operational Testing* apply to both new and existing systems. Notably, NFPA 110 does not specify where backup power systems must be used; other standards provide such requirements.

RELEVANCE TO OTHER CODES

- ***International Building Code*** - The International Building Code is one code that does identify where backup power is required. It identifies Emergency Systems (including but not limited to fire alarm, exit signage, and egress illumination systems) and Standby Systems (including but not limited to smoke control, powered door, and emergency ventilation systems).²
- ***NFPA 70 – National Electrical Code® (NEC®)*** - The purpose of the NEC is to safeguard persons and property from electrical hazards.³ Table 1 identifies key sections that relate to backup power systems and the loads they power.

The NEC also specifies requirements for generators and healthcare facilities in Articles 445 and 517, respectively. For additional information, review the ASCO power Technologies document entitled [2020 NEC Changes for Backup Power](#).

Table 1. NEC Article Summary

Article	Focus	Type	Installation	Operation	Maintenance	Monitoring	Control	Systems Affected
700	Emergency Systems	Permanent	X	X	X			Lighting and power for human safety
701	Legally Required Standby Systems	Permanent	X	X	X			Power to eliminate hazards and aid rescue/firefighting
702	Optional Standby Systems	Temporary or Permanent	X	X				Power to eliminate discomfort or damage to product/process
708	Critical Operations Power Systems	Temporary or Permanent	X	X	X	X	X	Power for national security, economy, public health/safety

¹ NFPA 110 – Standard for Emergency and Standby Power Systems, 2019 Edition. National Fire Protection Agency. Quincy, Massachusetts, USA. 2018.

² International Building Code, 2018 Edition. International Code Council. Washington, DC, USA. 2018.

³ NFPA 70 - National Electrical Code, 2020 Edition. National Fire Protection Agency. Quincy, Massachusetts, USA. 2019.

- **NFPA 99 – Health Care Facilities Code** - NFPA 99 specifies requirements for mitigating hazards from facilities, equipment, materials and other sources in healthcare facilities.⁴ For power systems, it specifies requirements for loads served by the *Life Safety Branch*, which addresses systems needed to ensure the safety of patients and personnel; the *Critical Branch* which serves area and functions involved in patient care; and the *Equipment Branch*, which serves other systems such as medical air, suction, and smoke control systems.

CATEGORIZATION OF EMERGENCY POWER SUPPLY SYSTEMS

NFPA 110 applies performance standards to Emergency Power Supply Systems (EPSS). The requirements necessarily vary by application. Section 4 of the standard thus differentiates systems by *Class*, *Type*, and *Level* as follows:

- **Class:** Class is identified by the amount of time in hours that a backup power system is designed to operate without refueling or recharging. The classifications are presented in Table 2.⁵
- **Type:** Types define the maximum time, in seconds, that the EPSS will permit the load terminals of the transfer switch to be without acceptable electrical power, as listed in Table 3.⁶
- **Level:** Level 1 systems are installed where a failure of backup power could result in loss of human life or serious injuries.⁷ Level 2 systems serve systems and equipment that are “less critical” to human life and safety.⁸

Table 2: Classification of EPSSs

Class	Minimum Time
Class 0.083	0.083 Hr. (5 Min.)
Class 0.25	0.25 Hr. (15 Min.)
Class 2	2 Hrs.
Class 6	6 Hrs.
Class 48	48 Hrs.
Class X	As required by code, application, or user

Table 3: Types of EPSSs

Type	Minimum Time
Type U	Basically Uninterruptible (UPS)
Type 10	10 Seconds
Type 60	60 Seconds
Type 120	120 Seconds
Type M	Manual Stationary or Nonautomatic – No Time Limit

⁴ NFPA 99 – Health Care Facilities Code, 2018 Edition. National Fire Protection Agency. Quincy, Massachusetts, USA. 2017.

⁵ NFPA 110. Article 4.2. p. 110-8.

⁶ Ibid. Article 4.3. p. 110-8.

⁷ Ibid. Article 4.4.1. p. 110-8.

⁸ Ibid. Article 4.4.2.p. 110-8.





ENERGY SOURCES

Section 5 - Emergency Power Supply: Energy Sources, Converters, and Accessories stipulates that liquified petroleum fuels (e.g. diesel, gasoline), liquified petroleum gases (e.g. propane), and natural or synthetic gases can be used for backup power generation. It also states that a utility service can be used for backup power where “the primary power source is by means of on-site energy conversion.”⁹

The standard identifies that the Emergency Power Supply (EPS) must be a generator driven by spark-ignited, diesel, or gas turbine engines.^{10,11} For Level 1 applications, the prime mover is not permitted to mechanically power any device that is not associated with the generator or its accessories.¹²

The Emergency Power Supply must be installed in accordance with NEC requirements, and must be of sufficient capacity to “pickup and carry” the emergency load in the time specified for its type (see Table 3 above).^{13,14} The remainder of Section 5 presents specific requirements for EPSs, including requirements for fuel systems, rotating equipment, starting batteries, controls, alarms, and important derating factors for certain site conditions.

TRANSFER SWITCHES

Transfer switches transfer electric loads from one power source to another. Their essential functions are further explained in the ASCO Power Technologies Technical Brief entitled Basic Automatic Transfer Switch Functions.¹⁵ General transfer switch requirements in *Chapter 6 - Transfer Switch Equipment* of NFPA 110 include:

- Switch ratings sized for the total load that is designed to be connected
- A separate enclosure or compartment for each switch
- Use of switches and their load carrying components listed for all load types to be served
- Switch and load current-carrying components designed to withstand the effects of available fault currents.
- Where available, switches that are listed for emergency service as a completely factory-assembled and factory-tested unit¹⁶

⁹ Ibid. Article 5.1.3. p. 110-8.

¹⁰ Ibid. Article 5.2.1. p. 110-8.

¹¹ Ibid. Article 5.2.4. p. 110-9.

¹² Ibid. Article 5.2.4.2. p. 110-9.

¹³ Ibid. Article 5.2.5. p. 110-9.

¹⁴ Ibid. Article 5.4, p. 110-9.

¹⁵ *Basic Automatic Transfer Switch Functions*. ASCO Power Technologies, Inc. Florham Park, NJ, USA. 2020. <https://www.ascopower.com/us/en/resources/technical-briefs/basic-automatic-transfer-switch-functions.jsp>. Accessed November 25, 2020.

¹⁶ NFPA 110. Article 6.1.6 et seq. p. 110-14.

Each ***Automatic Transfer Switch*** must be equipped with a test means for simulating a failure of a normal power source to initiate transfer the alternate source.¹⁷

Automatic transfer switches sense voltage and frequency on the active power source, then transfer to backup power when they sense unacceptable aberrations in voltage and frequency. For power source sensing, undervoltage sensing devices are required for all ungrounded lines of the normal power source, and on one ungrounded line of EPS. When voltages decrease below the minimum operating voltage of any load, the transfer switch must automatically initiate engine start and transfer to the alternate power source. However, this function must be inhibited until the voltage and frequency are within a specified range. Additional Information about power sensing and load transfer is available in the ASCO Technical Brief entitled ***Basic Power Source Synchronization and Paralleling***.¹⁸

When the voltage on all phases of the normal source returns to specified ranges in a specified time, retransfer must be initiated. Mechanical interlocking must prevent the inadvertent interconnection of power sources. Automatic Transfer Switches must also provide for manual operation.¹⁹ In ***non-automatic transfer switches***, switching devices must be mechanically held and operated by direct manual or electrical remote manual control.²⁰

Time delays are necessary for the proper operation of transfer switches. NFPA 110 requires specific delays for starting and transferring loads to an EPS, retransferring loads to the normal source, and engine cooldown. The code also requires the bypassing of transfer delays if the EPS should fail.²¹ Additional Information is available about power sensing and load transfer in the ASCO White Paper entitled ***Timing Delays for ATS Transition Modes***.²²

Where transfer switches serve motor loads, NFPA 110 calls for provisions to reduce in-rush currents if they could damage equipment or cause nuisance trips of overcurrent protective devices.²³ For information on four approaches for mitigating these currents, review the ASCO document entitled ***Transferring Motor Loads Between Power Sources*** and the ASCO video entitled ***White Paper Video – Transferring Motor Loads***.^{24, 25}

A power distribution system with a separately derived ground for the EPSS requires provisions for ensuring the continuity, transfer, and isolation of the primary and EPS neutral conductors.²⁶ Additional information on this topic can be found in the ASCO Power Technologies document entitled ***Switching the Neutral Conductor***.²⁷ For additional background on this subject, view the ASCO video entitled ***When to Separately Ground a Backup Generator***.

Bypass-Isolation Transfer Switches are permitted by NFPA 110. This equipment allows operators to bypass the transfer mechanism without disrupting power flow to loads. This capability enables inspection, service, and replacement of a transfer switch mechanism without impacting downstream operations. NFPA 110 requires that bypass-isolation switches have adequate ratings, be listed for emergency use as a factory-assembled and factory-tested unit, and to be able to function as an independent non-automatic transfer switch. The equipment must also be capable of reconnecting the transfer switch without interrupting power to loads.²⁸

¹⁷ Ibid. Article 6.2.12. p. 110-15.

¹⁸ *Basic Power Source Synchronization and Paralleling*. ASCO Power Technologies, Inc. Florham Park, NJ, USA. 2020. <https://www.ascopower.com/us/en/resources/technical-briefs/basic-power-source-synchronization.jsp>. Accessed November 25, 2020.

¹⁹ Ibid. Article 6.2 et seq. p. 110-14.

²⁰ Ibid. Article 6.2.16. p. 110-15.

²¹ Ibid. Article 6.2.5 et seq., 110-14.

²² *Timing Delays for ATS Transition Modes*. ASCO Power Technologies, Inc. Florham Park, NJ, USA. 2020. <https://www.ascopower.com/us/en/download/document/ASC-TS-WP-123-TD-ATS/>. Accessed November 25, 2020.

²³ Ibid. Article 6.2.14. p. 110-14.

²⁴ *Transferring Motor Loads Between Power Sources*. ASCO Power Technologies, Inc. Florham Park, NJ, USA. 2020. <https://www.ascopower.com/us/en/download/document/asc-ts-wp-119-motorloads/>. Accessed November 25, 2020.

²⁵ *White Paper Video - Transferring Motor Loads*. ASCO Power Technologies, Inc. Florham Park, NJ, USA. 2020. <https://www.youtube.com/watch?v=I75DQDUwvhg>. Accessed November 25, 2020.

²⁶ NFPA 110. Article 6.2.15. p. 110-14.

²⁷ *Switching the Neutral Conductor*. ASCO Power Technologies, Inc. Florham Park, NJ, USA. 2019. <https://www.ascopower.com/us/en/download/document/TS-WP-NEUTRALCON/>. Accessed November 25, 2020.

²⁸ NFPA 110. Article 6.4 et seq. p. 110-115.



SUMMARY

The first of a two-part series, this document highlights NFPA 110 requirements for Emergency Power Supplies and Emergency Power Supply Systems. In addition to explaining the relationship between NFPA 110 and other selected standards, this white paper describes how NFPA 110 categorizes back power systems and highlights key requirements for power sources and transfer switches. Part 2 of this document will review installation, testing, and maintenance of emergency and standby power systems in accordance with NFPA 110 requirements.

Life Is On | Schneider
Electric™

ASCO Power Technologies - Global Headquarters
160 Park Avenue
Florham Park, NJ 07932
Tel: 800 800 ASCO

whitepapers.ascopower.com
customercare@ascopower.com