

NFPA® 110

Standard for Emergency and Standby Power Systems

2010 Edition



NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA® DOCUMENTS
NOTICE AND DISCLAIMER OF LIABILITY CONCERNING THE USE OF NFPA DOCUMENTS

NFPA® codes, standards, recommended practices, and guides (“NFPA Documents”), of which the document contained herein is one, are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on fire and other safety issues. While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in NFPA Documents.

The NFPA disclaims liability for any personal injury, property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on NFPA Documents. The NFPA also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making NFPA Documents available, the NFPA is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the NFPA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The NFPA has no power, nor does it undertake, to police or enforce compliance with the contents of NFPA Documents. Nor does the NFPA list, certify, test, or inspect products, designs, or installations for compliance with this document. Any certification or other statement of compliance with the requirements of this document shall not be attributable to the NFPA and is solely the responsibility of the certifier or maker of the statement.

IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA DOCUMENTS

ADDITIONAL NOTICES AND DISCLAIMERS

Updating of NFPA Documents

Users of NFPA codes, standards, recommended practices, and guides (“NFPA Documents”) should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of Tentative Interim Amendments. An official NFPA Document at any point in time consists of the current edition of the document together with any Tentative Interim Amendments and any Errata then in effect. In order to determine whether a given document is the current edition and whether it has been amended through the issuance of Tentative Interim Amendments or corrected through the issuance of Errata, consult appropriate NFPA publications such as the National Fire Codes® Subscription Service, visit the NFPA website at www.nfpa.org, or contact the NFPA at the address listed below.

Interpretations of NFPA Documents

A statement, written or oral, that is not processed in accordance with Section 6 of the Regulations Governing Committee Projects shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

Patents

The NFPA does not take any position with respect to the validity of any patent rights referenced in, related to, or asserted in connection with an NFPA Document. The users of NFPA Documents bear the sole responsibility for determining the validity of any such patent rights, as well as the risk of infringement of such rights, and the NFPA disclaims liability for the infringement of any patent resulting from the use of or reliance on NFPA Documents.

NFPA adheres to the policy of the American National Standards Institute (ANSI) regarding the inclusion of patents in American National Standards (“the ANSI Patent Policy”), and hereby gives the following notice pursuant to that policy:

NOTICE: The user’s attention is called to the possibility that compliance with an NFPA Document may require use of an invention covered by patent rights. NFPA takes no position as to the validity of any such patent rights or as to whether such patent rights constitute or include essential patent claims under the ANSI Patent Policy. If, in connection with the ANSI Patent Policy, a patent holder has filed a statement of willingness to grant licenses under these rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such a license, copies of such filed statements can be obtained, on request, from NFPA. For further information, contact the NFPA at the address listed below.

Law and Regulations

Users of NFPA Documents should consult applicable federal, state, and local laws and regulations. NFPA does not, by the publication of its codes, standards, recommended practices, and guides, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

NFPA Documents are copyrighted by the NFPA. They are made available for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of safe practices and methods. By making these documents available for use and adoption by public authorities and private users, the NFPA does not waive any rights in copyright to these documents.

Use of NFPA Documents for regulatory purposes should be accomplished through adoption by reference. The term “adoption by reference” means the citing of title, edition, and publishing information only. Any deletions, additions, and changes desired by the adopting authority should be noted separately in the adopting instrument. In order to assist NFPA in following the uses made of its documents, adopting authorities are requested to notify the NFPA (Attention: Secretary, Standards Council) in writing of such use. For technical assistance and questions concerning adoption of NFPA Documents, contact NFPA at the address below.

For Further Information

All questions or other communications relating to NFPA Documents and all requests for information on NFPA procedures governing its codes and standards development process, including information on the procedures for requesting Formal Interpretations, for proposing Tentative Interim Amendments, and for proposing revisions to NFPA documents during regular revision cycles, should be sent to NFPA headquarters, addressed to the attention of the Secretary, Standards Council, NFPA, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101; email: stds_admin@nfpa.org

For more information about NFPA, visit the NFPA website at www.nfpa.org.

Copyright © 2009 National Fire Protection Association®. All Rights Reserved.

NFPA® 110
Standard for
Emergency and Standby Power Systems
2010 Edition

This edition of NFPA 110, *Standard for Emergency and Standby Power Systems*, was prepared by the Technical Committee on Emergency Power Supplies and released by the Technical Correlating Committee on National Electrical Code®. It was issued by the Standards Council on August 6, 2009, with an effective date of August 26, 2009, and supersedes all previous editions.

A tentative interim amendment (TIA) to 7.13.4.1.3(1) and 7.13.4.3.4 was issued on August 6, 2009. For further information on tentative interim amendments, see Section 5 of the NFPA Regulations Governing Committee Projects available at: <http://www.nfpa.org/assets/files/PDF/CodesStandards/TIAErrataFI/TIARegs.pdf>

This edition of NFPA 110 was approved as an American National Standard on August 26, 2009.

Origin and Development of NFPA 110

The Technical Committee on Emergency Power Supplies was organized in 1976 by NFPA in recognition of the demand for viable guidelines for the assembly, installation, and performance of electrical power systems to supply critical and essential needs during outages of the primary power source. It was the intent of the committee to establish the necessary equipment requirements to achieve an on-site auxiliary electrical power source suitable to the needs of the applicable requirements and user criteria.

In 1979, the committee's report proposing adoption of NFPA 110 was published but withdrawn because of issues involving the scope of the committee. In 1981, a revised committee report was returned to committee to resolve differences with other NFPA documents. At the 1982 NFPA Fall Meeting, the committee's report was adopted as a tentative standard (NFPA 110T-1983) in order to expose the document to as much public review as possible. NFPA 110 was formally adopted as a standard at the 1984 NFPA Fall Meeting and designated as the 1985 edition. The 1985 edition clarified scope statements, prototype testing, battery and bypass-isolation switch requirements, and revised maintenance requirements.

The requirements of the standard are considered necessary to obtain the minimum level of reliability and performance, particularly where life safety electrical power needs are involved.

The standard does not require the installation of emergency and standby power supply systems. Rather, it is a document that, if followed, results in a system suitable for various situations as required by other codes and standards.

The 1988 edition of NFPA 110 included several new definitions and further clarified transfer switch and installation testing requirements.

The 1993 edition of NFPA 110 revised the document to reflect (1) the adoption by NFPA of a new document on stored electrical energy emergency and standby power systems (NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*), (2) a basic requirement for one-step loading for all prime movers, (3) an update on battery technology, (4) restrictions on unnecessary transferring of loads, and (5) the need for battery maintenance.

The 1996 edition of NFPA 110 included, but was not limited to, the following changes: monthly load testing requirements for generator sets were changed, including taking into consideration wet stacking; definitions were added for various kinds of fuel tanks; types of fuel tanks and spillage considerations were added; restrictions on the types of batteries that can be used were added; the minimum number of cranks, including time-outs, that an engine must be capable of completing was clarified; cooling system requirements were clarified; working space requirements were added; and the issue of timing devices in health care facilities for testing a generator was clarified.

The 1999 edition was changed by the deletion of the testing of generator sets at 50 percent of the emergency power supply system (EPSS) load because the relevant measure is the nameplate rating. That edition also deleted the exception for wet stacking. Exhaust temperature monitoring was added, because it is an acceptable performance measure of proper emergency power supply (EPS) loading.

The 2002 edition included format and technical revisions. The 2000 edition of the *Manual of Style for NFPA Technical Committee Documents* was applied in this document's restructure and format. Introductory material in Chapter 1 was formatted for consistency among all NFPA documents. Referenced publications that apply to the document were relocated from the last chapter to Chapter 2, resulting in the renumbering of chapters. Informational references remained in the last annex. Appendices were designated as annexes. Definitions in Chapter 3 were reviewed for consistency with definitions in other NFPA documents, systematically aligned, and individually numbered. Paragraph structuring was revised with the intent of one mandatory requirement per section, subsection, or paragraph. Information that often accompanied many of the requirements was moved to Annex A, Explanatory Material. Exceptions were deleted or rephrased in mandatory text, unless the exception represented an allowance or required an alternate procedure to a general rule when limited specified conditions existed. The format appearance and structure provided continuity among NFPA documents, clarity of mandatory text, and greater ease in locating specific mandatory text.

Changes in the 2002 edition of NFPA 110 included definitive and broad-based requirements regarding electrical installations in accordance with NFPA 70, *National Electrical Code*®; additional EPS controls and safeguards, such as alerting staff of impending failure of the EPS to start; access and working space around the generator set; ventilation; energy converters; and EPSS testing requirements.

Changes in the 2005 edition of NFPA 110 included electrical installations in accordance with NFPA 70, *National Electrical Code*®; revised clearance distances between transfer switches and service equipment; revision of the definitions for both lead-acid (flooded) and valve-regulated lead-acid (VRLA) batteries; and changes in the testing and maintenance section to include testing for spark-ignited engines that parallels those for diesel. Changes for the 2005 edition also included new annex material for diesel fuel testing and maintenance procedures, as well as transfer switches.

Significant revisions to the 2010 edition include the following:

- (1) Clarification that the standard is intended to apply to those EPSSs classed as either Level 1 or Level 2 systems. Applying the requirements of this standard to systems classed as optional standby is not mandatory.
- (2) Revision of the application section to indicate that the operation testing and routine maintenance requirements of Chapter 8 cover new and existing EPSSs.
- (3) Revisions to the definitions of Automatic Transfer Switch (ATS) and Nonautomatic Transfer Switch for consistency with NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, and for correlation with relevant product standards covering the construction of transfer switches.
- (4) Revisions to the requirements of Chapter 7 for acceptance testing that distinguish what is required for new and unoccupied buildings and facilities versus the requirements for existing occupied buildings and facilities. In addition, requirements for test duration, step-testing intervals, and required documentation have been modified.
- (5) Revisions to the requirements of Chapter 8 on operational test durations for diesel and spark-ignited prime movers. In addition, the 36-month test requirement has been revised to clarify the maximum duration, the minimum acceptable EPS loading or operating condition, and the method of test initiation.

Technical Correlating Committee on National Electrical Code® (NEC-AAC)

James W. Carpenter, *Chair*
International Association of Electrical Inspectors, TX [E]

Mark W. Earley, *Secretary*
National Fire Protection Association, MA
(nonvoting)

Jean A. O'Connor, *Recording Secretary*
National Fire Protection Association, MA
(nonvoting)

James E. Brunssen, Telcordia, NJ [UT]
Rep. Alliance for Telecommunications Industry
Solutions

Merton W. Bunker, Jr., U.S. Department of State, VA [U]
(Voting limited to Document 110, Document 111,
Document 70, Document 70B, Document 70E,
Document 79)

James M. Daly, General Cable, NJ [M]
Rep. National Electrical Manufacturers Association

William R. Drake, Marinco, CA [M]

Stanley J. Folz, Morse Electric Company, NV [IM]
Rep. National Electrical Contractors Association

Palmer L. Hickman, National Joint Apprentice
& Training Committee, MD [L]

Rep. International Brotherhood of Electrical Workers
John R. Kovacik, Underwriters Laboratories Inc.,
IL [RT]

Neil F. LaBrake, Jr., National Grid, NY [UT]
Rep. Electric Light & Power Group/EEI

Danny Liggett, DuPont Company, TX [U]
Rep. American Chemistry Council

Robert G. Wilkinson, IEC Texas Gulf Coast,
TX [IM]
Rep. Independent Electrical Contractors, Inc.

Alternates

Thomas L. Adams, Engineering Consultant, IL [UT]
(Alt. to N. F. LaBrake, Jr.)

Larry D. Cogburn, Cogburn Bros. Inc., FL [IM]
(Alt. to S. J. Folz)

James T. Dollard, Jr., IBEW Local Union 98, PA [L]
(Alt. to P. L. Hickman)

Ernest J. Gallo, Telcordia Technologies, Inc., NJ [UT]
(Alt. to J. E. Brunssen)

David L. Hittinger, IEC of Greater Cincinnati, OH [IM]
(Alt. to R. G. Wilkinson)

Daniel J. Kissane, Pass & Seymour/Legrand, NY [M]
(Alt. to J. M. Daly)

Michael E. McNeil, FMC Bio Polymer, ME [U]
(Alt. to D. Liggett)

Mark C. Ode, Underwriters Laboratories Inc.,
NC [RT]

(Alt. to J. R. Kovacik)

Richard P. Owen, City of St. Paul, MN [E]
(Alt. to J. W. Carpenter)

Nonvoting

Richard G. Biermann, Biermann Electric Company, Inc.,
IA [IM]
(Member Emeritus)

David Mascarenhas, Canadian Standards Association,
Canada [RT]

D. Harold Ware, Libra Electric Company,
OK [IM]
(Member Emeritus)

This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on minimizing the risk of electricity as a source of electric shock and as a potential ignition source of fires and explosions. It shall also be responsible for text to minimize the propagation of fire and explosions due to electrical installations.

Technical Committee on Emergency Power Supplies (EPS-AAA)

David Stymiest, *Chair*
Smith Seckman Reid, Inc., TN [SE]

Ernest E. Allen, OHIC Insurance Company, OH [I]
Rep. NFPA Health Care Section
Dan Chisholm, Sr., Healthcare Engineering Network,
FL [IM]
Khimchand H. Chudasama, U.S. Department of Veterans
Affairs, DC [U]
Kenneth A. Cotton, U.S. Energy, CA [M]
Herbert H. Daugherty, Electric Generating Systems
Association, NJ [M]
Rep. Electrical Generating Systems Association
Dennis DeMoss, Sargent & Lundy, IL [SE]
Douglas S. Erickson, American Society for Healthcare
Engineering, VI [U]
William H. Everard, Everard Mid Atlantic Inc., VA [SE]
James R. Gregory, State of Florida, FL [E]
Ross M. Hardy, Beaumont Services Company, MI [U]
Don A. Hursey, Durham City-County Inspections
Department, NC [E]

Alan Manche, Square D Company/Schneider Electric,
KY [M]
Ronald Marts, Telcordia Technologies, NJ [U]
George Mills, The Joint Commission, IL [E]
Rep. Joint Commission on Accreditation Healthcare
Organizations
Hugh O. Nash, Jr., Nash Lipsey Burch, LLC, TN [SE]
Daniel J. O'Connor, Schirmer Engineering Corporation,
IL [I]
Ralph E. Patterson, Power Products & Solutions Inc.,
NC [IM]
Rep. InterNational Electrical Testing Association
Ronald A. Schroeder, ASCO Power Technologies,
NJ [M]
David E. Watters, H. F. Lenz Company, PA [IM]
Timothy P. Zgonena, Underwriters Laboratories Inc.,
IL [RT]

Alternates

Raymond J. Battalora, Schirmer Engineering
Corporation, TX [I]
(Alt. to D. J. O'Connor)
Dan Chisholm, Jr., Healthcare Engineering Network,
FL [IM]
(Alt. to D. Chisholm, Sr.)
James R. Iverson, Cummins Power Generation, MN [M]
(Voting Alt. to Cummins Rep.)
Larry Lau, U.S. Department of Veterans Affairs, DC [U]
(Alt. to K. H. Chudasama)

Stephen McCluer, APC by Schneider Electric, TX [M]
(Alt. to A. Manche)
Donald W. Shields, Underwriters Laboratories Inc.,
IL [RT]
(Alt. to T. P. Zgonena)
Ronald M. Smidt, Carolinas HealthCare System, NC [U]
(Alt. to D. S. Erickson)
Herbert V. Whittall, Electrical Generating Systems
Association, FL [M]
(Alt. to H. H. Daugherty)

Jeffrey S. Sargent, NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on performance criteria for the selection and assembly of the components for emergency and standby power systems in buildings and facilities, including categories of power supplies, transfer equipment, controls, supervisory equipment, and all related electrical and mechanical auxiliary or accessory equipment needed to supply emergency or standby power to the utilization equipment. The Committee also shall be responsible for criteria on the maintenance and testing of the system. This Committee does not cover requirements for the application of emergency power systems, self-contained emergency lighting units, and electrical wiring, except that wiring that is an integral part of the system up to the load side of the transfer switch(es). This Committee shall report to the Technical Correlating Committee on National Electrical Code®.



Contents

Chapter 1 Administration	110– 6	Chapter 6 Transfer Switch Equipment	110–13
1.1 Scope	110– 6	6.1 General	110–13
1.2 Purpose	110– 6	6.2 ATS Features	110–13
1.3 Application	110– 6	6.3 Load Switching (Load Shedding)	110–14
1.4 Equivalency	110– 6	6.4 Bypass-Isolation Switches	110–14
		6.5 Protection	110–14
Chapter 2 Referenced Publications	110– 6	Chapter 7 Installation and Environmental Considerations	110–14
2.1 General	110– 6	7.1 General	110–14
2.2 NFPA Publications	110– 6	7.2 Location	110–15
2.3 Other Publications	110– 6	7.3 Lighting	110–15
2.4 References for Extracts in Mandatory Sections (Reserved)	110– 6	7.4 Mounting	110–15
		7.5 Vibration	110–15
Chapter 3 Definitions	110– 7	7.6 Noise	110–15
3.1 General	110– 7	7.7 Heating, Cooling, and Ventilating	110–15
3.2 NFPA Official Definitions	110– 7	7.8 Installed EPS Cooling System	110–16
3.3 General Definitions	110– 7	7.9 Fuel System	110–16
		7.10 Exhaust System	110–17
Chapter 4 Classification of Emergency Power Supply Systems (EPSSs)	110– 7	7.11 Protection	110–17
4.1 General	110– 7	7.12 Distribution	110–17
4.2 Class	110– 7	7.13 Installation Acceptance	110–18
4.3 Type	110– 8		
4.4 Level	110– 8	Chapter 8 Routine Maintenance and Operational Testing	110–19
Chapter 5 Emergency Power Supply (EPS): Energy Sources, Converters, and Accessories	110– 8	8.1 General	110–19
5.1 Energy Sources	110– 8	8.2 Manuals, Special Tools, and Spare Parts ...	110–19
5.2 Energy Converters — General	110– 8	8.3 Maintenance and Operational Testing	110–19
5.3 Energy Converters — Temperature	110– 9	8.4 Operational Inspection and Testing	110–19
5.4 Energy Converters — Capacity	110– 9		
5.5 Energy Converters — Fuel Supply	110– 9	Annex A Explanatory Material	110–20
5.6 Rotating Equipment	110– 9	Annex B Diagrams of Typical Systems	110–33
		Annex C Informational References	110–35
		Index	110–36

NFPA 110

Standard for

Emergency and Standby Power Systems

2010 Edition

IMPORTANT NOTE: This NFPA document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading “Important Notices and Disclaimers Concerning NFPA Documents.” They can also be obtained on request from NFPA or viewed at www.nfpa.org/disclaimers.

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

Information on referenced publications can be found in Chapter 2 and Annex C.

Chapter 1 Administration

1.1 Scope. This standard covers performance requirements for emergency and standby power systems providing an alternate source of electrical power to loads in buildings and facilities in the event that the primary power source fails.

1.1.1 Power systems covered in this standard include power sources, transfer equipment, controls, supervisory equipment, and all related electrical and mechanical auxiliary and accessory equipment needed to supply electrical power to the load terminals of the transfer equipment.

1.1.2 This standard covers installation, maintenance, operation, and testing requirements as they pertain to the performance of the emergency power supply system (EPSS).

1.1.3 This standard does not cover the following:

- (1) Application of the EPSS
- (2) Emergency lighting unit equipment
- (3) Distribution wiring
- (4) Utility service when such service is permitted as the EPSS
- (5) Parameters for stored energy devices
- (6) The equipment of systems that are not classed as Level 1 or Level 2 systems in accordance with Chapter 4 of this standard

1.1.4* This standard does not establish criteria for stored energy systems.

1.1.5 The selection of any of the following is not within the scope of this standard:

- (1) Specific buildings or facilities, or both, requiring an EPSS
- (2) Specific loads to be served by the EPSS
- (3)*Assignment of type, class, or level to any specific load

1.2 Purpose. This standard contains performance requirements for an EPSS.

1.2.1 It is the role of other NFPA standards to specify which occupancies require an EPSS and the applicable level, type, and class. This standard does not specify where an EPSS is required.

1.2.2 This standard also is intended to provide guidance for inspectors, designers, installers, manufacturers, and users of EPSSs and to serve as a vehicle for communication between the parties involved. It is not intended as a design manual.

1.2.3 Compliance with this standard is not intended to exempt the parties involved from their respective responsibilities for the design, installation, maintenance, performance, or compliance with other applicable standards and codes.

1.3 Application. This document applies to new installations of EPSSs, except that the requirements of Chapter 8 shall apply to new and existing systems. Existing systems shall not be required to be modified to conform, except where the authority having jurisdiction determines that nonconformity presents a distinct hazard to life.

1.4 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety to those prescribed by this standard.

1.4.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.4.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 30, *Flammable and Combustible Liquids Code*, 2008 edition.

NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, 2006 edition.

NFPA 54, *National Fuel Gas Code*, 2009 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2008 edition.

NFPA 70®, *National Electrical Code®*, 2008 edition.

NFPA 72®, *National Fire Alarm and Signaling Code*, 2010 edition.

NFPA 99, *Standard for Health Care Facilities*, 2005 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2008 edition.

2.3 Other Publications.

2.3.1 ASCE Publications. American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA 20191.

ASCE 7, *Minimum Design Loads for Buildings and Other Structures*, 2002.

2.3.2 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections. (Reserved)



Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1* Battery Certification. The certification by a battery manufacturer that a battery is built to industry standards.

3.3.2 Battery, Lead-Acid.

3.3.2.1 Valve-Regulated (VRLA). A lead-acid battery consisting of sealed cells furnished with a valve that opens to vent the battery whenever the internal pressure of the battery exceeds the ambient pressure by a set amount. In VRLA batteries, the liquid electrolyte in the cells is immobilized in an absorptive glass mat (AGM cells or batteries) or by the addition of a gelling agent (gel cells or gelled batteries).

3.3.2.2 Vented (Flooded). A lead-acid battery consisting of cells that have electrodes immersed in liquid electrolyte. Flooded lead-acid batteries may have a provision for the

user to add water to the cell and are equipped with a flame-arresting vent which permits the escape of hydrogen and oxygen gas from the cell in a diffused manner such that a spark, or other ignition source, outside the cell will not ignite the gases inside the cell.

3.3.3 Black Start. Where the stored energy system has the capability to start the prime mover without using energy from another source.

3.3.4* Emergency Power Supply (EPS). The source of electric power of the required capacity and quality for an emergency power supply system (EPSS).

3.3.5* Emergency Power Supply System (EPSS). A complete functioning EPS system coupled to a system of conductors, disconnecting means and overcurrent protective devices, transfer switches, and all control, supervisory, and support devices up to and including the load terminals of the transfer equipment needed for the system to operate as a safe and reliable source of electric power.

3.3.6 Fuel Tank.

3.3.6.1 Day Fuel Tank. A fuel tank, located inside a structure, that provides fuel to the engine.

3.3.6.2 Enclosed Fuel Tank. A fuel tank located within a separate room, separated from other equipment.

3.3.6.3 Integral Fuel Tank in EPS Systems. A fuel tank furnished by the EPS supplier and mounted on the engine or under as a subbase.

3.3.6.4 Main Fuel Tank. A separate, main fuel tank for supplying fuel to the engine or a day tank.

3.3.7 Lamp. An illuminating indicator.

3.3.8 Occupancy Category. See ASCE 7, *Minimum Design Loads for Buildings and Other Structures*, Section 9, 2002 edition.

3.3.9 Switch.

3.3.9.1 Automatic Transfer Switch (ATS). Self-acting equipment for transferring the connected load from one power source to another power source.

3.3.9.2 Bypass-Isolation Switch. A manually operated device used in conjunction with an automatic transfer switch to provide a means of directly connecting load conductors to a power source and disconnecting the automatic transfer switch.

3.3.9.3 Nonautomatic Transfer Switch. A device, operated manually by a physical action or electrically by either a local or remote control, for transferring a common load between a normal and alternate supply.

Chapter 4 Classification of Emergency Power Supply Systems (EPSSs)

4.1* General. The EPSS shall provide a source of electrical power of required capacity, reliability, and quality to loads for a length of time as specified in Table 4.1(a) and within a specified time following loss or failure of the normal power supply as specified in Table 4.1(b).

4.2* Class. The class defines the minimum time, in hours, for which the EPSS is designed to operate at its rated load without being refueled or recharged. [See Table 4.1(a).]

Table 4.1(a) 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 hr
Class 6	6 hr
Class 48	48 hr
Class X	Other time, in hours, as required by the application, code, or user

Table 4.1(b) Types of EPSSs

Designation	Power Restoration
Type U	Basically uninterruptible (UPS systems)
Type 10	10 sec
Type 60	60 sec
Type 120	120 sec
Type M	Manual stationary or nonautomatic — no time limit

4.3 Type. The type defines the maximum time, in seconds, that the EPSS will permit the load terminals of the transfer switch to be without acceptable electrical power. Table 4.1(b) provides the types defined by this standard.

4.4* Level. This standard recognizes two levels of equipment installation, performance, and maintenance.

4.4.1* Level 1 systems shall be installed where failure of the equipment to perform could result in loss of human life or serious injuries.

4.4.2* Level 2 systems shall be installed where failure of the EPSS to perform is less critical to human life and safety.

4.4.3 All equipment shall be permanently installed.

4.4.4* Level 1 and Level 2 systems shall ensure that all loads served by the EPSS are supplied with alternate power that meets all the following criteria:

- (1) Of a quality within the operating limits of the load
- (2) For a duration specified for the class as defined in Table 4.1(a)
- (3) Within the time specified for the type as defined in Table 4.1(b)

Chapter 5 Emergency Power Supply (EPS): Energy Sources, Converters, and Accessories

5.1 Energy Sources.

5.1.1* The following energy sources shall be permitted to be used for the emergency power supply (EPS):

- (1)*Liquid petroleum products at atmospheric pressure
- (2) Liquefied petroleum gas (liquid or vapor withdrawal)
- (3) Natural or synthetic gas

Exception: For Level 1 installations in locations where the probability of interruption of off-site fuel supplies is high, on-site storage of an alternate energy source sufficient to allow full output of the EPSS to be delivered for the class specified shall be required, with the provision for automatic transfer from the primary energy source to the alternate energy source.

5.1.2 Seismic design category C, D, E, or F, as determined in accordance with ASCE 7, shall require a Level 1 EPSS Class X (minimum of 96 hours of fuel supply).

5.1.3 The energy sources listed in 5.1.1 shall be permitted to be used for the EPS where the primary source of power is by means of on-site energy conversion, provided that there is separately dedicated energy conversion equipment on-site with a capacity equal to the power needs of the EPSS.

5.1.4* A public electric utility that has a demonstrated reliability shall be permitted to be used as the EPS where the primary source is by means of on-site energy conversion.

5.2 Energy Converters — General.

5.2.1 Energy converters shall consist only of rotating equipment as indicated in 5.2.4.

5.2.1.1 Level 1 energy converters shall be representative products built from components that have proven compatibility and reliability and are coordinated to operate as a unit.

5.2.1.2 The capability of the energy converter, with its controls and accessories, to survive without damage from common and abnormal disturbances in actual load circuits shall be demonstrable by tests on separate prototype models, or by acceptable tests on the system components as performed by the component suppliers, or by tests performed in the listing process for the assembly.

5.2.1.3 A separate prototype unit shall be permitted to be utilized in a Level 1 or Level 2 installation, provided that all prototype tests produce no deleterious effects on the unit, and the authority having jurisdiction, the owner, and the user are informed that the unit is the prototype test unit.

5.2.2* The rotating equipment prototype unit shall be tested with all typical prime mover accessories that affect its power output in place and operating. These accessories include, but shall not be limited to, the following:

- (1) Battery-charging alternator
- (2) Water pump
- (3) Radiator fan for unit-mounted radiators or oil coolers (or comparable load)
- (4) Fuel pump and fuel filter(s)
- (5) Air filter(s)
- (6) Exhaust mufflers or restriction simulating the maximum backpressure recommended by the prime mover manufacturer

5.2.3 The energy converter for Level 1 systems shall be specifically designed, assembled, and tested to ensure system operation under the following conditions:

- (1) Short circuits
- (2) Load surges due to motor starting
- (3) Elevator operations
- (4) Silicon controlled rectifier (SCR) controllers
- (5) X-ray equipment
- (6) Overspeed, overtemperature, or overload
- (7) Adverse environmental conditions



5.2.4 Rotating equipment shall consist of a generator driven by one of the following prime mover types:

- (1) Otto cycle (spark ignited)
- (2) Diesel cycle
- (3) Gas turbine cycle

5.2.4.1 Other types of prime movers and their associated equipment meeting the applicable performance requirements of this standard shall be permitted, if acceptable to the authority having jurisdiction.

5.2.4.2 Where used for Level 1 applications, the prime mover shall not mechanically drive any equipment other than its operating accessories and its generator.

5.2.5 The EPS shall be installed in accordance with *NFPA 70, National Electrical Code*.

5.3 Energy Converters — Temperature.

5.3.1 The EPS shall be heated as necessary to maintain the water jacket and battery temperature determined by the EPS manufacturer for cold start and load acceptance for the type of EPSS.

5.3.2 All prime mover heaters shall be automatically deactivated while the prime mover is running. (*For combustion turbines, see 7.7.6.*)

5.3.2.1 Air-cooled prime movers shall be permitted to employ a heater to maintain lubricating oil temperature as recommended by the prime mover manufacturer.

5.3.3 Antifreeze protection shall be provided according to the manufacturer's recommendations.

5.3.4 Ether-type starting aids shall not be permitted.

5.4* Energy Converters — Capacity. The energy converters shall have the required capacity and response to pick up and carry the load within the time specified in Table 4.1(b) after loss of primary power.

5.5 Energy Converters — Fuel Supply.

5.5.1 The fuel supplies specified in 5.1.1(1) and 5.1.1(2) for energy converters intended for Level 1 use shall not be used for any other purpose. (*For fuel system requirements, see Section 7.9.*)

5.5.1.1 Enclosed fuel tanks shall be permitted to be used for supplying fuel for other equipment, provided that the draw-down level always guarantees the quantity needed for the EPSS.

5.5.1.2 Vapor-withdrawal LP-Gas systems shall have a dedicated fuel supply.

5.5.2* A low-fuel sensing switch shall be provided for the main fuel supply tank(s) using the energy sources listed in 5.1.1(1) and 5.1.1(2) to indicate when less than the minimum fuel necessary for full load running, as required by the specified class in Table 4.1(a), remains in the main fuel tank.

5.5.3* The main fuel tank shall have a minimum capacity of at least 133 percent of either the low-fuel sensor quantity specified in 5.5.2 or that specified in Table 4.1(a) (class).

5.6 Rotating Equipment.

5.6.1 General. Prime movers and accessories shall comply with NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, except as modified in this standard.

5.6.2 Prime Mover Ratings. Proper derating factors, such as altitudes, ambient temperature, fuel energy content, accessory losses, and site conditions as recommended by the manufacturer of the generator set shall be used in determining whether or not brake power meets the connected load requirements.

5.6.3 Prime Mover Accessories.

5.6.3.1 Governors shall maintain a bandwidth of rated frequency for any constant load (steady-state condition) that is compatible with the load.

5.6.3.1.1 The frequency droop between no load and full load shall be within the range for the load.

5.6.3.1.2 The frequency dip upon one-step application of the full load shall not be outside the range for the load, with a return to steady-state conditions occurring within the requirements of the load.

5.6.3.2 Solenoid valves, where used, both in the fuel line from the supply or day tank closest to the generator set and in the water-cooling lines, shall operate from battery voltage.

5.6.3.2.1 Solenoid valves shall have a manual (nonelectric) operation, or a manual bypass valve shall be provided.

5.6.3.2.1.1 The manual bypass valve shall be visible and accessible and its purpose identified.

5.6.3.2.1.2 The fuel bypass valve shall not be the valve used for malfunction or emergency shutdown.

5.6.3.3 The prime mover shall be provided with the following instruments:

- (1) Oil pressure gauge to indicate lubricating oil pressure. Engines with splash-lubricated systems shall not require this gauge.
- (2) Temperature gauge to indicate cooling medium temperature. Air-cooled engines shall not require this gauge.
- (3) Hour meter to indicate actual total running time.
- (4) Battery-charging meter indicating performance of prime mover-driven battery charging means.
- (5) Other instruments as recommended or provided by the prime mover manufacturer where required for maintenance.

5.6.3.4 The instruments required in 5.6.3.3(1) through 5.6.3.3(4) shall be placed on an enclosed panel, located in proximity to or on the energy converter, in a location that allows maintenance personnel to observe them readily. The enclosed panel shall be mounted by means of antishock vibration mountings if mounted on the energy converter.

5.6.3.5 All wiring for connection to the control panel shall be harnessed or flexibly enclosed, shall be securely mounted on the prime mover to prevent chafing and vibration damage, and shall terminate at the control panel in an enclosed box or panel. (*For control panel requirements, see 5.6.5.*)

5.6.3.6 The generator set shall be fitted with an integral accessory battery charger, driven by the prime mover and automatic voltage regulator, and capable of charging and maintaining the starting battery unit (and control battery, where used) in a fully charged condition during a running condition.

5.6.3.6.1 A battery charger driven by the prime mover shall not be required, provided the automatic battery charger has a high-low rate capable of fully charging the starting battery during running conditions as specified in 5.6.3.6.

5.6.4 Prime Mover Starting Equipment.

5.6.4.1 Starting Systems. Starting shall be accomplished using either an electric starter or a stored energy starting system.

5.6.4.1.1 Electric starter systems shall start using a positive shift solenoid to engage the starter motor and to crank the prime mover for the period specified in 5.6.4.2 without overheating, at a speed at least equal to that recommended by the manufacturer of the prime mover and at the lowest ambient temperature anticipated at the installation site.

5.6.4.1.2 Other types of stored energy starting systems (except pyrotechnic) shall be permitted to be used where recommended by the manufacturer of the prime mover and subject to approval of the authority having jurisdiction, under the following conditions:

- (1) Where two complete periods of cranking cycles are completed without replacement of the stored energy
- (2) Where a means for automatic restoration from the emergency source of the stored energy is provided
- (3) Where the stored energy system has the cranking capacity specified in 5.6.4.2.1
- (4) Where the stored energy system has a “black start” capability in addition to normal discharge capability

5.6.4.2* Otto or Diesel Cycle Prime Movers. For otto or diesel cycle prime movers, the type and duration of the cranking cycle shall be as specified in Table 5.6.4.2.

5.6.4.2.1 A complete cranking cycle shall consist of an automatic crank period of approximately 15 seconds followed by a rest period of approximately 15 seconds. Upon starting and running the prime mover, further cranking shall cease.

5.6.4.2.2 Two means of cranking termination shall be utilized so that one serves as backup to prevent inadvertent starter engagement.

5.6.4.2.3 Otto cycle prime movers of 15 kW and lower and all diesel prime movers shall be permitted to use continuous cranking methods.

5.6.4.3* Number of Batteries. Each prime mover shall be provided with both of the following:

- (1) Storage battery units as specified in Table 5.6.4.2
- (2) A storage rack for each battery or battery unit

Table 5.6.4.2 Starting Equipment Requirements

Starting Equipment Requirements	Level 1	Level 2
(a) Battery unit	X	X
(b) Battery certification	X	NA
(c) Cycle cranking	X or O	O
(d) Cranking limiter time-outs		
Cycle crank (3 cycles)	75 sec	75 sec
Continuous crank	45 sec	45 sec
(e) Float-type battery charger	X	X
1. dc ammeter	X	X
2. dc voltmeter	X	X
(f) Recharge time	24 hr	36 hr
(g) Low battery voltage alarm contacts	X	X

X: Required. O: Optional. NA: Not applicable.

5.6.4.4* Size of Batteries. The battery unit shall have the capacity to maintain the cranking speed recommended by the prime mover manufacturer through two complete periods of cranking limiter time-outs as specified in Table 5.6.4.2, item (d).

5.6.4.5 Type of Battery. The battery shall be of the nickel-cadmium or lead-acid type.

5.6.4.5.1* Lead-acid batteries shall be furnished as charged when wet. Drain-dry batteries or dry-charged lead-acid batteries shall be permitted.

5.6.4.5.2 When furnished, vented nickel-cadmium batteries shall be filled and charged and shall have listed flip-top, flame arrester vent caps.

5.6.4.5.3 The manufacturer shall provide installation, operation, and maintenance instructions and for batteries shipped dry, electrolyte mixing instructions.

5.6.4.5.4 Batteries shall not be installed until the battery charger is in service.

5.6.4.5.5 All batteries used in this service shall have been designed for this duty and shall have demonstrable characteristics of performance and reliability acceptable to the authority having jurisdiction.

5.6.4.5.6 Batteries shall be prepared for use according to the battery manufacturer's instructions.

5.6.4.6* Automatic Battery Charger. In addition to the prime mover– (engine–) driven charger required in 5.6.3.6.1, a battery charger(s) as required in Table 5.6.4.2 shall be supplied for recharging or maintaining a charge, or both, on the starting or control battery unit, or both.

5.6.4.7 All chargers shall include the following characteristics, which are to be accomplished without manual intervention (i.e., manual switch or manual tap changing):

- (1) At its rated voltage, the charger shall be capable of delivering energy into a fully discharged battery unit without damaging the battery.
- (2) The charger shall be capable of returning the fully discharged battery to 100 percent of its ampere-hour rating within the time specified in Table 5.6.4.2, item (f).
- (3) As specified in Table 5.6.4.2, item (e), meters with an accuracy within 5 percent of range shall be furnished.
- (4) The charger shall be permanently marked with the following:
 - (a) Allowable range of battery unit capacity
 - (b) Nominal output current and voltage
 - (c) Sufficient battery-type data to allow replacement batteries to be obtained
- (5) The battery charger output and performance shall be compatible with the batteries furnished.

5.6.5 Control Functions.

5.6.5.1 A control panel shall be provided and shall contain the following:

- (1) Automatic remote start capability
- (2) “Run-off-automatic” switch
- (3) Shutdowns as required by 5.6.5.2(3)
- (4) Alarms as required by 5.6.5.2(4)
- (5) Controls as required by 5.6.5.2(5)

