

NFPA 99

Standard for Health Care Facilities

2005 Edition



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NFPA 99

Standard for

Health Care Facilities

2005 Edition

This edition of NFPA 99, *Standard for Health Care Facilities*, was prepared by the Technical Committees on Administration, Electrical Equipment, Electrical Systems, Gas Delivery Equipment, Health Care Emergency Management, Hyperbaric and Hypobaric Facilities, Laboratories, and Piping Systems, released by the Technical Correlating Committee on Health Care Facilities, and acted on by NFPA at its November Association Technical Meeting held November 13–17, 2004, in Miami Beach, FL. It was issued by the Standards Council on January 14, 2005, with an effective date of February 7, 2005, and supersedes all previous editions.

A tentative interim amendment (TIA) to subsection 5.1.5.16 was issued on January 14, 2005. For further information on tentative interim amendments see Section 5 of the NFPA Regulations Governing Committee Projects available at <http://www.nfpa.org/Codes/NFPADirectory.asp#Regs&Procedures>.

This edition of NFPA 99 was approved as an American National Standard on February 7, 2005.

Origin and Development of NFPA 99

The idea for this document grew as the number of documents under the original NFPA Committee on Hospitals grew. By the end of 1980, there existed 12 documents on a variety of subjects, 11 directly addressing fire-related problems in and about health care facilities. These documents covered health care emergency preparedness, inhalation anesthetics, respiratory therapy, laboratories in health-related institutions, hyperbaric facilities, hypobaric facilities, inhalation anesthetics in ambulatory care facilities, home use of respiratory therapy, medical-surgical vacuum systems in hospitals, essential electrical systems for health care facilities, safe use of electricity in patient care areas of health care facilities, and safe use of high-frequency electricity in health care facilities.

A history on the documents that covered these topics can be found in the “Origin and Development of NFPA 99” in the 1984 edition of NFPA 99.

What was then the Health Care Facilities Correlating Committee reviewed the matter beginning in late 1979 and concluded that combining all the documents under its jurisdiction would be beneficial to those who used those documents, for the following reasons:

- (1) The referenced documents were being revised independently of each other. Combining all the individual documents into one document would place all of them on the same revision cycle.
- (2) It would place in one unit many documents that referenced each other.
- (3) It would be an easier and more complete reference for the various users of the document (e.g., hospital engineers, medical personnel, designers and architects, and the various types of enforcing authorities).

To learn if this proposal was desired or desirable to users of the individual documents, the Committee issued a request for public comments in the spring of 1981, asking whether purchasers of the individual documents utilized more than one document in the course of their activities and whether combining these individual documents would be beneficial. Seventy-five percent of responses supported such a proposal, with 90 percent of health care facilities and organizations supportive of it. Based on this support, the Correlating Committee proceeded with plans to combine all the documents under its jurisdiction into one document.

In January, 1982, a compilation of the latest edition of each of the 12 individual documents under the jurisdiction of the Correlating Committee was published. It was designated NFPA 99, *Health Care Facilities Code*. The Correlating Committee also entered the document into the revision cycle reporting to the 1983 Fall Meeting for the purpose of formally adopting the document.

For the 1984 edition of NFPA 99, in addition to technical changes, administrative and organizational changes were made.

For the 1987 edition of NFPA 99, the third and final step in the process of combining the previous individual documents took place — that of integrating the content of these individual documents into a cohesive document. In addition, there were again technical changes made. The 1987 edition also saw the incorporation of NFPA 56F, *Standard on Nonflammable Medical Piped Gas Systems*, into NFPA 99.

For the 1990 edition of NFPA 99, some structural changes were made and some modifiers were added to make it easier to determine where requirements are applicable. Technical changes made included the following: correlation with NFPA 101®, *Life Safety Code*®, changes for compressed medical air systems on the use of gas-powered medical devices operating at a gauge pressure of 200 psi, and piped gas systems in general; changes in leakage current limits for patient care electrical appliances; clarification that patient care areas and wet locations are mutually exclusive; and further guidance on the effects of a disaster on staff.

For the 1993 edition of NFPA 99 there were further efforts to make the document more user-friendly (e.g., placing all “recommended” guidance either in notes or in the appendix). Significant technical changes included the following: adding requirements and recommendations to further prevent or minimize fires in operating rooms; making major changes to requirements in Chapter 4 for installing, testing, inspecting, verifying, and maintaining nonflammable medical piped gas systems; adding new sections on dental compressed air and dental vacuum requirements in Chapter 4; changing leakage current limits of patient care-related electrical appliances to correlate more closely with an international document on the subject; revising laboratory requirements to correlate more closely with NFPA 45, *Standard for Laboratories Using Chemicals*; changing essential electrical system requirements in ambulatory health care clinics and medical/dental offices; and extensively revising hyperbaric chamber requirements (Chapter 19).

For the 1996 edition of NFPA 99, further changes to make the document more user-friendly were made. These included restructuring Chapters 3 and 4 so that all requirements for a Type 1, 2, or 3 essential electrical system, or a Level 1, 2, 3, or 4 piped gas or vacuum system, were contained in one section.

Other technical changes included the following:

- (1) Moving requirements on flammable anesthetizing locations and the use of flammable inhalation anesthetics to a new Appendix 2
- (2) Upgrading the subject of emergency preparedness from guidance to a new chapter containing requirements
- (3) Adding a new chapter (Chapter 18) on home health care
- (4) Revising Section 1-1 to reflect the intent that NFPA 99 applies only to facilities treating human beings
- (5) In Chapter 3, revising load testing requirements for emergency generators to reference NFPA-110, *Standard for Emergency and Standby Power Systems*, and revising emergency lighting criteria for operating rooms
- (6) In Chapter 4, revising requirements for medical compressed air systems, dental compressed air systems, waste anesthetic gas disposal systems, and dental piped gas/vacuum systems; adding a new section on “headwall units” (“manufactured assemblies”); and clarifying and moving requirements for transfilling containers of liquid oxygen to Chapter 8
- (7) In Chapter 8, adding requirements for storage rooms containing cylinders and containers totaling less than 3000 ft³
- (8) In Chapters 12 to 17, revising criteria for gas and vacuum systems
- (9) In Chapter 19, in addition to many technical changes, adding criteria for mobile hyperbaric facilities

For the 1999 edition, significant technical and structural changes included the following:

- (1) Chapters 13, 14, and 15 (on ambulatory health care centers, clinics, and medical/dental offices, respectively) were replaced completely by new Chapter 13 covering health care facilities other than hospitals, nursing homes, and limited care facilities as defined in Chapter 2.
- (2) Requirements for Level 2 gas and vacuum systems were developed (Section 4.4 in Chapter 4).
- (3) Subsections 12.3.4, 16.3.4, and 7.3.4 were revised to correlate with the two significant changes in (1) and (2).
- (4) In Chapter 3, load testing requirements for emergency power supplies of the essential electrical system were changed through reference, and the testing interval (“monthly”) was reworded to be more responsive to needs of health care facilities.
- (5) Clarification of transfer switches and branches of the emergency system was made.
- (6) Clarification on the use of emergency power supplies other than for emergency power was made in 3.4.1.1.5.
- (7) Paragraph 4.3.1.2, Distribution Requirements for Level 1 Gas Systems, was completely revised and restructured.
- (8) Chapter 4 was made more user-friendly by reducing the number of internal cross-references between Sections 4.3 and 4.5.
- (9) The order of installation and testing requirements for piped gas and vacuum systems was revised.
- (10) Emphasis on emergency preparedness was made in Chapter 11 and its appendix material.
- (11) Chapter 19, “Hyperbaric Facilities,” was extensively revised in the areas of electrical wiring, air quality, ventilation lighting, equipment, communication, and safety management.
- (12) A new chapter (Chapter 20) on freestanding birthing centers was added.

The 2002 edition included format and technical revisions. The *Manual of Style for NFPA Technical Committee Documents*, April 2000 edition, was applied to this document, resulting in changes to its structure 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, were systematically aligned, and were 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 alternate procedure to a general rule when limited specified conditions exist. The reformatted appearance and structure provided continuity among NFPA documents, clarity of mandatory text, and greater ease in locating specific mandatory text.

The document scope and individual chapter scopes defining the intent of each chapter and document as a whole were located in Chapter 1.

The occupancy Chapters 13–21 stated what is required, while Chapters 4–12 prescribed how those requirements are achieved. Each chapter began with a section explaining applicability. Information concerning the nature of hazards was moved to Annex B. Annexes A and C retained explanatory information, and Annexes 1 and 2 became Annexes D and E. Informational references were in Annex F.

The changes in Chapter 4, Electrical Systems, addressed electrical wiring, transfer switches, inspection, and application.

Chapter 5 on Piping Systems was realigned so that Level 1 requirements were found in Section 5.1, and concurrently Level 2 in Section 5.2 and Level 3 in Section 5.3. Level 4 associated with laboratories was deleted, with requirements realigned in Chapter 11 on laboratories. Definitions were developed for vacuum systems and Levels 1, 2, and 3 gas systems in Chapter 3. Revisions were made to compressed gas cylinder identification and restraint; valve venting; ventilation of storage rooms; alarms; connection of the electrical supply for central supply systems with the essential electrical system; allowance of a three-way full port ball valve to isolate one branch or component; provisions for a monitored and audible low-content alarm on the surge gas while brazing; the allowance of medical air systems for application with human respiration; and deletion of 20-year-old appendix information.

Gas Delivery, Chapter 8, included a new section on the storage of compressed gas cylinders in patient care areas.

Chapter 11, Laboratories, clarified the structural protection of exits, and intent of portable fire extinguishers. Revisions were made concerning flammable and combustible liquids handling requirements.

An increased focus on the total process of maintaining services during a disaster, mitigating damage from a disaster, and recovery from a disaster was reflected in Chapter 12, Emergency Management. Annexed security program information was expanded.

Chapter 20, Hyperbaric Facilities, contained revised emergency depressurization requirements, safety director responsibilities, and emergency procedure performance.

The changes made to the 2005 edition are mainly for clarity, and are editorial in nature. In Chapter 3, the definitions for medical gas, patient medical gas, and medical support gas have been modified to differentiate between the different types of gases.

In Chapter 4, the requirements for switches and receptacles in anesthetizing locations have been moved to Chapter 13, Hospital Requirements. The extracted material from NFPA 110, *Standard for Emergency and Standby Power Systems*, has been updated.

In Chapter 5, the requirements for construction materials for filters, dryers, regulators, vacuum pumps, and after coolers have been changed to allow the manufacturers to choose the materials.

A centralized computer is now allowed to be used in lieu of one of the master alarms. Cylinders are allowed to be fitted with a means to slow the initial opening pressure. The requirement to individually secure the cylinders has been changed to no longer require the cylinders to be secured individually. Two new methods for making joints have been added to the requirements. Stainless steel tubing has been added as an approved material for vacuum systems. The requirement to braze a joint within 1 hour after cleaning has been changed to 8 hours. Vacuum joints must be leak tested, and operational pressure testing can now be conducted with the source gas.

Chapters 6, 7, 8, 9, 10, and 11 have undergone minor changes for clarity or for editorial reasons.

Chapter 12 has been revised to update the techniques used in emergency management in health care facilities.

In Chapters 13, 14, 15, 16, 17, 18, and 19 editorial corrections have been made.

Chapter 20 has been revised to heating and ventilation changes in the chamber. Additional restrictions to the types of materials that are allowed in the chamber have been added.

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- (1) Chemicals
- (2) Radioactive materials
- (3)*Biological materials that will not result in fires or explosions

1.1.12* Chapter 12, Health Care Emergency Management, establishes minimum criteria for health care facility emergency management in the development of a program for effective disaster preparedness, response, mitigation, and recovery.

1.1.13 Chapter 13, Hospital Requirements, addresses safety requirements of hospitals.

1.1.14 Chapter 14, Other Health Care Facilities, addresses safety requirements for facilities, or portions thereof, that provide diagnostic and treatment services to patients in health care facilities. Requirements for specific health care facilities are addressed in the following chapters:

- (1) Hospitals — Chapter 13
- (2) Nursing homes — Chapter 17
- (3) Limited care facilities — Chapter 18

1.1.15 Reserved.

1.1.16 Reserved.

1.1.17 Chapter 17, Nursing Home Requirements, addresses safety requirements of nursing homes.

1.1.18 Chapter 18, Limited Care Facility Requirements, covers safety requirements of limited care facilities.

1.1.19 Chapter 19, Electrical and Gas Equipment for Home Care, addresses the requirements for the safe use of electrical and gas equipment used for home care medical treatment.

1.1.20* Chapter 20, Hyperbaric Facilities, covers the recognition of and protection against hazards of an electrical, explosive, or implosive nature, as well as fire hazards associated with hyperbaric chambers and associated facilities that are used, or intended to be used, for medical applications and experimental procedures at gauge pressures from 0 to 690 kPa (0 to 100 psi). Chapter 20 applies to both single- and multiple-occupancy hyperbaric chambers; to animal chambers, the size of which precludes human occupancy; and to those in which the chamber atmosphere contains an oxygen partial pressure greater than an absolute pressure of 21.3 kPa (3.09 psi) (0.21 atmospheres).

1.1.21 Chapter 21, Freestanding Birthing Centers, addresses the requirements for the safe use of electrical and gas equipment, and for electrical, gas, and vacuum systems used for the delivery and care of infants in freestanding birthing centers.

1.2 Purpose.

1.2.1 The purpose of this standard is to provide minimum requirements for the performance, maintenance, testing, and safe practices for facilities, material, equipment, and appliances, including other hazards associated with the primary hazards.

1.3 Application.

1.3.1 This document shall apply to all health care facilities.

1.3.2 Construction and equipment requirements shall be applied only to new construction and new equipment, except as modified in individual chapters. Only the altered, renovated, or modernized portion of an existing system or individual component shall be required to meet the installation and equipment requirements stated in this standard. If the alteration, renovation, or modernization adversely impacts existing performance requirements of a system or component, additional upgrading shall be required.

1.3.3 Chapters 13 through 19 specify the conditions under which the requirements of Chapters 4 through 12 shall apply in Chapters 13 through 19.

1.3.4 This document is intended for use by those persons involved in the design, construction, inspection, and operation of health care facilities and in the design, manufacture, and testing of appliances and equipment used in patient care areas of health care facilities. Nonflammable piped medical gases covered by this document include, but are not limited to, oxygen, nitrogen, nitrous oxide, medical air, carbon dioxide, and helium.

1.4 Equivalency.

1.4.1 The authority having jurisdiction for the enforcement of this document shall be permitted to grant exceptions to its requirements.

1.4.2 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. Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency. The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.5 Units and Formulas.

1.5.1* Primary units will be trade units, secondary will be the conversion. Although it is common practice for medical appliances to have metric units on their dials, gauges, and controls, many components of systems within the scope of this document, which are manufactured and used in the United States, employ nonmetric dimensions. Since these dimensions (such as nominal pipe sizes) are not established by the National Fire Protection Association, the Technical Correlating Committee on Health Care Facilities cannot independently change them. Accordingly, this document uses dimensions that are presently in common use by the building trades in the United States.

1.6 Standard Adoption Requirements.

1.6.1 The effective date of application of any provision of this document is not determined by the National Fire Protection Association. All questions related to applicability shall be directed to the authority having jurisdiction.

1.6.2 Enforcement. This standard shall be administered and enforced by the authority having jurisdiction designated by the governing authority. (See Annex F for a sample wording for enabling legislation.)

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 10, *Standard for Portable Fire Extinguishers*, 2002 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2002 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2003 edition.

NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, 2002 edition.

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 2004 edition.

NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*, 2002 edition.

NFPA 54, *National Fuel Gas Code*, 2002 edition.

NFPA 55, *Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks*, 2005 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2004 edition.

NFPA 70, *National Electrical Code*®, 2005 edition.

NFPA 72®, *National Fire Alarm Code*®, 2002 edition.

NFPA 99B, *Standard for Hypobaric Facilities*, 2005 edition.

NFPA 101®, *Life Safety Code*®, 2003 edition.

NFPA 110, *Standard for Emergency and Standby Power Systems*, 2005 edition.

NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, 2005 edition.

NFPA 220, *Standard on Types of Building Construction*, 1999 edition.

NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*, 2000 edition.

NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair*, 2005 edition.

NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*, 2004 edition.

NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, 2001 edition.

NFPA 1600, *Standard on Disaster/Emergency Management and Business Continuity Programs*, 2004 edition.

2.3 Other Publications.

2.3.1 ANSI Publication. American National Standards Institute, Inc., 22 West 43rd Street, 4th floor, New York, NY 10036.

ANSI C84.1, *Electric Power Systems and Equipment — Voltage Ratings*, 1995.

ANSI Z66.1, *Specifications for Paints and Coatings Accessible to Children to Minimize Dry Film Toxicity*, 1964.

ANSI/NEMA WD 6, *Wiring Devices — Dimensional Requirements*, 2002.

2.3.2 ASME Publications. American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

ANSI/ASME PVHO-1-1990, *Safety Standard for Pressure Vessels for Human Occupancy*.

ASME Boiler and Pressure Vessel Code, Sections VIII and IX, 2001.

ASME B1.20.1, *Pipe Threads, General Purpose*, 2001.

ANSI/ASME B16.50, *Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings*, 2001.

ASME B31.3, *Pressure Process Piping*, 2002.

ASME B40.100, *Pressure Gauges and Gauge Attachments*, 1998.

ASME B16.22, *Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings*, 2001.

2.3.3 ASSE Publications. American Society of Sanitary Engineering, 28901 Clemens Road, Suite 100, Westlake, OH 44145.

ASSE 6010, *Professional Qualifications Standard for Medical Gas Systems Installers*, 2001.

ASSE 6030, *Professional Qualifications Standard for Medical Gas Systems Verifiers*, 2001.

2.3.4 ASTM Publications. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*, 1994.

ASTM B 32, *Standard Specification for Solder Metal*, 1996.

ASTM B 88, *Standard Specification for Seamless Copper Water Tube*, 2002.

ASTM B 280, *Standard Specification for Seamless Copper Tubing for Air Conditioning and Refrigeration Field Service*, 2002.

ASTM B 819, *Standard Specification for Seamless Copper Tube for Medical Gas Systems*, 2000.

ASTM B 828, *Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings*, 2002.

ASTM D 5, *Standard Test Method for Penetration of Bituminous Materials*, 1997.

ASTM D 2855, *Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings*, 1996 (2002).

ASTM D 2863, *Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-like Combustion of Plastics (Oxygen Index) (ANSI D2863)*, 1997.

ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, 1998.

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ANSI/AWS A5.8, *Specification for Filler Metals for Brazing and Braze Welding*, 1992.

AWS B2.2, *Standard for Brazing Procedure and Performance Qualification*, 1991.

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CGA G-4.1, *Cleaning Equipment for Oxygen Service*, 2004.

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CGA G-6.5, *Standard for Small, Stationary Insulated Carbon Dioxide Supply Systems*, 2001.

CGA G-8.1, *Standard for Nitrous Oxide Systems at Consumer Sites*, 1990.

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CGA O2-DIR, *Directory of Cleaning Agents for Oxygen Service*, Edition 4.

CGA P-2.5, *Transfilling of High Pressure Gaseous Oxygen to be Used for Respiration*, 2000.

4.4.1.1.5 Where the normal source consists of generating units on the premises, the alternate source shall be either another generating set or an external utility service.

4.4.1.1.6 General. Generator sets installed as an alternate source of power for essential electrical systems shall be designed to meet the requirements of such service.

4.4.1.1.6.1 Type 1 and Type 2 essential electrical system power sources shall be classified as Type 10, Class X, Level 1 generator sets per NFPA 110, *Standard for Emergency and Standby Power Systems*.

4.4.1.1.6.2 Type 3 essential electrical system power sources shall be classified as Type 10, Class X, Level 2 generator sets per NFPA 110, *Standard for Emergency and Standby Power Systems*.

4.4.1.1.7 Uses for Essential Electrical System.

4.4.1.1.7.1 The generating equipment used shall be either reserved exclusively for such service or normally used for other purposes of peak demand control, internal voltage control, load relief for the external utility, or cogeneration. If normally used for the other purposes listed above, two or more sets shall be installed, such that the maximum actual demand likely to be produced by the connected load of the emergency system as well as medical air compressors, medical-surgical vacuum pumps, electrically operated fire pumps, jockey pumps, fuel pumps, and generator accessories shall be met with the largest single generator set out-of-service. The alternate source of emergency power for illumination and identification of means of egress shall be the essential electrical system. The alternate power source for fire protection signaling systems shall be the essential electrical systems.

4.4.1.1.7.2 A single generator set that operates the essential electrical system shall be permitted to be part of the system supplying the other purposes as listed in 4.4.1.1.7.1, provided any such use will not decrease the mean period between service overhauls to less than three years.

4.4.1.1.7.3* Optional loads shall be permitted to be served by the essential electrical system generating equipment. Optional loads shall be served by their own transfer means, such that these loads shall not be transferred onto the generating equipment if the transfer will overload the generating equipment and shall be shed upon a generating equipment overload. Use of the generating equipment to serve optional loads shall not constitute "other purposes" as described in 4.4.1.1.7.1 and therefore shall not require multiple generator sets.

4.4.1.1.7.4 Where optional loads include contiguous or same-site facilities not covered in Chapters 12 through 20, provisions shall be made to meet the requirements of NFPA 101, *Life Safety Code*, Article 700 of NFPA 70, *National Electrical Code*, and other applicable NFPA requirements for emergency egress under load-shed conditions.

4.4.1.1.8 Work Space or Room.

4.4.1.1.8.1 The EPS shall be installed in a separate room for Level 1 installations. EPSS equipment shall be permitted to be installed in this room. [110:7.2.1]

(A) The room shall have a minimum 2-hour fire rating or be located in an adequate enclosure located outside the building capable of resisting the entrance of snow or rain at a maximum wind velocity required by local building codes. [110:7.2.1.1]

4.4.1.1.8.2 The rooms, shelters, or separate buildings housing Level 1 or Level 2 EPSS equipment shall be designed and

located to minimize the damage from flooding, including that caused by the following:

- (1) Flooding resulting from fire fighting
- (2) Sewer water backup
- (3) Similar disasters or occurrences [110:7.2.3]

4.4.1.1.8.3 The EPS equipment shall be installed in a location that permits ready accessibility and a minimum of 76 cm (30 in.) from the skid rails' outermost point in the direction of access for inspection, repair, maintenance, cleaning, or replacement. This requirement shall not apply to units in outdoor housings. [110:7.2.5]

4.4.1.1.9* Capacity and Rating. The generator set(s) shall have sufficient capacity and proper rating to meet the maximum actual demand likely to be produced by the connected load of the essential electrical system(s) at any one time.

4.4.1.1.10 Load Pickup. 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) of NFPA 110, *Standard for Emergency and Standby Power Systems*, after loss of primary power.

4.4.1.1.11 Maintenance of Temperature. The EPS shall be heated as necessary to maintain the water jacket temperature determined by the EPS manufacturer for cold start and load acceptance for the type of EPSS. [110:5.3.1]

4.4.1.1.12 Heating, Cooling, and Ventilating.

4.4.1.1.12.1* With the EPS running at rated load, ventilation airflow shall be provided to limit the maximum air temperature in the EPS room to the maximum ambient air temperature required by the EPS manufacturer. [110:7.7.1]

(A) Consideration shall be given to all the heat rejected to the EPS equipment room by the energy converter, uninsulated or insulated exhaust pipes, and other heat-producing equipment. [110:7.7.1.1]

4.4.1.1.12.2 Air shall be supplied to the EPS equipment for combustion. [110:7.7.2]

(A) For EPS supplying Level 1 EPSS, ventilation air shall be supplied directly from a source outside of the building by an exterior wall opening or from a source outside the building by a 2-hour fire-rated air transfer system. [110:7.7.2.1]

(B) For EPS supplying Level 1 EPSS, discharge air shall be directed outside of the building by an exterior wall opening or to an exterior opening by a 2-hour fire-rated air transfer system. [110:7.7.2.2]

(C) Fire dampers, shutters, or other self-closing devices shall not be permitted in ventilation openings or ductwork for supply or return/discharge air to EPS equipment for Level 1 EPSS. [110:7.7.2.3]

4.4.1.1.12.3 Ventilation air supply shall be from outdoors or from a source outside of the building by an exterior wall opening or from a source outside the building by a 2-hour fire-rated air transfer system. [110:7.7.3]

4.4.1.1.12.4 Ventilation air shall be provided to supply and discharge cooling air for radiator cooling of the EPS when running at rated load. [110:7.7.4]

(A) Ventilation air supply and discharge for radiator cooled EPS shall have a maximum static restriction of 125 Pa (0.5 in.) of water column in the discharge duct at the radiator outlet. [110:7.7.4.1]

(B) Radiator air discharge shall be ducted outdoors or to an exterior opening by a 2-hour fire-rated air transfer switch. [110:7.7.4.2]

4.4.1.1.12.5 Motor operated dampers, when used, shall be spring-operated to open and motor-closed. Fire dampers, shutters, or other self-closing devices shall not be permitted in ventilation openings or ductwork for supply or return/discharge air to EPS equipment for Level 1 EPSS. [110:7.7.5]

4.4.1.1.12.6 The ambient air temperature in the EPS equipment room or outdoor housing containing Level 1 rotating equipment shall be not less than 4.5°C (40°F). [110:7.7.6]

4.4.1.1.12.7 Units housed outdoors shall be heated as specified in 5.3.3 of NFPA 110, *Standard for Emergency and Standby Power Systems*. [110:7.7.7]

4.4.1.1.12.8 Design of the heating, cooling, and ventilation system for the EPS equipment room shall include provision for factors including, but not limited to, the following:

- (1) Heat
- (2) Cold
- (3) Dust
- (4) Humidity
- (5) Snow and ice accumulations around housings
- (6) Louvers
- (7) Remote radiator fans
- (8) Prevailing winds blowing against radiator fan discharge air [110:7.7.8]

4.4.1.1.13 Cranking Batteries. Internal combustion engine cranking batteries shall be in accordance with the battery requirements of NFPA 110, *Standard for Emergency and Standby Power Systems*.

4.4.1.1.14 Compressed Air Starting Devices. 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 of NFPA 110, *Standard for Emergency and Standby Power Systems*
- (4) Where the stored energy system has a "black start" capability in addition to normal discharge capability [110:5.6.4.1.2]

4.4.1.1.15 Fuel Supply. The fuel supply for the generator set shall comply with Sections 5.5 and 7.9 of NFPA 110, *Standard for Emergency and Standby Power Systems*.

4.4.1.1.16 Requirements for Safety Devices.

4.4.1.1.16.1 Internal Combustion Engines. Internal combustion engines serving generator sets shall be equipped with the following:

- (1) A sensor device plus visual warning device to indicate a water-jacket temperature below those required in 4.4.1.1.11
- (2) Sensor devices plus visual prealarm warning device to indicate the following:
 - (a) High engine temperature (above manufacturer's recommended safe operating temperature range)

- (b) Low lubricating oil pressure (below manufacturer's recommended safe operating range)
- (c) Low water coolant level

(3) An automatic engine shutdown device plus visual device to indicate that a shutdown took place due to the following:

- (a) Overcrank (failed to start)
- (b) Overspeed
- (c) Low lubricating oil pressure
- (d) Excessive engine temperature

(4) A common audible alarm device to warn that any one or more of the prealarm or alarm conditions exist

4.4.1.1.16.2 Safety indications and shutdowns shall be in accordance with Table 4.4.1.1.16.2.

4.4.1.1.17 Alarm Annunciator. A remote annunciator, storage battery-powered, shall be provided to operate outside of the generating room in a location readily observed by operating personnel at a regular work station (*see Section 700.12 of NFPA 70, National Electrical Code*). The annunciator shall be hard-wired to indicate alarm conditions of the emergency or auxiliary power source as follows:

- (1) Individual visual signals shall indicate the following:
 - (a) When the emergency or auxiliary power source is operating to supply power to load
 - (b) When the battery charger is malfunctioning
- (2) Individual visual signals plus a common audible signal to warn of an engine-generator alarm condition shall indicate the following:
 - (a) Low lubricating oil pressure
 - (b) Low water temperature (below those required in 4.4.1.1.11)
 - (c) Excessive water temperature
 - (d) Low fuel — when the main fuel storage tank contains less than a 4-hour operating supply
 - (e) Overcrank (failed to start)
 - (f) Overspeed

4.4.1.1.17.1* A remote, common audible alarm shall be provided as specified in 4.4.1.1.17.4 that is powered by the storage battery and located outside of the EPS service room at a work site observable by personnel. [110:5.6.6]

4.4.1.1.17.2 An alarm-silencing means shall be provided, and the panel shall include repetitive alarm circuitry so that, after the audible alarm has been silenced, it reactivates after the fault condition has been cleared and has to be restored to its normal position to be silenced again. [110:5.6.6.1]

4.4.1.1.17.3 In lieu of the requirement of 5.6.6.1 of NFPA 110, a manual alarm-silencing means shall be permitted that silences the audible alarm after the occurrence of the alarm condition, provided such means do not inhibit any subsequent alarms from sounding the audible alarm again without further manual action. [110:5.6.6.2]

4.4.1.1.17.4 Individual alarm indication to annunciate any of the conditions listed in Table 4.4.1.1.16.2 shall have the following characteristics:

- (1) Battery-powered
- (2) Visually indicated
- (3) Have additional contacts or circuits for a common audible alarm that signals locally and remotely when any of the itemized conditions occurs
- (4) Have a lamp test switch(es) to test the operation of all alarm lamps

Table 4.4.1.1.16.2 Safety Indications and Shutdowns

Indicator Function (at Battery Voltage)	Level 1		
	C.V.	S.	R.A.
(a) Overcrank	X	X	X
(b) Low water temperature	X		X
(c) High engine temperature prealarm	X		X
(d) High engine temperature	X	X	X
(e) Low lube oil pressure prealarm	X		X
(f) Low lube oil pressure	X	X	X
(g) Overspeed	X	X	X
(h) Low fuel main tank	X		X
(i) Low coolant level	X	O	X
(j) EPS supplying load	X		
(k) Control switch not in automatic position	X		X
(l) High battery voltage	X		
(m) Low cranking voltage	X		X
(n) Low voltage in battery	X		
(o) Battery charger ac failure	X		
(p) Lamp test	X		
(q) Contacts for local and remote common alarm	X		X
(r) Audible alarm silencing switch			X
(s) Low starting air pressure	X		
(t) Low starting hydraulic pressure	X		
(u) Air shutdown damper when used	X	X	X
(v) Remote emergency stop		X	

C.V.: Control panel-mounted visual. S.: Shutdown of EPS indication. R.A.: Remote audible. X: Required.
O: Optional.

Notes:

- Item (p) shall be provided, but a separate remote audible signal shall not be required when the regular work site in 5.6.6 of NFPA 110 is staffed 24 hours a day.
- Item (b) is not required for combustion turbines.
- Item (r) or (s) shall apply only where used as a starting method.
- Item (j): EPS ac ammeter shall be permitted for this function.
- All required C.V. functions shall be visually annunciated by a remote, common visual indicator.
- All required functions indicated in the R.A. column shall be annunciated by a remote, common audible alarm as required in 5.6.5.2(4) of NFPA 110.
- Item (i) on gaseous systems shall require a low gas pressure alarm.
- Item (b) shall be set at 11°C (20°F) below the regulated temperature determined by the EPS manufacturer as required in 5.3.1 of NFPA 110.

4.4.1.2 Battery. Battery systems shall meet all requirements of Article 700 of NFPA 70, *National Electrical Code*.

4.4.2* Distribution (Type 1 EES).

4.4.2.1 General Requirements.

4.4.2.1.1 Electrical characteristics of the transfer switches shall be suitable for the operation of all functions and equipment they are intended to supply.

4.4.2.1.2 Switch Rating. The rating of the transfer switches shall be adequate for switching all classes of loads to be served and for withstanding the effects of available fault currents without contact welding.

4.4.2.1.3 Automatic Transfer Switch. Transfer of all loads shall be accomplished using automatic transfer switch(es). Each automatic transfer switch 600 volts or below shall be listed for the purpose and approved for emergency electrical service (see NFPA 70, *National Electrical Code, Article 700.3*) as a complete assembly.

4.4.2.1.4 Automatic Transfer Switch Features.

4.4.2.1.4.1 Source Monitoring.

(A)* Undervoltage-sensing devices shall be provided to monitor all ungrounded lines of the primary source of power as follows:

- When the voltage on any phase falls below the minimum operating voltage of any load to be served, the transfer switch shall automatically initiate engine start and the process of transfer to the emergency power supply (EPS).
- *When the voltage on all phases of the primary source returns to within specified limits for a designated period of time, the process of transfer back to primary power shall be initiated. [110:6.2.2.1]

(B) Both voltage-sensing and frequency-sensing equipment shall be provided to monitor one ungrounded line of the EPS power. [110:6.2.2.2]

(C) Transfer to the EPS shall be inhibited until the voltage and frequency are within a specified range to handle loads to be served. [110:6.2.2.3]

(D) Sensing equipment shall not be required in the transfer switch, provided it is included with the engine control panel. [110:6.2.2.3(A)]

(E) Frequency-sensing equipment shall not be required for monitoring the public utility source where used as an EPS, as permitted by 5.1.4 of NFPA 110, *Standard for Emergency and Standby Power Systems*. [110:6.2.2.3(B)]

4.4.2.1.4.2 Interlocking. Mechanical interlocking or an approved alternate method shall prevent the inadvertent interconnection of the primary power supply and the EPS, or any two separate sources of power. [110:6.2.3]

4.4.2.1.4.3* Manual Operation.

(A) Instruction and equipment shall be provided for safe manual nonelectric transfer in the event the transfer switch malfunctions. [110:6.2.4.1]

(B) An automatic transfer switch shall visually annunciate when "not-in-automatic." [110:6.2.4.2]

4.4.2.1.4.4* Time Delay on Starting of EPS. A time-delay device shall be provided to delay starting of the EPS. The timer shall prevent nuisance starting of the EPS and possible subsequent load transfer in the event of harmless momentary power dips and interruptions of the primary source. [110:6.2.5]

4.4.2.1.4.5 Time Delay at Engine Control Panel. Time delays shall be permitted to be located at the engine control panel in lieu of in the transfer switches. [110:6.2.6]

4.4.2.1.4.6 Time Delay on Transfer to EPS. An adjustable time-delay device shall be provided to delay transfer and sequence load transfer to the EPS to avoid excessive voltage drop when the transfer switch is installed for Level 1 use. [110:6.2.7]

(A) **Time Delay Commencement.** The time delay shall commence when proper EPS voltage and frequency are achieved. [110:6.2.7.1]

(B) **Time Delay at Engine Control Panel.** Time delays shall be permitted to be located at the engine control panel in lieu of in the transfer switches. [110:6.2.7.2]

4.4.2.1.4.7* Time Delay on Retransfer to Primary Source. An adjustable time-delay device with automatic bypass shall be provided to delay retransfer from the EPS to the primary source of power, and allow the primary source to stabilize before retransfer of the load. [110:6.2.8]

4.4.2.1.4.8 Time Delay Bypass If EPS Fails. The time delay shall be automatically bypassed if the EPS fails. [110:6.2.9]

(A) The transfer switch shall be permitted to be programmed for a manually initiated retransfer to the primary source to provide for a planned momentary interruption of the load. [110:6.2.9.1]

(B) If used, the arrangement in 6.2.9.1 of NFPA 110, *Standard for Emergency and Standby Power Systems*, shall be provided with a bypass feature to allow automatic retransfer in the event that the EPS fails and the primary source is available. [110:6.2.9.2]

4.4.2.1.4.9 Time Delay on Engine Shutdown. A minimum time delay of 5 minutes shall be provided for unloaded running of the EPS prior to shutdown to allow for engine cooldown. [110:6.2.10]

(A) The minimum 5-minute delay shall not be required on small (15 kW or less) air-cooled prime movers. [110:6.2.10.1]

(B) A time-delay device shall not be required, provided it is included with the engine control panel, or if a utility feeder is used as an EPS. [110:6.2.10.2]

4.4.2.1.4.10 Engine Generator Exercising Timer. A program timing device shall be provided to exercise the EPS as described in Chapter 8 of NFPA 110, *Standard for Emergency and Standby Power Systems*. [110:6.2.11]

(A) Transfer switches for Level 1 and Level 2 shall transfer the connected load to the EPS and immediately return to primary power automatically in case of the EPS failure. [110:6.2.11.1]

(B) Exercising timers shall be permitted to be located at the engine control panel in lieu of in the transfer switches. [110:6.2.11.2]

(C) A program timing device shall not be required in health care facilities that provide scheduled testing in accordance with NFPA 99, *Standard for Health Care Facilities*. [110:6.2.11.3]

4.4.2.1.4.11 Test Switch. A test means shall be provided on each automatic transfer switch (ATS) that simulates failure of the primary power source and then transfers the load to the EPS. [110:6.2.12]

4.4.2.1.4.12* Indication of Switch Position. Two pilot lights with identification nameplates or other approved position indicators shall be provided to indicate the transfer switch position. [110:6.2.13]

4.4.2.1.4.13 Motor Load Transfer. Provisions shall be included to reduce currents resulting from motor load transfer if such currents could damage EPSS equipment or cause nuisance tripping of EPSS overcurrent protective devices. [110:6.2.14]

4.4.2.1.4.14* Isolation of Neutral Conductors. Provisions shall be included for ensuring continuity, transfer, and isolation of the primary and the EPS neutral conductors wherever they are separately grounded to achieve ground-fault sensing. [110:6.2.15]

4.4.2.1.4.15* Nonautomatic Transfer Switch Features. Switching devices shall be mechanically held and shall be operated by direct manual or electrical remote manual control. [110:6.2.16]

(A) **Interlocking.** Reliable mechanical interlocking, or an approved alternate method, shall prevent the inadvertent interconnection of the primary power source and the EPS. [110:6.2.16.1]

(B) **Indication of Switch Position.** Two pilot lights with identification nameplates, or other approved position indicators, shall be provided to indicate the switch position. [110:6.2.16.2]

4.4.2.1.5 Nonautomatic Transfer Device Classification. Nonautomatic transfer devices 600 volts or below shall be listed for the purpose and approved.

4.4.2.1.6 Nonautomatic Transfer Device Features.

4.4.2.1.6.1 General. Switching devices shall be mechanically held and shall be operated by direct manual or electrical remote manual control. [110:6.2.16]

4.4.2.1.6.2 Interlocking. Reliable mechanical interlocking, or an approved alternate method, shall prevent the inadvertent interconnection of the primary power source and the EPS. [110:6.2.16.1]

4.4.2.1.6.3 Indication of Switch Position. Two pilot lights with identification nameplates, or other approved position indicators, shall be provided to indicate the switch position. [110:6.2.16.2]

4.4.2.1.7 Bypass-Isolation Switches. Bypass-isolation switches shall be permitted for bypassing and isolating the transfer switch and installed in accordance with 4.4.2.1.7.1 through 4.4.2.1.7.4. [110:6.4.1]

4.4.2.1.7.1 Bypass-Isolation Switch Rating. The bypass-isolation switch shall have a continuous current rating and a current rating compatible with that of the associated transfer switch. [110:6.4.2]

4.4.2.1.7.2 Bypass-Isolation Switch Classification. Each bypass-isolation switch shall be listed for emergency electrical service as a completely factory-assembled and factory-tested apparatus. [110:6.4.3]

4.4.2.1.7.3* Operation. With the transfer switch isolated or disconnected, the bypass-isolation switch shall be designed so it can function as an independent nonautomatic transfer switch and allow the load to be connected to either power source. [110:6.4.4]

4.4.2.1.7.4 Reconnection of Transfer Switch. Reconnection of the transfer switch shall be possible without a load interruption greater than the maximum time, in seconds, specified by the type of system. [110:6.4.5]

4.4.2.2 Specific Requirements.

4.4.2.2.1* General.

4.4.2.2.1.1 The emergency system shall be limited to circuits essential to life safety and critical patient care and are designated the life safety branch and the critical branch.

4.4.2.2.1.2 The equipment system shall supply major electrical equipment necessary for patient care and basic Type 1 operation.

4.4.2.2.1.3 Both systems shall be arranged for connection, within time limits specified in this chapter, to an alternate source of power following a loss of the normal source.

4.4.2.2.1.4 The number of transfer switches to be used shall be based upon reliability, design, and load considerations. Each branch of the emergency system and each equipment system shall have one or more transfer switches. One transfer switch shall be permitted to serve one or more branches or systems in a facility with a continuous load on the switch of 150 kVA (120 kW) or less.

4.4.2.2.2 Emergency System.

4.4.2.2.2.1 General. Those functions of patient care depending on lighting or appliances that shall be permitted to be connected to the emergency system are divided into two mandatory branches, described in 4.4.2.2.2.2 and 4.4.2.2.2.3.

4.4.2.2.2.2 Life Safety Branch. The life safety branch of the emergency system shall supply power for the following lighting, receptacles, and equipment:

- (1) Illumination of means of egress as required in NFPA 101, *Life Safety Code*
- (2) Exit signs and exit direction signs required in NFPA 101, *Life Safety Code*
- (3) Alarm and alerting systems including the following:
 - (a) Fire alarms
 - (b) Alarms required for systems used for the piping of non-flammable medical gases as specified in Chapter 5, Gas and Vacuum Systems
- (4)*Hospital communication systems, where used for issuing instruction during emergency conditions

- (5) Generator set location: Task illumination, battery charger for emergency battery-powered lighting unit(s), and selected receptacles at the generator set location and essential electrical system transfer switch locations
- (6) Elevator cab lighting, control, communication, and signal systems
- (7) Automatically operated doors used for building egress
- (8) The auxiliary functions of fire alarm combination systems complying with NFPA 72, *National Fire Alarm Code*

No function other than those listed in items 4.4.2.2.2.2(1) through 4.4.2.2.2.2(8) shall be connected to the life safety branch.

4.4.2.2.2.3* Critical Branch. The critical branch shall be permitted to be subdivided into two or more branches. The critical branch of the emergency system shall supply power for task illumination, fixed equipment, selected receptacles, and selected power circuits serving the following areas and functions related to patient care:

- (1) Critical care areas that utilize anesthetizing gases, task illumination, selected receptacles, and fixed equipment
- (2) The isolated power systems in special environments
- (3) Task illumination and selected receptacles in the following:
 - (a) Patient care areas, including infant nurseries, selected acute nursing areas, psychiatric bed areas (omit receptacles), and ward treatment rooms
 - (b) Medication preparation areas
 - (c) Pharmacy dispensing areas
 - (d) Nurses' stations (unless adequately lighted by corridor luminaires)
- (4) Additional specialized patient care task illumination and receptacles, where needed
- (5) Nurse call systems
- (6) Blood, bone, and tissue banks
- (7)*Telephone equipment rooms and closets
- (8) Task illumination, selected receptacles, and selected power circuits for the following areas:
 - (a) General care beds with at least one duplex receptacle per patient bedroom, and task illumination as required by the governing body of the health care facility
 - (b) Angiographic labs
 - (c) Cardiac catheterization labs
 - (d) Coronary care units
 - (e) Hemodialysis rooms or areas
 - (f) Emergency room treatment areas (selected)
 - (g) Human physiology labs
 - (h) Intensive care units
 - (i) Postoperative recovery rooms (selected)
- (9) Additional task illumination, receptacles, and selected power circuits needed for effective facility operation. Single-phase fractional horsepower motors shall be permitted to be connected to the critical branch.

4.4.2.2.3 Equipment System.

4.4.2.2.3.1 General. The equipment system shall be connected to equipment described in 4.4.2.2.3.3 through 4.4.2.2.3.5.

4.4.2.2.3.2 Connection to Alternate Power Source. The equipment system shall be installed and connected to the alternate power source, such that equipment described in 4.4.2.2.3.4 is automatically restored to operation at appropriate time-lag intervals following the energizing of the emergency system. Its arrangement shall also provide for the subsequent connection of equipment described in 4.4.2.2.3.5.

4.4.2.2.3.3 AC Equipment for Nondelayed Automatic Connection. Generator accessories, including, but not limited to, the transfer fuel pump, electrically operated louvers, and other generator accessories essential for generator operation, shall be arranged for automatic connection to the alternate power source.

4.4.2.2.3.4* Equipment for Delayed-Automatic Connection. The following equipment shall be permitted to be arranged for delayed-automatic connection to the alternate power source:

- (1) Central suction systems serving medical and surgical functions, including controls. It shall be permitted to place such suction systems on the critical branch.
- (2) Sump pumps and other equipment required to operate for the safety of major apparatus, including associated control systems and alarms.
- (3) Compressed air systems serving medical and surgical functions, including controls. It shall be permitted to place such air systems on the critical branch.
- (4) Smoke control and stair pressurization systems.
- (5) Kitchen hood supply and/or exhaust systems, if required to operate during a fire in or under the hood.
- (6) Supply, return, and exhaust ventilating systems for airborne infectious/isolation rooms, protective environment rooms, exhaust fans for laboratory fume hoods, nuclear medicine areas where radioactive material is used, ethylene oxide evacuation, and anesthetic evacuation. Where delayed automatic connection is not appropriate, such ventilation systems shall be permitted to be placed on the critical branch.

4.4.2.2.3.5* Equipment for Delayed-Automatic or Manual Connection. The following equipment shall be permitted to be arranged for either delayed-automatic or manual connection to the alternate power source (*also see A.4.4.2.2.3.4*):

- (1) Heating equipment to provide heating for operating, delivery, labor, recovery, intensive care, coronary care, nurseries, infection/isolation rooms, emergency treatment spaces, and general patient rooms; and pressure maintenance (jockey or make-up) pump(s) for water-based fire protection systems.
- (2)*Heating of general patient rooms during disruption of the normal source shall not be required under any of the following conditions:
 - (a) The outside design temperature is higher than -6.7°C ($+20^{\circ}\text{F}$).
 - (b) The outside design temperature is lower than -6.7°C ($+20^{\circ}\text{F}$) and a selected room(s) is provided for the needs of all confined patients [then only such room(s) need be heated].
 - (c) The facility is served by a dual source of normal power as described in 4.3.2.1.
- (3) Elevator(s) selected to provide service to patient, surgical, obstetrical, and ground floors during interruption of normal power.
- (4) Supply, return, and exhaust ventilating systems for surgical and obstetrical delivery suites, intensive care, coronary care, nurseries, and emergency treatment spaces.
- (5) Hyperbaric facilities.
- (6) Hypobaric facilities.
- (7) Autoclaving equipment shall be permitted to be arranged for either automatic or manual connection to the alternate source.

(8) Controls for equipment listed in 4.4.2.2.3.

(9)*Other selected equipment shall be permitted to be served by the equipment system.

4.4.2.2.4 Wiring Requirements.

4.4.2.2.4.1* Separation from Other Circuits. The life safety branch and critical branch of the emergency system shall be kept entirely independent of all other wiring and equipment.

4.4.2.2.4.2 Receptacles. The requirements for receptacles shall comply with 4.4.2.2.4.2(A) and 4.4.2.2.4.2(B).

(A) The number of receptacles on a single branch circuit for areas described in 4.4.2.2.3(8) shall be minimized to limit the effects of a branch circuit outage. Branch circuit overcurrent devices shall be readily accessible to authorized personnel.

(B)* The electrical receptacles or the cover plates for the electrical receptacles supplied from the emergency system shall have a distinctive color or marking so as to be readily identifiable.

4.4.2.2.4.3 Switches. Switches installed in the lighting circuits connected to the essential electrical system shall comply with Article 700, Section V, of NFPA 70, *National Electrical Code*.

4.4.2.2.4.4 Mechanical Protection of the Emergency System. The wiring of the emergency system shall be mechanically protected by raceways, as defined in NFPA 70, *National Electrical Code*.

4.4.2.2.4.5 Flexible power cords of appliances or other utilization equipment connected to the emergency system shall not be required to be enclosed in raceways.

4.4.2.2.4.6 Secondary circuits of transformer-powered communication or signaling systems shall not be required to be enclosed in raceways unless otherwise specified by Chapters 7 or 8 of NFPA 70, *National Electrical Code*.

4.4.3 Performance Criteria and Testing (Type 1 EES).

4.4.3.1 Source. The branches of the emergency system shall be installed and connected to the alternate power source specified in 4.4.1.1.4 and 4.4.1.1.5 so that all functions specified herein for the emergency system shall be automatically restored to operation within 10 seconds after interruption of the normal source.

4.4.3.2 Transfer Switches.

4.4.3.2.1 All ac-powered support and accessory equipment necessary to the operation of the EPS shall be supplied from the load side of the automatic transfer switch(es), or the output terminals of the EPS, ahead of the main EPS overcurrent protection, as necessary, to ensure continuity of the EPSS operation and performance. [110:7.12.5]

4.4.3.2.2 The essential electrical system shall be served by the normal power source except when the normal power source is interrupted or drops below a predetermined voltage level. Settings of the sensors shall be determined by careful study of the voltage requirements of the load.

4.4.3.2.3 Failure of the normal source shall automatically start the alternate source generator after a short delay as described in 4.4.2.1.4.4. When the alternate power source has attained a voltage and frequency that satisfies minimum operating requirements of the essential electrical system, the load shall be connected automatically to the alternate power source.

4.4.3.2.4 Upon connection of the alternate power source, the loads comprising the emergency system shall be automatically re-energized. The load comprising the equipment system shall be connected either automatically after a time

delay as described in 4.4.2.1.4.6 or nonautomatically and in such a sequential manner as not to overload the generator.

4.4.3.2.5 When the normal power source is restored, and after a time delay as described in 4.4.2.1.4.7, the automatic transfer switches shall disconnect the alternate source of power and connect the loads to the normal power source. The alternate power source generator set shall continue to run unloaded for a preset time delay as described in 4.4.2.1.4.9.

4.4.3.2.6 If the emergency power source fails and the normal power source has been restored, retransfer to the normal source of power shall be immediate, bypassing the retransfer delay timer.

4.4.3.2.7 If the emergency power source fails during a test, provisions shall be made to immediately retransfer to the normal source.

4.4.3.2.8 Nonautomatic transfer switching devices shall be restored to the normal power source as soon as possible after the return of the normal source or at the discretion of the operator.

4.4.4 Administration (Type 1 EES).

4.4.4.1 Maintenance and Testing of Essential Electrical System.

4.4.4.1.1 Maintenance and Testing of Alternate Power Source and Transfer Switches.

4.4.4.1.1.1 Maintenance of Alternate Power Source. The generator set or other alternate power source and associated equipment, including all appurtenant parts, shall be so maintained as to be capable of supplying service within the shortest time practicable and within the 10-second interval specified in 4.4.1.1.10 and 4.4.3.1. Maintenance shall be performed in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems*, Chapter 8.

4.4.4.1.1.2 Inspection and Testing. Criteria, conditions, and personnel requirements shall be in accordance with 4.4.4.1.1.2(A) through 4.4.4.1.1.2(C).

(A)* Test Criteria. Generator sets shall be tested 12 times a year with testing intervals between not less than 20 days or exceeding 40 days. Generator sets serving emergency and equipment systems shall be tested in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems*, Chapter 8.

(B) Test Conditions. The scheduled test under load conditions shall include a complete simulated cold start and appropriate automatic and manual transfer of all essential electrical system loads.

(C) Test Personnel. The scheduled tests shall be conducted by competent personnel. The tests are needed to keep the machines ready to function and, in addition, serve to detect causes of malfunction and to train personnel in operating procedures.

4.4.4.1.2 Maintenance and Testing of Circuitry.

4.4.4.1.2.1* Circuit Breakers. Main and feeder circuit breakers shall be inspected annually and a program for periodically exercising the components shall be established according to manufacturer's recommendations.

4.4.4.1.2.2 Insulation Resistance. The resistance readings of main feeder insulation shall be taken prior to acceptance and whenever damage is suspected.

4.4.4.1.3 Maintenance of Batteries. Batteries for on-site generators shall be maintained in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems*.

4.4.4.2 Recordkeeping. A written record of inspection, performance, exercising period, and repairs shall be regularly maintained and available for inspection by the authority having jurisdiction.

4.5 Essential Electrical System Requirements — Type 2.

4.5.1 Sources (Type 2 EES). The requirements for sources for Type 2 essential electrical systems shall conform to those listed in 4.4.1.

4.5.2 Distribution (Type 2 EES).

4.5.2.1 General. The distribution requirements for Type 2 essential electrical systems shall conform to those listed in 4.4.2.1.

4.5.2.2 Specific Requirements.

4.5.2.2.1* General. The number of transfer switches to be used shall be based upon reliability, design, and load considerations. Each branch of the emergency system and each critical system shall have one or more transfer switches. One transfer switch shall be permitted to serve one or more branches or systems in a facility with a continuous load on the switch of 150 kVA (120 kW) or less.

4.5.2.2.2 Emergency System. The emergency system shall supply power for lighting, receptacles, and equipment as follows:

- (1) Illumination of means of egress in accordance with NFPA 101, *Life Safety Code*
- (2) Exit signs and exit directional signs in accordance with NFPA 101, *Life Safety Code*
- (3) Alarm and alerting systems, including the following:
 - (a) Fire alarms
 - (b) Alarms required for systems used for the piping of non-flammable medical gases as specified in Chapter 5, Gas and Vacuum Systems
- (4)*Communication systems, where used for issuing instructions during emergency conditions
- (5) Sufficient lighting in dining and recreation areas to provide illumination to exit ways of a minimum of 5 ft-candles
- (6) Task illumination and selected receptacles at the generator set location
- (7) Elevator cab lighting, control, communication, and signal systems

No function other than those listed in 4.5.2.2.2(1) through 4.5.2.2.2(7) shall be connected to the emergency system.

4.5.2.2.3 Critical System.

4.5.2.2.3.1 General. The critical system shall be so installed and connected to the alternate power source that equipment listed in 4.5.2.2.3.2 shall be automatically restored to operation at appropriate time-lag intervals following the restoration of the emergency system to operation. Its arrangement shall also provide for the additional connection of equipment listed in 4.5.2.2.3.3.

4.5.2.2.3.2 AC Equipment for Nondelayed Automatic Connection. Generator accessories, including but not limited to, the transfer fuel pump, electrically operated louvers, and other generator accessories essential for generator operation, shall be arranged for automatic connection to the alternative power source.

4.5.2.2.3.3 Delayed-Automatic Connections to Critical System.

The following equipment shall be permitted to be connected to the critical system and be arranged for delayed-automatic connection to the alternate power source:

- (1) Task illumination and selected receptacles in the following:
 - (a) Patient care areas
 - (b) Medication preparation areas
 - (c) Pharmacy dispensing areas
 - (d) Nurses' stations (unless adequately lighted by corridor luminaires)
- (2) Supply, return, and exhaust ventilating systems for airborne infectious isolation rooms
- (3) Sump pumps and other equipment required to operate for the safety of major apparatus and associated control systems and alarms
- (4) Smoke control and stair pressurization systems
- (5) Kitchen hood supply and/or exhaust systems, if required to operate during a fire in or under the hood

4.5.2.2.3.4* Delayed-Automatic or Manual Connections to Critical System. The equipment in 4.5.2.2.3.4(A) and 4.5.2.2.3.4(B) shall be permitted to be connected to the critical system and be arranged for either delayed-automatic or manual connection to the alternate power source.

(A) Heating Equipment to Provide Heating for General Patient Rooms. Heating of general patient rooms during disruption of the normal source shall not be required under any of the following conditions:

- (1)*The outside design temperature is higher than -6.7°C ($+20^{\circ}\text{F}$).
- (2) The outside design temperature is lower than -6.7°C ($+20^{\circ}\text{F}$) and, where a selected room(s) is provided for the needs of all confined patients, then only such room(s) need be heated.
- (3) The facility is served by a dual source of normal power as described in A.4.4.1.1.1.

(B)* Elevator Service. In instances where interruptions of power would result in elevators stopping between floors, throw-over facilities shall be provided to allow the temporary operation of any elevator for the release of passengers.

(C) Optional Connections to the Critical System. Additional illumination, receptacles, and equipment shall be permitted to be connected only to the critical system.

(D) Multiple Systems. Where one switch serves multiple systems as permitted under 4.5.2.2, transfer for all loads shall be nondelayed automatic.

4.5.2.2.4 Wiring Requirements.

4.5.2.2.4.1* Separation from Other Circuits. The emergency system shall be kept entirely independent of all other wiring and equipment.

4.5.2.2.4.2* Receptacles. The electrical receptacles or the cover plates for the electrical receptacles supplied from the emergency system shall have a distinctive color or marking so as to be readily identifiable.

4.5.3 Performance Criteria and Testing (Type 2 EES).

4.5.3.1 Source. The emergency system shall be installed and connected to the alternate source of power specified in 4.4.1.1.4 and 4.4.1.1.5 so that all functions specified herein for the emer-

gency system will be automatically restored to operation within 10 seconds after interruption of the normal source.

4.5.3.2 Transfer Switches.

4.5.3.2.1 The essential electrical system shall be served by the normal power source until the normal power source is interrupted or drops below a predetermined voltage level. Settings of the sensors shall be determined by careful study of the voltage requirements of the load.

4.5.3.2.2 Failure of the normal source shall automatically start the alternate source generator, after a short delay as described in 4.4.2.1.4.4. When the alternate power source has attained a voltage and frequency that satisfies minimum operating requirements of the essential electrical system, the load shall be connected automatically to the alternate power source.

4.5.3.2.2.1 All ac-powered support and accessory equipment necessary to the operation of the EPS shall be supplied from the load side of the automatic transfer switch(es), or the output terminals of the EPS, ahead of the main EPS overcurrent protection to ensure continuity of the EPSS operation and performance.

4.5.3.2.3 Upon connection of the alternate power source, the loads comprising the emergency system shall be automatically reenergized. The loads comprising the critical system shall be connected either automatically after a time delay as described in 4.4.2.1.4.6 or nonautomatically and in such a sequential manner as not to overload the generator.

4.5.3.2.4 When the normal power source is restored, and after a time delay as described in 4.4.2.1.4.7, the automatic transfer switches shall disconnect the alternate source of power and connect the loads to the normal power source. The alternate power source generator set shall continue to run unloaded for a preset time delay as described in 4.4.2.1.4.9.

4.5.3.2.5 If the emergency power source fails and the normal power source has been restored, retransfer to the normal source of power shall be immediate, bypassing the retransfer delay timer.

4.5.3.2.6 If the emergency power source fails during a test, provisions shall be made to immediately retransfer to the normal source.

4.5.3.2.7 Nonautomatic transfer switching devices shall be restored to the normal power source as soon as possible after the return of the normal source or at the discretion of the operator.

4.5.4 Administration (Type 2 EES).

4.5.4.1 Maintenance and Testing of Essential Electrical System.

4.5.4.1.1 Maintenance and Testing of Alternate Power Source and Transfer Switches.

4.5.4.1.1.1 Maintenance of Alternate Power Source. The generator set or other alternate power source and associated equipment, including all appurtenant parts, shall be so maintained as to be capable of supplying service within the shortest time practicable and within the 10-second interval specified in 4.4.1.1.7 and 4.4.3.1.

4.5.4.1.1.2 Inspection and Testing. Generator sets shall be inspected and tested in accordance with 4.4.4.1.1.2.

4.5.4.1.2 Maintenance and Testing of Circuitry. Circuitry shall be maintained and tested in accordance with 4.4.4.1.2.

4.5.4.1.3 Maintenance of Batteries. Batteries shall be maintained in accordance with 4.4.4.1.3.

4.5.4.2 Recordkeeping. A written record of inspection, performance, exercising period, and repairs shall be regularly maintained and available for inspection by the authority having jurisdiction.

4.6 Essential Electrical System Requirements — Type 3.

4.6.1 Sources (Type 3 EES). The alternate source of power for the system shall be specifically designed for this purpose and shall be either a generator, battery system, or self-contained battery integral with the equipment.

4.6.1.1 Generators shall conform to 4.4.1.1 and 4.4.1.1.6.2.

4.6.1.2 Battery systems shall conform to 4.4.1.2.

4.6.2 Distribution (Type 3 EES).

4.6.2.1 General. The distribution requirements for Type 3 essential electrical systems shall conform to those listed in 4.4.2.1.

4.6.2.2 Specific Requirements.

4.6.2.2.1* General.

4.6.2.2.2 Connection to the Essential Electrical System. The system shall supply power for task illumination that is related to the safety of life and that is necessary for the safe cessation of procedures in progress.

4.6.2.2.3 Wiring Requirements.

4.6.2.2.3.1 General. The design, arrangement, and installation of the system shall be in accordance with NFPA 70, *National Electrical Code*.

4.6.2.2.3.2* Receptacles. The cover plates for the electrical receptacles or the electrical receptacles themselves supplied from the emergency system shall have a distinctive color or marking so as to be readily identifiable.

4.6.3 Performance Criteria and Testing (Type 3 EES).

4.6.3.1 Source.

4.6.3.1.1 The emergency system shall have an alternate source of power separate and independent from the normal source that will be effective for a minimum of 1½ hours after loss of the normal source.

4.6.3.1.2 The emergency system shall be so arranged that, in the event of failure of normal power source, the alternate source of power shall be automatically connected to the load within 10 seconds.

4.6.3.2 Transfer Switches with Engine Generator Sets.

4.6.3.2.1 The operation of the equipment shall be arranged such that the load will be served by the normal source until the normal source is interrupted, or when the voltage drops below the setting of the voltage-sensing device. The settings of the voltage-sensing relays shall be determined by careful study of the voltage requirements of the load.

4.6.3.2.2 When the normal source is restored, and after a time delay as described in 4.4.2.1.4.7, the automatic transfer switch shall disconnect the alternate source of power and connect the loads to the normal power source.

4.6.3.2.3 If the alternate power source fails and the normal power source has been restored, retransfer to the normal source of power shall be immediate.

4.6.3.3 Transfer Switches with Battery System.

4.6.3.3.1 Failure of the normal source shall automatically transfer the load to the battery system.

4.6.3.3.2 Retransfer to the normal source shall be automatic upon restoration of the normal source.

4.6.4 Administration (Type 3 EES).

4.6.4.1 Maintenance and Testing.

4.6.4.1.1 Maintenance and Testing of Alternate Power Source and Transfer Switches.

4.6.4.1.1.1 Maintenance of Alternate Power Source. The generator set or other alternate power source and associated equipment, including all appurtenant parts, shall be so maintained as to be capable of supplying service within the shortest time practicable and within the 10-second interval specified in 4.4.1.1.10 and 4.6.3.1.2.

4.6.4.1.1.2 Inspection and Testing. Generator sets shall be inspected and tested in accordance with 4.4.4.1.1.2.

4.6.4.1.1.3 Stored Energy Power Source. Maintenance and testing of stored emergency power supply systems shall be in accordance with NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, Section 6.1 through 6.4.5.

4.6.4.1.2 Maintenance and Testing Circuitry. Circuitry shall be maintained and tested in accordance with 4.4.4.1.2.

4.6.4.1.3 Maintenance of Batteries. Batteries shall be maintained in accordance with 4.4.4.1.3.

4.6.4.2 Recordkeeping. A written record of inspection, performance, exercising period, and repairs shall be regularly maintained and available for inspection by the authority having jurisdiction.

Chapter 5 Gas and Vacuum Systems

5.1 Level 1 Piped Gas and Vacuum Systems.

5.1.1* Applicability.

5.1.1.1 These requirements shall apply to health care facilities that require Level 1 systems as referenced in Chapters 13 through 21.

5.1.1.2* Wherever the terms *medical gas* or *vacuum* occur, the provisions shall apply to all piped systems for oxygen, nitrous oxide, medical air, carbon dioxide, helium, medical-surgical vacuum, waste anesthetic gas disposal, and mixtures thereof. Wherever the name of a specific gas or vacuum service occurs, the provision shall apply only to that gas.

5.1.1.3 Wherever the term *medical-surgical vacuum* occurs, the provisions shall apply to systems for piped medical-surgical vacuum and piped waste anesthetic gas disposal (WAGD). Wherever the name of a specific vacuum service occurs, the provision shall apply only to that vacuum service.

5.1.1.4 An existing system that is not in strict compliance with the provisions of this standard shall be permitted to be continued in use as long as the authority having jurisdiction has determined that such use does not constitute a distinct hazard to life.

5.1.2 Nature of Hazards of Gas and Vacuum Systems. Potential fire and explosion hazards associated with positive pressure gas central piping systems and medical-surgical vacuum

systems shall be considered in the design, installation, testing, operation, and maintenance of these systems.

5.1.3* Level 1 Sources.

5.1.3.1 Central Supply System Identification and Labeling.

5.1.3.1.1* Only cylinders and containers constructed, tested, and maintained in accordance with U.S. Department of Transportation specifications and regulations shall be permitted to be used.

5.1.3.1.2 Cylinder contents shall be identified by attached labels or stencils naming the contents in accordance with CGA C-7, *Guide to the Preparation of Precautionary Labeling and Marking of Compressed Gas Containers*.

5.1.3.1.3 Liquid containers shall have additional product identification visible from all directions with a minimum of 51 mm (2 in.) high letters such as a 360 degree wraparound tape for medical liquid containers.

5.1.3.1.4 Cryogenic liquid containers shall be provided with gas-specific outlet connections in accordance with CGA V-5, *Diameter-Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications)*, or CGA V-1, *Compressed Gas Association Standard for Compressed Gas Cylinder Valve Inlet and Outlet Connections*.

5.1.3.1.5 Cylinder and cryogenic liquid container outlet connections shall be affixed in such a manner as to be integral to the valve(s), unremovable with ordinary tools or so designed as to render the attachment point unusable when removed.

5.1.3.1.6 Contents of cylinders and cryogenic liquid containers shall be verified prior to use.

5.1.3.1.7 Labels shall not be defaced, altered, or removed, and connecting fittings shall not be modified.

5.1.3.1.8 Locations containing positive pressure gases other than oxygen and medical air shall have their door(s) labeled substantially as follows:

CAUTION

Positive Pressure Gases

NO Smoking or Open Flame

Room May Have Insufficient Oxygen

Open Door and Allow Room to Ventilate Before Entering

5.1.3.1.9 Locations containing central supply systems or cylinders containing only oxygen or medical air shall have their door(s) labeled as follows:

CAUTION

Medical Gases

NO Smoking or Open Flame

5.1.3.2 Central Supply System Operations.

5.1.3.2.1 The use of adapters or conversion fittings to adapt one gas-specific fitting to another shall be prohibited.

5.1.3.2.2 Cylinders and containers shall be handled in strict accordance with 5.1.13.

5.1.3.2.3 Only gas cylinders, reusable shipping containers, and their accessories shall be permitted to be stored in rooms containing central supply systems or gas cylinders.

5.1.3.2.4 No flammable materials, cylinders containing flammable gases, or containers containing flammable liquids shall be stored in rooms with gas cylinders.

5.1.3.2.5 Wooden racks for cylinder storage shall be permitted.

5.1.3.2.6 If cylinders are wrapped when received, the wrappers shall be removed prior to storage.

5.1.3.2.7 Cylinders not in use shall have their valve protection caps secured tightly in place.

5.1.3.2.8 Cylinders without correct markings or whose markings and gas-specific fittings do not match shall not be used.

5.1.3.2.9 Cryogenic liquid storage units intended to supply gas to the facility shall not be used to transfill other liquid storage vessels.

5.1.3.2.10 Care shall be exercised when handling cylinders that have been exposed to freezing temperatures or containers that contain cryogenic liquids to prevent injury to the skin.

5.1.3.2.11 Cylinders containing compressed gases and containers for volatile liquids shall be kept away from radiators, steam piping, and like sources of heat.

5.1.3.2.12 When cylinder valve protection caps are supplied, they shall be secured tightly in place unless the cylinder is connected for use.

5.1.3.2.13 Containers shall not be stored in a tightly closed space.

5.1.3.3* Central Supply System Locations.

5.1.3.3.1 Central supply systems shall be located to meet the criteria in 5.1.3.3.1.1 through 5.1.3.3.1.12.

5.1.3.3.1.1 Any of the following systems shall be permitted to be located together in the same outdoor enclosure:

- (1) Manifolds for gas cylinders without reserve supply (*See 5.1.3.4.10.*)
- (2) Manifolds for gas cylinders with reserve supply
- (3) Manifolds for cryogenic liquid containers (*See 5.1.3.4.12.*)
- (4) Bulk cryogenic liquid systems (*See 5.1.3.4.13.*)

5.1.3.3.1.2 Any of the following systems shall be permitted to be located together in the same indoor enclosure:

- (1) Manifolds for gas cylinders without reserve supply (*See 5.1.3.4.10.*)
- (2) Manifolds for gas cylinders with reserve supply
- (3) Manifolds for cryogenic liquid containers (*See 5.1.3.4.12.*)
- (4) In-building emergency reserves (*See 5.1.3.4.15.*)
- (5) Instrument air standby headers (*See 5.1.3.8.5.*)

5.1.3.3.1.3 Any of the following systems shall be permitted to be located together in the same room:

- (1) Medical air compressor supply sources (*See 5.1.3.5.3.*)
- (2) Medical-surgical vacuum sources (*See 5.1.3.6.*)
- (3) Waste anesthetic gas disposal (WAGD) sources (*See 5.1.3.7.*)
- (4) Instrument air compressor sources (*See 5.1.3.8.*)
- (5) Any other compressor, vacuum pump, or electrically powered machinery

5.1.3.3.1.4 Any system listed under 5.1.3.3.1.3 shall not be located in the same room with any system listed under 5.1.3.3.1.1 or 5.1.3.3.1.2, except instrument air reserve headers complying with 5.1.3.3.1.7 and 5.1.3.8.5 shall be allowed to be in the same room as an instrument air compressor.

A.4.4.1.1.1.2(5) Careful consideration should be given to the location of the spaces housing the components of the essential electrical system to minimize interruptions caused by natural forces common to the area (e.g., storms, floods, or earthquakes, or hazards created by adjoining structures or activities). Consideration should also be given to the possible interruption of normal electrical services resulting from similar causes as well as possible disruption of normal electrical service due to internal wiring and equipment failures.

Consideration should be given to the physical separation of the main feeders of the essential electrical system from the normal wiring of the facility to prevent possible simultaneous destruction as a result of a local catastrophe.

In selecting electrical distribution arrangements and components for the essential electrical system, high priority should be given to achieving maximum continuity of the electrical supply to the load. Higher consideration should be given to achieving maximum reliability of the alternate power source and its feeders rather than protection of such equipment, provided the protection is not required to prevent a greater threat to human life such as fire, explosion, electrocution, and so forth, than would be caused by the lack of essential electrical supply.

A.4.4.1.1.7.3 The intent of this subparagraph is as follows:

- (1) Contiguous or same site nonhospital buildings can be served by the generating equipment. However, such loads should not compromise the integrity of the system serving the hospital. Thus, any such contiguous or same site nonhospital buildings can be served by the generating equipment only if the transfer means operates in accordance with this subparagraph.
- (2) Within a hospital building, 4.4.2.2.3(9) allows "additional" loads on the critical branch and 4.4.2.3.5(9) allows "other equipment" on the equipment system in order to provide limited flexibility to a facility to add one or two loads not otherwise listed in 4.4.2.2.3(1) through 4.4.2.2.3(8), or 4.4.2.3.4, or 4.4.2.3.5(1) through 4.4.2.3.5(9) to a critical branch panel or an equipment system panel. This allowance is to prevent the need for an additional panel to serve a small number of selected circuits in a particular area. These sections are not intended to allow large blocks of loads not listed in these sections to be on the critical branch or equipment system. The intent of the division of the essential system loads into systems and branches is to ensure maximum reliability of service to loads considered essential. Every additional load placed onto a system somewhat increases the probability of a failure on the system that threatens the integrity of service to the balance of loads served by the system. Therefore, while "additional" loads and "other equipment" can be placed onto the critical branch and equipment system in very limited situations, where a facility wants to put large blocks of loads not listed in 4.4.2.2.3(1) through 4.4.2.2.3(8), or 4.4.2.3.4, or 4.4.2.3.5(1) through 4.4.2.3.5(9) onto the generating equipment, the facility can do so, but only by designating these large blocks of loads as "optional loads" and by complying with 4.4.1.1.7.3.

A.4.4.1.1.9 It is the intent of this subparagraph to mandate generator sizing based upon actual demand likely to be produced by the connected load of the essential electrical system(s) at any one time. It is not the intent that generator sizing be based upon connected load or feeder calculation procedures described in NFPA 70, *National Electrical Code*. Demand calculations should be based upon prudent demand factors and historical data.

A.4.4.1.1.12.1 During operation, EPS and related equipment reject considerable heat that needs to be removed by proper ventilation or air-cooling. In some cases, outdoor installations rely on natural air circulation, but enclosed installations need properly sized, properly positioned ventilation facilities, to prevent recirculation of cooling air. The optimum position of air-supply louvers and radiator air discharge is on opposite walls, both to the outdoors. [110: A.7.7.1]

A.4.4.1.1.17.1 As a supplement to hard-wired alarm annunciations, it is permissible to have Level 1 and Level 2 EPS and ATS functions monitored offsite. Monitoring stations can include pagers, cell phones, and internet-connected devices.

A.4.4.2 It should be emphasized that the type of system selected and its area and type of coverage should be appropriate to the medical procedures being performed in the facility. For example, a battery-operated emergency light that switches "on" when normal power is interrupted and an alternate source of power for suction equipment, along with the immediate availability of some portable hand-held lighting, would be advisable where oral and maxillofacial surgery (e.g., extraction of impacted teeth) is performed. On the other hand, in dental offices where simple extraction, restorative, prosthetic, or hygienic procedures are performed, only remote corridor lighting for purposes of egress would be sufficient. Emergency power for equipment would not be necessary. As with oral surgery locations, a surgical clinic requiring use of life support or emergency devices such as suction machines, ventilators, cauterizers, or defibrillators would require both emergency light and power.

A.4.4.2.1.4.1(A) Where special loads require more rapid detection of power loss, underfrequency monitoring also might be provided. Upon frequency decay below the lower limit necessary for proper operation of the loads, the transfer switch should automatically initiate transfer to the alternate source. (See A.6.2.15 of NFPA 110.) [110: A.6.2.2.1]

A.4.4.2.1.4.1(A)(2) See 6.2.5 and 6.2.7 of NFPA 110. [110: A.6.2.2.1(2)]

A.4.4.2.1.4.3 Authorized personnel should be available and familiar with manual operation of the transfer switch and should be capable of determining the adequacy of the alternate source of power prior to manual transfer. [110: A.6.2.4]

A.4.4.2.1.4.4 For most applications, a nominal delay of 1 second is adequate. The time delay should be short enough so that the generator can start and be on the line within the time specified for the type classification. [110: A.6.2.5]

A.4.4.2.1.4.7 It is recommended that the timer for delay on retransfer to the primary source be set for 30 minutes. The 30-minute recommendation is to establish a "normalized" engine temperature, when it is beneficial for the engine. NFPA 70, *National Electrical Code*, establishes a minimum time requirement of 15 minutes. [110: A.6.2.8]

A.4.4.2.1.4.12 For maintenance purposes, consideration should be given to a transfer switch counter. [110: A.6.2.13]

A.4.4.2.1.4.14 Automatic transfer switches (ATS) can be provided with accessory controls that provide a signal to operate remote motor controls that disconnect motors prior to transfer, and to reconnect them after transfer when the residual voltage has been substantially reduced. Another method is to provide inphase monitors within the ATS in order to prevent retransfer to the primary source until both sources are nearly

synchronized. A third method is to use a programmed neutral position transfer switch. See Section 230.95(B) of NFPA 70, *National Electrical Code*. [110: A.6.2.15]

A.4.4.2.1.4.15 Standards for nonautomatic transfer switches are similar to those for automatic transfer switches, as defined in 3.3.7.1 and 3.3.7.3 of NFPA 110, *Standard for Emergency and Standby Power Systems*, with the omission of automatic controls. [110: A.6.2.16]

A.4.4.2.1.7.3 Consideration should be given to the effect that load interruption could have on the load during maintenance and service of the transfer switch.

A.4.4.2.2.1 Type 1 essential electrical systems are comprised of two separate systems capable of supplying a limited amount of lighting and power service that is considered essential for life safety and effective facility operation during the time the normal electrical service is interrupted for any reason. These two systems are the emergency system and the equipment system.

A.4.4.2.2.2(4) Departmental installations such as digital dialing systems used for intradepartmental communications could have impaired use during a failure of electrical service to the area. In the event of such failure, those systems that have lighted selector buttons in the base of the telephone instrument or in the desk units known as "director sets" will be out of service to the extent that the lights will not function and that the buzzer used to indicate incoming calls will be silenced. The lack of electrical energy will not prevent the use of telephones for outgoing calls, but incoming calls will not be signaled, nor will intercommunicating calls be signaled. This communication failure should be taken into consideration in planning essential electrical systems.

A.4.4.2.2.3 It is recommended that facility authorities give consideration to providing and properly maintaining automatic battery-powered lighting units or systems to provide minimal task illumination in operating rooms, delivery rooms, and certain special-procedure radiology rooms where the loss of lighting due to failure of the essential electrical system could cause severe and immediate danger to a patient undergoing surgery or an invasive radiographic procedure.

A.4.4.2.2.3(7) Departmental installations such as digital dialing systems used for intradepartmental communications could have impaired use during a failure of electrical service to the area. In the event of such failure, those systems that have lighted selector buttons in the base of the telephone instrument or in the desk units known as "director sets" will be out of service to the extent that the lights will not function and that the buzzer used to indicate incoming calls will be silenced. The lack of electrical energy will not prevent the use of telephones for outgoing calls, but incoming calls will not be signaled, nor will intercommunicating calls be signaled. This communication failure should be taken into consideration in planning essential electrical systems.

A.4.4.2.2.3.4 The equipment in 4.4.2.2.3.4(1) through 4.4.2.2.3.4(3) can be arranged for sequential delayed-automatic connection to the alternate power source to prevent overloading the generator where engineering studies indicate that it is necessary.

A.4.4.2.2.3.5 For elevator cab lighting control, and signal system requirements, see 4.4.2.2.2(6).

In instances where interruption of normal power would result in other elevators stopping between floors, throw-over

facilities shall be provided to allow the temporary operation of any elevator for the release of patients or other persons who are confined between floors.

A.4.4.2.2.3.5(2) The outside design temperature is based on the 97½ percent design value as shown in Chapter 24 of the ASHRAE *Handbook of Fundamentals*.

A.4.4.2.2.3.5(9) Consideration should be given to selected equipment in kitchens, laundries, and radiology rooms and to selected central refrigeration.

It is desirable that, where heavy interruption currents can be anticipated, the transfer load be reduced by the use of multiple transfer devices. Elevator feeders, for instance, might be less hazardous to electrical continuity if they are fed through an individual transfer device.

A.4.4.2.2.4.1 See NFPA 70, *National Electrical Code*, for installation requirements.

A.4.4.2.2.4.2(B) If color is used to identify these receptacles, the same color should be used throughout the facility.

A.4.4.4.1.1.2(A) When indications such as the issuance of storm warnings indicate that power outages might be likely, good practice recommends the warming up of generator sets by a regular exercise period. Operation of generator sets for short intervals should be avoided, particularly with compression ignition engines, since it is harmful to the engines.

Records of changes to the essential electrical system should be maintained so that the actual demand likely to be produced by the connected load will be within the available capacity.

A.4.4.4.1.2.1 Main and feeder circuit breakers should be periodically tested under simulated overload trip conditions to ensure reliability (see C.4.2).

A.4.5.2.2.1 Type 2 essential electrical systems are comprised of two separate systems capable of supplying a limited amount of lighting and power service that is considered essential for the protection of life and safety and effective operation of the institution during the time normal electrical service is interrupted for any reason. These two separate systems are the emergency system and the critical system.

The number of transfer switches to be used shall be based upon reliability, design, and load considerations. Each branch of the emergency system and each critical system shall have one or more transfer switches. One transfer switch shall be permitted to serve one or more branches or systems in a facility with a maximum demand on the essential electrical system of 150 kVA (120 kW).

A.4.5.2.2.2(4) Departmental installations such as digital dialing systems used for intradepartmental communications could have impaired use during a failure of electrical service to the area. In the event of such failure, those systems that have lighted selector buttons in the base of the telephone instrument or in the desk units known as "director sets" will be out of service to the extent that the lights will not function and that the buzzer used to indicate incoming calls will be silenced. The lack of electrical energy will not prevent the use of telephones for outgoing calls, but incoming calls will not be signaled, nor will intercommunicating calls be signaled. This communication failure should be taken into consideration in planning essential electrical systems.

A.4.5.2.2.3.4 Other selected equipment can be served by the critical system.