MINUTES

NFPA Technical Committee on Electrical Systems (HEA-ELS)
NFPA 99 First Draft Meeting (A2026)

July 30-August 2, 2024
8:00 AM – 5:00 PM (CT)

Embassy Suites KC Plaza
Kansas City, MO

1. **Call to order.** Pamela Gwynn, chair, called the meeting to order at 8:07 AM on 7/30.
2. **Introductions.** Attendees introduced themselves and identified their affiliation and NFPA staff took attendance.
3. **Chair report.** Pamela Gwynn welcomed attendees and provided an overview of the meeting.
4. **Staff liaison report.** Jeff Sargent reported on the following:
   a. An overview of the standards development process and the revision cycle schedule.
      i. No members declared that they had been retained to represent the interest of an entity that would be classified in an interest category different from their own with respect to a specific issue or issues that were addressed by the committee.
   b. An overview of the reference publication/extract update policy was provided. The committee will address the referenced publication and extract date/edition updates at their Second Draft meeting.
5. **Previous meeting minutes.** The minutes from the August 22-23, 2022, remote Second Draft meeting were approved without revision.
6. **NFPA 99 First Draft.**
   a. **Review of Public Inputs.** The Technical Committee reviewed the Public Inputs and developed First Revisions and Committee Inputs, as necessary. These will be available in the First Draft Report at www.nfpa.org/99next.
      i. If the new chapter on cybersecurity in Committee Input 1024 is moved forward as a second revision, the HEA-ELS technical committee recommends to the Correlating Committee on Health Care that consideration be given to locating it as Chapter 17.
   b. **Task group report(s).** The following task groups provided their reports and recommendations.

i. **Public Input Review Task Group 1**. Jan Ehrenwerth. The task group provided a report, and first revisions were developed. The task group has been discharged with thanks. See attached.

ii. **Public Input Review Task Group 2**. Task Group Member Nancy Chilton presented on behalf of chair Stephen Lipster. The task group provided a report, and first revisions were developed. The task group has been discharged with thanks. See attached.

iii. **Public Input Review Task Group 3.** Walter Vernon. The task group provided a report, and first revisions were developed. The task group has been discharged with thanks. See attached.

iv. The Task Groups appointed at the August 2022 meetings had input to the reports of Public Input Review Task Groups 1, 2, and 3. These task groups were discharged with thanks. No attachments.

c. **Presentation(s).** There were no presentations made to the committee.

d. **New task groups.** The following task group was appointed to work between the first and second draft meetings:

i. **Low Voltage/Limited-Energy System Connection Point TG**. TG Chair: Joshua Griffith. Members: Nancy Chilton, David Dagenais, David Linder. This task group is to review the recommendation of resolved Public Input 367 and provide a recommendation on whether these connection points should be required or permitted and if so, where they should be covered in the code.

7. **Other Business.** There was no other business taken up by the technical committee.

8. **Future meetings.** The next committee meeting will be July or August 2025. A meeting notification will be posted at www.nfpa.org/99next when the meeting is scheduled.

9. **Adjournment.** The meeting was adjourned at 4:50 PM on 8/2.

Attendees

Committee Members:

✓	**Pamela Gwynn**	Chair	UL Solutions
✓	**Krista Biason**	Principal	HGA Architects and Engineers
✓	**David Campbell***	Principal	The Aluminum Association
✓	**David H. Chandler**	Principal	NFPA Health Care Section
✓	**Nancy Chilton**	Principal	Schneider Electric
✓	**Dan Chisholm**	Principal	Motor and Generator Institute/MGI
✓	**Jason D'Antona**	Principal	Partners Healthcare
✓	**Vincent Della Croce**	Principal	Siemens
✓	**Jan Ehrenwerth**	Principal	American Society of Anesthesiologists

	Steven Elliott	Principal	US Department of Veterans Affairs
✓	**Chris Finen**	Principal	Eaton Corporation
✓	**Joshua Griffith**	Principal	US Army Corps of Engineers (USACE)
✓	**Leif Hoegberg**	Principal	InterNational Electrical Testing Association
	Stephen Lipster	Principal	SNAG Consulting
✓	**Thomas Parrish**	Principal	Telgian Corporation
✓	**Kevin Porter**	Principal	National Electrical Manufacturers Association
✓	**Don Rabel**	Principal	National Electrical Contractors Association
✓	**Vincent Rea**	Principal	TLC Engineering for Architecture
	Mike Rink	Principal	University of Rochester Medical Center
	Brian Rock	Principal	Hubbell Incorporated
	Steve Sappington	Principal	Caterpillar Inc.
✓	**Michael Savage***	Principal	Marion County Building Safety
	Kevin Scarlett	Principal	Washington State Department of Health
	John Schutte	Principal	Mortenson Construction
✓	**Ronald Smidt***	Principal	American Society of Healthcare Engineers
✓	**Randy Stoddard**	Principal	Childrens Hospital Philadelphia
✓	**Walter Vernon**	Principal	Mazzetti
	Leonard White	Principal	Salas O'Brien/Stanford White Associates
✓	**David Williams**	Principal	IAEI
	Robert Wolff	Principal	BRE Engineers
	Jesse Avery	Alternate	Mazzetti
✓	**Chad Beebe**	Alternate	American Society of Healthcare Engineers
	Dan Chisholm	Alternate	MGI Systems, Inc.
✓	**Steve Chutka**	Alternate	Siemens
	James Coppage	Alternate	Eaton
✓	**David Dagenais***	Alternate	Partners/Wentworth-Douglass Hospital
✓	**Matthew Eason***	Alternate	NFPA Health Care Section
✓	**Paul Evers***	Alternate	UL Solutions
	Lauris Freidenfelds	Alternate	Telgian Corporation
✓	**Larry Geyer***	Alternate	National Electrical Contractors Association
✓	**Chad Kennedy**	Alternate	Schneider Electric

✓	**David Linder**	Alternate	Hubbell Incorporated
	David Lyons	Alternate	American Society of Anesthesiologists
	Terrance McKinch	Alternate	Signal Energy Constructors
✓	**Taw North**	Alternate	TLC Engineering for Architecture
	John Williams	Alternate	Washington State Department of Health
✓	**Jeff Sargent**	Staff Liaison	National Fire Protection Association

Guests:

Isaac Luria	American Society of Anesthesiologists
Jamie Schnick	CA Department of Health Care Access and Information
Frank Tse	Hubbell
Austin Wallace	American Society of Healthcare Engineers

*Participated by teleconference
Total number in attendance: 36

2027 NFPA 99 HEA-ELS Public Input Task Group Report

TG	**HEA-ELS #1**	
TG Chair	**Jan Ehrenwerth**	
TG Members	**David Campbell, Danny Chisholm, James Coppage, David Dagenais, Jason D'Antona, Vincent Della Croce, Leif Hoegberg, David Linder, Don Rabel, Mike Rink, Michael Savage, Randy Stoddard, David Williams, John Williams, Robert Wolff**	
Section	**Public Input #**	**TG Recommendation (Create FR, Create CI, Resolve) & Statement**
6.2.1	**96**	**Action:** Create First Revision **Statement:** The revision adds a requirement to include fire and explosion risk mitigation strategies in the electrical system design.
6.2.2	**97**	**Action:** Create First Revision **Statement:** The revision adds a requirement to include shock risk mitigation strategies in the electrical system design.
6.2.3	**98**	**Action:** Create First Revision **Statement:** The revision adds a requirement to include thermal risk mitigation strategies in the electrical system design.
New Section	**99**	**Action:** Create First Revision **Statement:** The revision adds a requirement to include natural disaster and severe weather risk mitigation strategies in the electrical system design.
6.2.4.3	**130**	**Action:** Resolve **Statement:** The recommended text is not necessary because the requirements for separation exist elsewhere in this document as well as in other NFPA standards such as the NEC. The separation requirements are based on the integrity of the installation and not on the facility's operation plan.
6.3.2.2.1(B)	**367**	**Action:** Resolve **Statement:** This section covers ac power receptacles. Devices for connection to other types of power supplies are not appropriately located in this section.
6.3.2.2.1(C)	**412**	**Action:** Resolve **Statement:** NFPA 99 is a risk-based standard and the requirement for the hospital grade receptacles mitigates the electrical hazard risk regardless of the type of health care occupancy in which the patient bed is located.
6.3.2.2.2(A), 6.3.2.2.2(B), 6.3.2.2.2(C)	**284**	**Action:** Create First Revision **Statement:** The revision is to align terminology that is used throughout the standard.
6.3.2.3.5	**1**	**Action:** Create First Revision

		Statement: The revision deletes an unnecessary reference to Chapter 3.
6.3.2.3.6	**3**	**Action:** Create First Revision **Statement:** The relocation is to group similar requirements related to special protection.
6.3.2.3.7	**2**	**Action:** Create First Revision **Statement:** The relocation is to group similar requirements related to special protection.
6.3.2.4.1	**102**	**Action:** Create First Revision **Statement:** The revision is to align terminology that is used throughout the standard.
6.3.2.5.1.4(B)	**415**	**Action:** Create First Revision **Statement:** The revision clarifies that either method of grounding/bonding is compliant.
6.3.2.5.1.5	**103**	**Action:** Create First Revision **Statement:** The revision is to align terminology that is used throughout the standard and provides clarity to the requirement.
6.3.2.5.2	**416**	**Action:** Create First Revision **Statement:** The revision makes an editorial correction.
6.3.2.6.2	**417**	**Action:** Resolve **Statement:** This requirement bridges the gap between when power is lost, and when power is restored in an operating room. The 50% level is supported only by anecdote and does not have a technical basis.
6.3.2.6.5	**285**	**Action:** Resolve **Statement:** The term “main electric room” is not defined and would introduce an applicability and enforcement problem.
6.3.2.6.6	**287**	**Action:** Create First Revision **Statement:** The revision is to align terminology that is used throughout the standard.
6.3.2.6.7	**418**	**Action:** Resolve **Statement:** The substantiation does not provide a technical basis to reduce the amount of time required for battery-powered lighting units to operate.
6.4.3	**291**	**Action:** Create First Revision **Statement:** The revision is to align terminology that is used throughout the standard.
6.5.2	**292**	**Action:** Create First Revision **Statement:** The revision is to align terminology that is used throughout the standard.
6.7.1.2.2.3	**4**	**Action:** Resolve **Statement:** The subdivision is not required to have a title unless all the same level subdivisions have titles.
6.7.1.2.2.5(A)	**109**	**Action:** Resolve

		Statement: The substantiation is lacking technical basis to support the recommended revision.
6.7.2.2.3.2	**110**	**Action:** Resolve **Statement:** The recommended detail is specified in Section 6.7.2.2.3.3(A)(2).
6.7.2.2.5	**29**	Action: Resolve Statement: The requirements cited in support of the revision are specific to Category 1 and 2 spaces. The proposed revision removes the requirement for receptacles in other spaces within a health care facility.
6.7.5.1.2.2	**5** **429**	**Action:** Create First Revision **Statement:** The revision to (3) adds a type of communication system currently being installed and used in health care facilities. The revision to (4)(c) adds the defined term "selected receptacle".
6.7.5.1.2.2	**379**	**Action:** Resolve **Statement:** The substantiation does not provide documentation that the types of systems covered by (3) are not in use within health care facilities.
6.7.5.1.2.2	**429**	**Action:** Grouped with PI 5 **Statement:**
6.7.5.1.3.1	**395**	**Action:** Resolve **Statement:** The recommendation adds terminology ("A and B power feeds") that is not defined in industry standards.
6.7.5.1.3.2	**6** **87** **394** **431**	**Action:** Create First Revision **Statement:** The revision adds the defined term "selected receptacle", replaces terminology associated with telecommunications with terminology used in industry and Chapter 7 of this standard, and reorganizes the section for clarity of application. Additionally, the revision clarifies that the items are not required to be provided, but if they are provided, they must be supplied by the critical branch.
6.7.5.1.3.2	**87**	**Action:** Grouped with PIs 6, 394, and 431 **Statement:**
6.7.5.1.3.2	**133**	**Action:** Resolve **Statement:** The substantiation does not provide technical support for adding emergency operations centers.
6.7.5.1.3.2	**394**	**Action:** Grouped with PIs 6, 87, and 431. **Statement:**
6.7.5.1.3.2	**431**	**Action:** Grouped with PIs 6, 87, and 394. **Statement:**
6.7.5.1.4.1	**84**	**Action:** No recommendation from TG **Statement:**
6.7.5.1.4.2(A)	**134**	**Action:** Create First Revision.

		Statement: The revision clarifies that the equipment branch must be supplied by two independent sources of power.
6.7.5.1.4.2(B)	**135**	**Action:** Create First Revision **Statement:** The revision clarifies the transfer between independent power sources must subsequently provide power to the loads supplied by the equipment branch.
6.7.5.1.4.3(A)	**136**	**Action:** Resolve **Statement:** The recommendation introduces the undefined and possibly ambiguous term “emergency operations center”.
6.7.5.1.4.3	**439**	**Action:** Create First Revision **Statement:** The revision to (A) clarifies the requirement is not mandating the installation of the types of equipment listed in (A)(1) through (6), but if that equipment is installed it is permitted to be connected to the equipment branch through a delayed-automatic connection.
6.7.5.1.4.4	**88**	**Action:** Create First Revision **Statement:** The revision clarifies the requirement is not mandating the installation of the types of equipment or facilities listed in (1) through (9), but if that equipment or facility is installed or provided, it is permitted to be connected to the equipment branch through a delayed-automatic connection. The revision to (9) adds additional equipment and circuits to the list of loads permitted to be supplied via a delayed-automatic or manual connection to the on-site power source.
6.7.5.1.4.4	**441**	**Action:** Resolve **Statement:** The term “functional program” is not defined in NFPA 99, and the requirement introduces a mandatory requirement to have an autoclave. This requirement is focused on what equipment can be supplied by the equipment branch and not what type of equipment is to be provided in the facility.

Chapter 6 Electrical Systems
6.1* Applicability.
6.1.1 Electrical Installation.

Installation shall be in accordance with *NFPA 70.*

6.1.2

This chapter shall apply to new health care facilities as specified in Section 1.3.

6.1.3

The following paragraphs shall apply to new and existing health care facilities:

(1) 6.3.2.2.1

(2) 6.3.2.3.6(B)(2) and 6.3.2.3.6(B)(3)

(3) 6.3.2.3.8

(4) 6.3.2.6.8

(5) 6.3.2.8.2

(6) 6.3.3.2.5 through 6.3.3.2.7

(7) 6.3.3.3.3 and 6.3.3.3.4

(8) 6.3.4

(9) 6.7.1.2.7.2(H)

(10) 6.7.2.2.5(B)

(11) 6.7.2.2.6

(12) 6.7.4

(13) Section 6.8

6.1.4

The following paragraphs shall apply only to existing health care facilities:

(1) 6.3.2.5.1.3

(2) Section 6.9

6.2 Nature of Hazards.

6.2.1* Fire and Explosions. Electrical systems shall be designed to mitigate the risks from fire and explosions as dictated by the facility's emergency operations plan.

6.2.2 Shock. ~~**(Reserved)**~~Electrical systems shall be designed to mitigate the risks from shock to patients, staff, and visitors.

6.2.3 Thermal. ~~**(Reserved)**~~Electrical systems shall be designed to mitigate the risks from thermal conditions as dictated by the facility's emergency operations plan.

6.2.4 Natural Disasters. Electrical systems shall be designed to mitigate the risks from natural disasters and severe weather events as dictated by the facility's operations plan.

6.2.~~4~~5 Location of Electrical System Components.
6.2.~~4~~5.1

Electrical system components shall be located to minimize interruptions caused by natural forces common to the area or natural disasters identified in the facility's emergency operations plan.

6.2.~~4~~5.2

Installations of electrical sources shall be located to reduce possible interruption of electrical systems resulting from natural forces and to reduce possible disruption of electrical systems due to internal wiring and equipment failures.

6.2.~~4~~5.3

Feeders and associated raceways serving essential electrical system transfer equipment shall be located such that physical separation is provided between each of the electrical system feeders to prevent possible simultaneous interruption.

6.3 General.
6.3.1 Sources.

Each health care appliance requiring electrical power for operation shall be supplied by one or more power sources as required for the particular system.

6.3.1.1 Power/Utility Company. (Reserved)
6.3.1.2 On-Site Generator Set. (Reserved)
6.3.2 Distribution.
6.3.2.1*

Distribution system arrangements shall be designed to minimize interruptions to the electrical systems due to internal failures by the use of equipment rated for the application.

6.3.2.2 Receptacles.

6.3.2.2.1* Types of Receptacles.

(A)

Each receptacle shall provide at least one separate, grounding terminal capable of maintaining low-contact resistance with its mating plug, despite severe electrical and mechanical use of the receptacle. The grounding terminal of each receptacle shall be connected to the reference grounding point by means of an insulated copper equipment grounding conductor.

(B)

Special receptacles, such as the following, shall be permitted:

(1) Four-pole units providing an extra pole for redundant grounding or ground continuity monitoring

(2) Locking-type receptacles

(C)

All non-locking-type, 125-volt, 15- or 20-ampere single, duplex, or quadruplex type receptacles, or any combination thereof, located in operating rooms and at patient bed locations in Category 1 and Category 2 spaces shall be listed and identified as "hospital grade."

(D)

Receptacles that are located within patient rooms, bathrooms, playrooms, and activity rooms of pediatric units or spaces with similar risk as determined by the health care facility's governing body by conducting a risk assessment, other than infant nurseries, shall be listed and identified as "tamper resistant" or shall employ a listed tamper-resistant cover.

6.3.2.2.2 Minimum Number of Receptacles.

The number of receptacles shall be determined by the intended use of the spaces in accordance with 6.3.2.2.2(A) through 6.3.2.2.2(E).

(A) Receptacles Serving Patient Bed Locations in Category 2 Spaces.

Each patient bed location shall be provided with a minimum of eight non-locking-type, 125-volt, 15- or 20-ampere receptacles, at least four of which shall be connected to either ~~the normal~~ a non-essential branch circuit or a critical branch circuit supplied by a different transfer switch other than the receptacles at the same location. These receptacles shall be permitted to be of the single, duplex, or quadruplex type, or any combination thereof. Other receptacles (e.g., portable x-ray receptacles) serving special-purpose, cord-and-plug-connected equipment shall be permitted to be of the locking or non-locking-type.

(B) Receptacles Serving Patient Bed Locations in Category 1 Spaces Other than Operating Rooms.

Each patient bed location shall be provided with a minimum of 14 non-locking-type, 125-volt, 15- or 20-ampere receptacles, at least seven of which shall be connected to either ~~the normal~~ a non-essential branch circuit or a critical branch circuit supplied by a different transfer switch other than the receptacles at the same location. These receptacles shall be permitted to be of the single, duplex, or quadruplex type, or any combination thereof. Other receptacles (e.g., portable x-ray receptacles) serving special-purpose, cord-and-plug-connected equipment shall be permitted to be of the locking or non-locking-type.

(C) Receptacles in Operating Rooms.

Each operating room shall be provided with a minimum of 36 125-volt, 15- or 20-ampere receptacles, at least 12 of which shall be connected to either ~~the normal~~ a non-essential branch circuit or a critical branch circuit supplied by a different transfer switch other than the receptacles at the same location. They shall be permitted to be of the single, duplex, or quadruplex type, or any combination of the three. Other receptacles (e.g., portable x-ray receptacles) serving special-purpose, cord-and-plug-connected equipment shall be permitted to be of the locking or non-locking-type.

(D) Receptacles in Bathrooms or Toilet Rooms.

Receptacles shall not be required in bathrooms or toilet rooms.

(E) Receptacles for Special Rooms.

Receptacles shall not be required in rooms where medical requirements mandate otherwise (e.g., certain psychiatric, pediatric, or hydrotherapy rooms).

6.3.2.2.3 Polarity of Receptacles.

Each receptacle shall be wired in accordance with *NFPA 70* to ensure correct polarity.

6.3.2.2.4 Other Services Receptacles.

Receptacles provided for other services having different voltages, frequencies, or types on the same premises shall be of such design that attachment plugs and caps used in such receptacles cannot be connected to circuits of a different voltage, frequency, or type, but shall be interchangeable within each classification and rating required for two-wire, 125-V, single-phase ac service.

6.3.2.2.5* Use of Isolated Ground Receptacles.
(A)

An isolated ground receptacle, if used, shall not defeat the purposes of the safety features of the grounding systems detailed in 6.3.2.5.1.

(B)

An isolated ground receptacle shall not be installed within a patient care vicinity.

(C)

Isolated grounding receptacles installed in branch circuits for patient care spaces shall be connected to an insulated equipment grounding conductor in accordance with 250.146(D) of *NFPA 70* in addition to the two equipment grounding conductor paths required in 6.3.2.5.1.4.

(D)

The equipment grounding conductor installed for isolated grounding receptacles in patient care areas shall be clearly identified using green insulation with one or more yellow stripes along its entire length.

6.3.2.2.6 Special-Purpose Outlets.

Branch circuits serving only special-purpose outlets or receptacles (e.g., portable x-ray receptacles) shall not be required to conform to the requirements of 6.4.3.

6.3.2.2.7* Clinical Laboratories.

Outlets with two to four receptacles, or an equivalent multioutlet assembly, shall be installed every 0.5 m to 1.0 m (1.6 ft to 3.3 ft) in instrument usage areas, and either installation shall be at least 80 mm (3.15 in.) above the countertop.

6.3.2.3 Wet Procedure Locations.
6.3.2.3.1*

Wet procedure locations shall be provided with special protection against electric shock.

6.3.2.3.2

This special protection shall be provided as follows:

(1) Power distribution system that inherently limits the possible ground-fault current due to a first fault to a low value, without interrupting the power supply

(2) Power distribution system in which the power supply is interrupted if the ground-fault current does, in fact, exceed the trip value of a Class A GFCI

6.3.2.3.3

The use of an isolated power system (IPS) shall be permitted as a protective means capable of limiting ground-fault current without power interruption if the IPS complies with 6.3.2.9.

6.3.2.3.~~3~~4

Patient beds, toilets, bidets, and wash basins shall not be required to be considered wet procedure locations.

6.3.2.3.~~4~~5*

Operating rooms shall be considered to be a wet procedure location, unless a risk assessment conducted by the health care governing body determines otherwise.

6.3.2.3.~~5~~6

If the risk assessment conducted by the health care facility's governing body~~, as defined in Chapter 3,~~ determines that the operating room is not a wet procedure location, then the special protection of 6.3.2.3 shall not be required.

~~**6.3.2.3.6**~~

~~In existing construction, the requirements of 6.3.2.3.1 shall not be required when a written inspection procedure, acceptable to the authority having jurisdiction, is performed by a designated individual at the hospital to indicate that equipment grounding conductors for 120-V, single-phase, 15-A and 20-A receptacles; equipment connected by cord and plug; and fixed electrical equipment are installed and maintained in accordance with *NFPA 70*, the applicable performance requirements of this chapter, and Chapter 10 of this code.~~

~~**(A)**~~

~~The procedure shall include electrical continuity tests of all required equipment, grounding conductors, and their connections.~~

~~**(B)**~~

~~Fixed receptacles, equipment connected by cord and plug, and fixed electrical equipment shall be tested as follows:~~

~~(1) When first installed~~

~~(2) Where there is evidence of damage~~

~~(3) After any repairs~~

~~**6.3.2.3.7**~~

~~The use of an isolated power system (IPS) shall be permitted as a protective means capable of limiting ground-fault current without power interruption if the IPS complies with 6.3.2.9.~~

6.3.2.3.~~7~~8*

Operating rooms defined as wet procedure locations shall be protected by either isolated power or ground-fault circuit interrupters.

6.3.2.3.~~8~~9

Where GFCI protection is used in an operating room, one of the following shall apply:

(1) Each receptacle shall be an individual GFCI device.

(2) Each receptacle shall be individually protected by a single GFCI device.

6.3.2.3.9

In existing construction, the requirements of 6.3.2.3.1 shall not be required when a written inspection procedure, acceptable to the authority having jurisdiction, is performed by a designated individual at the hospital to indicate that equipment grounding conductors for 120-V, single-phase, 15-A and 20-A receptacles; equipment connected by cord and plug; and fixed electrical equipment are installed and maintained in accordance with *NFPA 70*, the applicable performance requirements of this chapter, and Chapter 10 of this code.

(A)

The procedure shall include electrical continuity tests of all required equipment, grounding conductors, and their connections.

(B)
Fixed receptacles, equipment connected by cord and plug, and fixed electrical equipment shall be tested as follows:

(1) When first installed

(2) Where there is evidence of damage

(3) After any repairs

6.3.2.4* Circuits.
6.3.2.4.1

~~Normal~~Non-essential branch circuits serving a patient bed location shall be supplied from not more than one ~~normal~~non-essential branch-circuit distribution panel.

6.3.2.4.2

Branch circuits serving a patient bed location shall be permitted to be supplied from more than one critical branch-circuit distribution panel.

6.3.2.4.3

Only authorized personnel shall have access to overcurrent protective devices serving Category 1 and Category 2 spaces.

6.3.2.4.4

Overcurrent protective devices serving Category 1 and Category 2 spaces shall not be located in public access spaces.

6.3.2.4.5

Isolated power panels shall be permitted to be located in Category 1 spaces.

6.3.2.4.6

Low-voltage wiring shall comply with either of the following:

(1) Fixed systems of 30 V (dc or ac rms) or less shall be permitted to be ungrounded if the insulation between each ungrounded conductor and the primary circuit, which is supplied from a conventionally grounded distribution system, is the same protection as required for the primary voltage.

(2) A grounded low-voltage system shall be permitted if load currents are not carried on the equipment grounding conductors.

6.3.2.5 Grounding.
6.3.2.5.1

Grounding requirements shall comply with the requirements in 6.3.2.5.1.1 through 6.3.2.5.1.5.

6.3.2.5.1.1 Equipment Grounding Circuitry Integrity.

Equipment grounding and bonding conductors and patient care vicinity grounding and bonding conductors shall be installed such that the continuity of the system cannot be interrupted nor the resistance raised above an acceptable level by the installation, removal, or replacement of any installed device or end use equipment.

6.3.2.5.1.2 Reliability of Grounding.

The equipment grounding conductors shall conform to *NFPA 70.* Branch circuits serving electrical equipment within the patient care vicinity shall be provided with effective ground-fault current paths dual-fed by a wiring method that qualifies as an equipment grounding conductor and by an insulated copper equipment grounding conductor.

6.3.2.5.1.3 Separate Equipment Grounding Conductor.

When existing construction does not have a separate equipment grounding conductor, the continued use of the system shall be permitted if it meets the performance requirements in 6.3.3.1.

6.3.2.5.1.4 Grounding of Receptacles and Fixed Electrical Equipment in Patient Care Spaces.
(A) Wiring Methods.

All branch circuits serving patient care spaces shall be provided with an effective ground-fault current path by installation in a metal raceway system, or a cable having a metallic armor or sheath assembly. The metal raceway system, or metallic cable armor, or sheath assembly shall itself qualify as an equipment grounding conductor.

(B) Insulated Equipment Grounding Conductors and Insulated Equipment Bonding Jumpers.

The following shall be directly connected to an insulated copper equipment grounding conductor that is clearly identified along its entire length by green insulation, with no yellow stripes, and installed with the branch circuit conductors in the wiring methods as provided in 6.3.2.5.1.4(A):

(1) The grounding terminals of all receptacles other than isolated ground receptacles.

(2) Where receptacles are mounted in metal receptacle outlet boxes, metal device boxes, or metal enclosures, the performance of the connection between the receptacle grounding terminal and the metal box or enclosure shall be equivalent to the performance provided by copper wire sized in accordance with 250.146 and Table 250.122 of *NFPA 70*, but no smaller than 12 AWG.

(3) All non-current-carrying conductive surfaces of fixed electrical equipment likely to become energized and subject to personal contact, operating at over 100 volts.

(4) Metal faceplates, which shall be connected to the equipment grounding conductor by means of a metal mounting screw(s) securing the faceplate to a grounded outlet box or grounded wiring device.

(5) Luminaires more than 2.3 m (7½ ft) above the floor and switches located outside of the patient care vicinity, which shall be permitted to be connected to an equipment grounding return path complying with 6.3.2.5.1.4(A) ~~and~~or 6.3.2.5.1.4(B).

6.3.2.5.1.5* Grounding Interconnects.

In patient care spaces supplied by more than one power source, ~~the normal distribution system and any branch of the essential electrical system,~~ the grounding system of the power sources ~~the normal distribution system and that of the essential electrical system~~ shall be interconnected.

6.3.2.5.2 Patient Equipment Grounding Point.

A patient equipment grounding point comprised~~ing~~of one or more grounding terminals or jacks shall be permitted in an accessible location in the patient care vicinity.

6.3.2.5.3* Special Grounding in Patient Care Rooms.

In addition to the grounding required to meet the performance requirements of 6.3.3.1, additional grounding shall be permitted where special circumstances so dictate.

6.3.2.6 Battery-Powered Lighting Units.
6.3.2.6.1

One or more battery-powered lighting units shall be provided within locations where deep sedation and general anesthesia is administered.

6.3.2.6.2

The lighting level of each unit shall be sufficient to terminate procedures intended to be performed within the operating room.

6.3.2.6.3

The sensor for units shall be wired to the unswitched portion of branch circuit(s) serving general lighting within the room.

6.3.2.6.4

The Level 1 or Level 2 EPS [emergency power supply] equipment location(s) shall be provided with battery-powered emergency lighting. This requirement shall not apply to units located outdoors in enclosures that do not include walk-in access. [**110:**7.3.1]

6.3.2.6.5

The emergency lighting charging system and the normal service room lighting shall be supplied from the load side of the transfer switch. [**110:**7.3.2]

6.3.2.6.6

The minimum average horizontal illumination provided by ~~normal~~non-essential lighting sources in the separate building or room housing the EPS equipment for Level 1 shall be 32.3 lux (3.0 ft-candles) measured at the floor level, unless otherwise specified by a requirement recognized by the authority having jurisdiction. ~~[**110:**7.3.3]~~

6.3.2.6.7

Units shall be capable of providing lighting for 1½ hours.

6.3.2.6.8

Units shall be tested monthly for 30 seconds, and annually for 30 minutes.

6.3.2.7 Other Non-Patient Care Areas. (Reserved)
6.3.2.8 Ground-Fault Protection.
6.3.2.8.1 Ground-Fault Protection of Equipment (GFPE).
6.3.2.8.1.1 Applicability.

The requirements of 6.3.2.8.1 shall apply to health care facilities housing Category 1 spaces or using life-support equipment and buildings that provide essential utilities or services for the operation of Category 1 spaces or electrical life-support equipment.

6.3.2.8.1.2 Disconnecting Means.

Where ground-fault protection is provided for operation of the service or feeder disconnecting means in accordance with 517.17 of *NFPA 70*, an additional step of ground-fault protection shall be provided at the disconnecting means for the next level of feeders downstream toward the load.

6.3.2.8.1.3 Selectivity.

GFPE for operation of the service and feeder disconnecting means shall be fully selective such that the downstream device and not the upstream device opens for downstream ground faults.

6.3.2.8.2 Ground-Fault Circuit-Interrupter (GFCI) Protection of Personnel.

Ground-fault circuit interrupters (GFCIs) shall be listed.

6.3.2.9* Isolated Power Systems.
6.3.2.9.1 Isolation Transformer.

An isolated power system shall not be required to be installed in any patient care space, except as specified in 6.3.2.3.

6.3.2.9.1.1

The isolation transformer shall be listed and approved for the purpose.

6.3.2.9.1.2

The primary winding shall be connected to a power source so that it is not energized with more than 600 V (nominal).

(A)

If present, the neutral of the primary winding shall be grounded in an approved manner.

(B)

If an electrostatic shield is present, it shall be connected to the reference grounding point.

6.3.2.9.1.3

Wiring of isolated power systems shall be in accordance with 517.160 of *NFPA 70*.

6.3.2.9.2 Impedance of Isolated Wiring.
6.3.2.9.2.1*

The impedance (capacitive and resistive) to ground of either conductor of an isolated system shall exceed 200,000 ohms when installed. The installation at this point shall include receptacles but is not required to include lighting fixtures or components of fixtures. This value shall be determined by energizing the system and connecting a low-impedance ac milliammeter (0 to 1 mA scale) between the reference grounding point and either conductor in sequence. This test shall be permitted to be performed with the line isolation monitor *(see 6.3.2.9.3.1)* connected, provided that the connection between the line isolation monitor and the reference grounding point is open at the time of the test. After the test is made, the milliammeter shall be removed and the grounding connection of the line isolation monitor shall be restored. When the installation is completed, including permanently connected fixtures, the reading of the meter on the line isolation monitor, which corresponds to the unloaded line condition, shall be made. This meter reading shall be recorded as a reference for subsequent line impedance evaluation. This test shall be conducted with no phase conductors grounded.

6.3.2.9.2.2

An approved capacitance suppressor shall be permitted to be used to improve the impedance of the permanently installed isolated system; however, the resistive impedance to ground of each isolated conductor of the system shall be at least 1 megohm prior to the connection of the suppression equipment. Capacitance suppressors shall be installed so as to prevent inadvertent disconnection during normal use.

6.3.2.9.3 Line Isolation Monitor.
6.3.2.9.3.1*

In addition to the usual control and protective devices, each isolated power system shall be provided with an approved, continually operating line isolation monitor that indicates possible leakage or fault currents from either isolated conductor to ground.

6.3.2.9.3.2

The monitor shall be designed such that a green signal lamp, conspicuously visible in the area where the line isolation monitor is utilized, remains lighted when the system is adequately isolated from ground; and an adjacent red signal lamp and an audible warning signal (remote if desired) shall be energized when the total hazard current (consisting of possible resistive and capacitive leakage currents) from either isolated conductor to ground reaches a threshold value of 5.0 mA under normal line voltage conditions. The line isolation monitor shall not alarm for a fault hazard current of less than 3.7 mA.

6.3.2.9.3.3*

The line isolation monitor shall comply with either of the following:

(1) It shall have sufficient internal impedance such that, when properly connected to the isolated system, the maximum internal current that will flow through the line isolation monitor, when any point of the isolated system is grounded, shall be 1 mA.

(2) It shall be permitted to be of the low-impedance type such that the current through the line isolation monitor, when any point of the isolated system is grounded, will not exceed twice the alarm threshold value for a period not exceeding 5 milliseconds.

6.3.2.9.3.4*

An ammeter connected to indicate the total hazard current of the system (contribution of the fault hazard current plus monitor hazard current) shall be mounted in a plainly visible place on the line isolation monitor with the "alarm on" zone (total hazard current = 5.0 mA) at approximately the center of the scale. A line isolation monitor shall be located in the operating room.

6.3.2.9.3.5

Means shall be provided for shutting off the audible alarm while leaving the red warning lamp activated. When the fault is corrected and the green signal lamp is reactivated, the audible alarm-silencing circuit shall reset automatically, or an audible or distinctive visual signal shall indicate that the audible alarm is silenced.

6.3.2.9.3.6

A reliable test switch shall be mounted on the line isolation monitor to test its capability to operate (i.e., cause the alarms to operate and the meter to indicate in the "alarm on" zone). This switch shall transfer the grounding connection of the line isolation monitor from the reference grounding point to a test impedance arrangement connected across the isolated line; the test impedance(s) shall be of the appropriate magnitude to produce a meter reading corresponding to the rated total hazard current at the nominal line voltage, or to a lesser alarm hazard current if the line isolation monitor is so rated. The operation of this switch shall break the grounding connection of the line isolation monitor to the reference grounding point before transferring this grounding connector to the test impedance(s), so that making this test will not add to the hazard of a system in actual use; nor will the test include the effect of the line-to-ground stray impedance of the system. The test switch shall be of a self-restoring type.

6.3.2.9.3.7

The line isolation monitor shall not generate energy of sufficient amplitude or frequency, as measured by a physiological monitor with a gain of at least 104 with a source impedance of 1000 ohms connected to the balanced differential input of the monitor, to create interference or artifact on human physiological signals. The output voltage from the amplifier shall not exceed 30 mV when the gain is 104. The impedance of 1000 ohms shall be connected to the ends of typical unshielded electrode leads that are a normal part of the cable assembly furnished with physiological monitors. A 60 Hz notch filter shall be used to reduce ambient interference, as is typical in physiological monitor design.

6.3.2.9.4 Identification of Conductors for Isolated (Ungrounded) Systems.

The isolated conductors shall be identified in accordance with 517.160(A)(5) of *NFPA 70.*

6.3.3 Performance Criteria and Testing.
6.3.3.1 Grounding System in Patient Care Spaces.
6.3.3.1.1* Grounding System Testing.

The effectiveness of the grounding system shall be determined by voltage measurements and impedance measurements.

6.3.3.1.1.1

For new construction, the effectiveness of the grounding system shall be evaluated before acceptance.

6.3.3.1.1.2

Small wall-mounted conductive surfaces not likely to become energized, such as surface-mounted towel and soap dispensers, mirrors, and so forth, shall not be required to be intentionally grounded or tested.

6.3.3.1.1.3

Large metal conductive surfaces not likely to become energized, such as windows, door frames, and drains, shall not be required to be intentionally grounded or periodically tested.

6.3.3.1.1.4*

Whenever the electrical system has been altered or replaced, that portion of the system shall be tested.

6.3.3.1.2 Reference Point.

The voltage and impedance measurements shall be taken with respect to a reference point, which shall be one of the following:

(1) Reference grounding point *(see Chapter 3)*

(2) Grounding point, in or near the room under test, that is electrically remote from receptacles (e.g., an all-metal cold-water pipe)

(3) Grounding contact of a receptacle that is powered from a different branch circuit from the receptacle under test.

6.3.3.1.3* Voltage Measurements.
6.3.3.1.3.1

The voltage measurements shall be made under no-fault conditions between a reference point and exposed fixed electrical equipment with conductive surfaces in a patient care vicinity.

6.3.3.1.3.2

The voltage measurements shall be made with an accuracy of ± 5 percent.

6.3.3.1.3.3

Voltage measurements for faceplates of wiring devices shall not be required.

6.3.3.1.4* Impedance Measurements.

The impedance measurement shall be made with an accuracy of ± 5 percent.

6.3.3.1.4.1

For new construction, the impedance measurement shall be made between the reference point and the grounding contact of 10 percent of all receptacles within the patient care vicinity.

6.3.3.1.4.2

The impedance measurement shall be the ratio of voltage developed (either 60 Hz or dc) between the point under test and the reference point to the current applied between these two points.

6.3.3.1.5 Test Equipment.

Electrical safety test instruments shall be tested periodically, but not less than annually, for acceptable performance.

6.3.3.1.5.1

Voltage measurements specified in 6.3.3.1.3 shall be made with an instrument having an input resistance of 1000 ohms ± 10 percent at frequencies of 1000 Hz or less.

6.3.3.1.5.2

The voltage across the terminals (or between any terminal and ground) of resistance-measuring instruments used in occupied patient care rooms shall not exceed 500 mV rms or 1.4 dc or peak to peak.

6.3.3.1.6 Criteria for Acceptability for New Construction.
6.3.3.1.6.1

The voltage limit shall be 20 mV.

6.3.3.1.6.2

The impedance limit shall be 0.2 ohm for systems containing isolated ground receptacles and 0.1 ohm for all others.

6.3.3.2 Receptacle Testing in Patient Care Spaces.
6.3.3.2.1

The physical integrity of each receptacle shall be confirmed by visual inspection.

6.3.3.2.2

The continuity of the grounding circuit in each electrical receptacle shall be verified.

6.3.3.2.3

Correct polarity of the hot and neutral connections in each electrical receptacle shall be confirmed.

6.3.3.2.4

The retention force of the grounding blade of each electrical receptacle (except locking-type receptacles) shall be not less than 115 g (4 oz).

6.3.3.2.5

Where hospital-grade receptacles are required at patient bed locations and in locations where deep sedation or general anesthesia is administered, testing shall be performed after initial installation, replacement, or servicing of the device.

6.3.3.2.6

Additional testing of receptacles in patient care spaces shall be performed at intervals defined by documented performance data.

6.3.3.2.7

Receptacles not listed as hospital-grade, at patient bed locations and in locations where deep sedation or general anesthesia is administered, shall be tested at intervals not exceeding 12 months.

6.3.3.3 Isolated Power Systems.
6.3.3.3.1 Patient Care Spaces.

If installed, the isolated power system shall be tested in accordance with 6.3.3.3.2.

6.3.3.3.2 Line Isolation Monitor Tests.

The line isolation monitor (LIM) circuit shall be tested after installation, and prior to being placed in service, by successively grounding each line of the energized distribution system through a resistor whose value is 200 × V (ohms), where V equals measured line voltage. The visual and audible alarms *(see 6.3.2.9.3.2)* shall be activated.

6.3.3.3.3

The LIM circuit shall be tested at intervals of not more than 1 month by actuating the LIM test switch *(see 6.3.2.9.3.6)*. For a LIM circuit with automated self-test and self-calibration capabilities, this test shall be performed at intervals of not more than 12 months. Actuation of the test switch shall activate both visual and audible alarm indicators.

6.3.3.3.4

After any repair or renovation to an electrical distribution system, the LIM circuit shall be tested in accordance with 6.3.3.3.2.

6.3.3.4 Ground-Fault Protection Testing.

When equipment ground-fault protection is first installed, each level shall be performance-tested to ensure compliance with 6.3.2.8.

6.3.4 Administration of Electrical System.
6.3.4.1 Record Keeping.
6.3.4.1.1*

A record shall be maintained of the tests required by this chapter and associated repairs or modification.

6.3.4.1.2

At a minimum, the record shall contain the date, the rooms or areas tested, and an indication of which items have met, or have failed to meet, the performance requirements of this chapter.

6.3.4.1.3 Isolated Power System (Where Installed).

A permanent record shall be kept of the results of each of the tests.

6.4 Category 1 Spaces.
6.4.1

Category 1 spaces shall be served by an essential electrical system in accordance with 6.7.5.

6.4.2

Category 1 spaces shall not be served by an essential electrical system in accordance with 6.7.6.

6.4.3

Category 1 spaces shall be served by circuits from a critical branch panel(s) served from a single automatic transfer switch and a minimum of one circuit served by ~~the normal~~ nonessential power ~~distribution system~~ or by a system originating from a second critical branch automatic transfer switch.

6.4.4

An essential electrical system in accordance with 6.7.5 serving a Category 1 space shall be permitted to serve Category 2 spaces in the same facility.

6.5 Category 2 Spaces.

6.5.1

Category 2 spaces shall be served by a Type 1 or Type 2 EES.

6.5.2

Category 2 spaces served by a Type 1 or Type 2 EES shall be served by circuits from a branch panel(s) served from a single automatic transfer switch and a minimum of one circuit served by the ~~normal~~ nonessential power ~~distribution system~~ or by a system originating from a second automatic transfer switch.

6.6 Category 3 and 4 Spaces.
6.6.1

Category 3 or Category 4 spaces shall not be required to be served by an EES.

6.7* Essential Electrical Systems.
6.7.1.1* Design Considerations.

Essential electrical system loads shall be supplied by a minimum of two independent sources or sets of sources and sets of feeders designed to ensure sufficient reliability to provide effective facility operation consistent with the facility's emergency operations plan.

6.7.1.1.1

Current-sensing devices, phase and ground, shall be selected to minimize the extent of interruption to the electrical system due to abnormal current caused by overload or short circuits, or both.

6.7.1.1.2

The essential electrical system shall have a minimum of two independent power sources or sets of power sources.

6.7.1.1.2.1

At least one power source shall be on-site and sized to supply the entire essential electrical system.

6.7.1.1.2.2

The additional power source(s) shall be permitted to be either on-site or off-site.

6.7.1.2 General.

Alternate power sources for essential electrical systems shall be designed to meet the requirements of such service.

6.7.1.2.1* Power Source.

Type 1 and Type 2 essential electrical system power sources shall be classified as Type 10, Class X, Level 1 sources as defined in Table 6.11.1(a).

6.7.1.2.2 Use for Essential Electrical System.
6.7.1.2.2.1

The power source supplying the essential electrical system shall be either reserved exclusively for such service or used for other purposes of peak demand control, internal voltage control, load relief for the external utility, cogeneration, or other approved uses.

6.7.1.2.2.2*

Each independent source or sets of sources supplying the essential electrical system shall be designed to meet the maximum demand likely to be produced by the connected load and be consistent with the facility's emergency operations plan.

6.7.1.2.2.3*
(A)

Sources supplying the essential electrical system shall be permitted to supply optional loads.

(B)

Optional loads shall be served by their own transfer means, such that they will not be transferred onto the generating equipment if the transfer would overload the equipment and will be shed prior to a generating equipment overload.

6.7.1.2.2.4

Where optional loads include contiguous or same-site facilities not covered in this code, provisions shall be made to meet the requirements of NFPA *101* for emergency egress under load-shed conditions.

6.7.1.2.2.5 Temporary On-Site Power Source for Maintenance or Repair of the On-Site Power Source.

(A)

If the essential electrical system relies on a single on-site power source that will be disabled for maintenance or repair, it shall include a permanent switching means to connect a portable or temporary on-site power source that is available for the duration of the maintenance or repair and that complies with the following requirements:

(1) The connection to the portable or temporary on-site power source shall not require modification of the permanent system wiring.

(2) Transfer of power to the portable or temporary on-site power source shall be in accordance with 6.7.2.1.3.

(3) The connection point for the portable or temporary on-site power source shall be marked with the phase rotation and system bonding requirements.

(4) Mechanical or electrical interlocking shall prevent inadvertent interconnection of power sources.

(5) The switching means shall include a contact point that annunciates at a location remote from the generator or at another facility monitoring system to indicate that the on-site power source is disconnected from the essential electrical system.

(B)

Using manual switching to switch from the on-site power source to the portable or temporary on-site power source and using the switching means for connection of a load bank shall be permitted.

(C)

The permanent switching means to connect a portable or temporary on-site power source for the duration of maintenance or repair shall not be required where any of the following conditions exists:

(1) All processes that rely on the essential electrical system source are capable of being disabled during maintenance or repair of the on-site power source.

(2) The building or structure is unoccupied and fire protection systems are fully functional and do not require an on-site power source.

(3) Other temporary on-site power sources can be substituted for the essential electrical system.

6.7.1.2.3.1 Indoor On-Site Power Source Installations.

Indoor on-site power sources for Level 1 installations shall be installed in a room dedicated to such sources.

(A)

The on-site power sources room shall be separated from the rest of the building by construction with a minimum 2-hour fire resistance rating.

(B)

The on-site power source equipment shall be permitted to be installed in the room with the on-site power sources.

(C)

No other equipment, including architectural appurtenances, except those that serve the space shall be permitted in the room containing the on-site power sources.

6.7.1.2.3.2 Outdoor On-Site Power Source Installations.

(A)

If the on-site power source is a generator, it shall comply with either of the following:

(1) The generator shall be installed in a suitable enclosure located outside the building and capable of resisting the entrance of snow or rain at a maximum wind velocity as required by local building codes.

(2) The generator shall be constructed such that it is capable of resisting the impacts of snow or rain.

(B)

Equipment serving a generator shall be permitted to be installed in the generator enclosure.

(C)

No other equipment, including architectural appurtenances, except those that serve the space shall be permitted in the generator enclosure.

6.7.1.2.3.3

On-site power source equipment for Level 1 systems shall not be installed in the same room as other power source service equipment where the service equipment is rated over 150 volts to ground and equal to or greater than 1000 amperes.

6.7.1.2.3.4

The rooms, enclosures, or separate buildings housing on-site power source equipment for Level 1 or Level 2 systems shall be designed and located to minimize damage from flooding, including that caused by the following:

(1) Firefighting

(2) Sewer water backup

(3) Other disasters or occurrences

6.7.1.2.3.5

Minimizing the possibility of damage resulting from interruptions of the on-site power source shall be a design consideration for that equipment.

6.7.1.2.3.6

Design considerations shall minimize the effect of the failure of one on-site power source on the continued operation of other units.

6.7.1.2.4* Capacity and Rating.

The essential electrical system source or sets of sources shall have the capacity and rating to meet the maximum demand likely to be produced by the connected load and be consistent with the facility's emergency operations plan.

6.7.1.2.5 Load Pickup.

The source or set of sources shall have the required capacity and response to pick up and carry the load within the time specified in Table 6.11.1(b) upon failure of the other source or set of sources.

6.7.1.2.6 Heating, Cooling, and Ventilating.

Design of the heating, cooling, and ventilation system for the on-site power sources room shall provide 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, as applicable

(8) Prevailing winds blowing against radiator fan discharge air

6.7.1.2.7 Alarm Annunciator.
6.7.1.2.7.1

A remote annunciator that is 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.

6.7.1.2.7.2

The annunciator shall be hard-wired to indicate alarm conditions of the on-site power source as indicated in 6.7.1.2.7.2(A) through 6.7.1.2.7.2(H).

(A)

Individual visual signals shall indicate the following:

(1) When the on-site power source is operating to supply power to load

(2) When the battery charger is malfunctioning (if provided)

(B)*

A remote, common audible alarm shall be provided as specified in 6.7.1.2.7.2(G). [**110:**5.6.6]

(C)

Local annunciation and either facility or network remote annunciation shall be provided for a Level 1 on-site power source.

(D)

For the purposes of defining the types of annunciation in 6.7.1.2.7.2(C), the following shall apply:

(1) Local annunciation is located on the equipment itself or within the same equipment room.

(2) Facility remote annunciation is located on site but not within the room where the equipment is located.

(3) Network remote annunciation is located off site.

[**110:**5.6.6.3]

(E)

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:**5.6.6.4]

(F)

In lieu of the requirement in 6.7.1.2.7.2(E), 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:**5.6.6.5]

(G)

Individual alarm indication to annunciate any of the conditions listed in Table 6.7.1.3.8.2 shall have the following characteristics:

(1) Be battery powered

(2) Be 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 switches to test the operation of all visual alarm indicators

(H)*

The following shall apply to centralized computer systems:

(1) They shall not be used as a substitute for the alarm annunciator in 6.7.1.2.7.

(2) They shall be permitted to supplement the alarm annunciator in 6.7.1.2.7.

(I)

Wireless transmission of the EPS data required by 6.7.1.3.8.2 and 6.7.1.3.8.3 shall be permitted.

6.7.1.3 Generator Set.

6.7.1.3.1 General.

A single generator set that operates the essential electrical system shall be permitted to be part of the system supplying the other purposes as specified in 6.7.1.2.2.1, provided that any such use will not decrease the mean period between service overhauls to less than 3 years.

6.7.1.3.2 Location.

The generator equipment shall be installed in a location that permits ready accessibility and a minimum of 0.9 m (36 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.

6.7.1.3.3 Maintenance of Temperature.

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

6.7.1.3.4* Heating, Cooling, and Ventilating.

With the generator running at rated load, ventilation airflow shall be provided to limit the maximum air temperature in the generator room or the enclosure housing the unit to the maximum ambient air temperature permitted by the generator manufacturer.

6.7.1.3.4.1

Consideration shall be given to all the heat emitted to the generator equipment room by the energy converter, uninsulated or insulated exhaust pipes, and other heat-producing equipment.

6.7.1.3.4.2*

If required by the manufacturer, ventilation shall be supplied to the generator equipment.

(A)

For generators supplying Level 1 EPSS, ventilation air shall be supplied directly from a source outside the building by an exterior wall opening or from a source outside the building by a 2-hour fire-rated air transfer system.

(B)

For generators supplying Level 1 EPSS, discharge air shall be directed outside the building by an exterior wall opening or to an exterior opening by a 2-hour fire-rated air transfer system.

(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 generator equipment for Level 1 EPSS.

6.7.1.3.4.3

Ventilation air supply shall be from outdoors or from a source outside 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]

6.7.1.3.4.4

Ventilation air shall be provided to supply and discharge cooling air for radiator cooling of the generator when running at rated load.

(A)

Ventilation air supply and discharge for a radiator-cooled generator shall have a maximum static restriction of 125 Pa (0.5 in. of water column) in the discharge duct at the radiator outlet.

(B)

Radiator air discharge shall be ducted outdoors or to an exterior opening by a 2-hour rated air transfer system. [**110:**7.7.4.2]

6.7.1.3.4.5

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 generator equipment for Level 1 systems.

6.7.1.3.4.6

The ambient air temperature in the generator equipment room or outdoor housing containing Level 1 rotating equipment shall stabilize at not less than 4.5°C (40°F) when the equipment is not operating.

6.7.1.3.5* Energy Converters.

Internal combustion engine energy converters and associated cranking batteries shall be in accordance with the requirements of NFPA 110.

6.7.1.3.6 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

(4) Where the stored energy system has a "black start" capability in addition to normal discharge capability

[**110:**5.6.4.1.2]

6.7.1.3.7 Fuel Supply.

The fuel supply for the generator set shall comply with Sections 5.5 and 7.9 of NFPA 110.

6.7.1.3.8 Requirements for Safety Devices.
6.7.1.3.8.1 Internal Combustion Engines.

Internal combustion engines serving generator sets shall be equipped with the following:

(1) Sensor device plus visual warning device to indicate a water-jacket temperature below that required in 6.7.1.3.3

(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) 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) Common audible alarm device to warn that one or more of the prealarm or alarm conditions exist

6.7.1.3.8.2 Safety Indications and Shutdowns.

Safety indications and shutdowns shall be in accordance with Table 6.7.1.3.8.2.

Table 6.7.1.3.8.2 Safety Indications and Shutdowns

Indicator Function (at Battery Voltage)	Level 1		
	CV	S	RA
(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

Indicator Function (at Battery Voltage)	Level 1		
	CV	S	RA
(v) Remote emergency stop	—	X	—

CV: Control panel–mounted visual. S: Shutdown of EPS indication. RA: Remote audible. X: Required. O: Optional.

Notes:

(1) Item (p) is to be provided, but a separate remote audible signal is not required when the regular work site in 5.6.6 of NFPA 110 is staffed 24 hours a day.

(2) Item (b) is not required for combustion turbines.

(3) Item (r) or (s) is required only where used as a starting method.

(4) Item (j): EPS ac ammeter is permitted for this function.

(5) All required CV functions are to be visually annunciated by a remote, common visual indicator.

(6) All required functions indicated in the RA column are to be annunciated by a remote, common audible alarm as required in 5.6.5.2(4) of NFPA 110.

(7) Item (i) requires a low gas pressure alarm on gaseous systems.

(8) Item (b) must 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.

6.7.1.3.8.3

Individual visual signals plus a common audible signal to warn of an engine-generator alarm condition shall indicate the following:

(1) Low lubricating oil pressure

(2) Low water temperature (below that required in 6.7.1.3.3)

(3) Excessive water temperature

(4) Low fuel when the main fuel storage tank contains less than a 4-hour operating supply

(5) Overcrank (failed to start)

(6) Overspeed

6.7.1.4 Health Care Microgrid.

A health care microgrid in accordance with Section 6.10 shall be permitted to serve as the EPS for all or part of an essential electrical system.

6.7.2* Distribution.
6.7.2.1 General Requirements.
6.7.2.1.1* Coordination.
6.7.2.1.1.1

Overcurrent protective devices serving the essential electrical system shall be coordinated for the period of time that a fault's duration extends beyond 0.1 second.

6.7.2.1.1.2

Coordination shall not be required as follows:

(1) Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exists on the transformer secondary

(2) Between overcurrent protective devices of the same size (ampere rating) in series

6.7.2.1.2 Ground-Fault Protection of Equipment, Essential Electrical System.
6.7.2.1.2.1

Ground-fault protection of equipment with automatic disconnecting means shall not be required on alternate power supply sources, between alternate power supply sources and any essential electrical system transfer switch, or on the load side of any essential electrical system transfer switch.

6.7.2.1.2.2

Ground-fault indication without automatic disconnection shall be provided at any on-site power source.

6.7.2.1.3 Automatic Transfer Switch Features.
6.7.2.1.3.1 Source Monitoring.
(A)*

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

(1) 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 other power source.

(2) *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 the primary power source shall be initiated.

(B)

Both voltage-sensing and frequency-sensing equipment shall be provided to monitor one ungrounded line of the power sources.

(C)

Transfer to a power source shall be inhibited until the voltage and frequency are within a specified range to handle loads to be served.

(D)

Sensing equipment shall not be required in the transfer switch, provided it is included with the engine control panel. [**110:**6.2.2.3.1]

(E)

Frequency-sensing equipment shall not be required for monitoring the off-site power source.

6.7.2.1.3.2 Interlocking.

Mechanical interlocking or an approved alternate method shall prevent the inadvertent interconnection of any two separate power sources.

6.7.2.1.3.3* Manual Operation.

Instruction and equipment shall be provided for safe manual nonelectric transfer in the event the transfer switch malfunctions. [**110:**6.2.4]

6.7.2.1.3.4* Time Delay on Starting of Power Sources.
(A)

A time-delay device shall be provided to delay starting of the on-site power source.

(B)

The time-delay device shall prevent nuisance starting of the power source and possible subsequent load transfer in the event of harmless momentary power dips and interruptions of the primary power source.

6.7.2.1.3.5 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]

6.7.2.1.3.6 Time Delay on Transfer.

An adjustable time-delay device shall be provided to delay transfer and sequence load transfer to the power source to avoid excessive voltage drop when the transfer switch is installed for Level 1 use.

(A) Time Delay Commencement.

The time delay shall commence when proper voltage and frequency are achieved.

(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]

6.7.2.1.3.7* Time Delay on Retransfer to Primary Power Source.

An adjustable time-delay device with automatic bypass shall be provided to delay retransfer from one power source to the other power source, and allow the power source to stabilize before retransfer of the load.

6.7.2.1.3.8 Time Delay Bypass If a Power Source Fails.

The time delay shall be automatically bypassed if a power source fails.

(A)

The transfer switch shall be permitted to be programmed for a manually initiated retransfer to the on-site power source to provide for a planned momentary interruption of the load.

(B)

If used, the arrangement in 6.7.2.1.3.8(A) shall be provided with a bypass feature to allow automatic retransfer in the event that the on-site power source fails and the other power source is available.

6.7.2.1.3.9 Time Delay on Engine Shutdown.

A minimum time delay of 5 minutes shall be provided for unloaded running of a generator prior to shutdown to allow for engine cooldown.

(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 if it is included with the engine control panel or if a utility feeder is used as a power source.

6.7.2.1.3.10 Test Switch.

A test means shall be provided on each automatic transfer switch (ATS) that simulates failure of one power source and then transfers the load to another power source(s).

6.7.2.1.3.11* Indication of Transfer 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]

6.7.2.1.3.12 Motor Load Transfer.

Provisions shall be included to reduce currents resulting from motor load transfer if such currents could damage power source equipment or cause nuisance tripping of power source overcurrent protective devices.

6.7.2.1.3.13* Isolation of Neutral Conductors.

Provisions shall be included for ensuring continuity, transfer, and isolation of the power source neutral conductors wherever they are separately grounded to achieve ground-fault sensing.

6.7.2.1.3.14 Retransfer.

If a power source or set of power sources fails during a test, provisions shall be made to immediately retransfer to the other power source or set of power sources.

6.7.2.1.3.15 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.

6.7.2.1.3.16* Automatic Transfer Switch.
(A)

Transfer of all loads shall be accomplished using an automatic transfer switch(es).

(B)

Each automatic transfer switch of 600 V or less shall be listed for the purpose and marked for emergency use.

6.7.2.1.3.17* 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 Transfer 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]

6.7.2.1.4 Nonautomatic Transfer Device Classification.

Nonautomatic transfer devices of 600 V or less shall be listed for the purpose and approved.

6.7.2.1.5 Nonautomatic Transfer Device Features.
6.7.2.1.5.1 General.

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

6.7.2.1.5.2 Interlocking.

Reliable mechanical interlocking or an approved alternate method shall prevent the inadvertent interconnection of two power sources.

6.7.2.1.5.3 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]

6.7.2.1.6 Bypass and Isolating Transfer Switches.

Bypass-isolation switches shall be permitted for bypassing and isolating the transfer switch and installed in accordance with 6.4.2, 6.4.3, and 6.4.4 of NFPA 110. [**110:**6.4.1]

6.7.2.1.6.1 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]

6.7.2.1.6.2 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]

6.7.2.1.6.3* 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]

6.7.2.1.6.4 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]

6.7.2.2 Branches.
6.7.2.2.1

The division between the branches shall occur at transfer switches where more than one transfer switch is required.

6.7.2.2.2

Each branch shall be arranged for connection, within the time limits specified in this chapter, to another power source following a loss of a power source or set of sources.

6.7.2.2.3

The number of transfer switches to be used shall be based upon reliability, design, and load considerations.

6.7.2.2.3.1

Each branch of the essential electrical system shall have one or more transfer switches.

6.7.2.2.3.2

One transfer switch shall be permitted to serve one or more branches in a facility with a continuous load on the switch of 150 kVA (120 kW) or less.

6.7.2.2.3.3
(A)

Where a single transfer switch is used as permitted in 6.7.2.2.3.2, the following requirements shall apply:

(1) The single transfer switch shall include a bypass-isolation switch to facilitate maintenance of the transfer switch without jeopardizing continuity of power to the connected load.

(2) Division into separate branches shall not be required.

(B)

A bypass-isolation switch in accordance with 6.7.2.2.3.3(A) shall not be required where any of the following conditions exist:

(1) All processes that rely on the essential electrical system are capable of being disabled during maintenance or repair activities.

(2) The building or structure is unoccupied and fire protection systems are fully functional and do not require an alternate power source.

(3) Other temporary means are permitted to be substituted for the essential electrical system.

6.7.2.2.4 Feeders from On-Site Power Source.
6.7.2.2.4.1

A single feeder supplied by the on-site power source shall be permitted to supply the essential electrical system to the point at which the life safety, critical, and equipment branches are separated.

6.7.2.2.4.2

Installation of the transfer equipment shall be permitted at locations other than that of the on-site power source.

6.7.2.2.5 Receptacles.

The requirements for receptacles shall comply with 6.7.2.2.5(A) and 6.7.2.2.5(B).

(A)

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 life safety and critical branches shall have a distinctive color or marking so as to be readily identifiable.

6.7.2.2.6 Switches.

Switches of all types shall be permitted in the lighting circuits connected to the essential electrical system in accordance with NFPA *101*.

6.7.2.2.7

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*.

6.7.3 Performance Criteria and Testing.
6.7.3.1 Transfer Switches.

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

6.7.3.2

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.

6.7.3.3

Failure of the normal source shall automatically start the other power source after a short delay, as described in 6.7.2.1.3.4.

6.7.3.3.1

When the other power source has attained a voltage and frequency that satisfies the minimum operating requirements of the essential electrical system, the load shall be connected automatically to the that source.

6.7.3.4 Generator Control Wiring.

Control conductors installed between the transfer switch and the emergency generator(s) shall be kept entirely independent of all other wiring.

6.7.3.4.1

The integrity of the generator remote start circuit shall be monitored for broken, disconnected, or short-circuited wires.

6.7.3.4.2

Loss of integrity shall start the generator(s).

6.7.3.5

Upon connection of a power source, the loads comprising the life safety and critical branches shall be automatically re-energized.

6.7.3.5.1

The load comprising the equipment branch shall be connected either automatically after a time delay, as described in 6.7.2.1.3.6, or nonautomatically and in a sequential manner that will not overload the other power source.

6.7.3.6

When the first power source is restored, and after a time delay as described in 6.7.2.1.3.7, the automatic transfer switches shall disconnect the other power source and connect the loads to the first power source.

6.7.3.6.1

The other power source shall continue to run unloaded for a preset time delay, as described in 6.7.2.1.3.9.

6.7.3.7

If a power source fails and the other power source has been restored, retransfer to the other power source shall be immediate, bypassing the retransfer delay timer.

6.7.3.8

Nonautomatic transfer switching devices shall be restored as soon as possible or at the discretion of the operator.

6.7.4 Administration.
6.7.4.1 Maintenance and Testing of Essential Electrical System.
6.7.4.1.1 Maintenance and Testing of On-Site Power Source, Transfer Switches, and Associated Equipment.
6.7.4.1.1.1 Maintenance of On-Site Power Source.

The on-site power source and associated equipment, including all appurtenance parts, shall be maintained such that it is capable of supplying service within the shortest time practicable and within the 10-second interval specified in 6.7.1.2.5 and 6.7.5.3.1.

6.7.4.1.1.2
(A)

The 10-second criterion shall not apply during the monthly testing of an essential electrical system.

(B)

If the 10-second criterion is not met during the monthly test, a process shall be provided to annually confirm the capability of the life safety and critical branches to comply with 6.7.5.3.1.

6.7.4.1.1.3

Maintenance shall be performed in accordance with Section 6.9.

6.7.4.1.1.4

Maintenance of the electrical equipment for the life safety branch, critical branch, and equipment branch shall be maintained in accordance with the manufacturer's instructions and preventative maintenance programs.

6.7.4.1.1.5 Inspection and Testing.

Criteria, conditions, and personnel requirements shall be in accordance with 6.7.4.1.1.5(A) through 6.7.4.1.1.5(C).

(A)* Test Criteria.

Testing criteria shall be as follows:

(1) Generator sets shall be tested 12 times a year, with testing intervals of not less than 20 days nor more than 40 days.

(2) Generator sets serving essential electrical systems shall be tested in accordance with Chapter 8 of NFPA 110.

(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 qualified personnel to keep the machines ready to function and, in addition, serve to detect causes of malfunction and to train personnel in operating procedures.

6.7.4.1.1.6

When a transfer switch is bypassed to facilitate maintenance, one of the following conditions shall apply:

(1) The bypass switch automatically transfers the load between power sources upon loss of the connected power source.

(2) The bypass switch remains actively supervised by a qualified person who can manually initiate a transfer of the load between power sources.

6.7.4.1.1.7

Where bypass isolation switches are used, inadvertent parallel operation shall be avoided.

6.7.4.1.2 Maintenance and Testing of Circuitry.
6.7.4.1.2.1 Insulation Resistance.

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

6.7.4.1.2.2 Maintenance of Batteries.

Batteries for on-site generators shall be maintained in accordance with NFPA 110.

6.7.4.2 Record Keeping.

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

6.7.5* Type 1 Essential Electrical System Requirements.
6.7.5.1* Branches.
6.7.5.1.1

The essential electrical system shall be divided into the following three branches:

(1) Life safety

(2) Critical

(3) Equipment

6.7.5.1.2 Life Safety Branch.
6.7.5.1.2.1

The life safety branch shall be limited to circuits essential to life safety.

6.7.5.1.2.2

The life safety branch shall supply power as follows:

(1) Illumination of means of egress in accordance with NFPA *101*

(2) Exit signs and exit directional signs in accordance with NFPA *101*

(3) *Communications systems as follows:~~,~~

(a) ~~w~~Where used for issuing instruction during emergency conditions

(b) All components of Emergency Responder Radio Communications Systems (ERRCs)

(4) Generator set location as follows:

(a) Task illumination

(b) Battery charger for emergency battery-powered lighting unit(s)

(c) Selected receptacles at the generator set location and essential electrical system transfer switch locations

(5) Elevator cab lighting, control, communications, and signal systems

(6) Electrically powered doors used for building egress

(7) Fire alarms and auxiliary functions of fire alarm combination systems complying with *NFPA 72*

6.7.5.1.2.3

Alarm and alerting systems (other than fire alarm systems) shall be connected to the life safety branch or critical branch.

6.7.5.1.2.4

Loads dedicated to a specific generator, including the fuel transfer pump(s), ventilation fans, electrically operated louvers, controls, cooling system, and other generator accessories essential for generator operation, shall be connected to the life safety branch or the output terminals of the generator with overcurrent protective devices.

6.7.5.1.2.5

No functions other than those in 6.7.5.1.2.2, 6.7.5.1.2.3, and 6.7.5.1.2.4 shall be connected to the life safety branch, except as specifically permitted in 6.7.5.1.2.

6.7.5.1.2.6 Branch Circuits for Life Safety Lighting.

Branch circuits supplying life safety lighting shall be served from a source in compliance with 6.7.1 when the normal supply for lighting is interrupted or where single circuits supply luminaires containing secondary batteries.

6.7.5.1.2.7 Life Safety Lighting Circuit Switches.

Life safety lighting circuit switches shall meet the following requirements:

(1) The switch(es) for the life safety lighting circuits shall be arranged so that only authorized persons have control of the life safety lighting switch(es) unless one of the following conditions are met:

(a) Where two or more single-throw switches are connected in parallel to control a single circuit, at least one of these switches is accessible only to authorized persons.

(b) Additional switches are included that act only to put life safety lights into operation, but not to disconnect them.

(2) Switches connected in series or 3- and 4-way switches shall not be used.

(3) All manual switches for controlling life safety lighting shall meet the following requirements:

(a) The manual switches shall be in locations convenient to authorized persons responsible for their actuation unless there are multiple switches provided.

(b) One of the switches shall be permitted to be located so that it can only energize, but not de-energize, the circuit.

6.7.5.1.2.8 Life Safety Lighting Dimmer and Relay Systems.

A dimmer or relay system containing more than one dimmer or relay and listed for emergency use shall be permitted to be used as a control device for energizing life safety lighting circuits.

(A)

Upon failure of normal power, the dimmer or relay system shall be permitted to selectively energize only those branch circuits necessary to provide the minimum required illumination using a control bypass function.

(B)

Where the dimmer or relay system is supplied by an upstream transfer switch, normal power sensing for this function shall be permitted to be from a normal-only power source upstream of the transfer switch.

6.7.5.1.2.9 Directly Controlled Life Safety Luminaires.

Where life safety illumination is provided by a directly controlled life safety luminaire(s) that responds to an external control input, or loss thereof, to bypass normal control upon loss of normal power, the luminaire(s) and external bypass control(s) shall be individually listed for emergency use.

6.7.5.1.2.10 Life Safety Lighting Automatic Load Control Relay.
(A)

If a life safety lighting load is automatically energized upon loss of the normal supply, a listed automatic load control relay shall be permitted to energize the load.

(B)

The load control relay shall not be used as transfer equipment.

6.7.5.1.3* Critical Branch.
6.7.5.1.3.1

The critical branch shall be permitted to be subdivided into two or more branches.

6.7.5.1.3.2

The critical branch shall supply power for task illumination, fixed equipment, select receptacles, and select power circuits serving the following spaces and functions related to patient care:

(1) Category 1 spaces where deep sedation or general anesthesia is administered, task illumination, select receptacles, and fixed equipment

(2) Task illumination and select receptacles in the following:

(a) Patient care spaces, including infant nurseries, selected acute nursing areas, psychiatric bed areas (omit receptacles), and ward treatment rooms

(b) Medication preparation spaces

(c) Pharmacy dispensing spaces

(d) Nurses' stations — unless adequately lighted by corridor luminaires

(3) Additional specialized patient care task illumination and receptacles, where needed

(4) Nurse call systems

(5) Blood, bone, and tissue banks

(6) *Telecommunications entrance facility, telecommunications equipment rooms, and telecommunication rooms and equipment in these rooms.

(7) Task illumination, select receptacles, and select power circuits for the following areas:

(a) Category 1 or 2 spaces with at least one duplex receptacle per patient bed location, 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 (select)

(g) Human physiology labs

(h) Intensive care units

(i) Postoperative recovery rooms (select)

(8) Clinical IT-network equipment

(9) Wireless phone and paging equipment for clinical staff communications

(10) Additional task illumination, receptacles, and select power circuits needed for effective facility operation, including single-phase fractional horsepower motors, which are permitted to be connected to the critical branch

6.7.5.1.4 Equipment Branch.
6.7.5.1.4.1 General.

The equipment branch shall be connected to equipment described in 6.7.5.1.4.3 through 6.7.5.1.4.4.

6.7.5.1.4.2 Connection to On-Site Power Source.
(A)

The equipment branch shall be installed and connected to the ~~on-site~~ two independent power sources or sets of sources such that equipment described in 6.7.5.1.4.3 is automatically restored to operation at appropriate time-lag intervals following the energizing of the life safety and critical branches.

(B)

The ~~arrangement of the connection to the on-site power source~~ transfer between the independent sources or sets of sources shall also provide for the subsequent connection of equipment described in 6.7.5.1.4.4.

6.7.5.1.4.3* Equipment for Delayed-Automatic Connection.
(A)

Where ~~T~~the following equipment is present, it shall be permitted to be arranged for delayed-automatic connection to the on-site power source:

(1) Central suction systems serving medical and surgical functions, including controls, with such suction systems permitted to be placed 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, with such air systems permitted to be placed on the critical branch

(4) Smoke control and stair pressurization systems

(5) Kitchen hood supply or exhaust systems, or both, if required to operate during a fire in or under the hood

(6) Supply, return, and exhaust ventilating systems for the following:

(a) Airborne infectious/isolation rooms

(b) Protective environment rooms

(c) Exhaust fans for laboratory fume hoods

(d) Nuclear medicine areas where radioactive material is used

(e) Ethylene oxide evacuation

(f) Anesthetic evacuation

(B)

Where delayed-automatic connection is not appropriate, the ventilation systems specified in 6.7.5.1.4.3(A)(6) shall be permitted to be placed on the critical branch.

6.7.5.1.4.4* Equipment for Delayed-Automatic or Manual Connection.

Where the following equipment is present, ~~The following equipment~~ it shall be permitted to be arranged for either delayed-automatic or manual connection to the on-site power source *(also see A.6.7.5.1.4.3)*:

(1) Heating equipment used to provide heating for operating, delivery, labor, recovery, intensive care, and coronary care spaces; nurseries; infection/isolation rooms; emergency

treatment spaces; and general patient rooms and pressure maintenance (i.e., jockey or make-up) pumps 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) Outside design temperature is higher than −6.7°C (+20°F)

(b) Outside design temperature is lower than −6.7°C (+20°F), where a selected room(s) is provided for the needs of all confined patients [then only such room(s) need be heated]

(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 and coronary care spaces; nurseries; and emergency treatment spaces

(5) Hyperbaric facilities

(6) Hypobaric facilities

(7) Autoclaving equipment, which is permitted to be arranged for either automatic or manual connection to the alternate source

(8) Controls for equipment listed in 6.7.5.1.3

(9) *Other selected equipment, task illumination, receptacles, and select power circuits.

6.7.5.1.5

Generator load-shed circuits designed for the purpose of load reduction or for load priority systems shall not shed life safety branch loads, critical branch loads serving Category 1 spaces, medical air compressors, medical–surgical vacuum pumps, fire pumps, the pressure maintenance (i.e., jockey) pump(s) for water-based fire protection systems, generator fuel pumps, or other generator accessories.

6.7.5.2 Wiring Requirements.
6.7.5.2.1* Separation from Other Circuits.

The life safety branch and critical branch shall be kept independent of all other wiring and equipment.

6.7.5.2.2 Mechanical Protection of the Life Safety and Critical Branches.

The wiring of the life safety and critical branches shall be mechanically protected by raceways, as defined in *NFPA 70*.

6.7.5.2.3

Flexible power cords of appliances or other utilization equipment connected to the life safety and critical branches shall not be required to be enclosed in raceways.

6.7.5.3 Performance Criteria and Testing.

The life safety and critical branches shall be installed and connected to the on-site power source specified in 6.7.1.1.2 so that all functions specified herein for the life safety and critical branches are automatically restored to operation within 10 seconds after interruption of power.

6.7.6* Type 2 Essential Electrical System Requirements.
6.7.6.1 Sources.

The requirements for sources for Type 2 essential electrical systems shall conform to those listed in 6.7.1.

6.7.6.2 Distribution.
6.7.6.2.1* Branches.
6.7.6.2.1.1

The number of transfer switches to be used shall be based upon reliability, design, and load considerations.

6.7.6.2.1.2

The essential electrical system shall be divided into the following two branches:

(1) Life safety branch

(2) Equipment branch

6.7.6.2.1.3

Each branch of the essential electrical system shall have one or more transfer switches.

6.7.6.2.1.4

One transfer switch shall be permitted to serve one or more branches in a facility with a continuous load on the switch of 150 kVA (120 kW) or less.

6.7.6.2.1.5 Life Safety Branch.

(A) Required to be Connected.

The life safety branch shall supply power to the following:

(1) Illumination of means of egress in accordance with NFPA *101*

(2) Exit signs and exit directional signs in accordance with NFPA *101*

(3) Alarm and alerting systems, including the following:

(a) Fire alarms

(b) Alarms required for systems used for the piping of nonflammable medical gases as specified in Chapter 5

(4) *Communications systems, where used for issuing instructions during emergency conditions

(5) Task illumination and select receptacles at the generator set location

(6) Elevator cab lighting, control, communications, and signal systems

(B) Prohibited to be Connected.

No functions other than those listed in 6.7.6.2.1.5(A)(1) through 6.7.6.2.1.5(A)(6) shall be connected to the life safety branch.

(C) Branch Circuits for Life Safety Lighting.

Branch circuits that supply life safety lighting shall be served from a source in accordance with 6.7.1 when the normal supply for lighting is interrupted or where single circuits supply luminaries containing secondary batteries.

(D) Life Safety Lighting Circuit Switches.

Life safety lighting circuit switches shall meet the following requirements:

(1) The switch(es) for the life safety lighting circuits shall be arranged so that only authorized persons have control of the life safety lighting switch(es) unless one of the following conditions are met:

(a) Where two or more single-throw switches are connected in parallel to control a single circuit, at least one of these switches is accessible only to authorized persons.

(b) Additional switches are included that act only to put life safety lights into operation, but not to disconnect them.

(2) Switches connected in series or 3- and 4-way switches shall not be used.

(3) All manual switches for controlling life safety lighting shall meet the following requirements:

(a) The manual switches shall be in locations convenient to authorized persons responsible for their actuation unless there are multiple switches provided.

(b) One of the switches shall be permitted to be located so that it can only energize, but not de-energize, the circuit.

(E) Life Safety Lighting Dimmer and Relay Systems.

A dimmer or relay system containing more than one dimmer or relay and listed for emergency use shall be permitted to be used as a control device for energizing life safety lighting circuits. Upon failure of normal power, the dimmer or relay system shall be permitted to selectively energize only those branch circuits necessary to provide minimum required illumination using a control bypass function. Where the dimmer or relay system is supplied by an upstream transfer switch, normal power sensing for this function shall be permitted to be from a normal-only power source upstream of the transfer switch.

(F) Life Safety Lighting Automatic Load Control Relay.

If a life safety lighting load is automatically energized upon loss of the normal supply, a listed automatic load control relay shall be permitted to energize the load. The load control relay shall not be used as transfer equipment.

6.7.6.2.1.6 Equipment Branch.

(A) Equipment Automatically Restored to Operation.

The equipment branch shall be installed and connected to the on-site power source such that equipment listed in 6.7.6.2.1.6(C) is automatically restored to operation at appropriate time-lag intervals following the restoration of the life safety branch to operation.

(B) Connection of Additional Equipment.

The equipment branch arrangement shall provide for the additional connection of equipment listed in 6.7.6.2.1.6(D).

(C) 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 on-site power source.

(D) Delayed-Automatic Connections to Equipment Branch.

The following equipment shall be permitted to be connected to the equipment branch and shall be arranged for delayed-automatic connection to the on-site power source:

(1) Task illumination and select receptacles in the following:

(a) Patient care spaces

(b) Medication preparation spaces

(c) Pharmacy dispensing spaces

(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 or exhaust systems, or both, if required to operate during a fire in or under the hood

(6) Nurse call systems

(7) HVAC systems serving the EF, TER, and TR

(E)* Delayed-Automatic or Manual Connections to Equipment Branch.

The following equipment shall be permitted to be connected to the equipment branch and shall be arranged for either delayed-automatic or manual connection to the alternate power source:

(1) *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:

(a) *The outside design temperature is higher than −6.7°C (+20°F).

(b) The outside design temperature is lower than −6.7°C (+20°F) and, where 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. *(See A.6.7.1.1 for more information.)*

(2) **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.

(3) *Optional Connections to the Equipment Branch*. Additional illumination, receptacles, and equipment shall be permitted to be connected only to the equipment branch.

(4) *Multiple Systems*. Where one switch serves multiple systems as permitted in 6.7.6.2, transfer for all loads shall be nondelayed automatic.

6.7.6.3 Wiring Requirements.
6.7.6.3.1* Separation from Other Circuits.

The life safety and equipment branches shall be kept entirely independent of all other wiring and equipment.

6.7.6.3.2* Receptacles.

The electrical receptacles or the cover plates for the electrical receptacles supplied from the life safety and equipment branches shall have a distinctive color or marking so as to be readily identifiable.

6.7.6.4 Performance Criteria and Testing.
6.7.6.4.1 Source.

The life safety and equipment branches shall be installed and connected to the on-site power source specified in 6.7.1.1.2 so that all functions specified herein for the life safety and equipment branches are automatically restored to operation within 10 seconds after interruption of power.

6.8 Site Acceptance Testing.
6.8.1*

Site acceptance testing shall be performed on the electrical system and all electrical components serving Category 1 and Category 2 spaces.

6.8.1.1

Acceptance testing is required after initial installation or major renovation prior to the system being placed into service.

6.8.2*

Site acceptance testing procedures shall be in accordance with industry-recognized standards and practices for equipment testing and system commissioning.

6.8.3 Site Acceptance Testing Records.
6.8.3.1

A record of all site acceptance testing procedures required in 6.8.1 and testing results shall be maintained.

6.8.3.2

Site acceptance testing records shall be retained for 5 years.

6.8.3.3 Record Medium.
6.8.3.3.1

The records shall be on a medium that will survive the retention period.

6.8.3.3.2

Paper or electronic media shall be permitted.

6.8.3.4 Record Reporting and Archiving.
6.8.3.4.1

The record shall be available for examination and, if required, reported to the authority having jurisdiction.

6.8.3.4.2

Archiving of records by any means shall be permitted if hard copies of the records can be provided promptly when requested.

6.9 Electrical Maintenance Program (EMP).
6.9.1 EMP Program.
6.9.1.1*

All electrical components which are part of an electrical system serving a Category 1 and Category 2 space shall be part of an electrical maintenance program (EMP).

6.9.1.2

The EMP shall include the following elements:

(1) Listing of all equipment and systems included as part of the program

(2) Schedule of inspection, testing, and servicing (maintenance) of equipment

(3) Survey and analysis of electrical equipment and systems to determine maintenance requirements and priorities

(4) Scheduled routine inspections and tests

(5) Review of inspection and test reports so that proper corrective measures can be prescribed

(6) Performance of necessary work

(7) Complete records

6.9.2 EMP Records.
6.9.2.1

A record of all testing and maintenance described in 6.9.4 shall be maintained.

6.9.2.2

EMP inspection, testing, and maintenance records shall be retained for 5 years.

6.9.2.3 EMP Record Medium.
6.9.2.3.1

The records shall be on a medium that will survive the retention period.

6.9.2.3.2

Paper or electronic media shall be permitted.

6.9.2.4 EMP Record Reporting and Archiving.
6.9.2.4.1

The record shall be available for examination and, if required, reported to the authority having jurisdiction.

6.9.2.4.2

Archiving of records by any means shall be permitted if hard copies of the records can be provided promptly when requested.

6.9.3 Corrective Measures.
6.9.3.1* Analysis of Inspection, Testing, and Maintenance Reports.

Analysis of inspection, testing, and maintenance reports shall be followed by the implementation of appropriate corrective measures.

6.9.3.2

All corrective measures shall be documented in accordance with the requirements of 6.9.2.

6.9.4 EMP Intervals.
6.9.4.1*

EMP intervals shall be in accordance with Table 6.9.4.1.

Table 6.9.4.1 Electrical Maintenance Program (EMP) Intervals

Item	Inspection Period	Testing Period	Maintenance Period
Medium-voltage switchgear	Every 3 months	Every 3 years	Every 3 years
Power distribution transformers (≥ 750 kVA)	Monthly	Every 3 years	Every 3 years
Generator (alternate source)	*(See Chapter 8 of NFPA 110.)*	*(See Chapter 8 of NFPA 110.)*	*(See Chapter 8 of NFPA 110.)*
Generator paralleling switchgear	Monthly	Annually	Every 3 years
Low-voltage switchgear/switchboards	Every 3 years	Every 3 years	Every 3 years
Overcurrent Protective Devices			
Fuses (≥ 400 A)	Every 3 years	Every 3 years	Every 3 years
Low-voltage power circuit breakers (≥ 400 A)	Every 3 years	Every 3 years	Every 3 years
Low-voltage molded-case circuit breakers (≥ 400 A)	Every 3 years	Every 3 years	Every 3 years
Medium-voltage circuit breakers	Every 3 years	Every 3 years	Every 3 years
Relays (including polyphase ground-fault equipment protection)	Every 3 years	Every 3 years	Every 3 years
Transfer equipment	Monthly	Every 3 years	Every 3 years
Bus duct	Every 3 years	Every 3 years	Every 3 years
Uninterruptible power supplies (≥ 100 kW)	Every 3 months	Every 6 months	Every 6 months
Isolated power panels	*(See 6.3.3.3.3.)*	*(See 6.3.3.3.3.)*	*(See 6.3.3.3.3.)*
Motor control equipment	Annually	Every 3 years	Every 3 years
Branch-circuit panelboards	Annually	Every 3 years	N/A
Wiring devices	*(See 6.3.3.2.)*	*(See 6.3.3.2.)*	*(See 6.3.3.2.)*
Battery-powered lighting units	*(See 6.3.2.6.8.)*	*(See 6.3.2.6.8.)*	*(See 6.3.2.6.8.)*

N/A: not applicable.

6.9.4.2* Alternative Equipment Maintenance (AEM) Program.
6.9.4.2.1

EMP intervals shall be permitted to be developed as part of an alternative equipment maintenance (AEM) program.

6.9.4.2.2

The AEM shall include the following elements:

(1) *The AEM program shall be based on accepted standards of practice for electrical equipment maintenance.

(2) The AEM program requirements (including EMP schedules) shall be clearly documented and available for inspection by the authority having jurisdiction.

(3) The AEM program shall be developed and administered by qualified personnel, regardless of whether they are health care facility employees or contractors.

(4) *The AEM program shall consider the typical health and safety risks associated with the equipment's use, including "critical equipment" for which there exists a risk of serious injury or death to a patient or staff person if the equipment fails.

6.10 Health Care Microgrids.
6.10.1 General Requirements.
6.10.1.1 Applicability. (Reserved)
6.10.1.2* Purpose.

The purpose of Section 6.10 shall be to describe requirements for multiple-source health care microgrid systems, ac or dc, utilized as all or a portion of EPSSs for health care facilities.

6.10.1.3* Campuses.

Health care microgrids shall be permitted to serve individual buildings or campuses consisting of several buildings.

6.10.1.4 Non–Health Care Buildings.

Health care microgrids shall be permitted to serve buildings that fall into multiple use categories as described in Chapter 4.

6.10.2 Sources.
6.10.2.1

All sources shall meet the installation and maintenance requirements of the applicable NFPA code.

6.10.2.2

Any combination of generation, storage, or transformation assets shall be permitted to serve as the on-site power source for all or a portion of health care microgrids.

6.10.2.2.1

The combination of sources shall provide performance equivalent to that of the requirements of 6.7.1.2.1.

6.10.3 Reliability.
6.10.3.1

Health care microgrid systems shall be designed with sufficient reliability to provide effective facility operation consistent with the facility's emergency operations plan.

6.10.3.2*

Health care microgrid system components shall not be compromised by failure of the normal source.

6.10.4 Interconnection to an Electrical Utility.

Health care microgrids that are interconnected to an external electrical utility shall comply with regulations relevant to the serving utility.

6.10.5 Distribution System. (Reserved)
6.10.6* Control System.

Health care microgrid control systems shall comply with the requirements of this subsection.

6.10.6.1* Network Segregation.
6.10.6.1.1

Health care microgrid control system networks shall be segregated from other networks.

6.10.6.1.2

Intelligence and memory of health care microgrid control systems shall not be dependent on off-site resources.

6.10.6.2 Source Monitoring. (Reserved)
6.10.6.3 Design.

The design of health care microgrid control systems shall include a sequence of operations for manual controlling of sources in the event of system failure.

6.10.6.4 Controller Backup Power.

Health care microgrid controllers shall have a dedicated battery backup having a minimum 90-minute capacity.

6.10.6.5 Annunciation.
6.10.6.5.1

Health care microgrid control systems shall be capable of providing readouts that indicates which sources are operating.

6.10.6.5.2

The amount of power provided to the health care microgrid by each source shall be visible at all times.

6.10.6.6 Security. (Reserved)
6.10.7 Commissioning.

Health care microgrid systems shall be commissioned in accordance with their sequence of operations.

6.10.7.1 Verification of Means and Methods.

Health care microgrid system installers or commissioning agents shall prepare a written commissioning plan that provides a description of the means and methods necessary to document and verify that the system and its associated controls and safety systems are in proper working condition.

6.10.7.2 Commissioning Plan.

Commissioning plans shall include the following:

(1) An overview of the commissioning process developed specifically for the health care microgrid and its controller to be installed and a narrative description of the activities to be conducted

(2) *Roles and responsibilities for all those involved in the planning, design, construction, installation, and operation of the health care microgrid

(3) Means and methods whereby the commissioning plan will be made available during the implementation of the health care microgrid project

(4) Plans and specifications necessary to understand the installation and operation of the health care microgrid and all associated components, operational controls, and safety systems

(5) A detailed description of each activity to be conducted during the commissioning process, who will perform each activity, and at what point in time each activity is to be conducted

(6) Procedures to be used in documenting the proper operation of the health care microgrid and all associated components, operational controls, and safety systems

(7) Guidelines and format for a commissioning checklist, relevant operational testing forms, and necessary commissioning

(8) Means and methods whereby facility operation and maintenance staff will be trained on the system

(9) Identification of personnel qualified to service, maintain, and respond to incidents involving the system

6.10.7.3 Commissioning Report.

A commissioning report documenting the commissioning process and the results shall be provided.

6.10.7.3.1

The commissioning report shall be prepared by the health care microgrid system commissioning agent and summarize the commissioning process, the operation of the system, the associated operational controls, and the safety systems.

6.10.7.3.2

The commissioning report shall include the final commissioning plan and the results of the commissioning process, as well as a copy of the plans and specifications associated with the as-built health care microgrid system design and installation.

6.10.7.3.3

The commissioning report shall include any issues identified during commissioning and the measures taken to resolve them.

6.10.8 Inspection, Testing, and Maintenance.
6.10.8.1

The health care microgrid system shall be inspected, tested, and maintained by qualified personnel.

6.10.8.2

All health care microgrid components shall be inspected and maintained in accordance with manufacturers' instructions or annually, whichever occurs first.

6.10.8.3

Health care microgrid system components shall be tested in accordance with the manufacturers' requirements.

6.10.8.4

Health care microgrid systems shall be recommissioned for operation when the system configuration changes or every five years, whichever occurs first.

6.11 Classification of Emergency Power Supply Systems (EPSSs).
6.11.1 General.

The EPSS shall provide a source of electrical power of required capacity, reliability, and quality to loads for a length of time as specified in Table 6.11.1(a) and within a specified time following loss or failure of power as specified in Table 6.11.1(b).

Table 6.11.1(a) Classification of EPSSs

Class	Minimum Time
Class 0.083	0.083 hr (5 min)
Class 0.25	0.25 hr (15 min)
Class 2	2 hr
Class 6	6 hr
Class 48	48 hr
Class X	Other time, in hours, as required by the application, code, or user

[**110:**Table 4.1(a)]

Table 6.11.1(b) Types of EPSSs

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

[**110:**Table 4.1(b)]

6.11.2 Class.

The class defines the minimum time, in hours, for which the EPSS is designed to operate at its rated load without being refueled or recharged. *[See Table 6.11.1(a).]* [**110:**4.2]

6.11.3 Type.

The type defines the maximum time, in seconds, that the EPSS will permit the load terminals of the transfer switch to be without acceptable electrical power. Table 6.11.1(b) provides the types defined by this standard. [**110:**4.3]

6.11.4 Level.

This standard recognizes two levels of equipment installation, performance, and maintenance. [**110:**4.4]

6.11.4.1

Level 1 systems shall be installed where failure of the equipment to perform could result in loss of human life or serious injuries. [**110:**4.4.1]

6.11.4.2

Level 2 systems shall be installed where failure of the EPSS to perform is less critical to human life and safety. [**110:**4.4.2]

6.11.4.3

All equipment shall be permanently installed. [**110:**4.4.3]

6.11.4.4

Level 1 and Level 2 systems shall ensure that all loads served by the EPSS are supplied by an on-site power source that meets all the following criteria:

(1) It is of a quality within the operating limits of the load.

(2) It operates for a duration specified for the class as defined in Table 6.11.1(a).

(3) It operates within the time specified for the type as defined in Table 6.11.1(b).

6.7.5.1.3.2
The critical branch shall supply power for ~~task illumination, fixed equipment, select receptacles, and select power~~ circuits serving the following spaces and functions related to patient care as follows:

(1) ~~Category 1 spaces where deep sedation or general anesthesia is administered,~~ ~~t~~Task illumination, selected receptacles, and fixed equipment for the following areas:

~~(2) Task illumination and select receptacles in the following:~~

(a) Category 1 spaces where deep sedation or general anesthesia is administered ~~Patient care spaces, including infant nurseries, selected acute nursing areas, psychiatric bed areas (omit receptacles), and ward treatment rooms~~

(b) Information and communication technologies (ICT) spaces and equipment serving Category 1 functions ~~Medication preparation spaces~~

~~(c) Pharmacy dispensing spaces~~

~~(d) Nurses' stations — unless adequately lighted by corridor luminaires~~

~~(3) Additional specialized patient care task illumination and receptacles, where needed~~
~~(4) Nurse call systems~~
~~(5) Blood, bone, and tissue banks~~
~~(6) *Telecommunications entrance facility, telecommunications equipment rooms, and telecommunication rooms and equipment in these rooms.~~

(~~7~~2) Task illumination, selected receptacles, and select power circuits for the following areas:

(a) Category 1 or 2 spaces with at least one duplex receptacle per patient bed location, 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 (select)

(g) Human physiology labs

(h) Intensive care units

(i) Postoperative recovery rooms (select)

(3) Task illumination and selected receptacles in the following:

(a) Patient care spaces, including infant nurseries, selected acute nursing areas, psychiatric bed locations (omit receptacles), and ward treatment rooms

(b) Medication preparation spaces

(c) Pharmacy dispensing spaces

(d) Nurses' stations – unless adequately lighted by corridor luminaires

(e) Nurse call systems

(f) Blood, bone, and tissue banks

(g) Clinical IT-network equipment

(h) Wireless phone and paging equipment for clinical staff communications

(i) Additional task illumination, receptacles, and select power circuits needed for effective facility operation, including single-phase fractional horsepower motors, which are permitted to be connected to the critical branch

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~~(8) Clinical IT network equipment~~
~~(9) Wireless phone and paging equipment for clinical staff communications~~
~~(10) Additional task illumination, receptacles, and select power circuits needed for effective facility operation, including single-phase fractional horsepower motors, which are permitted to be connected to the critical branch~~

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6.7.5.1.3.2
The critical branch shall supply power for circuits serving the following spaces and functions related to patient care as follows:

(1) Task illumination, selected receptacles, and fixed equipment for the following areas:

(a) Category 1 spaces where deep sedation or general anesthesia is administered

(b) Information and communication technologies (ICT) spaces and equipment serving Category 1 functions

(2) Task illumination, selected receptacles, and select power circuits for the following areas:

(a) Category 1 or 2 spaces with at least one duplex receptacle per patient bed location, 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 (select)

(g) Human physiology labs

(h) Intensive care units

(i) Postoperative recovery rooms (select)

(3) Task illumination and selected receptacles in the following:

(a) Patient care spaces, including infant nurseries, selected acute nursing areas, psychiatric bed locations (omit receptacles), and ward treatment rooms

(b) Medication preparation spaces

(c) Pharmacy dispensing spaces

(d) Nurses' stations – unless adequately lighted by corridor luminaires

(e) Nurse call systems

(f) Blood, bone, and tissue banks

(g) Clinical IT-network equipment

(h) Wireless phone and paging equipment for clinical staff communications

(i) Additional task illumination, receptacles, and select power circuits needed for effective facility operation, including single-phase fractional horsepower motors, which are permitted to be connected to the critical branch

6.7.5.1.3.2

If the following spaces, functions, or equipment listed in (1), (2), or (3) are present or provided, they shall be supplied by the critical branch.

(1) Task illumination for the following:

(a) Category 1 spaces where deep sedation or general anesthesia is administered
(b) Information and communication technologies (ICT) spaces and equipment serving Category 1 functions
(c) Category 1 or 2 spaces as required by the governing body of the health care facility
(d) Angiographic labs
(e) Cardiac catheterization labs
(f) Coronary care units
(g) Hemodialysis rooms or areas
(h) Emergency room treatment areas (select)
(i) Human physiology labs
(j) Intensive care units
(k) Postoperative recovery rooms (select)
(l) Patient care spaces, including infant nurseries, selected acute nursing areas, psychiatric bed locations, and ward treatment rooms
(m) Medication preparation spaces
(n) Pharmacy dispensing spaces
(o) Nurses' stations – unless adequately lighted by corridor luminaires
(p) Blood, bone, and tissue banks
(q) Additional task illumination needed for effective facility operation

(2) Selected receptacles for the following:

(a) Category 1 spaces where deep sedation or general anesthesia is administered
(b) Information and communication technologies (ICT) spaces and equipment serving Category 1 functions
(c) Category 1 or 2 spaces as required by the governing body of the health care facility
(d) Angiographic labs
(e) Cardiac catheterization labs
(f) Coronary care units
(g) Hemodialysis rooms or areas
(h) Emergency room treatment areas (select)
(i) Human physiology labs
(j) Intensive care units
(k) Postoperative recovery rooms (select)
(l) Patient care spaces, including infant nurseries, selected acute nursing areas, and ward treatment rooms
(m) Medication preparation spaces
(n) Pharmacy dispensing spaces
(o) Nurses' stations
(p) Blood, bone, and tissue banks
(q) Additional receptacles needed for effective facility operation

(3) Select power circuits for the following:

(a) Category 1 spaces where deep sedation or general anesthesia is administered
(b) Information and communication technologies (ICT) spaces and equipment serving Category 1 functions
(c) Category 1 or 2 spaces as required by the governing body of the health care facility
(d) Angiographic labs
(e) Cardiac catheterization labs
(f) Coronary care units
(g) Hemodialysis rooms or areas
(h) Emergency room treatment areas (select)
(i) Human physiology labs
(j) Intensive care units
(k) Postoperative recovery rooms (select)
(l) Patient care spaces, including infant nurseries, selected acute nursing areas, and ward treatment rooms
(m) Medication preparation spaces
(n) Pharmacy dispensing spaces
(o) Nurse call systems
(p) Blood, bone, and tissue banks
(q) Clinical IT-network equipment
(r) Wireless phone and paging equipment for clinical staff communications
(s) Additional power circuits needed for effective facility operation
(t) Single-phase fractional horsepower motors permitted to be connected to the critical branch

2027 NFPA 99 HEA-ELS Public Input Task Group Report

TG#	Two	
TG Chair	SM Lipster	
TG Members	Don Rabel, Nancy Chilton, H. David Chandler, Joshua Griffin, Thomas Parrish, Vincent Rea, Brian Rock, John Schutte, Leonard White, Chad Beebe, Robert Wolff, Paul Evers, Taw North, Lauris Freidenfelds, Vincent Della Croce, Danny Chisholm, Isaac Luria	
Section	**Public Input #**	**TG Recommendation (Create FR, Create CI, Resolve) & Statement**
New Chapter X	396	**Create FR TG2-1** This action coordinates with the NFPA Cybersecurity Advisory Committee. Negating the impact of cybersecurity threats across the health care facility landscape is critical to the patients and providers. The addition of this new chapter is an important first step to improve the cybersecurity infrastructure in NFPA 99 environments. TG-2 PI 396 New Chapter Submittial .docx
6.7.6.1	315	**Create FR TG2-2** This first revision uses the defined Chapter 3 term "power sources" and is in alignment with the Microgrid Task Group. 315.docx
6.7.6.2.1.4	443	**Create FR TG2-3** This action aligns with the manual of style. 443.docx
6.7.6.2.1.6(C)	230	**Create FR TG2-4** This equipment ensures generator function and reliability in the event of a source transfer. These accessories are extremely important and must be removed from the Equipment Branch and placed in the Life Safety Branch. See FR TG2-5 230.docx
6.7.6.1.5	239	**Create FR TG2-5** This equipment ensures generator function and reliability in the event of a source transfer. These accessories are extremely important and must be removed from the Equipment Branch and placed in the Life Safety Branch. See FR TG2-4
6.7.6.2.1.5(A)	7	**Resolve** See committee action on PI 319

6.7.6.2.1.5(A)	319	**Create FR TG2-6** This first revision provides important updates regarding technical changes in the Type 2 EES environment and brings the section in alignment with the installation of multiple power sources. 319.docx
6.7.6.2.1.5(A)	384	**Resolve** See committee action on PI 319
6.7.6.2.1.5(A)	444	**Resolve** See committee action on PI 319
6.7.6.2.1.6(D)	8	**Create FR TG2-7** This action aligns with the manual of style. 8.docx
6.7.6.2.1.6(E)	476	**Create FR TG2-8** This first revision clarifies the intent of the code. 476.docx
6.7.6.3.2	83	**Resolve** The submitter provided no technical substantiation for this public input. The clear, unambiguous identification of these essential electrical receptacles eliminates confusion in the event of an emergency.
6.9.1.1	34	**Create FR TG2-9** This first revision provides insight into what constitutes an EMP. NFPA 70B is now a standard, rather than a recommended practice as it was prior to the 2023 edition. 34.docx
7.3.1.1.1 & 7.3.1.1.2	256	**Resolve** See Panel Action on Public Input 471, which is more consistent with the manual of style. 256.docx
7.3.1.1.2	471	**Create FR TG2-10** ANSI/TIA-606-D is the correct and current version of the standard 471.docx
7.3.1.2	258	**Create FR TG2-11** This action correlates with the action taken on Public Input 469 and simplifies the code.

		258.docx
7.3.1.2.1.3	259	**Create FR TG2-12** The committee maintains that redundant pathways have value, regardless of the physical location of the data. 259.docx
7.3.1.2.1.4(E)	232	**Resolve** The panel maintains the long-standing prohibition on extraneous mechanical systems in EF's provide an important and necessary safeguard against accidents and maintenance issues, while providing space for future growth. See Committee action on Public Input 233 and 234 232.docx
7.3.1.2.1.4(G)	261	**Create FR TG2-13** The panel deletes "close as practicable" as it is not enforceable. Furthermore, the panel notes that modern engineering practice favors the location of these facilities in physically safer interior spaces. 261.docx
7.3.1.2.1.5	262	**Create FR TG2-14** This Public Input establishes important guidelines regarding the safe maintenance and access of critical equipment. See Committee action on Public Input 263. 262.docx
7.3.1.2.1.7	264	**Create FR TG2-15** The committee agrees that the regulations for EF power are better placed in Chapter 6. This action aids the code user and avoids potential conflicts. The panel also notes that this space is currently covered in Chapter 6. See Committee action on Public Input 265 and 266. 264.docx
7.3.1.2.2.4(B)	233	**Resolve** The panel maintains the long-standing prohibition on extraneous mechanical systems in EF's provide an important and necessary safeguard against accidents and maintenance issues, while providing space for future growth. See Committee Action on Public Input 232 and 234 233.docx
7.3.1.2.2.5	263	**Create FR TG2-16** This Public Input establishes important guidelines regarding the safe maintenance and access of critical equipment. See Committee action on Public Input 262. 263.docx
7.3.1.2.2.7	265	**Create FR TG2-17** The committee agrees that the regulations for EF power are better

		placed in Chapter 6. This action aids the code user and avoids potential conflicts. The panel also notes that this space is currently covered in Chapter 6. See Committee action on Public Input 264 and 266 265.docx
7.3.1.2.3.2	330	**Create FR TG2-18** The use of modern cabling media such as PON and Class IV products provides the system designer with important options regarding the placement of TRs and should be permitted in health care facilities. 330.docx
7.3.1.2.3.3 (New after)	326	**Resolve** The proposed addition of Shallow Rooms to this section provides no real usefulness for the code user. The concept needs to be reviewed and refined. 326.docx
7.3.1.2.3.4(B)	234	**Resolve** The committee maintains the long-standing prohibition on extraneous mechanical systems in EF's provide an important and necessary safeguard against accidents and maintenance issues, while providing space for future growth. See Committee Action on Public Input 232 and 233 234.docx
7.3.1.2.3.7	266	**Create FR TG2-19** The committee agrees that the regulations for EF power are better placed in Chapter 6. This action aids the code user and avoids potential conflicts. The panel also notes that this space is currently covered in Chapter 6. See Committee action on Public Input 264 and 265 266.docx
7.3.1.2.4	337	**Create FR TG2-20** This committee action aids the code user by employing industry-defined pathways in the document as appropriate. 337.docx
7.3.1.2.5.2	336	**Create FR TG2-21** The addition of Outside Plant clearly defines the scope of this section and, as a result, aids the code user. 336.docx
7.3.3.1.8	200	**Resolve** This Public Input details no actionable items. 200.docx
7.3.3.2, 7.3.3.3, 7.3.3.4	341	**Create FR TG2-22** The adoption of this technology will improve both patient outcomes and facility efficiency.

		341.docx
7.3.3.7.3	338	**Create FR TG2-23** This committee action aids the code user by clarifying the ICT pathway and better detailing the required pathway separation. 338.docx
7.4.1.1.1	340	**Create FR TG2-24** This revision clearly details that physically independent pathways are not required in Category 2 spaces. 340.docx
Chapter 7-Title	255	**Create FR TG2-25** This committee action aids the code user by aligning with current industry nomenclature. See committee action on Public Input 469. 255.docx
Chapter 7-Title	469	**Resolve** See Committee action on Public Input 225. 469.docx
Revise 3.3.115	116	**Resolve** The committee suggests the submitter revise ambiguous language in the code rather than revise the definition to suit the unclear text. Furthermore, the use of “sources” in NFPA 99 should not be limited to just power generation. 116.docx
New 3.3.X	331	**Create FR TG2-26** First Revisions in Chapter Seven have adopted the ICT nomenclature; therefore, the term should be defined in Chapter Three. 331.docx
New 3.3.X	334	**Create FR TG2-27** First Revisions in Chapter Seven have adopted the ICT nomenclature; therefore, this phrase should be defined in Chapter Three. 334.docx
New 3.3.X	335	**Create FR TG2-28** First Revisions in Chapter Seven have adopted the current industry standard nomenclature; therefore, this phrase should be defined in Chapter Three. 335.docx
Chapter 1 Scope	CI-TG2 1	**Create Committee Input TG2-1** The scope of NFPA 99 should be expanded to include the subject matter found in the new chapter on Cybersecurity. TG2 Committee Input 1 Scope.docx
Chapter 3 Definition	CI TG2-2	**Create Committee Input TG2-2**

		This definition should be added to NFPA 99 as the document has been expanded to include a new chapter on Cybersecurity. TG2 Committee Input 2 Def.docx

2027 NFPA 99 HEA-ELS Public Input Task Group Report

TG#	3	
TG Chair	Walt Vernon	
TG Members	Chris Finen, Krista Biason, Larry Geyer, Vincent Della Croce, Chad Kennedy, Jesse Avery, Kevin Porter, Kevin Scarlett, Steve Sappington, Ron Smidt, Dan Chisholm Sr, Steve Chutka, Terrance McKinch, David Williams, Jamie Schnick (non-committee member).	
Section	**Public Input #**	**TG Recommendation (Create FR, Create CI, Resolve) & Statement**
3.3.155	116	Resolve. The Microgrids task force added the word Power wherever needed.
6.2.4	329	FR 5 Accept. The FR moves requirements currently in 6.7.1 that provide requirements for the location of EES sources into this section for all sources. A corresponding FR9, PI 339 removes these requirements from 6.7.1. Because microgrids can serve either or both sides of a transfer switch, locating them with similar requirements protects their reliability. In some cases, the on-site source may operate “normally” while the off-site source is available if the on-site source fails. That is, we want to ensure the effective operation of the on-site sources on either side of the transfer switch. In addition, the FR makes several modifications as in following PIs, as well as to make consistent terminology.
6.2.4.1	128	Incorporate into FR 5.
6.2.4.2	129	Incorporate into FR 5.
6.2.4.3	225	Incorporate into FR 5.
6.3.1 (new section after)	100	Accept as FR6. NFPA 99 defines with great precision the EES; this FR reminds the reader that other sections of the document include

		requirements for EES and identifies the remaining parts of the distribution system.
6.3.1	101	See FR7. FR7 better coordinates with NEC allowances for energy management systems especially in articles 750 and 220.
6.3.1	226	Include in FR7.
6.3.1 (new section after)	281	Accept; See FR8. This diagram, as an informational note, helps to explain the evolution of electrical distribution in healthcare. .
6.3.1.5	137	Resolve. Included in FR7.
6.7.1	310	Accept. See FR9. The defined term is Power Source, not Source.
6.7.1.1.1	104	Accept. Include in FR9.
6.7.1.2	105	Accept. Include in FR9.
6.7.1.2.1	106	Accept. Include in FR9. This requirement only applies to power sources on one side of the transfer switch.
6.7.1.2.1	185	Reject. Insufficient technical substantiation.
6.7.1.2.2.1	107	Accept. This section being deleted is a relic from an old paradigm when the diesel generator never ran. We have steadily chipped away at it, allowing, now, designs to use any on site source for any purpose. This section is now irrelevant.
6.7.1.2.2.2	108	Accept. Moved to 6.3.1 in FR7.
6.7.1.2.2.5(A)	109	FR13. Change language to refer to on-site power sources to be consistent with language used in this document.
6.7.1.2.2.3(B)	298	Accept. See FR9. It is important to replace “generating equipment” with current language used in other sections due to microgrids.
6.7.1.2.2.5(A)	302	See FR13. We used the power source language to correlate with the second clause in the sentence.

6.7.1.2.3	339	Accept. Included in FR9. This is the movement from this section to the general section described in FR5.
6.7.1.2.7.1	138	Accept. Included in FR9. This simplifies and clarifies the language. It eliminates the need for the alarm to be at a continuously staffed location, as technology has made this requirement unnecessary.
6.7.1.2.7.1	293	Accept. Included in FR9. Fixes terminology to Power sources to use a defined term.
6.7.1.2.7.2	139	Accept in part. Include in FR13. The current requirements refer only to generators. The FR makes the requirements more general.
6.7.1.3	184	Accept. This is the nuclear option. NFPA 99 is a performance document, not an installation document. The information here is installation requirements. And, this information applies to only one potential technology. 99 has no other guidance for any other technology. We need parallel treatment for all potential power source technologies. Our task group recommends a future Task Force to address the way that power sources are regulated in other NFPA documents, and their applicability to healthcare.
6.7.1.3.1	131	Accept. Included in FR 10. If 184 is rejected, accept this one, because it is unenforceable.
6.7.2.1.2.1	140	Accept. Included in FR11. We need to eliminate the term Alternate Power Source.
6.7.2.1.3.1	311	Accept. Included in FR12. Correlate terms in the document (e.g. Power Source, not Source).
6.7.2.1.3(A)	141	Accept. Included in FR12. This language more accurately reflects the sequence of operations from deploying microgrids.
6.7.2.1.3.1(D)	142	Accept. Included in FR12. we can now have many technologies other than engines.

6.7.1.2.3.1(E)	143	Accept. Included in FR12. the "normal" source may be an on-site generator.
6.7.2.1.3.4(B)	144	Accept. Included in FR12. we need to clean up the references to different sources including "primary source."
6.7.2.1.3.5	145	Accept. Included in FR12. Change from engine to power source. This is a duplicate of 6.7.2.1.3.6 (B)
6.7.2.1.3.6	146	Accept. Included in FR12. This requirement should apply to transfer switches for all systems.
6.7.2.1.3.6(B)	147	Accept. Included in FR12. it better reflects the diversity of potential power sources.
6.7.2.1.3.7	148	Accept. See FR12.
6.7.2.1.3.8(A)	149	Accept. See FR12.
6.7.2.1.3.8(B)	150	Accept See FR12.
6.7.2.1.3.16(A)	151	Accept. Included in FR12. we only transfer the EES loads with transfer switches; we use transfer means to transfer Optional loads. Some transfer switches on the EES can be manual.
6.7.2.1.3.17(A)	152	Accept. Included in FR12. The reference is to the two sources serving the ATS.
6.7.3.2	154	Accept.
6.7.3.3	155	FR14. Change to power source.
6.7.3.3	312	FR14. Accept
6.7.3.4	156	FR14. Make the generator language more general, without expanding the requirements.
6.7.4.1.1.5(A)	303	Accept. See FR15.
6.7.4.1.1.5(B)	304	FR 15. This PI generalizes the language and uses language similar to other portions of the chapter.
6.7.5.1.2.2	305	Accept, but change to on-site power source language to be consistent. FR 16
6.7.5.1.2.4	306	Accept but change to on-site power source language to be consistent. FR17.
6.7.5.1.2.6	307	Accept. FR18.

6.7.5.1.2.6	313	FR18. Accept. However, authors note. I think we should actually delete 6.7.5.1.2.6. It adds nothing to the general requirements for loads on the life safety branch.
6.7.5.1.2.8, 6.7.5.1.2.9, 6.7.5.1.2.10	308	FR19. Accept but modify since threre is no such thing as a nonessential power source.
6.7.5.1.4.4	309	FR20. Accept but reword. Also, consider, should we say in (3), one per bank or something?
6.7.5.1.5	157	FR21. Accept but change to power source.
6.7.5.1.5	318	Included in FR21.
6.7.5.3.1	314	FR 29. Accept.
6.7.6.2.1.5(C)	316	FR23. Accept. But, suggest we delete this item as per PI 313.
6.7.6.2.1.5(C)	320	Include in FR23.
6.7.6.2.1.5(E)	321	FR 24. Accept but reword to make consistent with the chapter language.
6.7.6.2.1.5(F)	322	FR 25. Accept but reword to make consistent with the chapter language.
6.7.6.2.1(C)	323	FR 26. Accept but make more general.
6.7.6.2.1(E)	324	FR 27. Accept
6.7.6.4.1	317	FR 28. Accept.
6.10.1.1	111	See FR 1. The language we used more precisely describes the intent of this section.
6.10.1.2	112	See FR 2. The language we used more precisely describes the intent of this section.
6.10.1.4	9	Accept; see FR 3.
6.10.2.2.1	113	Reject. The current language is sufficient.
6.10.3.1	114	See FR-19. This requirement defines a bit better the needed reliability and effective operation.
6.10.3.2	325	See FR 4. The described source is the off-site source. This replaces the word normal, which is undefined and uses the term off-site which is used throughout the document.

Chapter 6 Electrical Systems
6.1* Applicability.
6.1.1 Electrical Installation.

Installation shall be in accordance with *NFPA 70*.

6.1.2

This chapter shall apply to new health care facilities as specified in Section 1.3.

6.1.3

The following paragraphs shall apply to new and existing health care facilities:

(1) 6.3.2.2.1

(2) 6.3.2.3.6(B)(2) and 6.3.2.3.6(B)(3)

(3) 6.3.2.3.8

(4) 6.3.2.6.8

(5) 6.3.2.8.2

(6) 6.3.3.2.5 through 6.3.3.2.7

(7) 6.3.3.3.3 and 6.3.3.3.4

(8) 6.3.4

(9) 6.7.1.2.7.2(H)

(10) 6.7.2.2.5(B)

(11) 6.7.2.2.6

(12) 6.7.4

(13) Section 6.8

6.1.4

The following paragraphs shall apply only to existing health care facilities:

(1) 6.3.2.5.1.3

(2) Section 6.9

6.2 Nature of Hazards.
6.2.1* Fire and Explosions.
6.2.2 Shock. (Reserved)
6.2.3 Thermal. (Reserved)
6.2.4 Location of Electrical System Components.
6.2.4.1

FR 5: Installations of ~~E~~electrical service equipment, power sources, accessories, and associated distribution equipment~~main switchgear system components~~ shall be located to reduce possible interruption of electrical sources resulting from natural forces. ~~minimize interruptions caused by natural forces common to the area or natural disasters identified in the facility's emergency operations plan.~~

6.2.4.1.1 Indoor On-Site Power Source Installations. Indoor on-site power sources shall be installed in a room dedicated to such sources.

(A) The on-site power sources room shall be separated from the rest of the building by construction with a minimum of 2-hour fire resistance rating.

Commented [DCV(USES1]: 6.2.4.1 The PI language is "installations of electrical service equipment, power sources and associated distribution equipment…"

(B) The on-site power source equipment shall be permitted to be installed in the room with the on-site power sources.
(C) No other equipment, including architectural appurtenances, except those that serve the space shall be permitted in the room containing the on-site power sources.

6.2.4.1.2 Outdoor On-Site Power Source Installations

(A) The on-site power source ~~supply~~ shall comply with either of the following:

(1) The source(s) shall be installed in a suitable enclosure located outside the building and capable of resisting the entrance of snow or rain at a maximum wind velocity as required by the local building codes.

(2) The source(s) shall be constructed such that it is capable of resisting the impacts of snow or rain.

(B) Equipment serving the source(s) shall be permitted to be installed in the source(s) enclosure.

(C) No other equipment, including architectural appurtenances, except those that werve the space, shall be permitted in the source(s) enclosure.

6.2.4.2

The rooms, enclosures, or separate buidings housing on-site electrical power production and or storage equipment for Level 1 or Level 2 systems shall be designed and located to minimize damage from flooding, including that cause by the following:

(1) Firefighting
(2) Sewer water backup
(3) Other disasters or occurrences

6.2.4.3

Minimizing the possibility of damage resulting from interruptions of the on-site electrical power production and/or storage units shall be a design consideration for that equipment.

6.2.4.4

Design considerations shall minimize the effect of the failure of on-site power production equipment on the continued operation of other electrical power production and distrivution equipment.

~~Installations of electrical sources shall be located to reduce possible interruption of electrical systems resulting from natural forces and to reduce possible disruption of electrical systems due to internal wiring and equipment failures.~~

~~**6.2.4.3**~~

Commented [DCV(USES2]: 6.2.4.1.2(A)(1) "power supply" should be "power source" to correlate the use of the defined term. The entire section requires this correlation.

Commented [DCV(USES3]: 6.2.4.1.2(A)(1) The PI language is "...as required by local building codes."

~~Feeders and associated raceways serving essential electrical system transfer equipment shall be located such that physical separation is provided between each of the electrical system feeders to prevent possible simultaneous interruption.~~

6.3 General.
6.3.1 FR7: Power **Sources.**

As required in 6.4, 6.5, and 6.6, ~~Each~~ health care facilities~~y~~ shall have a minimum of two independent sources or sets of sources. Each independent source or set of sources shall be sized, as a minimum, to serve the maximum demand likely to be produced by the connected load of the Essential Electrical System. ~~appliance requiring electrical power for operation shall be supplied by one or more power sources as required for the particular system.~~

In addition, the power sources or sets of power sources shall have sufficient capacity to serve the non-essential electrical system in accordance with 6.3.1.1 or 6.3.1.2.

6.3.1.1 The capacity shall be based on the maximum demand likely to be produced.

6.3.1.2 If an energy management system is employed that automatically manages the connected load, the capacity shall be based on the maximum demand permitted by the energy management system.

~~**6.3.1.1 Power/Utility Company. (Reserved)**~~
~~**6.3.1.2 On-Site Generator Set. (Reserved)**~~

6.3.2 Distribution.
6.3.2.1*

Distribution system arrangements shall be designed to minimize interruptions to the electrical systems due to internal failures by the use of equipment rated for the application.

FR6: 6.3.2.2

Essential Electrical Systems shall comply with 6.4, 6.5, or 6.6.

All loads in a health care facility not served by an Essential Electrical system shall be served by the Non-Essential Electrical System.

FR8: Informational Note 1: See Figure 6.3.1. (NOTE attached as separate document).

6.3.2.2 Receptacles.
6.3.2.2.1* Types of Receptacles.
(A)

Each receptacle shall provide at least one separate, grounding terminal capable of maintaining low-contact resistance with its mating plug, despite severe electrical and mechanical use of the receptacle. The grounding terminal of each receptacle shall be connected to the reference grounding point by means of an insulated copper equipment grounding conductor.

(B)

Special receptacles, such as the following, shall be permitted:

(1) Four-pole units providing an extra pole for redundant grounding or ground continuity monitoring

(2) Locking-type receptacles

(C)

All non-locking-type, 125-volt, 15- or 20-ampere single, duplex, or quadruplex type receptacles, or any combination thereof, located in operating rooms and at patient bed locations in Category 1 and Category 2 spaces shall be listed and identified as "hospital grade."

(D)

Commented [DCV(USES4]: 6.3.1 Typo…"shall be sized, as a minimum, to serve the maximum demand…" Also the defined term "power sources" should be used in the requirement, not just the title.

Receptacles that are located within patient rooms, bathrooms, playrooms, and activity rooms of pediatric units or spaces with similar risk as determined by the health care facility's governing body by conducting a risk assessment, other than infant nurseries, shall be listed and identified as "tamper resistant" or shall employ a listed tamper-resistant cover.

6.3.2.2.2 Minimum Number of Receptacles.

The number of receptacles shall be determined by the intended use of the spaces in accordance with 6.3.2.2.2(A) through 6.3.2.2.2(E).

(A) Receptacles Serving Patient Bed Locations in Category 2 Spaces.

Each patient bed location shall be provided with a minimum of eight non-locking-type, 125-volt, 15- or 20-ampere receptacles, at least four of which shall be connected to either the normal branch circuit or a critical branch circuit supplied by a different transfer switch other than the receptacles at the same location. These receptacles shall be permitted to be of the single, duplex, or quadruplex type, or any combination thereof. Other receptacles (e.g., portable x-ray receptacles) serving special-purpose, cord-and-plug-connected equipment shall be permitted to be of the locking or non-locking-type.

(B) Receptacles Serving Patient Bed Locations in Category 1 Spaces Other than Operating Rooms.

Each patient bed location shall be provided with a minimum of 14 non-locking-type, 125-volt, 15- or 20-ampere receptacles, at least seven of which shall be connected to either the normal branch circuit or a critical branch circuit supplied by a different transfer switch other than the receptacles at the same location. These receptacles shall be permitted to be of the single, duplex, or quadruplex type, or any combination thereof. Other receptacles (e.g., portable x-ray receptacles) serving special-purpose, cord-and-plug-connected equipment shall be permitted to be of the locking or non-locking-type.

(C) Receptacles in Operating Rooms.

Each operating room shall be provided with a minimum of 36 125-volt, 15- or 20-ampere receptacles, at least 12 of which shall be connected to either the normal branch circuit or a critical branch circuit supplied by a different transfer switch other than the receptacles at the same location. They shall be permitted to be of the single, duplex, or quadruplex type, or any combination of the three. Other receptacles (e.g., portable x-ray receptacles) serving special-purpose, cord-and-plug-connected equipment shall be permitted to be of the locking or non-locking-type.

(D) Receptacles in Bathrooms or Toilet Rooms.

Receptacles shall not be required in bathrooms or toilet rooms.

(E) Receptacles for Special Rooms.

Receptacles shall not be required in rooms where medical requirements mandate otherwise (e.g., certain psychiatric, pediatric, or hydrotherapy rooms).

6.3.2.2.3 Polarity of Receptacles.

Each receptacle shall be wired in accordance with *NFPA 70* to ensure correct polarity.

6.3.2.2.4 Other Services Receptacles.

Receptacles provided for other services having different voltages, frequencies, or types on the same premises shall be of such design that attachment plugs and caps used in such receptacles cannot be connected to circuits of a different voltage, frequency, or type, but shall be interchangeable within each classification and rating required for two-wire, 125-V, single-phase ac service.

6.3.2.2.5* Use of Isolated Ground Receptacles.
(A)

An isolated ground receptacle, if used, shall not defeat the purposes of the safety features of the grounding systems detailed in 6.3.2.5.1.

(B)

An isolated ground receptacle shall not be installed within a patient care vicinity.

(C)

Isolated grounding receptacles installed in branch circuits for patient care spaces shall be connected to an insulated equipment grounding conductor in accordance with 250.146(D) of *NFPA 70* in addition to the two equipment grounding conductor paths required in 6.3.2.5.1.4.

(D)

The equipment grounding conductor installed for isolated grounding receptacles in patient care areas shall be clearly identified using green insulation with one or more yellow stripes along its entire length.

6.3.2.2.6 Special-Purpose Outlets.

Branch circuits serving only special-purpose outlets or receptacles (e.g., portable x-ray receptacles) shall not be required to conform to the requirements of 6.4.3.

6.3.2.2.7* Clinical Laboratories.

Outlets with two to four receptacles, or an equivalent multioutlet assembly, shall be installed every 0.5 m to 1.0 m (1.6 ft to 3.3 ft) in instrument usage areas, and either installation shall be at least 80 mm (3.15 in.) above the countertop.

6.3.2.3 Wet Procedure Locations.
6.3.2.3.1*

Wet procedure locations shall be provided with special protection against electric shock.

6.3.2.3.2

This special protection shall be provided as follows:

(1) Power distribution system that inherently limits the possible ground-fault current due to a first fault to a low value, without interrupting the power supply

(2) Power distribution system in which the power supply is interrupted if the ground-fault current does, in fact, exceed the trip value of a Class A GFCI

6.3.2.3.3

Patient beds, toilets, bidets, and wash basins shall not be required to be considered wet procedure locations.

6.3.2.3.4*

Operating rooms shall be considered to be a wet procedure location, unless a risk assessment conducted by the health care governing body determines otherwise.

6.3.2.3.5

If the risk assessment conducted by the health care facility's governing body, as defined in Chapter 3, determines that the operating room is not a wet procedure location, then the special protection of 6.3.2.3 shall not be required.

6.3.2.3.6

In existing construction, the requirements of 6.3.2.3.1 shall not be required when a written inspection procedure, acceptable to the authority having jurisdiction, is performed by a designated individual at the hospital to indicate that equipment grounding conductors for 120-V, single-phase, 15-A and 20-A receptacles; equipment connected by cord and plug; and fixed electrical equipment are installed and maintained in accordance with *NFPA 70*, the applicable performance requirements of this chapter, and Chapter 10 of this code.

(A)

The procedure shall include electrical continuity tests of all required equipment, grounding conductors, and their connections.

(B)

Fixed receptacles, equipment connected by cord and plug, and fixed electrical equipment shall be tested as follows:

(1) When first installed

(2) Where there is evidence of damage

(3) After any repairs

6.3.2.3.7

The use of an isolated power system (IPS) shall be permitted as a protective means capable of limiting ground-fault current without power interruption if the IPS complies with 6.3.2.9.

6.3.2.3.8*

Operating rooms defined as wet procedure locations shall be protected by either isolated power or ground-fault circuit interrupters.

6.3.2.3.9

Where GFCI protection is used in an operating room, one of the following shall apply:

(1) Each receptacle shall be an individual GFCI device.

(2) Each receptacle shall be individually protected by a single GFCI device.

6.3.2.4* Circuits.
6.3.2.4.1

Normal branch circuits serving a patient bed location shall be supplied from not more than one normal branch-circuit distribution panel.

6.3.2.4.2

Branch circuits serving a patient bed location shall be permitted to be supplied from more than one critical branch-circuit distribution panel.

6.3.2.4.3

Only authorized personnel shall have access to overcurrent protective devices serving Category 1 and Category 2 spaces.

6.3.2.4.4

Overcurrent protective devices serving Category 1 and Category 2 spaces shall not be located in public access spaces.

6.3.2.4.5

Isolated power panels shall be permitted to be located in Category 1 spaces.

6.3.2.4.6

Low-voltage wiring shall comply with either of the following:

(1) Fixed systems of 30 V (dc or ac rms) or less shall be permitted to be ungrounded if the insulation between each ungrounded conductor and the primary circuit, which is supplied from a conventionally grounded distribution system, is the same protection as required for the primary voltage.

(2) A grounded low-voltage system shall be permitted if load currents are not carried on the equipment grounding conductors.

6.3.2.5 Grounding.
6.3.2.5.1

Grounding requirements shall comply with the requirements in 6.3.2.5.1.1 through 6.3.2.5.1.5.

6.3.2.5.1.1 Equipment Grounding Circuitry Integrity.

Equipment grounding and bonding conductors and patient care vicinity grounding and bonding conductors shall be installed such that the continuity of the system cannot be interrupted nor the resistance raised above an acceptable level by the installation, removal, or replacement of any installed device or end use equipment.

6.3.2.5.1.2 Reliability of Grounding.

The equipment grounding conductors shall conform to *NFPA 70.* Branch circuits serving electrical equipment within the patient care vicinity shall be provided with effective ground-fault current paths dual-fed by a wiring method that qualifies as an equipment grounding conductor and by an insulated copper equipment grounding conductor.

6.3.2.5.1.3 Separate Equipment Grounding Conductor.

When existing construction does not have a separate equipment grounding conductor, the continued use of the system shall be permitted if it meets the performance requirements in 6.3.3.1.

6.3.2.5.1.4 Grounding of Receptacles and Fixed Electrical Equipment in Patient Care Spaces.
(A) Wiring Methods.

All branch circuits serving patient care spaces shall be provided with an effective ground-fault current path by installation in a metal raceway system, or a cable having a metallic armor or sheath assembly. The metal raceway system, or metallic cable armor, or sheath assembly shall itself qualify as an equipment grounding conductor.

(B) Insulated Equipment Grounding Conductors and Insulated Equipment Bonding Jumpers.

The following shall be directly connected to an insulated copper equipment grounding conductor that is clearly identified along its entire length by green insulation, with no yellow stripes, and installed with the branch circuit conductors in the wiring methods as provided in 6.3.2.5.1.4(A):

(1) The grounding terminals of all receptacles other than isolated ground receptacles.

(2) Where receptacles are mounted in metal receptacle outlet boxes, metal device boxes, or metal enclosures, the performance of the connection between the receptacle grounding terminal and the metal box or enclosure shall be equivalent to the performance provided by copper wire sized in accordance with 250.146 and Table 250.122 of *NFPA 70*, but no smaller than 12 AWG.

(3) All non-current-carrying conductive surfaces of fixed electrical equipment likely to become energized and subject to personal contact, operating at over 100 volts.

(4) Metal faceplates, which shall be connected to the equipment grounding conductor by means of a metal mounting screw(s) securing the faceplate to a grounded outlet box or grounded wiring device.

(5) Luminaires more than 2.3 m (7½ ft) above the floor and switches located outside of the patient care vicinity, which shall be permitted to be connected to an equipment grounding return path complying with 6.3.2.5.1.4(A) and 6.3.2.5.1.4(B).

6.3.2.5.1.5* Grounding Interconnects.

In patient care spaces supplied by the normal distribution system and any branch of the essential electrical system, the grounding system of the normal distribution system and that of the essential electrical system shall be interconnected.

6.3.2.5.2 Patient Equipment Grounding Point.

A patient equipment grounding point comprising one or more grounding terminals or jacks shall be permitted in an accessible location in the patient care vicinity.

6.3.2.5.3* Special Grounding in Patient Care Rooms.

In addition to the grounding required to meet the performance requirements of 6.3.3.1, additional grounding shall be permitted where special circumstances so dictate.

6.3.2.6 Battery-Powered Lighting Units.
6.3.2.6.1

One or more battery-powered lighting units shall be provided within locations where deep sedation and general anesthesia is administered.

6.3.2.6.2

The lighting level of each unit shall be sufficient to terminate procedures intended to be performed within the operating room.

6.3.2.6.3

The sensor for units shall be wired to the unswitched portion of branch circuit(s) serving general lighting within the room.

6.3.2.6.4

The Level 1 or Level 2 EPS [emergency power supply] equipment location(s) shall be provided with battery-powered emergency lighting. This requirement shall not apply to units located outdoors in enclosures that do not include walk-in access. [**110:**7.3.1]

6.3.2.6.5

The emergency lighting charging system and the normal service room lighting shall be supplied from the load side of the transfer switch. [**110:**7.3.2]

6.3.2.6.6

The minimum average horizontal illumination provided by normal lighting sources in the separate building or room housing the EPS equipment for Level 1 shall be 32.3 lux (3.0 ft-candles) measured at the floor level, unless otherwise specified by a requirement recognized by the authority having jurisdiction. [**110:**7.3.3]

6.3.2.6.7

Units shall be capable of providing lighting for 1½ hours.

6.3.2.6.8

Units shall be tested monthly for 30 seconds, and annually for 30 minutes.

6.3.2.7 Other Non-Patient Care Areas. (Reserved)
6.3.2.8 Ground-Fault Protection.
6.3.2.8.1 Ground-Fault Protection of Equipment (GFPE).
6.3.2.8.1.1 Applicability.

The requirements of 6.3.2.8.1 shall apply to health care facilities housing Category 1 spaces or using life-support equipment and buildings that provide essential utilities or services for the operation of Category 1 spaces or electrical life-support equipment.

6.3.2.8.1.2 Disconnecting Means.

Where ground-fault protection is provided for operation of the service or feeder disconnecting means in accordance with 517.17 of *NFPA 70*, an additional step of ground-fault protection shall be provided at the disconnecting means for the next level of feeders downstream toward the load.

6.3.2.8.1.3 Selectivity.

GFPE for operation of the service and feeder disconnecting means shall be fully selective such that the downstream device and not the upstream device opens for downstream ground faults.

6.3.2.8.2 Ground-Fault Circuit-Interrupter (GFCI) Protection of Personnel.

Ground-fault circuit interrupters (GFCIs) shall be listed.

6.3.2.9* Isolated Power Systems.
6.3.2.9.1 Isolation Transformer.

An isolated power system shall not be required to be installed in any patient care space, except as specified in 6.3.2.3.

6.3.2.9.1.1

The isolation transformer shall be listed and approved for the purpose.

6.3.2.9.1.2

The primary winding shall be connected to a power source so that it is not energized with more than 600 V (nominal).

(A)

If present, the neutral of the primary winding shall be grounded in an approved manner.

(B)

If an electrostatic shield is present, it shall be connected to the reference grounding point.

6.3.2.9.1.3

Wiring of isolated power systems shall be in accordance with 517.160 of *NFPA 70*.

6.3.2.9.2 Impedance of Isolated Wiring.
6.3.2.9.2.1*

The impedance (capacitive and resistive) to ground of either conductor of an isolated system shall exceed 200,000 ohms when installed. The installation at this point shall include receptacles but is not required to include lighting fixtures or components of fixtures. This value shall be determined by energizing the system and connecting a low-impedance ac milliammeter (0 to 1 mA scale) between the reference grounding point and either conductor in sequence. This test shall be permitted to be performed with the line isolation monitor *(see 6.3.2.9.3.1)* connected, provided that the connection between the line isolation monitor and the reference grounding point is open at the time of the test. After the test is made, the milliammeter shall be removed and the grounding connection of the line isolation monitor shall be restored. When the installation is completed, including permanently connected fixtures, the reading of the meter on the line isolation monitor, which corresponds to the unloaded line condition, shall be made. This meter reading shall be recorded as a reference for subsequent line impedance evaluation. This test shall be conducted with no phase conductors grounded.

6.3.2.9.2.2

An approved capacitance suppressor shall be permitted to be used to improve the impedance of the permanently installed isolated system; however, the resistive impedance to ground of each isolated conductor of the system shall be at least 1 megohm prior to the connection of the suppression equipment. Capacitance suppressors shall be installed so as to prevent inadvertent disconnection during normal use.

6.3.2.9.3 Line Isolation Monitor.
6.3.2.9.3.1*

In addition to the usual control and protective devices, each isolated power system shall be provided with an approved, continually operating line isolation monitor that indicates possible leakage or fault currents from either isolated conductor to ground.

6.3.2.9.3.2

The monitor shall be designed such that a green signal lamp, conspicuously visible in the area where the line isolation monitor is utilized, remains lighted when the system is adequately isolated from ground; and an adjacent red signal lamp and an audible warning signal (remote if desired) shall be energized when the total hazard current (consisting of possible resistive and capacitive leakage currents) from either isolated conductor to ground reaches a threshold value of 5.0 mA under normal line voltage conditions. The line isolation monitor shall not alarm for a fault hazard current of less than 3.7 mA.

6.3.2.9.3.3*

The line isolation monitor shall comply with either of the following:

(1) It shall have sufficient internal impedance such that, when properly connected to the isolated system, the maximum internal current that will flow through the line isolation monitor, when any point of the isolated system is grounded, shall be 1 mA.

(2) It shall be permitted to be of the low-impedance type such that the current through the line isolation monitor, when any point of the isolated system is grounded, will not exceed twice the alarm threshold value for a period not exceeding 5 milliseconds.

6.3.2.9.3.4*

An ammeter connected to indicate the total hazard current of the system (contribution of the fault hazard current plus monitor hazard current) shall be mounted in a plainly visible place on the line isolation

monitor with the "alarm on" zone (total hazard current = 5.0 mA) at approximately the center of the scale. A line isolation monitor shall be located in the operating room.

6.3.2.9.3.5

Means shall be provided for shutting off the audible alarm while leaving the red warning lamp activated. When the fault is corrected and the green signal lamp is reactivated, the audible alarm-silencing circuit shall reset automatically, or an audible or distinctive visual signal shall indicate that the audible alarm is silenced.

6.3.2.9.3.6

A reliable test switch shall be mounted on the line isolation monitor to test its capability to operate (i.e., cause the alarms to operate and the meter to indicate in the "alarm on" zone). This switch shall transfer the grounding connection of the line isolation monitor from the reference grounding point to a test impedance arrangement connected across the isolated line; the test impedance(s) shall be of the appropriate magnitude to produce a meter reading corresponding to the rated total hazard current at the nominal line voltage, or to a lesser alarm hazard current if the line isolation monitor is so rated. The operation of this switch shall break the grounding connection of the line isolation monitor to the reference grounding point before transferring this grounding connector to the test impedance(s), so that making this test will not add to the hazard of a system in actual use; nor will the test include the effect of the line-to-ground stray impedance of the system. The test switch shall be of a self-restoring type.

6.3.2.9.3.7

The line isolation monitor shall not generate energy of sufficient amplitude or frequency, as measured by a physiological monitor with a gain of at least 104 with a source impedance of 1000 ohms connected to the balanced differential input of the monitor, to create interference or artifact on human physiological signals. The output voltage from the amplifier shall not exceed 30 mV when the gain is 104. The impedance of 1000 ohms shall be connected to the ends of typical unshielded electrode leads that are a normal part of the cable assembly furnished with physiological monitors. A 60 Hz notch filter shall be used to reduce ambient interference, as is typical in physiological monitor design.

6.3.2.9.4 Identification of Conductors for Isolated (Ungrounded) Systems.

The isolated conductors shall be identified in accordance with 517.160(A)(5) of *NFPA 70.*

6.3.3 Performance Criteria and Testing.
6.3.3.1 Grounding System in Patient Care Spaces.
6.3.3.1.1* Grounding System Testing.

The effectiveness of the grounding system shall be determined by voltage measurements and impedance measurements.

6.3.3.1.1.1

For new construction, the effectiveness of the grounding system shall be evaluated before acceptance.

6.3.3.1.1.2

Small wall-mounted conductive surfaces not likely to become energized, such as surface-mounted towel and soap dispensers, mirrors, and so forth, shall not be required to be intentionally grounded or tested.

6.3.3.1.1.3

Large metal conductive surfaces not likely to become energized, such as windows, door frames, and drains, shall not be required to be intentionally grounded or periodically tested.

6.3.3.1.1.4*

Whenever the electrical system has been altered or replaced, that portion of the system shall be tested.

6.3.3.1.2 Reference Point.

The voltage and impedance measurements shall be taken with respect to a reference point, which shall be one of the following:

(1) Reference grounding point *(see Chapter 3)*

(2) Grounding point, in or near the room under test, that is electrically remote from receptacles (e.g., an all-metal cold-water pipe)

(3) Grounding contact of a receptacle that is powered from a different branch circuit from the receptacle under test.

6.3.3.1.3* Voltage Measurements.
6.3.3.1.3.1

The voltage measurements shall be made under no-fault conditions between a reference point and exposed fixed electrical equipment with conductive surfaces in a patient care vicinity.

6.3.3.1.3.2

The voltage measurements shall be made with an accuracy of ± 5 percent.

6.3.3.1.3.3

Voltage measurements for faceplates of wiring devices shall not be required.

6.3.3.1.4* Impedance Measurements.

The impedance measurement shall be made with an accuracy of ± 5 percent.

6.3.3.1.4.1

For new construction, the impedance measurement shall be made between the reference point and the grounding contact of 10 percent of all receptacles within the patient care vicinity.

6.3.3.1.4.2

The impedance measurement shall be the ratio of voltage developed (either 60 Hz or dc) between the point under test and the reference point to the current applied between these two points.

6.3.3.1.5 Test Equipment.

Electrical safety test instruments shall be tested periodically, but not less than annually, for acceptable performance.

6.3.3.1.5.1

Voltage measurements specified in 6.3.3.1.3 shall be made with an instrument having an input resistance of 1000 ohms ± 10 percent at frequencies of 1000 Hz or less.

6.3.3.1.5.2

The voltage across the terminals (or between any terminal and ground) of resistance-measuring instruments used in occupied patient care rooms shall not exceed 500 mV rms or 1.4 dc or peak to peak.

6.3.3.1.6 Criteria for Acceptability for New Construction.
6.3.3.1.6.1

The voltage limit shall be 20 mV.

6.3.3.1.6.2

The impedance limit shall be 0.2 ohm for systems containing isolated ground receptacles and 0.1 ohm for all others.

6.3.3.2 Receptacle Testing in Patient Care Spaces.
6.3.3.2.1

The physical integrity of each receptacle shall be confirmed by visual inspection.

6.3.3.2.2

The continuity of the grounding circuit in each electrical receptacle shall be verified.

6.3.3.2.3

Correct polarity of the hot and neutral connections in each electrical receptacle shall be confirmed.

6.3.3.2.4

The retention force of the grounding blade of each electrical receptacle (except locking-type receptacles) shall be not less than 115 g (4 oz).

6.3.3.2.5

Where hospital-grade receptacles are required at patient bed locations and in locations where deep sedation or general anesthesia is administered, testing shall be performed after initial installation, replacement, or servicing of the device.

6.3.3.2.6

Additional testing of receptacles in patient care spaces shall be performed at intervals defined by documented performance data.

6.3.3.2.7

Receptacles not listed as hospital-grade, at patient bed locations and in locations where deep sedation or general anesthesia is administered, shall be tested at intervals not exceeding 12 months.

6.3.3.3 Isolated Power Systems.
6.3.3.3.1 Patient Care Spaces.

If installed, the isolated power system shall be tested in accordance with 6.3.3.3.2.

6.3.3.3.2 Line Isolation Monitor Tests.

The line isolation monitor (LIM) circuit shall be tested after installation, and prior to being placed in service, by successively grounding each line of the energized distribution system through a resistor whose value is 200 × V (ohms), where V equals measured line voltage. The visual and audible alarms *(see 6.3.2.9.3.2)* shall be activated.

6.3.3.3.3

The LIM circuit shall be tested at intervals of not more than 1 month by actuating the LIM test switch *(see 6.3.2.9.3.6)*. For a LIM circuit with automated self-test and self-calibration capabilities, this test shall be performed at intervals of not more than 12 months. Actuation of the test switch shall activate both visual and audible alarm indicators.

6.3.3.3.4

After any repair or renovation to an electrical distribution system, the LIM circuit shall be tested in accordance with 6.3.3.3.2.

6.3.3.4 Ground-Fault Protection Testing.

When equipment ground-fault protection is first installed, each level shall be performance-tested to ensure compliance with 6.3.2.8.

6.3.4 Administration of Electrical System.
6.3.4.1 Record Keeping.
6.3.4.1.1*

A record shall be maintained of the tests required by this chapter and associated repairs or modification.

6.3.4.1.2

At a minimum, the record shall contain the date, the rooms or areas tested, and an indication of which items have met, or have failed to meet, the performance requirements of this chapter.

6.3.4.1.3 Isolated Power System (Where Installed).

A permanent record shall be kept of the results of each of the tests.

6.4 Category 1 Spaces.
6.4.1

Category 1 spaces shall be served by an essential electrical system in accordance with 6.7.5.

6.4.2

Category 1 spaces shall not be served by an essential electrical system in accordance with 6.7.6.

6.4.3

Category 1 spaces shall be served by circuits from a critical branch panel(s) served from a single automatic transfer switch and a minimum of one circuit served by the normal power distribution system or by a system originating from a second critical branch automatic transfer switch.

6.4.4

An essential electrical system in accordance with 6.7.5 serving a Category 1 space shall be permitted to serve Category 2 spaces in the same facility.

6.5 Category 2 Spaces.
6.5.1

Category 2 spaces shall be served by a Type 1 or Type 2 EES.

6.5.2

Category 2 spaces served by a Type 1 or Type 2 EES shall be served by circuits from a branch panel(s) served from a single automatic transfer switch and a minimum of one circuit served by the normal power distribution system or by a system originating from a second automatic transfer switch.

6.6 Category 3 and 4 Spaces.
6.6.1

Category 3 or Category 4 spaces shall not be required to be served by an EES.

6.7* Essential Electrical Systems.

6.7.1 FR 9 Power Sources

6.7.1.1* Design Considerations.

Essential electrical system loads shall be supplied by a minimum of two independent power sources or sets of power sources and sets of feeders designed to ensure sufficient reliability to provide effective facility operation consistent with the facility's emergency operations plan.

6.7.1.1.1

~~Current-sensing devices,~~ One on-site power source or set of power sources shall be provided with phase and ground current-sensing devices ~~, shall be selected~~ to minimize the extent of interruption to the electrical system due to abnormal current caused by overload or short circuits, or both.

6.7.1.1.2

The essential electrical system shall have a minimum of two independent power sources or sets of power sources.

6.7.1.1.2.1

At least one power source shall be on-site and sized to supply the entire essential electrical system.

6.7.1.1.2.2

The additional power source(s) shall be permitted to be either on-site or off-site.

6.7.1.2 General.

~~Alternate p~~Power sources for essential electrical systems shall be designed to meet the requirements of such service.

6.7.1.2.1* Power Source.

One on-site power source of set of power sources for Type 1 and Type 2 essential electrical systems ~~power sources~~ shall be classified as Type 10, Class X, Level 1 power sources as defined in Table 6.11.1(a).

Commented [DCV(USES5]: Revise to "power sources"

6.7.1.2.2 Use for Essential Electrical System.
~~**6.7.1.2.2.1**~~

~~The power source supplying the essential electrical system shall be either reserved exclusively for such service or used for other purposes of peak demand control, internal voltage control, load relief for the external utility, cogeneration, or other approved uses.~~

6.7.1.2.2.2*

Each independent power source or sets of power sources supplying the essential electrical system shall be designed to meet the maximum demand likely to be produced by the connected load and be consistent with the facility's emergency operations plan.

6.7.1.2.2.3*
(A)

Power Sources supplying the essential electrical system shall be permitted to supply optional loads.

(B)

Optional loads shall be served by their own transfer means, such that they will not be transferred onto the Essential Electrical System (EES) power sources ~~generating equipment~~ if the transfer would overload the equipment and, if connected, will be shed prior to an EES power source ~~generating equipment~~ overload.

6.7.1.2.2.4

Where optional loads include contiguous or same-site facilities not covered in this code, provisions shall be made to meet the requirements of NFPA *101* for emergency egress under load-shed conditions.

6.7.1.2.2.5 Temporary On-Site Power Source for Maintenance or Repair of the On-Site Power Source.
(A)

(FR-13) If the onsite power source or set of power sources serving the essential electrical system does not have sufficient capacity to support the maximum likely demand load when any single on-site power source is disabled for maintenance or repair, ~~relies on a single on-site power source that will be disabled for maintenance or repair,~~ it shall include a permanent switching means to connect a portable or temporary on-site power source that is available for the duration of the maintenance or repair and that complies with the following requirements:

(1) The connection to the portable or temporary on-site power source shall not require modification of the permanent system wiring.

(2) Transfer of power to the portable or temporary on-site power source shall be in accordance with 6.7.2.1.3.

(3) The connection point for the portable or temporary on-site power source shall be marked with the phase rotation and system bonding requirements.

(4) Mechanical or electrical interlocking shall prevent inadvertent interconnection of power sources.

(5) The switching means shall include a contact point that annunciates at a location remote from the on site power source(s) ~~generator~~ or at another facility monitoring system to indicate that the on-site power source is disconnected from the essential electrical system.

(B)

Using manual switching to switch from the on-site power source to the portable or temporary on-site power source and using the switching means for connection of a load bank shall be permitted.

(C)

The permanent switching means to connect a portable or temporary on-site power source for the duration of maintenance or repair shall not be required where any of the following conditions exists:

(1) All processes that rely on the essential electrical system source are capable of being disabled during maintenance or repair of the on-site power source.

(2) The building or structure is unoccupied and fire protection systems are fully functional and do not require an on-site power source.

(3) Other temporary on-site power sources can be substituted for the essential electrical system.

6.7.1.2.3 Location

6.7.1.2.3.1 Indoor On-Site Power Source Installations.

~~Indoor on-site power sources for Level 1 installations shall be installed in a room dedicated to such sources.~~

~~**(A)**~~

~~The on-site power sources room shall be separated from the rest of the building by construction with a minimum 2-hour fire resistance rating.~~

~~**(B)**~~

~~The on-site power source equipment shall be permitted to be installed in the room with the on-site power sources.~~

~~**(C)**~~

~~No other equipment, including architectural appurtenances, except those that serve the space shall be permitted in the room containing the on-site power sources.~~

~~**6.7.1.2.3.2 Outdoor On-Site Power Source Installations.**~~
~~**(A)**~~

~~If the on-site power source is a generator, it shall comply with either of the following:~~

~~(1) The generator shall be installed in a suitable enclosure located outside the building and capable of resisting the entrance of snow or rain at a maximum wind velocity as required by local building codes.~~

~~(2) The generator shall be constructed such that it is capable of resisting the impacts of snow or rain.~~

~~**(B)**~~

~~Equipment serving a generator shall be permitted to be installed in the generator enclosure.~~

~~**(C)**~~

~~No other equipment, including architectural appurtenances, except those that serve the space shall be permitted in the generator enclosure.~~

~~**6.7.1.2.3.3**~~

On-site power source equipment for Level 1 systems shall not be installed in the same room as other power source service equipment where the service equipment is rated over 150 volts to ground and equal to or greater than 1000 amperes.

6.7.1.2.3.2~~4~~ Feeders and associated raceways serving essential electrical system transfer equipment shall be located such that physical separation is provided between each of the electrical system feeders to prevent possible simultaneous interruption.

~~The rooms, enclosures, or separate buildings housing on-site power source equipment for Level 1 or Level 2 systems shall be designed and located to minimize damage from flooding, including that caused by the following:~~

~~(1) Firefighting~~

~~(2) Sewer water backup~~

~~(3) Other disasters or occurrences~~

~~**6.7.1.2.3.5**~~

~~Minimizing the possibility of damage resulting from interruptions of the on-site power source shall be a design consideration for that equipment.~~

~~**6.7.1.2.3.6**~~

~~Design considerations shall minimize the effect of the failure of one on-site power source on the continued operation of other units.~~

6.7.1.2.4* Capacity and Rating.

The essential electrical system power source or sets of power sources shall have the capacity and rating to meet the maximum demand likely to be produced by the connected load and be consistent with the facility's emergency operations plan.

6.7.1.2.5 Load Pickup.

The power source or set of power sources shall have the required capacity and response to pick up and carry the load within the time specified in Table 6.11.1(b) upon failure of the other power source or set of power sources.

6.7.1.2.6 Heating, Cooling, and Ventilating.

Design of the heating, cooling, and ventilation system for the on-site power sources room shall provide 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, as applicable

(8) Prevailing winds blowing against radiator fan discharge air

6.7.1.2.7 Alarm Annunciator.
6.7.1.2.7.1

~~A remote annunciator that is storage b~~Battery–powered annunciators shall be provided at the location of each on-site power source and at a remote ~~to operate outside of the generating room in a~~ location readily observed by operating personnel ~~at a regular work station~~.

6.7.1.2.7.2

FR13: A supervised ~~The~~ annunciator shall ~~be hard-wired to~~ indicate alarm conditions of each~~the~~ on-site and off-site power source as indicated in 6.7.1.2.7.2(A) through 6.7.1.2.7.2(H).

(A)

Individual visual signals shall indicate the following:

(1) When the ~~on-site~~ power source is operating to supply power to load

(2) When the ~~battery charger is malfunctioning (if provided)~~power source is unavailable

(B)*

A remote, common audible alarm shall be provided as specified in 6.7.1.2.7.2(G). [**110:**5.6.6]

(C)

Local annunciation and either facility or network remote annunciation shall be provided for a Level 1 on-site power source.

(D)

For the purposes of defining the types of annunciation in 6.7.1.2.7.2(C), the following shall apply:

(1) Local annunciation is located on the equipment itself or within the same equipment room.

(2) Facility remote annunciation is located on site but not within the room where the equipment is located.

(3) Network remote annunciation is located off site.

[**110:**5.6.6.3]

(E)

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:**5.6.6.4]

(F)

In lieu of the requirement in 6.7.1.2.7.2(E), 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:**5.6.6.5]

(G)

Individual alarm indication to annunciate any of the conditions listed in Table 6.7.1.3.8.2 shall have the following characteristics:

(1) Be battery powered

(2) Be 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 switches to test the operation of all visual alarm indicators

(H)*

The following shall apply to centralized computer systems:

(1) They shall not be used as a substitute for the alarm annunciator in 6.7.1.2.7.

(2) They shall be permitted to supplement the alarm annunciator in 6.7.1.2.7.

(I)

Wireless transmission of the EPS data required by 6.7.1.3.8.2 and 6.7.1.3.8.3 shall be permitted.

6.7.1.3 Generator Set.
6.7.1.3.1 General.

FR 10: Comply with Chapters 7 and 8 only of NFPA 110.

~~A single generator set that operates the essential electrical system shall be permitted to be part of the system supplying the other purposes as specified in 6.7.1.2.2.1, provided that any such use will not decrease the mean period between service overhauls to less than 3 years.~~

~~**6.7.1.3.2 Location.**~~

~~The generator equipment shall be installed in a location that permits ready accessibility and a minimum of 0.9 m (36 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.~~

~~**6.7.1.3.3 Maintenance of Temperature.**~~

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

~~**6.7.1.3.4* Heating, Cooling, and Ventilating.**~~

With the generator running at rated load, ventilation airflow shall be provided to limit the maximum air temperature in the generator room or the enclosure housing the unit to the maximum ambient air temperature permitted by the generator manufacturer.

6.7.1.3.4.1

Consideration shall be given to all the heat emitted to the generator equipment room by the energy converter, uninsulated or insulated exhaust pipes, and other heat-producing equipment.

6.7.1.3.4.2*

If required by the manufacturer, ventilation shall be supplied to the generator equipment.

(A)

For generators supplying Level 1 EPSS, ventilation air shall be supplied directly from a source outside the building by an exterior wall opening or from a source outside the building by a 2-hour fire-rated air transfer system.

(B)

For generators supplying Level 1 EPSS, discharge air shall be directed outside the building by an exterior wall opening or to an exterior opening by a 2-hour fire-rated air transfer system.

(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 generator equipment for Level 1 EPSS.

6.7.1.3.4.3

Ventilation air supply shall be from outdoors or from a source outside 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]

6.7.1.3.4.4

Ventilation air shall be provided to supply and discharge cooling air for radiator cooling of the generator when running at rated load.

(A)

Ventilation air supply and discharge for a radiator-cooled generator shall have a maximum static restriction of 125 Pa (0.5 in. of water column) in the discharge duct at the radiator outlet.

(B)

Radiator air discharge shall be ducted outdoors or to an exterior opening by a 2-hour rated air transfer system. [**110:**7.7.4.2]

6.7.1.3.4.5

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 generator equipment for Level 1 systems.

6.7.1.3.4.6

The ambient air temperature in the generator equipment room or outdoor housing containing Level 1 rotating equipment shall stabilize at not less than 4.5°C (40°F) when the equipment is not operating.

6.7.1.3.5* Energy Converters.

Internal combustion engine energy converters and associated cranking batteries shall be in accordance with the requirements of NFPA 110.

6.7.1.3.6 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

(4) Where the stored energy system has a "black start" capability in addition to normal discharge capability

[**110:**5.6.4.1.2]

6.7.1.3.7 Fuel Supply.

The fuel supply for the generator set shall comply with Sections 5.5 and 7.9 of NFPA 110.

6.7.1.3.8 Requirements for Safety Devices.
6.7.1.3.8.1 Internal Combustion Engines.

Internal combustion engines serving generator sets shall be equipped with the following:

(1) Sensor device plus visual warning device to indicate a water jacket temperature below that required in 6.7.1.3.3

(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) 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) Common audible alarm device to warn that one or more of the prealarm or alarm conditions exist

6.7.1.3.8.2 Safety Indications and Shutdowns.

Safety indications and shutdowns shall be in accordance with Table 6.7.1.3.8.2.

Table 6.7.1.3.8.2 Safety Indications and Shutdowns

-	Level 1		
Indicator Function (at Battery Voltage)	**CV**	**S**	**RA**
(a) Overcrank	X	X	X
(b) Low water temperature	X	—	X
(c) High engine temperature prealarm	X	—	X

Indicator Function (at Battery Voltage)	Level 1		
	CV	S	RA
(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	—

CV: Control panel–mounted visual. S: Shutdown of EPS indication. RA: Remote audible. X: Required. O: Optional.

Notes:

(1) Item (p) is to be provided, but a separate remote audible signal is not required when the regular work site in 5.6.6 of NFPA 110 is staffed 24 hours a day.

(2) Item (b) is not required for combustion turbines.

(3) Item (r) or (s) is required only where used as a starting method.

(4) Item (j): EPS ac ammeter is permitted for this function.

(5) All required CV functions are to be visually annunciated by a remote, common visual indicator.

(6) All required functions indicated in the RA column are to be annunciated by a remote, common audible alarm as required in 5.6.5.2(4) of NFPA 110.

(7) Item (i) requires a low gas pressure alarm on gaseous systems.

(8) Item (b) must 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.

6.7.1.3.8.3

Individual visual signals plus a common audible signal to warn of an engine-generator alarm condition shall indicate the following:

(1) Low lubricating oil pressure

(2) Low water temperature (below that required in 6.7.1.3.3)

~~(3) Excessive water temperature~~

~~(4) Low fuel when the main fuel storage tank contains less than a 4-hour operating supply~~

~~(5) Overcrank (failed to start)~~

~~(6) Overspeed~~

6.7.1.4 Health Care Microgrid.

A health care microgrid in accordance with Section 6.10 shall be permitted to serve as the EPS for all or part of an essential electrical system.

6.7.2* Distribution.
6.7.2.1 General Requirements.
6.7.2.1.1* Coordination.
6.7.2.1.1.1

Overcurrent protective devices serving the essential electrical system shall be coordinated for the period of time that a fault's duration extends beyond 0.1 second.

6.7.2.1.1.2

Coordination shall not be required as follows:

(1) Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exists on the transformer secondary

(2) Between overcurrent protective devices of the same size (ampere rating) in series

6.7.2.1.2 Ground-Fault Protection of Equipment, Essential Electrical System.
6.7.2.1.2.1

FR11: Ground-fault protection of equipment with automatic disconnecting means shall not be required between on-site ~~on alternate~~ power supply sources~~, between alternate power supply sources~~ and any essential electrical system transfer switch, or on the load side of any essential electrical system transfer switch.

6.7.2.1.2.2

Ground-fault indication without automatic disconnection shall be provided at any on-site power source.

6.7.2.1.3 Automatic Transfer Switch Features.
6.7.2.1.3.1 FR 12: Power **Source Monitoring.**
(A)*

Undervoltage-sensing devices shall be provided to monitor all ungrounded lines of each ~~the primary power~~ source to the ATS as follows:

(1) When the voltage on any phase falls below the minimum operating voltage of any load to be served, the transfer switch shall automatically initiate start up and ~~engine start and the process of~~ transfer to the other power source.

(2) *When the voltage on all phases of the interrupted~~primary~~ source returns to ~~within~~ specified limits~~ for a designated period of time~~, the process of transfer back to th~~at~~e ~~primary~~ power source may~~shall~~ be initiated.

(B)

Both voltage-sensing and frequency-sensing equipment shall be provided to monitor one ungrounded line of the power sources.

(C)

Transfer to a power source shall be inhibited until the voltage and frequency are within a specified range to handle loads to be served.

(D)

Sensing equipment shall not be required in the transfer switch, provided it is included with the power source ~~engine~~ control panel. ~~[**110:**6.2.2.3.1]~~

~~**(E)**~~

~~Frequency-sensing equipment shall not be required for monitoring the off-site power source.~~

6.7.2.1.3.2 Interlocking.

Mechanical interlocking or an approved alternate method shall prevent the inadvertent interconnection of any two separate power sources.

6.7.2.1.3.3* Manual Operation.

Instruction and equipment shall be provided for safe manual nonelectric transfer in the event the transfer switch malfunctions. [**110:**6.2.4]

6.7.2.1.3.4* Time Delay on Starting of Power Sources.
(A)

A time-delay device shall be provided to delay starting of the on-site power source.

(B)

The time-delay device shall prevent nuisance starting of an on-site ~~the~~ power source and ~~possible subsequent~~ load transfer in the event of harmless momentary power dips and interruptions of the ~~primary~~ other power source.

~~**6.7.2.1.3.5 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]~~

6.7.2.1.3.6 Time Delay on Transfer.

An adjustable time-delay device shall be provided to delay transfer and sequence load transfer to the power source to avoid excessive voltage drop ~~when the transfer switch is installed for Level 1 use~~.

(A) Time Delay Commencement.

The time delay shall commence when proper voltage and frequency are achieved.

(B) Time Delay at ~~Engine Control Panel.~~Power Source

Time delays shall be permitted to be located at the Power source ~~engine~~ control panel in lieu of in the transfer switches. ~~[**110:**6.2.7.2]~~

6.7.2.1.3.7* Time Delay on Retransfer ~~to Primary Power Source.~~

An adjustable time-delay device with automatic bypass shall be provided to delay retransfer from either ~~one~~ power source to the other power source~~, and allow the power source to stabilize before retransfer of the load.~~

6.7.2.1.3.8 Time Delay Bypass If a Power Source Fails.

The time delay shall be automatically bypassed if a power source fails.

(A)

The transfer switch shall be permitted to be programmed for a manually initiated retransfer ~~to the on-site power source~~ to provide for a planned momentary interruption of the load.

(B)

If used, the arrangement in 6.7.2.1.3.8(A) shall be provided with a bypass feature to allow automatic retransfer in the event that the selected ~~on-site~~ power source fails and the other power source is available.

6.7.2.1.3.9 Time Delay on Engine Shutdown.

A minimum time delay of 5 minutes shall be provided for unloaded running of a generator prior to shutdown to allow for engine cooldown.

(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 if it is included with the engine control panel or if a utility feeder is used as a power source.

6.7.2.1.3.10 Test Switch.

A test means shall be provided on each automatic transfer switch (ATS) that simulates failure of one power source and then transfers the load to another power source(s).

6.7.2.1.3.11* Indication of Transfer 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]

6.7.2.1.3.12 Motor Load Transfer.

Provisions shall be included to reduce currents resulting from motor load transfer if such currents could damage power source equipment or cause nuisance tripping of power source overcurrent protective devices.

6.7.2.1.3.13* Isolation of Neutral Conductors.

Provisions shall be included for ensuring continuity, transfer, and isolation of the power source neutral conductors wherever they are separately grounded to achieve ground-fault sensing.

6.7.2.1.3.14 Retransfer.

If a power source or set of power sources fails during a test, provisions shall be made to immediately retransfer to the other power source or set of power sources.

6.7.2.1.3.15 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.

6.7.2.1.3.16* Automatic Transfer Switch.
(A)

Transfer of Essential System ~~all~~ loads shall be accomplished using a~~n automatic~~ transfer switch(es).

(B)

Each automatic transfer switch of 600 V or less shall be listed for the purpose and marked for emergency use.

6.7.2.1.3.17* 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]~~two power sources.

Commented [DCV(USES6]: Revise to "power sources"

(B) Indication of Transfer 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]

6.7.2.1.4 Nonautomatic Transfer Device Classification.

Nonautomatic transfer devices of 600 V or less shall be listed for the purpose and approved.

6.7.2.1.5 Nonautomatic Transfer Device Features.
6.7.2.1.5.1 General.

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

6.7.2.1.5.2 Interlocking.

Reliable mechanical interlocking or an approved alternate method shall prevent the inadvertent interconnection of two power sources.

6.7.2.1.5.3 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]

6.7.2.1.6 Bypass and Isolating Transfer Switches.

Bypass-isolation switches shall be permitted for bypassing and isolating the transfer switch and installed in accordance with 6.4.2, 6.4.3, and 6.4.4 of NFPA 110. [**110:**6.4.1]

6.7.2.1.6.1 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]

6.7.2.1.6.2 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]

6.7.2.1.6.3* 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]

6.7.2.1.6.4 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]

6.7.2.2 Branches.
6.7.2.2.1

The division between the branches shall occur at transfer switches where more than one transfer switch is required.

6.7.2.2.2

Each branch shall be arranged for connection, within the time limits specified in this chapter, to another power source following a loss of a power source or set of sources.

6.7.2.2.3

The number of transfer switches to be used shall be based upon reliability, design, and load considerations.

6.7.2.2.3.1

Each branch of the essential electrical system shall have one or more transfer switches.

6.7.2.2.3.2

One transfer switch shall be permitted to serve one or more branches in a facility with a continuous load on the switch of 150 kVA (120 kW) or less.

6.7.2.2.3.3
(A)

Where a single transfer switch is used as permitted in 6.7.2.2.3.2, the following requirements shall apply:

(1) The single transfer switch shall include a bypass-isolation switch to facilitate maintenance of the transfer switch without jeopardizing continuity of power to the connected load.

(2) Division into separate branches shall not be required.

(B)

A bypass-isolation switch in accordance with 6.7.2.2.3.3(A) shall not be required where any of the following conditions exist:

(1) All processes that rely on the essential electrical system are capable of being disabled during maintenance or repair activities.

(2) The building or structure is unoccupied and fire protection systems are fully functional and do not require an alternate power source.

(3) Other temporary means are permitted to be substituted for the essential electrical system.

6.7.2.2.4 Feeders from On-Site Power Source.
6.7.2.2.4.1

A single feeder supplied by the on-site power source shall be permitted to supply the essential electrical system to the point at which the life safety, critical, and equipment branches are separated.

6.7.2.2.4.2

Installation of the transfer equipment shall be permitted at locations other than that of the on-site power source.

6.7.2.2.5 Receptacles.

The requirements for receptacles shall comply with 6.7.2.2.5(A) and 6.7.2.2.5(B).

(A)

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 life safety and critical branches shall have a distinctive color or marking so as to be readily identifiable.

6.7.2.2.6 Switches.

Switches of all types shall be permitted in the lighting circuits connected to the essential electrical system in accordance with NFPA *101*.

6.7.2.2.7

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*.

6.7.3 Performance Criteria and Testing.
6.7.3.1 Transfer Switches.

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

~~**6.7.3.2**~~

~~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.~~

6.7.3.3 (FR-14)

Failure of the selected power ~~normal~~ source shall automatically start the other power source (if required to meet essential loads capacity) after a short delay, as described in 6.7.2.1.3.4.

6.7.3.3.1

When the other power source has attained a voltage and frequency that satisfies the minimum operating requirements of the essential electrical system, the load shall be connected automatically to the that power source.

6.7.3.4 ~~Generator~~ Control Wiring.

Control conductors installed between the transfer switch and the on-site power sources ~~emergency generator(s)~~ shall be kept entirely independent of all other wiring.

6.7.3.4.1

The integrity of the power source ~~generator remote~~ start circuit shall be monitored for broken, disconnected, or short-circuited wires.

6.7.3.4.2

Loss of integrity shall start the on site power source or sources. ~~generator(s)~~.

6.7.3.5

Upon connection of a power source, the loads comprising the life safety and critical branches shall be automatically re-energized.

6.7.3.5.1

The load comprising the equipment branch shall be connected either automatically after a time delay, as described in 6.7.2.1.3.6, or nonautomatically and in a sequential manner that will not overload the other power source.

6.7.3.6

When the first power source is restored, and after a time delay as described in 6.7.2.1.3.7, the automatic transfer switches shall disconnect the other power source and connect the loads to the first power source.

6.7.3.6.1

The other power source shall continue to run unloaded for a preset time delay, as described in 6.7.2.1.3.9.

6.7.3.7

If a power source fails and the other power source has been restored, retransfer to the other power source shall be immediate, bypassing the retransfer delay timer.

6.7.3.8

Nonautomatic transfer switching devices shall be restored as soon as possible or at the discretion of the operator.

6.7.4 Administration.
6.7.4.1 Maintenance and Testing of Essential Electrical System.
6.7.4.1.1 Maintenance and Testing of On-Site Power Source, Transfer Switches, and Associated Equipment.
6.7.4.1.1.1 Maintenance of On-Site Power Source.

The on-site power source and associated equipment, including all appurtenance parts, shall be maintained such that it is capable of supplying service within the shortest time practicable and within the 10-second interval specified in 6.7.1.2.5 and 6.7.5.3.1.

6.7.4.1.1.2
(A)

The 10-second criterion shall not apply during the monthly testing of an essential electrical system.

(B)

If the 10-second criterion is not met during the monthly test, a process shall be provided to annually confirm the capability of the life safety and critical branches to comply with 6.7.5.3.1.

6.7.4.1.1.3

Maintenance shall be performed in accordance with Section 6.9.

6.7.4.1.1.4

Maintenance of the electrical equipment for the life safety branch, critical branch, and equipment branch shall be maintained in accordance with the manufacturer's instructions and preventative maintenance programs.

6.7.4.1.1.5 Inspection and Testing. (FR-15)

Criteria, conditions, and personnel requirements shall be in accordance with 6.7.4.1.1.5(A) through 6.7.4.1.1.5(C).

(A)* Test Criteria.

Testing criteria shall be as follows:

(1) ~~Generator sets~~On-site power sources serving essential electrical systems shall be tested 12 times a year, with testing intervals of not less than 20 days nor more than 40 days.

(2) On-site power sources ~~Generator sets~~ serving essential electrical systems shall be tested in accordance with Chapter 8 of NFPA 110.

(B) Test Conditions.

The scheduled test under load conditions shall include a ~~complete~~ simulated unanticipated failure of each independent power source or set of power soures ~~cold start~~ and appropriate automatic and manual transfer of all essential electrical system loads.

(C) Test Personnel.

The scheduled tests shall be conducted by qualified personnel to keep the machines ready to function and, in addition, serve to detect causes of malfunction and to train personnel in operating procedures.

6.7.4.1.1.6

When a transfer switch is bypassed to facilitate maintenance, one of the following conditions shall apply:

(1) The bypass switch automatically transfers the load between power sources upon loss of the connected power source.

(2) The bypass switch remains actively supervised by a qualified person who can manually initiate a transfer of the load between power sources.

6.7.4.1.1.7

Where bypass isolation switches are used, inadvertent parallel operation shall be avoided.

6.7.4.1.2 Maintenance and Testing of Circuitry.
6.7.4.1.2.1 Insulation Resistance.

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

6.7.4.1.2.2 Maintenance of Batteries.

Batteries for on-site generators shall be maintained in accordance with NFPA 110.

6.7.4.2 Record Keeping.

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

6.7.5* Type 1 Essential Electrical System Requirements.
6.7.5.1* Branches.
6.7.5.1.1

The essential electrical system shall be divided into the following three branches:

(1) Life safety

(2) Critical

(3) Equipment

6.7.5.1.2 Life Safety Branch.

6.7.5.1.2.1

The life safety branch shall be limited to circuits essential to life safety.

6.7.5.1.2.2

The life safety branch shall supply power as follows:

(1) Illumination of means of egress in accordance with NFPA *101*

(2) Exit signs and exit directional signs in accordance with NFPA *101*

(3) *Communications systems, where used for issuing instruction during emergency conditions

(4) (FR-16) ~~Generator set~~On-site power source locations as follows:

(a) Task illumination

(b) Battery charger for emergency battery-powered lighting unit(s)

(c) Select receptacles at the power source ~~generator set~~ location and essential electrical system transfer switch locations

(5) Elevator cab lighting, control, communications, and signal systems

(6) Electrically powered doors used for building egress

(7) Fire alarms and auxiliary functions of fire alarm combination systems complying with *NFPA 72*

6.7.5.1.2.3

Alarm and alerting systems (other than fire alarm systems) shall be connected to the life safety branch or critical branch.

6.7.5.1.2.4 (FR-17)

Loads dedicated to on-site power sources ~~a specific generator~~, including the fuel transfer pump(s), ventilation fans, electrically operated louvers, controls, cooling system, and other ~~generator~~ accessories essential for power source ~~generator~~ operation, shall be connected to the life safety branch or the output terminals of the power sources ~~generator~~ with overcurrent protective devices.

6.7.5.1.2.5

No functions other than those in 6.7.5.1.2.2, 6.7.5.1.2.3, and 6.7.5.1.2.4 shall be connected to the life safety branch, except as specifically permitted in 6.7.5.1.2.

6.7.5.1.2.6 Branch Circuits for Life Safety Lighting. (FR-18)

Branch circuits supplying life safety lighting shall be served from a power source in compliance with 6.7.1 when the non-essential ~~normal~~ power supply for lighting is interrupted or where single circuits supply luminaires containing secondary batteries.

6.7.5.1.2.7 Life Safety Lighting Circuit Switches.

Life safety lighting circuit switches shall meet the following requirements:

(1) The switch(es) for the life safety lighting circuits shall be arranged so that only authorized persons have control of the life safety lighting switch(es) unless one of the following conditions are met:

(a) Where two or more single-throw switches are connected in parallel to control a single circuit, at least one of these switches is accessible only to authorized persons.

(b) Additional switches are included that act only to put life safety lights into operation, but not to disconnect them.

(2) Switches connected in series or 3- and 4-way switches shall not be used.

(3) All manual switches for controlling life safety lighting shall meet the following requirements:

(a) The manual switches shall be in locations convenient to authorized persons responsible for their actuation unless there are multiple switches provided.

(b) One of the switches shall be permitted to be located so that it can only energize, but not de-energize, the circuit.

6.7.5.1.2.8 FR19. **Life Safety Lighting Dimmer and Relay Systems.**

A dimmer or relay system containing more than one dimmer or relay and listed for emergency use shall be permitted to be used as a control device for energizing life safety lighting circuits.

(A)

Upon failure of one power source~~normal power~~, the dimmer or relay system shall be permitted to selectively energize only those branch circuits necessary to provide the minimum required illumination using a control bypass function.

(B)

Where the dimmer or relay system is supplied by an upstream transfer switch, ~~normal~~ power sensing for this function shall be permitted to be from ~~a normal only~~ either power source or set of source upstream of the transfer switch.

6.7.5.1.2.9 Directly Controlled Life Safety Luminaires.

Where life safety illumination is provided by a directly controlled life safety luminaire(s) that responds to an external control input, or loss thereof, to bypass ~~normal~~ control upon loss of ~~normal~~ one power source, the luminaire(s) and external bypass control(s) shall be individually listed for emergency use.

6.7.5.1.2.10 Life Safety Lighting Automatic Load Control Relay.
(A)

If a life safety lighting load is automatically energized upon loss of one power source~~the normal supply~~, a listed automatic load control relay shall be permitted to energize the load.

(B)

The load control relay shall not be used as transfer equipment.

6.7.5.1.3* Critical Branch.
6.7.5.1.3.1

The critical branch shall be permitted to be subdivided into two or more branches.

6.7.5.1.3.2

The critical branch shall supply power for task illumination, fixed equipment, select receptacles, and select power circuits serving the following spaces and functions related to patient care:

(1) Category 1 spaces where deep sedation or general anesthesia is administered, task illumination, select receptacles, and fixed equipment

(2) Task illumination and select receptacles in the following:

(a) Patient care spaces, including infant nurseries, selected acute nursing areas, psychiatric bed areas (omit receptacles), and ward treatment rooms

(b) Medication preparation spaces

(c) Pharmacy dispensing spaces

(d) Nurses' stations — unless adequately lighted by corridor luminaires

(3) Additional specialized patient care task illumination and receptacles, where needed

(4) Nurse call systems

(5) Blood, bone, and tissue banks

(6) *Telecommunications entrance facility, telecommunications equipment rooms, and telecommunication rooms and equipment in these rooms.

(7) Task illumination, select receptacles, and select power circuits for the following areas:

(a) Category 1 or 2 spaces with at least one duplex receptacle per patient bed location, 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 (select)

(g) Human physiology labs

(h) Intensive care units

(i) Postoperative recovery rooms (select)

(8) Clinical IT-network equipment

(9) Wireless phone and paging equipment for clinical staff communications

(10) Additional task illumination, receptacles, and select power circuits needed for effective facility operation, including single-phase fractional horsepower motors, which are permitted to be connected to the critical branch

6.7.5.1.4 Equipment Branch.
6.7.5.1.4.1 General.

The equipment branch shall be connected to equipment described in 6.7.5.1.4.3 through 6.7.5.1.4.4.

6.7.5.1.4.2 Connection to On-Site Power Source.
(A)

The equipment branch shall be installed and connected to the on-site power source such that equipment described in 6.7.5.1.4.3 is automatically restored to operation at appropriate time-lag intervals following the energizing of the life safety and critical branches.

(B)

The arrangement of the connection to the on-site power source shall also provide for the subsequent connection of equipment described in 6.7.5.1.4.4.

6.7.5.1.4.3* Equipment for Delayed-Automatic Connection.
(A)

The following equipment shall be permitted to be arranged for delayed-automatic connection to the on-site power source:

(1) Central suction systems serving medical and surgical functions, including controls, with such suction systems permitted to be placed 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, with such air systems permitted to be placed on the critical branch

(4) Smoke control and stair pressurization systems

(5) Kitchen hood supply or exhaust systems, or both, if required to operate during a fire in or under the hood

(6) Supply, return, and exhaust ventilating systems for the following:

(a) Airborne infectious/isolation rooms

(b) Protective environment rooms

(c) Exhaust fans for laboratory fume hoods

(d) Nuclear medicine areas where radioactive material is used

(e) Ethylene oxide evacuation

(f) Anesthetic evacuation

(B)

Where delayed-automatic connection is not appropriate, the ventilation systems specified in 6.7.5.1.4.3(A)(6) shall be permitted to be placed on the critical branch.

6.7.5.1.4.4* FR 20 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 on-site power source *(also see A.6.7.5.1.4.3)*:

(1) Heating equipment used to provide heating for operating, delivery, labor, recovery, intensive care, and coronary care spaces; nurseries; infection/isolation rooms; emergency treatment spaces; and general patient rooms and pressure maintenance (i.e., jockey or make-up) pumps for water-based fire protection systems

(2) *Heating equipment used to provide heating for ~~of~~ general patient rooms except: ~~during disruption of the normal source shall not be required under any of the following conditions:~~

(a) Outside design temperature is higher than −6.7°C (+20°F)

(b) Outside design temperature is lower than −6.7°C (+20°F), where a selected room(s) is provided for the needs of all confined patients [then only such room(s) need be heated]

(3) Elevator(s) selected to provide service to patient, surgical, obstetrical, and ground floors during interruption of one~~normal~~ power source or set of sources

(4) Supply, return, and exhaust ventilating systems for surgical and obstetrical delivery suites; intensive care and coronary care spaces; nurseries; and emergency treatment spaces

(5) Hyperbaric facilities

(6) Hypobaric facilities

(7) Autoclaving equipment, which is permitted to be arranged for either automatic or manual connection to the alternate source

(8) Controls for equipment listed in 6.7.5.1.3

(9) *Other selected equipment

6.7.5.1.5 FR21

~~Generator l~~Load-shed circuits designed for the purpose of load reduction or for load priority systems shall not shed life safety branch loads, critical branch loads serving Category 1 spaces, medical air compressors, medical–surgical vacuum pumps, fire pumps, the pressure maintenance (i.e., jockey) pump(s) for water-based fire protection systems, ~~generator~~ fuel pumps for onsite power sources, or other ~~generator~~ accessories for on-site power sources.

6.7.5.2 Wiring Requirements.
6.7.5.2.1* Separation from Other Circuits.

The life safety branch and critical branch shall be kept independent of all other wiring and equipment.

6.7.5.2.2 Mechanical Protection of the Life Safety and Critical Branches.

The wiring of the life safety and critical branches shall be mechanically protected by raceways, as defined in *NFPA 70*.

6.7.5.2.3

Flexible power cords of appliances or other utilization equipment connected to the life safety and critical branches shall not be required to be enclosed in raceways.

6.7.5.3 Performance Criteria and Testing.

6.7.5.3.1 FR 29 Power Source. The life safety and critical branches shall be installed and connected to the on-site power source specified in 6.7.1.1.2 so that all functions specified herein for the life safety and critical branches are automatically restored to operation within 10 seconds after interruption of power.

6.7.6* Type 2 Essential Electrical System Requirements.
6.7.6.1 FR 22 Power **Sources.**

The requirements for sources for Type 2 essential electrical systems shall conform to those listed in 6.7.1.

6.7.6.2 Distribution.
6.7.6.2.1* Branches.
6.7.6.2.1.1

The number of transfer switches to be used shall be based upon reliability, design, and load considerations.

6.7.6.2.1.2

The essential electrical system shall be divided into the following two branches:

(1) Life safety branch

(2) Equipment branch

6.7.6.2.1.3

Each branch of the essential electrical system shall have one or more transfer switches.

6.7.6.2.1.4

One transfer switch shall be permitted to serve one or more branches in a facility with a continuous load on the switch of 150 kVA (120 kW) or less.

6.7.6.2.1.5 Life Safety Branch.
(A) Required to be Connected.

The life safety branch shall supply power to the following:

(1) Illumination of means of egress in accordance with NFPA *101*

(2) Exit signs and exit directional signs in accordance with NFPA *101*

(3) Alarm and alerting systems, including the following:

(a) Fire alarms

(b) Alarms required for systems used for the piping of nonflammable medical gases as specified in Chapter 5

(4) *Communications systems, where used for issuing instructions during emergency conditions

(5) Task illumination and select receptacles at the generator set location

(6) Elevator cab lighting, control, communications, and signal systems

(B) Prohibited to be Connected.

No functions other than those listed in 6.7.6.2.1.5(A)(1) through 6.7.6.2.1.5(A)(6) shall be connected to the life safety branch.

(C) Branch Circuits for Life Safety Lighting. FR23

Branch circuits that supply life safety lighting shall be served from a power source in accordance with 6.7.1 when one power source ~~the normal supply~~ for lighting is interrupted or where single circuits supply luminaries containing secondary batteries.

(D) Life Safety Lighting Circuit Switches.

Life safety lighting circuit switches shall meet the following requirements:

(1) The switch(es) for the life safety lighting circuits shall be arranged so that only authorized persons have control of the life safety lighting switch(es) unless one of the following conditions are met:

(a) Where two or more single-throw switches are connected in parallel to control a single circuit, at least one of these switches is accessible only to authorized persons.

(b) Additional switches are included that act only to put life safety lights into operation, but not to disconnect them.

(2) Switches connected in series or 3- and 4-way switches shall not be used.

(3) All manual switches for controlling life safety lighting shall meet the following requirements:

(a) The manual switches shall be in locations convenient to authorized persons responsible for their actuation unless there are multiple switches provided.

(b) One of the switches shall be permitted to be located so that it can only energize, but not de-energize, the circuit.

(E) FR 24 Life Safety Lighting Dimmer and Relay Systems.

A dimmer or relay system containing more than one dimmer or relay and listed for emergency use shall be permitted to be used as a control device for energizing life safety lighting circuits. Upon failure of ~~normal~~ a power source or set of sources, the dimmer or relay system shall be permitted to selectively energize only those branch circuits necessary to provide minimum required illumination using a control bypass function. Where the dimmer or relay system is supplied by an upstream transfer switch, ~~normal~~ power sensing for this function shall be permitted to be from either ~~a normal only~~ power source or set of sources upstream of the transfer switch.

(F) FR 25 Life Safety Lighting Automatic Load Control Relay.

If a life safety lighting load is automatically energized upon loss of ~~the normal supply~~a power source, a listed automatic load control relay shall be permitted to energize the load. The load control relay shall not be used as transfer equipment.

6.7.6.2.1.6 Equipment Branch.
(A) Equipment Automatically Restored to Operation.

The equipment branch shall be installed and connected to the on-site power source such that equipment listed in 6.7.6.2.1.6(C) is automatically restored to operation at appropriate time-lag intervals following the restoration of the life safety branch to operation.

(B) Connection of Additional Equipment.

The equipment branch arrangement shall provide for the additional connection of equipment listed in 6.7.6.2.1.6(D).

(C) FR 26 AC Equipment for Nondelayed-Automatic Connection.

~~Generator a~~Accessories for onsite power sources including, but not limited to, the transfer fuel pump, electrically operated louvers, and other ~~generator~~ accessories essential for power source~~generator~~ operation shall be arranged for automatic connection to the other independent ~~on-site~~ power source or set of sources.

(D) Delayed-Automatic Connections to Equipment Branch.

The following equipment shall be permitted to be connected to the equipment branch and shall be arranged for delayed-automatic connection to the on-site power source:

(1) Task illumination and select receptacles in the following:

(a) Patient care spaces

(b) Medication preparation spaces

(c) Pharmacy dispensing spaces

(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 or exhaust systems, or both, if required to operate during a fire in or under the hood

(6) Nurse call systems

(7) HVAC systems serving the EF, TER, and TR

(E)* FR 27 Delayed-Automatic or Manual Connections to Equipment Branch.

The following equipment shall be permitted to be connected to the equipment branch and shall be arranged for either delayed-automatic or manual connection to ~~the~~ either ~~alternate~~ power source or set of power sources:

(1) ~~*Heating* *~~*Equipment to Provide Heating for General Patient Rooms, except where:* . ~~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°F).

(b) The outside design temperature is lower than −6.7°C (+20°F) and, where 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. *(See A.6.7.1.1 for more information.)*

(2) **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.

(3) *Optional Connections to the Equipment Branch*. Additional illumination, receptacles, and equipment shall be permitted to be connected only to the equipment branch.

(4) *Multiple Systems*. Where one switch serves multiple systems as permitted in 6.7.6.2, transfer for all loads shall be nondelayed automatic.

6.7.6.3 Wiring Requirements.

6.7.6.3.1* Separation from Other Circuits.

The life safety and equipment branches shall be kept entirely independent of all other wiring and equipment.

6.7.6.3.2* Receptacles.

The electrical receptacles or the cover plates for the electrical receptacles supplied from the life safety and equipment branches shall have a distinctive color or marking so as to be readily identifiable.

6.7.6.4 Performance Criteria and Testing.
6.7.6.4.1 FR 28 Power **Source**s**.**

The life safety and equipment branches shall be installed and connected to the on-site power source specified in 6.7.1.1.2 so that all functions specified herein for the life safety and equipment branches are automatically restored to operation within 10 seconds after interruption of power.

6.8 Site Acceptance Testing.
6.8.1*

Site acceptance testing shall be performed on the electrical system and all electrical components serving Category 1 and Category 2 spaces.

6.8.1.1

Acceptance testing is required after initial installation or major renovation prior to the system being placed into service.

6.8.2*

Site acceptance testing procedures shall be in accordance with industry-recognized standards and practices for equipment testing and system commissioning.

6.8.3 Site Acceptance Testing Records.
6.8.3.1

A record of all site acceptance testing procedures required in 6.8.1 and testing results shall be maintained.

6.8.3.2

Site acceptance testing records shall be retained for 5 years.

6.8.3.3 Record Medium.
6.8.3.3.1

The records shall be on a medium that will survive the retention period.

6.8.3.3.2

Paper or electronic media shall be permitted.

6.8.3.4 Record Reporting and Archiving.
6.8.3.4.1

The record shall be available for examination and, if required, reported to the authority having jurisdiction.

6.8.3.4.2

Archiving of records by any means shall be permitted if hard copies of the records can be provided promptly when requested.

6.9 Electrical Maintenance Program (EMP).
6.9.1 EMP Program.
6.9.1.1*

All electrical components which are part of an electrical system serving a Category 1 and Category 2 space shall be part of an electrical maintenance program (EMP).

6.9.1.2

The EMP shall include the following elements:

(1) Listing of all equipment and systems included as part of the program

(2) Schedule of inspection, testing, and servicing (maintenance) of equipment

(3) Survey and analysis of electrical equipment and systems to determine maintenance requirements and priorities

(4) Scheduled routine inspections and tests

(5) Review of inspection and test reports so that proper corrective measures can be prescribed

(6) Performance of necessary work

(7) Complete records

6.9.2 EMP Records.
6.9.2.1

A record of all testing and maintenance described in 6.9.4 shall be maintained.

6.9.2.2

EMP inspection, testing, and maintenance records shall be retained for 5 years.

6.9.2.3 EMP Record Medium.
6.9.2.3.1

The records shall be on a medium that will survive the retention period.

6.9.2.3.2

Paper or electronic media shall be permitted.

6.9.2.4 EMP Record Reporting and Archiving.
6.9.2.4.1

The record shall be available for examination and, if required, reported to the authority having jurisdiction.

6.9.2.4.2

Archiving of records by any means shall be permitted if hard copies of the records can be provided promptly when requested.

6.9.3 Corrective Measures.
6.9.3.1* Analysis of Inspection, Testing, and Maintenance Reports.

Analysis of inspection, testing, and maintenance reports shall be followed by the implementation of appropriate corrective measures.

6.9.3.2

All corrective measures shall be documented in accordance with the requirements of 6.9.2.

6.9.4 EMP Intervals.
6.9.4.1*

EMP intervals shall be in accordance with Table 6.9.4.1.

Table 6.9.4.1 Electrical Maintenance Program (EMP) Intervals

Item	Inspection Period	Testing Period	Maintenance Period
Medium-voltage switchgear	Every 3 months	Every 3 years	Every 3 years
Power distribution transformers (≥ 750 kVA)	Monthly	Every 3 years	Every 3 years
Generator (alternate source)	*(See Chapter 8 of NFPA 110.)*	*(See Chapter 8 of NFPA 110.)*	*(See Chapter 8 of NFPA 110.)*
Generator paralleling switchgear	Monthly	Annually	Every 3 years
Low-voltage switchgear/switchboards	Every 3 years	Every 3 years	Every 3 years

Item	Inspection Period	Testing Period	Maintenance Period
Overcurrent Protective Devices			
Fuses (≥ 400 A)	Every 3 years	Every 3 years	Every 3 years
Low-voltage power circuit breakers (≥ 400 A)	Every 3 years	Every 3 years	Every 3 years
Low-voltage molded-case circuit breakers (≥ 400 A)	Every 3 years	Every 3 years	Every 3 years
Medium-voltage circuit breakers	Every 3 years	Every 3 years	Every 3 years
Relays (including polyphase ground-fault equipment protection)	Every 3 years	Every 3 years	Every 3 years
Transfer equipment	Monthly	Every 3 years	Every 3 years
Bus duct	Every 3 years	Every 3 years	Every 3 years
Uninterruptible power supplies (≥ 100 kW)	Every 3 months	Every 6 months	Every 6 months
Isolated power panels	*(See 6.3.3.3.3.)*	*(See 6.3.3.3.3.)*	*(See 6.3.3.3.3.)*
Motor control equipment	Annually	Every 3 years	Every 3 years
Branch-circuit panelboards	Annually	Every 3 years	N/A
Wiring devices	*(See 6.3.3.2.)*	*(See 6.3.3.2.)*	*(See 6.3.3.2.)*
Battery-powered lighting units	*(See 6.3.2.6.8.)*	*(See 6.3.2.6.8.)*	*(See 6.3.2.6.8.)*

N/A: not applicable.

6.9.4.2* Alternative Equipment Maintenance (AEM) Program.
6.9.4.2.1

EMP intervals shall be permitted to be developed as part of an alternative equipment maintenance (AEM) program.

6.9.4.2.2

The AEM shall include the following elements:

(1) *The AEM program shall be based on accepted standards of practice for electrical equipment maintenance.

(2) The AEM program requirements (including EMP schedules) shall be clearly documented and available for inspection by the authority having jurisdiction.

(3) The AEM program shall be developed and administered by qualified personnel, regardless of whether they are health care facility employees or contractors.

(4) *The AEM program shall consider the typical health and safety risks associated with the equipment's use, including "critical equipment" for which there exists a risk of serious injury or death to a patient or staff person if the equipment fails.

6.10 Health Care Microgrids.
6.10.1 General Requirements.
6.10.1.1 Applicability. ~~(Reserved)~~

FR 1: This section shall apply to Health Care Microgrids acting as the power source for the EES loads and/or the non-essential loads.

6.10.1.2* Purpose.

FR 2: The purpose of Section 6.10 shall be to describe requirements for ~~multiple source~~ health care microgrid systems ~~, ac or dc, utilized as all or a portion of EPSSs~~ for health care facilities.

6.10.1.3* Campuses.

Health care microgrids shall be permitted to serve individual buildings or campuses consisting of several buildings.

6.10.1.4 Non–Health Care Buildings.

FR 3: Health care microgrids shall be permitted to serve buildings that are designed to comply with ~~fall into~~ multiple use categories as described in Chapter 4.

6.10.2 Sources.
6.10.2.1

All sources shall meet the installation and maintenance requirements of the applicable NFPA code.

6.10.2.2

Any combination of generation, storage, or transformation assets shall be permitted to serve as the on-site power source for all or a portion of health care microgrids.

6.10.2.2.1

The combination of sources shall provide performance equivalent to that of the requirements of 6.7.1.2.1.

6.10.3 Reliability.
6.10.3.1

Health care microgrid systems shall be designed with sufficient reliability to provide effective facility operation consistent with the facility's emergency operations plan.

Microgrids used to supply power to the EES shall meet power quality requirements detailed in IEEE 1159 and IEEE 1547. The commissioning plan required by 6.10.7.2 shall include verification of power quality requirements.

6.10.3.2*

FR 4: Health care microgrid system components shall not be compromised by failure of the off-site ~~normal~~ power source.

Commented [VD7]: Revise to "power source"

6.10.4 Interconnection to an Electrical Utility.

Health care microgrids that are interconnected to an external electrical utility shall comply with regulations relevant to the serving utility.

6.10.5 Distribution System. (Reserved)
6.10.6* Control System.

Health care microgrid control systems shall comply with the requirements of this subsection.

6.10.6.1* Network Segregation.
6.10.6.1.1

Health care microgrid control system networks shall be segregated from other networks.

6.10.6.1.2

Intelligence and memory of health care microgrid control systems shall not be dependent on off-site resources.

6.10.6.2 Source Monitoring. (Reserved)
6.10.6.3 Design.

The design of health care microgrid control systems shall include a sequence of operations for manual controlling of sources in the event of system failure.

6.10.6.4 Controller Backup Power.

Health care microgrid controllers shall have a dedicated battery backup having a minimum 90-minute capacity.

6.10.6.5 Annunciation.
6.10.6.5.1

Health care microgrid control systems shall be capable of providing readouts that indicates which sources are operating.

6.10.6.5.2

The amount of power provided to the health care microgrid by each source shall be visible at all times.

6.10.6.6 Security. (Reserved)
6.10.7 Commissioning.

Health care microgrid systems shall be commissioned in accordance with their sequence of operations.

6.10.7.1 Verification of Means and Methods.

Health care microgrid system installers or commissioning agents shall prepare a written commissioning plan that provides a description of the means and methods necessary to document and verify that the system and its associated controls and safety systems are in proper working condition.

6.10.7.2 Commissioning Plan.

Commissioning plans shall include the following:

(1) An overview of the commissioning process developed specifically for the health care microgrid and its controller to be installed and a narrative description of the activities to be conducted

(2) *Roles and responsibilities for all those involved in the planning, design, construction, installation, and operation of the health care microgrid

(3) Means and methods whereby the commissioning plan will be made available during the implementation of the health care microgrid project

(4) Plans and specifications necessary to understand the installation and operation of the health care microgrid and all associated components, operational controls, and safety systems

(5) A detailed description of each activity to be conducted during the commissioning process, who will perform each activity, and at what point in time each activity is to be conducted

(6) Procedures to be used in documenting the proper operation of the health care microgrid and all associated components, operational controls, and safety systems

(7) Guidelines and format for a commissioning checklist, relevant operational testing forms, and necessary commissioning

(8) Means and methods whereby facility operation and maintenance staff will be trained on the system

(9) Identification of personnel qualified to service, maintain, and respond to incidents involving the system

6.10.7.3 Commissioning Report.

A commissioning report documenting the commissioning process and the results shall be provided.

6.10.7.3.1

The commissioning report shall be prepared by the health care microgrid system commissioning agent and summarize the commissioning process, the operation of the system, the associated operational controls, and the safety systems.

6.10.7.3.2

The commissioning report shall include the final commissioning plan and the results of the commissioning process, as well as a copy of the plans and specifications associated with the as-built health care microgrid system design and installation.

6.10.7.3.3

The commissioning report shall include any issues identified during commissioning and the measures taken to resolve them.

6.10.8 Inspection, Testing, and Maintenance.
6.10.8.1

The health care microgrid system shall be inspected, tested, and maintained by qualified personnel.

6.10.8.2

All health care microgrid components shall be inspected and maintained in accordance with manufacturers' instructions or annually, whichever occurs first.

6.10.8.3

Health care microgrid system components shall be tested in accordance with the manufacturers' requirements.

6.10.8.4

Health care microgrid systems shall be recommissioned for operation when the system configuration changes or every five years, whichever occurs first.

6.11 Classification of Emergency Power Supply Systems (EPSSs).
6.11.1 General.

The EPSS shall provide a source of electrical power of required capacity, reliability, and quality to loads for a length of time as specified in Table 6.11.1(a) and within a specified time following loss or failure of power as specified in Table 6.11.1(b).

Table 6.11.1(a) Classification of EPSSs

Class	Minimum Time
Class 0.083	0.083 hr (5 min)
Class 0.25	0.25 hr (15 min)
Class 2	2 hr
Class 6	6 hr
Class 48	48 hr
Class X	Other time, in hours, as required by the application, code, or user

[**110:**Table 4.1(a)]

Table 6.11.1(b) Types of EPSSs

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

[**110:**Table 4.1(b)]

6.11.2 Class.

The class defines the minimum time, in hours, for which the EPSS is designed to operate at its rated load without being refueled or recharged. *[See Table 6.11.1(a).]* [**110:**4.2]

6.11.3 Type.

The type defines the maximum time, in seconds, that the EPSS will permit the load terminals of the transfer switch to be without acceptable electrical power. Table 6.11.1(b) provides the types defined by this standard. [**110:**4.3]

6.11.4 Level.

This standard recognizes two levels of equipment installation, performance, and maintenance. [**110:**4.4]

6.11.4.1

Level 1 systems shall be installed where failure of the equipment to perform could result in loss of human life or serious injuries. [**110:**4.4.1]

6.11.4.2

Level 2 systems shall be installed where failure of the EPSS to perform is less critical to human life and safety. [**110:**4.4.2]

6.11.4.3

All equipment shall be permanently installed. [**110:**4.4.3]

6.11.4.4

Level 1 and Level 2 systems shall ensure that all loads served by the EPSS are supplied by an on-site power source that meets all the following criteria:

(1) It is of a quality within the operating limits of the load.

(2) It operates for a duration specified for the class as defined in Table 6.11.1(a).

(3) It operates within the time specified for the type as defined in Table 6.11.1(b).