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—ESTABLISHED 1971—

To: Members of the Fire Code Committee

Jeff Lucas, Chair, Stephen Bailey PE, Vice Chair, Michael Pella P.E., Daniel Potkay, John Duffin, Harlan L. Kuritzky, John Kneiss, Guillermo A. Echezabal CSI, CDT, Greg McLellan P.E., James Godfrey, Pablo Camacho, Don Perdue, John Preston, Bruce Bowers, Charlena Smith, Pete McGinnis

Members of the Electrical Committee

Stephen Bailey, Robert Kamm, David Tringo, David Rice, Jeff Gary, Kenneth Gilbert, George Kropp, Steven Busick, Jack Fisher, Robert Sikorski, Bob Messing, John Simmons

From: Bryan Parks, Chief Fire and Ken Castronovo, Chief Electrical

Date: September 26, 2019

Time: 9:30 AM

Location: Mangrove Hall (West Lake Park) 1200 Sheridan Street, Hollywood

The Chairs, Jeff Lucas and Stephen Bailey have called for a meeting of the Board of Rules and Appeals, Joint Fire and Electrical Code Committee for September 26, 2019 at 9:30am to discuss proposed new Fire Uniform Generator Codes F-124.

Chairman's Remarks

Roll Call

Item 1: Overview of Electrical and Fire Codes as it relates to State Requirement for Generators (Ken and Bryan) (Pg. 1)

- A. FAC 59A-4.1265, 59A-5.036 (Pg. 2)
- B. FFPC, FBC and NEC References (Pg. 15)
- C. New Fire Uniform Generator Provisions F-124 (Pg. 45)
- C. Public Comment
- D. Committee discussions and recommendation.

Reference:

NFPA 110, 2013 (Pg. 49)

NFPA 99, 2015 (Pertaining to EPSS) (Pg. 85)

Item 2: Committee Discussions other issues

Item 3: Adjournment

Sunshine Law Reminder: Advisory Board members cannot communicate with each other on a possible committee or Board topic outside of a public meeting, per State statute.

Item 1: Overview of Electrical and Fire Codes as it relates to State Requirement for Generators

Item 1a: FAC 59A-4.1265, 59A-5.036

58A-5.036: Emergency Environmental Control for Assisted Living Facilities

(1) DETAILED EMERGENCY ENVIRONMENTAL CONTROL PLAN. Each assisted living facility shall prepare a detailed plan (“plan”) to serve as a supplement to its Comprehensive Emergency Management Plan, to address emergency environmental control in the event of the loss of primary electrical power in that assisted living facility which includes the following information:

(a) The acquisition of a sufficient alternate power source such as a generator(s), maintained at the assisted living facility, to ensure that current licensees of assisted living facilities will be equipped to ensure ambient air temperatures will be maintained at or below 81 degrees Fahrenheit for a minimum of ninety-six (96) hours in the event of the loss of primary electrical power

1. The required temperature must be maintained in an area or areas, determined by the assisted living facility, of sufficient size to maintain residents safely at all times and that is appropriate for resident care needs and life safety requirements. For planning purposes, no less than twenty (20) net square feet per resident must be provided. The assisted living facility may use eighty percent (80%) of its licensed bed capacity as the number of residents to be used in the calculation to determine the required square footage. This may include areas that are less than the entire assisted living facility if the assisted living facility’s comprehensive emergency management plan includes allowing a resident to congregate when he or she desires in portions of the building where temperatures will be maintained and includes procedures for monitoring residents for signs of heat related injury as required by this rule. This rule does not prohibit a facility from acting as a receiving provider for evacuees when the conditions stated in s. 408.821, F.S. and Rule 58A-5.026(5), F.A.C., are met. The plan shall include information regarding the area(s) within the assisted living facility where the required temperature will be maintained.

2. The alternate power source and fuel supply shall be located in an area(s) in accordance with local zoning and the Florida Building Code.

3. Each assisted living facility is unique in size; the types of care provided; the physical and mental capabilities and needs of residents; the type, frequency, and amount of services and care offered; and staffing characteristics. Accordingly, this rule does not limit the types of systems or equipment that may be used to achieve ambient temperatures at or below 81 degrees Fahrenheit for a minimum of ninety-six (96) hours in the event of the loss of primary electrical power. The plan shall include information regarding the systems and equipment that will be used by the assisted living facility and the fuel required to operate the systems and equipment.

a. An assisted living facility in an evacuation zone pursuant to chapter 252, F, S. must maintain an alternative power source and fuel as required by this subsection at all times when the assisted living facility is occupied but is permitted to utilize a mobile generator(s) to enable portability if evacuation is necessary.

b. Assisted living facilities located on a single campus with other facilities under common ownership, may share fuel, alternative power resources, and resident space available on the campus if such resources are sufficient to support the requirements of each facility's residents, as specified in this rule. Details regarding how resources will be shared and any necessary movement of residents must be clearly described in the emergency power plan.

c. A multistory facility, whose comprehensive emergency management plan is to move residents to a higher floor during a flood or surge event, must place its alternative power source and all necessary additional equipment so it can safely operate in a location protected from flooding or storm surge damage.

(b) The acquisition of sufficient fuel, and safe maintenance of that fuel at the facility, to ensure that in the event of the loss of primary electrical power there is sufficient fuel available for the alternate power source to maintain ambient temperatures at or below 81 degrees Fahrenheit for a minimum of ninety-six (96) hours after the loss of primary electrical power during a declared state of emergency. The plan must include information regarding fuel source and fuel storage.

1. Facilities must store minimum amounts of fuel onsite as follows:

a. A facility with a licensed capacity of 16 beds or less must store 48 hours of fuel onsite.

b. A facility with a licensed capacity of 17 or more beds must store 72 hours of fuel onsite.

2. An assisted living facility located in an area in a declared state of emergency area pursuant to section 252.36, F.S. that may impact primary power delivery must secure ninety-six (96) hours of fuel. The assisted living facility may utilize portable fuel storage containers for the remaining fuel necessary for ninety-six (96) hours during the period of a declared state of emergency.

3. Piped natural gas is an allowable fuel source and meets the onsite fuel supply requirements under this rule.

4. If local ordinances or other regulations limit the amount of onsite fuel storage for the assisted living facility's location, then the assisted living facility must develop a plan that includes maximum onsite fuel storage allowable by the ordinance or regulation and a reliable method to obtain the maximum additional fuel at least 24 hours prior to depletion of onsite fuel.

(c) The acquisition of services necessary to maintain, and test the equipment and its functions to ensure the safe and sufficient operation of the alternate power source maintained at the assisted living facility.

(d) The acquisition and maintenance of a carbon monoxide alarm.

(2) SUBMISSION OF THE PLAN.

(a) Each assisted living facility licensed prior to the effective date of this rule shall submit its plan to the local emergency management agency for review within 30 days of the effective date of this rule. Assisted living facility plans previously submitted and approved pursuant to emergency rule 58AER17-1 will require resubmission only if changes are made to the plan.

(b) Each new assisted living facility shall submit the plan required under this rule prior to obtaining a license.

(c) Each existing assisted living facility that undergoes any additions, modifications, alterations, refurbishment, renovations or reconstruction that require modification of its systems or equipment affecting the facility's compliance with this rule shall amend its plan and submit it to the local emergency management agency for review and approval.

(3) APPROVED PLANS.

(a) Each assisted living facility must maintain a copy of its approved plan in a manner that makes the plan readily available at the licensee's physical address for review by a legally authorized entity. If the plan is maintained in an electronic format, assisted living facility staff must be readily available to access and produce the plan. For purposes of this section, "readily available" means the ability to immediately produce the plan, either in electronic or paper format, upon request.

(b) Within two (2) business days of the approval of the plan from the local emergency management agency, the assisted living facility shall submit in writing proof of the approval to the Agency for Health Care Administration.

(c) The assisted living facility shall submit a consumer-friendly summary of the emergency power plan to the Agency. The Agency shall post the summary and notice of the approval and implementation of the assisted living facility emergency power plans on its website within ten (10) business days of the plan's approval by the local emergency management agency and update within ten (10) business days of implementation.

(4) IMPLEMENTATION OF THE PLAN.

(a) Each assisted living facility licensed prior to the effective date of this rule shall, no later than June 1, 2018, have implemented the plan required under this rule.

(b) The Agency shall allow an extension up to January 1, 2019 to providers in compliance with (c) below and who can show delays caused by necessary construction, delivery of ordered equipment, zoning or other regulatory approval processes. Assisted living facilities shall notify the Agency that they will utilize the extension and keep the Agency apprised of progress on a quarterly basis to ensure there are no unnecessary delays. If an assisted living facility can show in its quarterly progress reports that unavoidable delays caused by necessary construction, delivery of ordered equipment, zoning or other regulatory approval processes will occur beyond the initial extension date, the assisted living facility may request a waiver pursuant to s. 120.542, F.S.

(c) During the extension period, an assisted living facility must make arrangements pending full implementation of its plan that provides the residents with an area or areas to congregate that meets the safe indoor air temperature requirements of subsection (1) (a) for a minimum of ninety-six (96) hours.

1. An assisted living facility not located in an evacuation zone must either have an alternative power source onsite or have a contract in place for delivery of an alternative power source and fuel when requested. Within twenty-four (24) hours of the issuance of a state of emergency for an event that may impact primary power delivery for the area of the assisted living facility, it must have the alternative power source and no less than ninety-six (96) hours of fuel stored onsite.

2. An assisted living facility located in an evacuation zone pursuant to chapter 252, F.S. must either:

a. Fully and safely evacuate its residents prior to the arrival of the event; or

b. Have an alternative power source and no less than ninety-six (96) hours of fuel stored onsite, within twenty-four (24) hours of the issuance of a state of emergency for the area of the assisted living facility.

(d) Each new assisted living facility shall implement the plan required under this rule prior to obtaining a license.

(e) Existing assisted living facilities that undergo any additions, modifications, alterations, refurbishment, renovations or reconstruction that require modification of the systems or equipment affecting the assisted living facility's compliance with this rule shall implement its amended plan concurrent with any such additions, modifications, alterations, refurbishment, renovations or reconstruction.

(f) The Agency for Health Care Administration may request cooperation from the State Fire Marshal to conduct inspections to ensure implementation of the plan in compliance with this rule.

(5) POLICIES AND PROCEDURES.

(a) Each assisted living facility shall develop and implement written policies and procedures to ensure that the assisted living facility can effectively and immediately activate, operate and maintain the alternate power source and any fuel required for the operation of the alternate power source. The procedures shall ensure that residents do not experience complications from fluctuations in ambient air temperatures inside the facility. Procedures must address the care of residents occupying the facility during a declared state of emergency, specifically, a description of the methods to be used to mitigate the potential for heat related injury including:

1. The use of cooling devices and equipment;
2. The use of refrigeration and freezers to produce ice and appropriate temperatures for the maintenance of medicines requiring refrigeration;
3. Wellness checks by assisted living facility staff to monitor for signs of dehydration and heat injury; and
4. A provision for obtaining medical intervention from emergency services for residents whose life safety is in jeopardy.

(b) Each assisted living facility shall maintain the written policies and procedures in a manner that makes them readily available at the licensee's physical address for review by a legally authorized entity. If the policies and procedures are maintained in an electronic format, assisted living facility staff must be readily available to access the policies and procedures and produce the requested information. For purposes of this section, "readily available" means the ability to immediately produce the policies and procedures, either in electronic or paper format, upon request.

(c) The written policies and procedures must be readily available for inspection by each resident; each resident's legal representative, designee, surrogate, guardian, attorney in fact, or case manager; each resident's estate; and such additional parties as authorized in writing or by law.

(6) REVOCATION OF LICENSE, FINES OR SANCTIONS. For a violation of any part of this rule, the Agency for Health Care Administration may seek any remedy authorized by Chapter 429, Part I, Florida Statutes, or Chapter 408, part II, Florida Statutes, including, but not limited to, license revocation, license suspension, and the imposition of administrative fines.

(7) COMPREHENSIVE EMERGENCY MANAGEMENT PLAN.

(a) Assisted living facilities whose comprehensive emergency management plan is to evacuate must comply with this rule.

(b) Each facility whose plan has been approved shall submit the plan as an addendum with any future submissions for approval of its comprehensive emergency management plan.

(8) NOTIFICATION.

(a) Within five (5) business days, each assisted living facility must notify in writing, unless permission for electronic communication has been granted, each resident and the resident's legal representative:

1. Upon submission of the plan to the local emergency management agency that the plan has been submitted for review and approval;

2. Upon final implementation of the plan by the assisted living facility.

(b) Each assisted living facility must maintain a copy of each notification set forth in paragraph (a) above in a manner that makes each notification readily available at the licensee's physical address for review by a legally authorized entity. If the notifications are maintained in an electronic format, facility staff must be readily available to access and produce the notifications. For purposes of this section, "readily available" means the ability to immediately produce the notifications, either in electronic or paper format, upon request.

Rulemaking Authority 429.41, FS. Law Implemented 429.19, 429.41, FS. History – New _____.

59A-4.1265 Emergency Environmental Control for Nursing Homes

(1) DETAILED NURSING HOME EMERGENCY POWER PLAN. Each nursing home shall prepare a detailed plan ("plan"), to serve as a supplement to its Comprehensive Emergency Management Plan, to address emergency power in the event of the loss of primary electrical power in that nursing home, which includes the following information:

(a) The acquisition of a sufficient alternate power source such as a generator(s), maintained at the nursing home, to ensure that current licensees of nursing homes will be equipped to ensure the protection of resident health, safety, welfare, and comfort for a minimum of ninety-six (96) hours in the event of the loss of primary electrical power. Safe indoor air temperatures in resident occupied areas shall be determined by the licensee to meet the clinical needs of residents, but shall not exceed eighty-one (81) degrees Fahrenheit.

1. The required temperature must be maintained in an area or areas determined by the nursing home of sufficient size to maintain all residents safely at all times and is appropriate for the care needs and life safety requirements. For planning purposes, no less than thirty (30) net square feet per resident must be provided. This may include areas that are less than the entire nursing home if the nursing home's comprehensive emergency management plan includes relocating residents to portions of the building where the health, safety, welfare, and comfort of the residents will be maintained as required by this rule. The plan shall include information regarding the area(s) within the nursing home where the required temperature will be maintained.

2. The alternate power source for the equipment necessary to maintain the safe indoor air temperature required by this rule may be provided by the essential electrical system required by the Florida Building Code for Nursing Home design and construction or onsite optional standby system as defined by NFPA 70 National Electrical Code supplying normal power to the nursing home maintained onsite at all times when the building is occupied. If an optional standby system is used, it must be connected and maintained in accordance with the manufacturer's recommendations. The alternate power source and fuel supply shall be located in an area(s) in accordance with local zoning and the Florida Building Code.

3. Each nursing home is unique in size; the types of care provided; the physical and mental capabilities and needs of residents; the type, frequency, and amount of services and care offered; and staffing characteristics. Accordingly, this rule does not limit the types of systems or equipment that may be used to maintain the safe indoor air temperature required by this rule for a minimum of ninety-six (96) hours in the event of the loss of primary

electrical power. The plan shall include information regarding the systems and equipment that will be used by the nursing home required to operate the systems and equipment.

a. A nursing home in an evacuation zone pursuant to chapter 252, F. S. must maintain an alternative power source and fuel as required by this subsection at all times when the facility is occupied but is permitted to utilize a mobile generator(s) to enable portability if evacuation is necessary.

b. Facilities located on a single campus with other facilities licensed by the Agency under common ownership, may share fuel, alternative power resources, and resident space available on the campus if such resources are sufficient to support the requirements of each facility's residents, as specified in this rule. Details regarding how resources will be shared and any necessary movement of residents must be clearly described in the emergency power plan.

c. A multistory facility, whose comprehensive emergency management plan is to move residents to a higher floor during a flood or surge event, must place its alternative power source and all necessary additional equipment so it can safely operate in a location protected from flooding or storm surge damage.

(b) The acquisition of sufficient fuel, and safe maintenance of that fuel on-site at the facility, to ensure that in the event of the loss of primary electrical power there is sufficient fuel available for the alternate power source required in subsection (1)(a) to power life safety systems, critical systems, and equipment necessary to maintain safe indoor air temperatures as described in this rule for ninety-six (96) hours after the loss of electrical power during a declared state of emergency. The plan shall include information regarding fuel source and fuel storage.

1. A nursing home located in an area in a declared state of emergency area pursuant to section 252.36, F.S. that may impact primary power delivery must secure ninety-six (96) hours of fuel. The nursing home may utilize portable fuel storage containers for the remaining fuel necessary for ninety-six (96) hours during the period of a declared state of emergency.

2. A nursing home must store a minimum of seventy-two (72) hours of fuel onsite.

3. Piped natural gas is an allowable fuel source and meets the onsite fuel requirement under this rule.

4. If local ordinances or other regulations that limit the amount of onsite fuel storage for the nursing home's location and the nursing home does not have access to piped natural gas, then the nursing home must develop a plan that includes maximum onsite fuel storage allowable by the ordinance or regulation and a reliable method to obtain the maximum additional fuel at least 24 hours prior to depletion of onsite fuel.

(c) The acquisition of services necessary to install, maintain, and test the equipment and its functions to ensure the safe and sufficient operation of the alternate power source installed in the nursing home.

(2) SUBMISSION OF THE PLAN.

(a) Each nursing home licensed prior to the effective date of this rule shall submit its plan to the local emergency management agency for review and approval within thirty (30) days of the effective date of the rule. Nursing Home plans previously received and approved under emergency rule 59AER17-1 will require resubmission only if changes are made.

(b) Each new nursing home shall submit the plan required under this rule prior to obtaining a license.

(c) Each existing nursing home that undergoes additions, modifications, alterations, refurbishment, reconstruction or renovations that require modification of the systems or equipment affecting the nursing home's compliance with this rule shall amend its plan and submit it to the local emergency management agency for review and approval.

(3) PLAN REVIEW. Architectural and engineering plans are subject to review by the Agency's Office of Plans and Construction. The local emergency management agency shall review the emergency power plan for compliance with the subsection and may rely on the technical review of the Office of Plans and Construction. Once the review is complete, the local emergency management agency shall:

(a) Report deficiencies in the plan to the nursing home for resolution. The nursing home must resubmit the plan within ten (10) business days.

(b) Report approval or denial of the plan to the Agency and the nursing home.

(4) APPROVED PLANS.

(a) Each nursing home must maintain a copy of its plan in a manner that makes the plan readily available at the licensee's physical address for review by the authority having jurisdiction. If the plan is maintained in an electronic format, nursing home staff must be readily available to access and produce the plan. For purposes of this section, "readily available" means the ability to immediately produce the plan, either in electronic or paper format, upon request.

(b) Within two (2) business days of the approval of the plan from the local emergency management agency, the nursing home shall submit in writing proof of the approval to the Agency for Health Care Administration.

(c) The nursing home shall submit a consumer friendly summary of the emergency power plan to the Agency. The Agency shall post the summary and notice of the approval and implementation of the nursing home emergency power plans on its website within ten (10) business days of the plan's approval by the local emergency management agency and update within ten (10) business days of implementation.

(5) IMPLEMENTATION OF THE PLAN.

(a) Each nursing home licensed prior to the effective date of this rule shall, no later than June 1, 2018 have implemented the plan required under this rule.

(b) The Agency shall grant an extension up to January 1, 2019 to providers in compliance with (c) below and who can show delays caused by necessary construction, delivery of ordered equipment, zoning or other regulatory approval processes. Nursing homes granted an extension must keep the Agency apprised of progress on a monthly basis to ensure there are no unnecessary delays.

(c) During the extension period, a nursing home must make arrangements pending full implementation of its plan that the residents are housed in an area that meets the safe indoor air temperature requirements of subsection (1) (a) for a minimum of ninety-six (96) hours.

1. A nursing home not located in an evacuation zone must either have an alternative power source onsite or have a contract in place for delivery of an alternative power source and fuel when requested. Within twenty-four (24) hours of the issuance of a state of emergency for an event that may impact primary power delivery for the area of the nursing home, it must have the alternative power source and no less than ninety-six (96) hours of fuel stored onsite.

2. A nursing home located in an evacuation zone pursuant to chapter 252, F.S. must either:

a. Fully and safely evacuate its residents prior to the arrival of the event; or

b. Have an alternative power source and no less than ninety-six (96) hours of fuel stored onsite, within twenty-four (24) hours of the issuance of a state of emergency for the area of the nursing home.

(d) Each new nursing home shall implement the plan prior to obtaining a license.

(e) Each nursing home that undergoes any additions, modifications, alterations, refurbishment, reconstruction or renovations that require modification of the systems or equipment affecting the nursing home's compliance with this rule shall implement its amended plan subsequent with the completion of construction.

(f) The Agency may request cooperation from the State Fire Marshal to conduct inspections to ensure implementation of the plan in compliance with this rule.

(6) POLICIES AND PROCEDURES.

(a) Each nursing home shall develop and implement written policies and procedures to ensure that each nursing home can effectively and immediately activate, operate and maintain the alternate power source and any fuel required for the operation of the alternate power source. The procedures shall be resident-focused to ensure that residents do not experience complications from heat exposure, and shall include a contingency plan to transport residents to a safe facility if the current nursing home's plan to keep the residents in a safe and comfortable location within the nursing home at or below the indoor air temperature required by this rule becomes compromised.

(b) Each nursing home shall maintain its written policies and procedures in a manner that makes them readily available at the licensee's physical address for review by the authority having jurisdiction. If the policies and procedures are maintained in an electronic format, nursing home staff must be readily available to access the policies and procedures and produce the requested information.

(c) The written policies and procedures must be readily available for inspection by each resident; each resident's legal representative, designee, surrogate, guardian, attorney in fact, or case manager; each resident's estate; and all parties authorized in writing or by law.

(7) REVOCATION OF LICENSE, FINES OR SANCTIONS. For a violation of any part of this rule, the Agency may seek any remedy authorized by Chapter 400, Part II, Florida Statutes, or Chapter 408, Part II, Florida Statutes, including but not limited to, license revocation, license suspension, and the imposition of administrative fines.

(8) COMPREHENSIVE EMERGENCY MANAGEMENT PLAN.

(a) Nursing homes whose comprehensive emergency management plan is to evacuate must comply with this rule.

(b) Once the plan has been approved, the nursing home shall submit the plan as an addendum with any future submissions for approval of its Comprehensive Emergency Management Plan.

(9) NOTIFICATION.

(a) Within three (3) business days, each nursing home must notify in writing, unless permission for electronic communication has been granted, each resident and the resident's legal representative:

1. Upon submission of the plan to the local emergency management agency that the plan has been submitted for review and approval;

2. Upon final implementation of the plan by the nursing home following review by the State Fire Marshal or the Agency's Office of Plans and Construction.

(b) The nursing home shall keep a copy of each written or electronic notification sent by the nursing home to the resident and resident's representative on file.

Rulemaking Authority 400.23, FS, Law Implemented 400.23, FS, History-New _____.

Item 1b: FFPC, FBC and NEC References

11.5.1.10.2 Crankcase oil or used oil shall not be used as fuel unless all of the following conditions are met:

- (1) The installation is in a commercial or industrial occupancy.
- (2) The oil-burning appliance is designed to burn crankcase oil or used oil and is listed for such use.
- (3) The appliance is installed in accordance with the manufacturer's instructions and with the terms of its listing.
- (4) The installation meets the applicable requirements of Section 4.6 and Chapter 12 of NFPA 31. [31:4.5.2]

11.5.1.10.3* Where heavy oils are used, the following shall be required:

- (1) The oil-burning appliance shall be designed to burn such fuels.
- (2) Means shall be provided to maintain the oil at its proper atomizing temperature.
- (3) Automatically operated burners that require preheating of oil shall be arranged so that no oil can be delivered for combustion until the oil is at the proper atomizing temperature.
- (4)*Use of an oil-fired appliance that is listed in accordance with ANSI/UL 296A, *Standard for Waste Oil-Burning Air-Heating Appliances*, shall be deemed as meeting the intent of 11.5.1.10.3(1) through 11.5.1.10.3(3). [31:4.5.3]

11.5.1.10.4 A properly sized and rated oil filter or strainer shall be installed in the oil supply line to an oil burner. [31:4.5.4]

11.5.1.11 Clothes Dryers.

11.5.1.11.1 Clothes dryers shall be cleaned to maintain the lint trap and keep the mechanical and heating components free from excessive accumulations of lint.

11.5.1.11.2 The requirements of 11.5.1.11.1 shall not apply to clothes dryers in individual dwelling units of residential occupancies.

11.5.2 Kerosene Burners and Oil Stoves.

11.5.2.1 Kerosene burners and oil stoves shall be equipped with a primary safety control furnished as an integral part of the appliance by the manufacturer to stop the flow of oil in the event of flame failure. Barometric oil feed shall not be considered a primary safety control.

11.5.2.2 A conversion range oil burner shall be equipped with a thermal (heat-actuated) valve in the oil supply line, located in the burner compartment of the stove.

11.5.2.3 Only listed kerosene heaters shall be used. The following safeguards shall apply:

- (1) Provide adequate ventilation
- (2) Do not place on carpeting
- (3) Keep 3 ft (0.9 m) away from combustible furnishings or drapes
- (4) Use only approved Type 1-K water clear kerosene
- (5) Allow to cool before refueling

11.5.3 Portable Electric Heater.

11.5.3.1 The AHJ shall be permitted to prohibit use of portable electric heaters in occupancies or situations where such use or operation would present an undue danger to life or property.

11.5.3.2 Portable electric heaters shall be designed and located so that they cannot be easily overturned.

11.5.3.3 All portable electric heaters shall be listed.

11.5.4 Vents. All chimneys, smokestacks, or similar devices for conveying smoke or hot gases to the outer air and the stoves, furnaces, incinerators, boilers, or any other heat-producing devices or appliances shall be installed and maintained in accordance with NFPA 54 and NFPA 211.

11.6 Waste Chutes, Incinerators, and Laundry Chutes.

11.6.1 Enclosure.

11.6.1.1 Waste chutes and laundry chutes shall be separately enclosed by walls or partitions in accordance with the provisions of Section 12.7. [101:9.5.1.1]

11.6.1.2 Chute intake openings shall be protected in accordance with Section 12.7. [101:9.5.1.2]

11.6.1.3 The doors of chutes specified in 11.6.1.2 shall open only to a room that is designed and used exclusively for accessing the chute opening. [101:9.5.1.3]

11.6.1.4 Chute service opening rooms shall be separated from other spaces in accordance with Section 8.7 of NFPA 101. [101:9.5.1.4]

11.6.1.5 The requirements of 11.6.1.1 through 11.6.1.4 shall not apply where otherwise permitted by the following:

- (1) Existing installations having properly enclosed service chutes and properly installed and maintained chute intake doors shall be permitted to have chute intake doors open to a corridor or normally occupied space.
- (2) Waste chutes and laundry chutes shall be permitted to open into rooms not exceeding 400 ft² (37 m²) that are used for storage, provided that the room is protected by automatic sprinklers. [101:9.5.1.5]

11.6.2 Installation and Maintenance. Waste chutes, laundry chutes, and incinerators shall be installed and maintained in accordance with NFPA 82, *Standard on Incinerators and Waste and Linen Handling Systems and Equipment*, unless such installations are approved existing installations, which shall be permitted to be continued in service. [101:9.5.2]

11.7 Stationary Generators and Standby Power Systems.

11.7.1 Stationary Combustion Engines and Gas Turbines Installation. Stationary generator sets shall be installed in accordance with NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, and NFPA 70.

11.7.2 Portable Generators.

11.7.2.1* Portable generators shall not be operated or refueled within buildings, on balconies, or on roofs.

11.7.2.1.1 Portable generators shall be permitted to be operated or refueled in a building or room that has been constructed for such use in accordance with the building code.

11.7.2.1.2 Fueling from a container shall be permitted when the engine is shut down and engine surface temperature is below the autoignition temperature of the fuel.

11.7.2.2 Portable generators shall be positioned so that the exhaust is directed as follows:

- (1) At least 5 ft (1.5 m) in any direction away from any openings or air intakes
- (2) Away from the building

11.7.3 Emergency and Legally Required Standby Power Systems.

11.7.3.1 General. New stationary generators for emergency use or for legally required standby power required by this Code.

the building code, or other codes and standards shall be installed in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems*.

11.7.3.2 Acceptance. Newly installed stationary generators for emergency use or for legally required standby power for fire protection systems and features shall demonstrate the capacity of the energy converter, with its controls and accessories, to survive without damage from common and abnormal disturbances in actual load circuits by any of the following means:

- (1) By tests on separate prototype models
- (2) By acceptance tests on the system components as performed by the component suppliers
- (3) By listing for emergency service as a completely factory-assembled and factory-tested apparatus

11.7.4 Stored Electrical Energy Emergency and Legally Required Standby Power System Installation. Stored electrical energy systems required by this *Code*, the building code, or other NFPA codes and standards shall be installed in accordance with NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, and NFPA 70.

11.7.5 Maintenance and Testing.

11.7.5.1 Stationary generators used for emergency or legally required standby power shall be tested and maintained in accordance with NFPA 110 and NFPA 37.

11.7.5.2 Stationary generators required by this *Code*, the building code, or other NFPA codes and standards shall be maintained in accordance with NFPA 110.

11.7.5.3 Stored electrical energy systems required by this *Code*, the building code, or other NFPA codes and standards shall be maintained in accordance with NFPA 111.

11.8* Smoke Control.

11.8.1 Newly installed smoke-control systems shall be inspected by the AHJ and tested in accordance with the criteria established in the approved design documents, NFPA 204 and NFPA 92.

11.8.2 Smoke-control systems shall have an approved maintenance and testing program to ensure operational integrity in accordance with this section. Components of such systems shall be operated, maintained, and tested in accordance with their operation and maintenance manuals.

11.8.2.1 Testing. Operational testing of the smoke-control system shall be in accordance with NFPA 92, and shall include all equipment related to the system including, but not limited to, initiating devices, fans, dampers, controls, doors, and windows.

11.8.2.1.1 An approved written schedule for such operational tests shall be established.

11.8.2.2 Test records shall be maintained on the premises and must indicate the date of such testing, the qualified service personnel, and any corrective measures needed or taken.

11.8.3 All smoke-control systems and devices shall be maintained in a reliable operating condition and shall be replaced or repaired where defective.

11.8.4 The AHJ shall be notified when any smoke-control system is out of service for more than 4 hours in a 24-hour period and again upon restoration of service of such systems.

11.8.5 The AHJ shall be permitted to require the building to be evacuated or an approved fire watch to be provided for all por-

tions left unprotected by the fire protection system shutdown until the fire protection system has been returned to service.

11.9 Emergency Command Center. Where required, emergency command centers shall comply with Section 11.9.

11.9.1 The location, design, content, and fire department access of the emergency command center shall be approved by the fire department.

11.9.2 The emergency command center shall be separated from the remainder of the building by a fire barrier having a fire resistance rating of not less than 1 hour.

11.9.3 The emergency command center room shall be a minimum of 96 ft² (8.9 m²) with a minimum dimension of 8 ft (2.4 m).

11.9.4 The following shall be provided in the emergency command center:

- (1) The fire department communication unit
- (2) A telephone for fire department use with controlled access to the public telephone system
- (3) Schematic building plans indicating the typical floor plan and detailing the building core means of egress, fire protection systems, fire-fighting equipment, and fire department access
- (4) Work table
- (5) If applicable, hazardous material management plans for the building

11.9.5 Where otherwise required, the following devices or functions shall be provided within the emergency command center:

- (1) The emergency voice/alarm communication system unit
- (2) Fire detection and alarm system annunciator unit
- (3) Annunciator visually indicating the location of the elevators and whether they are operational
- (4) Status indicators and controls for air-handling systems
- (5) Controls for unlocking stairway doors simultaneously
- (6) Sprinkler valve and waterflow detector display panels
- (7) Emergency and standby power status indicators
- (8) Fire pump status indicators
- (9) Generator supervision devices and manual start and transfer features
- (10) Public address system, where specifically required by other sections of this *Code*
- (11) Controls required for smoke control

11.9.6 Emergency Command Center Acceptance Testing. Devices, equipment, components, and sequences shall be individually tested in accordance with appropriate standards and manufacturers' documented instructions.

11.10* Two-Way Radio Communication Enhancement Systems.

11.10.1 In all new and existing buildings, minimum radio signal strength for fire department communications shall be maintained at a level determined by the AHJ.

11.10.2 Where required by the AHJ, two-way radio communication enhancement systems shall comply with *NFPA 72*.

11.10.3 Where a two-way radio communication enhancement system is required and such system, components, or equipment has a negative impact on the normal operations of the facility at which it is installed, the AHJ shall have the authority to accept an automatically activated responder system.

11.11 Medical Gas and Vacuum Systems. Medical gas and vacuum systems shall comply with NFPA 99, *Health Care Facilities Code*.

11.12 Photovoltaic Systems.

11.12.1 Photovoltaic systems shall be in accordance with Section 11.12 and NFPA 70.

11.12.2 Building-Mounted Photovoltaic Installations.

11.12.2.1* Marking. Photovoltaic systems shall be permanently marked as specified in this subsection.

11.12.2.1.1 Main Service Disconnect Marking. A label shall be permanently affixed to the main service disconnect panel serving alternating current (ac) and direct current (dc) photovoltaic systems. The label shall be red with white capital letters at least 3/4 in. (19 mm) in height and in a nonserif font, to read: "WARNING: PHOTOVOLTAIC POWER SOURCE." The materials used for the label shall be reflective, weather resistant, and suitable for the environment.

11.12.2.1.2 Circuit Disconnecting Means Marking. A permanent label shall be affixed adjacent to the circuit breaker controlling the inverter or other photovoltaic system electrical controller serving ac and dc photovoltaic systems. The label shall have contrasting color with capital letters at least 3/8 in. (10 mm) in height and in a nonserif font, to read: "PHOTOVOLTAIC DISCONNECT." The label shall be constructed of durable adhesive material or other approved material.

11.12.2.1.3* Conduit, Raceway, Enclosure, Cable Assembly, and Junction Box Markings. Marking shall be required on all interior and exterior dc conduits, raceways, enclosures, cable assemblies, and junction boxes.

11.12.2.1.3.1 Marking Locations. Marking shall be placed on all dc conduits, raceways, enclosures, and cable assemblies every 10 ft (3048 mm), at turns, and above and below penetrations. Marking shall be placed on all dc combiner and junction boxes.

11.12.2.1.3.2* Marking Content and Format. Marking for dc conduits, raceways, enclosures, cable assemblies, and junction boxes shall be red with white lettering with minimum 3/8 in. (10 mm) capital letters in a nonserif font, to read: "WARNING: PHOTOVOLTAIC POWER SOURCE." Marking shall be reflective, weather resistant, and suitable for the environment.

11.12.2.1.4 Secondary Power Source Markings. Where photovoltaic systems are interconnected to battery systems, generator backup systems, or other secondary power systems, additional signage acceptable to the AHJ shall be required indicating the location of the secondary power source shutoff switch.

11.12.2.1.5 Installer Information. Signage, acceptable to the AHJ, shall be installed adjacent to the main disconnect indicating the name and emergency telephone number of the installing contractor.

11.12.2.1.6* Inverter Marking. Markings shall not be required for inverters.

11.12.2.2 Access, Pathways, and Smoke Ventilation.

11.12.2.2.1 General. Access and spacing requirements shall be required to provide emergency access to the roof, provide pathways to specific areas of the roof, provide for smoke ventilation opportunity areas, and to provide emergency egress from the roof.

11.12.2.2.1.1 Exceptions. The AHJ shall be permitted to grant exceptions where access, pathway, or ventilation requirements are reduced due to any of the following circumstances:

- (1) Proximity and type of adjacent exposures
- (2) Alternative access opportunities, as from adjoining roofs
- (3) Ground level access to the roof
- (4) Adequate ventilation opportunities beneath photovoltaic module arrays
- (5) Adequate ventilation opportunities afforded by module set back from other rooftop equipment
- (6) Automatic ventilation devices
- (7) New technologies, methods, or other innovations that ensure adequate fire department access, pathways, and ventilation opportunities

11.12.2.2.1.2 Pitch. Designation of ridge, hip, and valley shall not apply to roofs with 2-in-12 or less pitch.

11.12.2.2.1.3 Roof Access Points. Roof access points shall be defined as areas where fire department ladders are not placed over openings (windows or doors), are located at strong points of building construction, and are in locations where they will not conflict with overhead obstructions (tree limbs, wires, or signs).

11.12.2.2.2 One- and Two-Family Dwellings and Townhouses. Photovoltaic systems installed in one- and two-family dwellings and townhouses shall be in accordance with this section.

11.12.2.2.2.1 Access and Pathways.

11.12.2.2.2.1.1 Hip Roof Layouts. Photovoltaic modules shall be located in a manner that provides a 3 ft (914 mm) wide clear access pathway from the eave to the ridge of each roof slope where the photovoltaic modules are located. The access pathway shall be located at a structurally strong location of the building, such as a bearing wall.

Exception: The requirement of 11.12.2.2.2.1.1 shall not apply where adjoining roof planes provide a 3 ft (914 mm) wide clear access pathway.

11.12.2.2.2.1.2 Single Ridge Layouts. Photovoltaic modules shall be located in a manner that provides two 3 ft (914 mm) wide access pathways from the eave to the ridge on each roof slope where the modules are located.

11.12.2.2.2.1.3 Hip and Valley Layouts. Photovoltaic modules shall be located no closer than 1 1/2 ft (457 mm) to a hip or valley if modules are to be placed on both sides of the hip or valley. Where modules are located on only one side of a hip or valley of equal length, the photovoltaic modules shall be allowed to be placed directly adjacent to the hip or valley.

11.12.2.2.2.2 Ridge Setback. Photovoltaic modules shall be located not less than 3 ft (914 mm) below the ridge.

11.12.2.2.3 Buildings Other Than One- and Two-Family Dwellings and Townhouses. Photovoltaic energy systems installed in any building other than one- and two-family dwellings and townhouses shall be in accordance with this section. Where the AHJ determines that the roof configuration is similar to a one- and two-family dwelling or townhouse, the AHJ shall allow the requirements of 11.12.2.2.2.

11.12.2.2.3.1 Access. A minimum 4 ft (1219 mm) wide clear perimeter shall be provided around the edges of the roof for buildings with a length or width of 250 ft (76.2 m) or less along either axis. A minimum 6 ft (1829 mm) wide clear perimeter shall be provided around the edges of the roof for buildings

SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY

SECTION 401 SCOPE

401.1 Detailed use and occupancy requirements. In addition to the occupancy and construction requirements in this code, the provisions of this chapter apply to the special uses and occupancies described herein.

401.2 Additional design criteria.

401.2.1 Scope. In addition to the provisions of this chapter, the following special occupancies, standards, requirements and codes shall conform to the following sections:

- Section 449: Hospitals
- Section 450: Nursing homes
- Section 451: Ambulatory surgical centers
- Section 452: Birthing centers
- Section 453: State requirements for educational facilities
- Section 454: Swimming pools and bathing places
- Section 455: Public lodging establishments
- Section 456: Public food service establishments
- Section 457: Mental health programs
- Section 458: Manufactured buildings
- Section 459: Boot camps for children
- Section 460: Mausoleums and columbariums
- Section 461: Transient public lodging establishments
- Section 462: Use of asbestos in new public buildings or buildings newly constructed for lease to government entities—prohibition
- Section 463: Adult day care
- Section 464: Assisted living facilities
- Section 465: Control of radiation hazards
- Section 466: Day care occupancies
- Section 467: Hospice inpatient facilities and units and hospice residences.
- Section 468: Schools, colleges and universities
- Section 469: Office surgery suite
- Chapter 30: Elevators and conveying systems
- Section 3109: Structures seaward of a coastal construction control line

401.2.2 General. Where in any specific case, Sections 449 through 469 specify different materials, methods of construction, design criteria or other requirements than found in this code, the requirements of Sections 449 through 469 shall be applicable.

401.2.3 Referenced standards. Further information concerning the requirements for licensing, maintenance, equipment or other items not related to design and construction may be obtained for all state codes, rules and standards from the State of Florida Bureau of Administrative Codes.

SECTION 402 COVERED MALL AND OPEN MALL BUILDINGS

402.1 Applicability. The provisions of this section shall apply to buildings or structures defined herein as *covered or open mall buildings* not exceeding three floor levels at any point nor more than three *stories above grade plane*. Except as specifically required by this section, *covered and open mall buildings* shall meet applicable provisions of this code.

Exceptions:

1. Foyers and lobbies of Groups B, R-1 and R-2 are not required to comply with this section.
2. Buildings need not comply with the provisions of this section where they totally comply with other applicable provisions of this code.

402.1.1 Open space. A *covered mall building* and attached *anchor buildings* and parking garages shall be surrounded on all sides by a permanent open space or not less than 60 feet (18 288 mm). An *open mall building* and *anchor buildings* and parking garages adjoining the perimeter line shall be surrounded on all sides by a permanent open space of not less than 60 feet (18 288 mm).

Exception: The permanent open space of 60 feet (18 288 mm) shall be permitted to be reduced to not less than 40 feet (12 192 mm), provided the following requirements are met:

1. The reduced open space shall not be allowed for more than 75 percent of the perimeter of the *covered or open mall building* and *anchor buildings*;
2. The *exterior wall* facing the reduced open space shall have a *fire-resistance rating* of not less than 3 hours;
3. Openings in the *exterior wall* facing the reduced open space shall have opening protectives with a *fire protection rating* of not less than 3 hours; and
4. Group E, H, I or R occupancies are not located within the *covered or open mall building* or *anchor buildings*.

402.1.2 Open mall building perimeter line. For the purpose of this code, a perimeter line shall be established. The perimeter line shall encircle all buildings and structures that comprise the *open mall building* and shall

449.3.12 Fire alarm systems. Reference *The Guidelines* for other requirements.

449.3.12.1 Fire alarm systems. A fire alarm annunciator panel shall be provided at a 24-hour monitored location. The panel shall indicate visually the zone of actuation of the alarm, and there shall be a system trouble signal indicator. Each smoke compartment shall be annunciated as a separate fire alarm zone. A fire alarm system zone shall not include rooms or spaces in other smoke compartments. A fire alarm zone location map to quickly locate alarm condition shall be provided at the fire alarm control panel.

449.3.12.2 In all inpatient care rooms, spaces and areas, including sleeping, treatment, diagnostic, and therapeutic, the private operating mode as permitted and described in NFPA 72, *National Fire Alarm and Signaling Code*, shall be required. Only the attendants and other personnel required to evacuate occupants from a zone, area, room, floor, or building shall be required to be notified.

449.3.12.3 The disconnecting device or circuit breaker for the fire alarm control unit shall be clearly identified and secured from unauthorized operation.

449.3.13 Nurse call system. Reference *The Guidelines* for other requirements.

449.3.13.1 In addition to the requirements of radiofrequency systems described in *The Guidelines*, wireless-type nurse call systems shall be permitted if they have been tested and approved by a national recognized testing laboratory (NRTL) to meet the requirements of UL 1069, 7th edition, Section 49, *Wireless Systems* published October 12, 2007 as referenced in Chapter 35 of this code.

449.3.13.2 In addition to the areas required by *The Guidelines*, an emergency resuscitation alarm (Code Blue) calling station shall be provided for staff use in each operating and cesarean delivery room.

449.3.13.3 An emergency staff assistance station shall be located within each psychiatric seclusion room and shall be of hands-free operation.

449.3.14 Emergency electric service. Reference *The Guidelines* for other requirements.

449.3.14.1 A Type 1 essential electrical system shall be provided in all hospitals as described in NFPA 99, *Health Care Facilities*. The emergency power for this system shall meet the requirements of a Level 1, Type 10, Class 48 generator as described in NFPA 110, *Standard for Emergency and Standby Power Systems*.

449.3.14.2 In new facility construction, the normal main service equipment shall be separated from the emergency distribution equipment by locating it in a separate room. Transfer switches shall be considered emergency distribution equipment for this purpose.

449.3.14.3 There shall be a generator remote alarm annunciator in accordance with the requirements of

NFPA 110 located at a designated on-site 24-hour staffed location.

449.3.14.4 There shall be illumination of the means of egress in accordance with NFPA 101 and designed for automatic dusk-to-dawn operation. Such illumination shall continue to the public way or to a safe area(s) located at a minimum of 30 feet (9.144 m) from the building and large enough to accommodate the required occupant load of the exit discharge.

449.3.14.5 A minimum of one elevator per bank serving any patient use floor shall be connected to the equipment branch of the essential electric system and arranged for manual or automatic operation during loss of normal power.

449.3.14.6 If a day tank is provided, it shall be equipped with a dedicated low-level fuel alarm and a manual pump. The alarm shall be located at the generator remote alarm annunciator as described in Section 449.3.14.3.

449.3.14.7 Outpatient surgery facilities, cardiac catheterization facilities, or pain management facilities that utilize intravenous (IV) drip sedation located in a separate building or on another campus shall have a Type 1 essential electrical system in compliance with NFPA 99, *Health Care Facilities*. The emergency power for this system shall meet the requirements of a Level 1, Type 10, Class 8 generator as described in NFPA 110, *Standard for Emergency and Standby Power Systems*.

449.3.14.8 The generator remote manual stop (sometimes called the "generator emergency stop") shall be switchable and tamper resistant. It shall be located outside the housing of the generator, adjacent to the opening of the generator enclosure or to the door to the generator room, and viewable from the generator location.

449.3.15 Lightning protection.

449.3.15.1 A lightning protection system shall be provided for all new buildings and additions in accordance with NFPA 780, *Installation of Lightning Protection Systems*.

449.3.15.2 Where additions are constructed to existing buildings, the existing building's lightning protection system, if connected to the new lightning protection system, shall be inspected and brought into compliance with current standards.

449.3.15.3 A lightning protection system shall be installed on all buildings in which outpatient surgical procedures, cardiac catheterization procedures, or pain management procedures that utilize I.V. drip sedation are provided.

449.3.15.4 There shall be surge protection for all normal and emergency electrical services.

449.3.15.5 Additional surge protection shall be provided for all low voltage and power connections to all electronic equipment in critical care areas and life safety systems and equipment such as fire alarm, nurse

tion. The panel shall indicate visually, the zone of actuation of the alarm and audibly and visually system trouble. Each smoke compartment shall be annunciated as a separate fire alarm zone. A fire alarm system zone shall not include rooms or spaces in other smoke compartments. A zone location map to quickly locate alarm condition shall be provided at the fire alarm control panel.

450.3.16.2 In all resident care rooms, spaces and areas, including sleeping, treatment, diagnostic and therapeutic, the design and installation of the private operating mode fire alarm as permitted and described in NFPA 72, *National Fire Alarm and Signaling Code*, shall be required. Only the attendants and other personnel required to evacuate occupants from a zone, area, room, floor, or building shall be required to be notified.

450.3.16.3 The disconnecting device or circuit breaker for the fire alarm control unit shall be clearly identified and secured from unauthorized operation.

450.3.17 Nurse call systems. Wired- or wireless-type nurse call systems shall be permitted if they have been tested and approved by a national recognized testing laboratory (NRTL) to meet the requirements of UL 1069, 7th edition, published October 12, 2007, as referenced in Chapter 35 of this code. All wireless systems shall have been tested and approved by a nationally recognized testing laboratory (NRTL) to meet the requirements of Section 49, Wireless Systems of UL 1069, 7th edition as referenced in Chapter 35 of this code. All nurse call systems whether wired or wireless shall have electronically supervised visual and audible annunciation in accordance with the supervision criteria of UL 1069, 7th edition for nurse call systems and tested and approved by a nationally recognized testing laboratory (NRTL) to meet those requirements.

450.3.17.1 A nurse call system shall be provided that will register a call from a call button from each resident bed to the related staff work area(s) by activating a visual signal at the resident room door or wireless pager and activating a visual and audible signal in the clean utility, soiled utility, nourishment station, medication prep or mobile nurse station receiver and the master station of the resident. If a mobile nurse station receiver is utilized to receive the resident call, it will be worn by all staff who are assigned to the resident unit and shall identify the specific resident and or room from which the call was placed. Audible signals may be temporarily silenced, provided subsequent calls automatically reactivate the audible signal. In rooms containing two or more calling stations, indicating lights shall be provided for each calling station. In multicorridor nursing units, corridor zone lights shall be installed at corridor intersections in the vicinity of staff work areas.

450.3.17.2 An emergency calling station of the pull cord-type shall be provided and shall be conveniently located for resident use at each exam room (if provided), resident toilet, bath or shower room but not inside of the shower unless the nurse call device is listed for wet locations. The call signal shall be the

highest priority and shall be cancelled only at the emergency calling station. The emergency calling station shall activate distinctive audible and visual signals immediately at the resident room door or wireless pager, and activate a visual and audible signal in the clean utility, soiled utility, nourishment station, medication prep or mobile nurse station receiver and the master station of the resident unit. If a mobile nurse station receiver is utilized to receive the resident call, it will be worn by all staff who are assigned to the resident unit and shall identify the specific resident and or room from which the call was placed.

450.3.17.3 The nurse call master station shall be located inside the resident unit at a staff administrative area and shall not block any incoming resident calls. The master station control settings shall not prevent the activation of the incoming audible and visual signals. In wireless systems, all orphaned calls to mobile nurse station receivers will register at the nurse call master station.

450.3.17.4 Activation of an emergency call shall not cancel a normal call from the same room.

450.3.17.5 A corridor dome light shall be located directly outside of any resident care area that is equipped with a wired nurse call system.

450.3.18 Essential electrical system.

450.3.18.1 A Type 1 essential electrical system shall be provided in all new nursing homes as described in NFPA 99, *Health Care Facilities Code*. The emergency power for this system shall meet the requirements of a Level 1, Type 10, Class 48 generator as described in NFPA 110, Standard for Emergency and Standby Power Systems.

450.3.18.2 In new facility construction, the normal main service equipment shall be separated from the emergency distribution equipment by locating it in a separate room. Transfer switches shall be considered emergency distribution equipment for this purpose.

450.3.18.3 There shall be a generator remote alarm annunciator in accordance with the requirements of NFPA 110 located at a designated on-site 24-hour staffed location.

450.3.18.4 There shall be illumination of the means of egress in accordance with NFPA 101 and designed for automatic dusk-to-dawn operation. Such illumination shall continue to the public way or to a safe area(s) located at a minimum of 30 feet (9.144 m) from the building and large enough to accommodate the required occupant load of the exit discharge.

450.3.18.5 A minimum of one elevator per bank serving any patient use floor shall be connected to the equipment branch of the essential electric system and arranged for manual or automatic operation during loss of normal power.

450.3.18.6 If a day tank is provided, it shall be equipped with a dedicated low-level fuel alarm and a manual pump. The alarm shall be located at the genera-

cotton, where manufactured, generated or used in such a manner that the concentration and conditions create a fire or explosion hazard based on information prepared in accordance with Section 414.1.3.

- Consumer fireworks, 1.4G (Class C, Common)
- Cryogenic fluids, oxidizing
- Flammable solids
- Organic peroxides, Class II and III
- Oxidizers, Class 2
- Oxidizers, Class 3, that are used or stored in normally closed containers or systems pressurized at 15 pounds per square inch gauge (103 kPa) or less
- Oxidizing gases
- Unstable (reactive) materials, Class 2
- Water-reactive materials, Class 2

[F] 307.6 High-hazard Group H-4. Buildings and structures containing materials that are health hazards shall be classified as Group H-4. Such materials shall include, but not be limited to, the following:

- Corrosives
- Highly toxic materials
- Toxic materials

[F] 307.7 High-hazard Group H-5. Semiconductor fabrication facilities and comparable research and development areas in which hazardous production materials (HPM) are used and the aggregate quantity of materials is in excess of those listed in Tables 307.1(1) and 307.1(2) shall be classified as Group H-5. Such facilities and areas shall be designed and constructed in accordance with Section 415.11.

[F] 307.8 Multiple hazards. Buildings and structures containing a material or materials representing hazards that are classified in one or more of Groups H-1, H-2, H-3 and H-4 shall conform to the code requirements for each of the occupancies so classified.

**SECTION 308
INSTITUTIONAL GROUP I**

308.1 Institutional Group I. Institutional Group I occupancy includes, among others, the use of a building or structure, or a portion thereof, in which care or supervision is provided to persons who are or are not capable of self-preservation without physical assistance or in which persons are detained for penal or correctional purposes or in which the liberty of the occupants is restricted. Institutional occupancies shall be classified as Group I-1, I-2, I-3 or I-4.

308.2 Definitions. The following terms are defined in Chapter 2:

- 24-HOUR BASIS.**
- CUSTODIAL CARE.**
- DETOXIFICATION FACILITIES.**
- FOSTER CARE FACILITIES.**
- HOSPITALS AND PSYCHIATRIC HOSPITALS.**
- INCAPABLE OF SELF-PRESERVATION.**
- MEDICAL CARE.**

NURSING HOMES.

308.3 Institutional Group I-1. Institutional Group I-1 occupancy shall include buildings, structures or portions thereof for more than 16 persons, excluding staff, who reside on a 24-hour basis in a supervised environment and receive custodial care. Buildings of Group I-1 shall be classified as one of the occupancy conditions specified in Section 308.3.1 or 308.3.2. This group shall include, but not be limited to, the following:

- Alcohol and drug centers
- Assisted living facilities
- Congregate care facilities
- Group homes
- Halfway houses
- Residential board and care facilities
- Social rehabilitation facilities

308.3.1 Condition 1. This occupancy condition shall include buildings in which all persons receiving custodial care who, without any assistance, are capable of responding to an emergency situation to complete building evacuation.

308.3.2 Condition 2. This occupancy condition shall include buildings in which there are any persons receiving custodial care who require limited verbal or physical assistance while responding to an emergency situation to complete building evacuation.

308.3.3 Six to 16 persons receiving custodial care. A facility housing not fewer than six and not more than 16 persons receiving custodial care shall be classified as Group R-4.

308.3.4 Five or fewer persons receiving custodial care. A facility with five or fewer persons receiving custodial care shall be classified as Group R-3 or shall comply with the *Florida Building Code, Residential* provided an *automatic sprinkler system* is installed in accordance with Section 903.3.1.3 or Section P2904 of the *Florida Building Code, Residential*.

308.4 Institutional Group I-2. Institutional Group I-2 occupancy shall include buildings and structures used for *medical care* on a 24-hour basis for more than five persons who are *incapable of self-preservation*. This group shall include, but not be limited to, the following:

- Foster care facilities*
- Detoxification facilities*
- Hospitals*
- Nursing homes*
- Psychiatric hospitals*

308.4.1 Occupancy conditions. Buildings of Group I-2 shall be classified as one of the occupancy conditions specified in Section 308.4.1.1 or 308.4.1.2.

308.4.1.1 Condition 1. This occupancy condition shall include facilities that provide nursing and medical care but do not provide emergency care, surgery, obstetrics or in-patient stabilization units for psychiatric or detoxification, including but not limited to nursing homes and foster care facilities.

308.4.1.2 Condition 2. This occupancy condition shall include facilities that provide nursing and medical care and could provide emergency care, surgery, obstetrics or in-patient stabilization units for psychiatric or detoxification, including but not limited to hospitals.

308.4.2 Five or fewer persons receiving medical care. A facility with five or fewer persons receiving medical care shall be classified as Group R-3 or shall comply with the *Florida Building Code, Residential* provided an *automatic sprinkler system* is installed in accordance with Section 903.3.1.3 or Section P2904 of the *Florida Building Code, Residential*.

308.5 Institutional Group I-3. Institutional Group I-3 occupancy shall include buildings and structures that are inhabited by more than five persons who are under restraint or security. A Group I-3 facility is occupied by persons who are generally *incapable of self-preservation* due to security measures not under the occupants' control. This group shall include, but not be limited to, the following:

- Correctional centers
- Detention centers
- Jails
- Prerelease centers
- Prisons
- Reformatories

Buildings of Group I-3 shall be classified as one of the occupancy conditions specified in Sections 308.5.1 through 308.5.5 (see Section 408.1).

308.5.1 Condition 1. This occupancy condition shall include buildings in which free movement is allowed from sleeping areas, and other spaces where access or occupancy is permitted, to the exterior via *means of egress* without restraint. A Condition 1 facility is permitted to be constructed as Group R.

308.5.2 Condition 2. This occupancy condition shall include buildings in which free movement is allowed from sleeping areas and any other occupied *smoke compartment* to one or more other *smoke compartments*. Egress to the exterior is impeded by locked *exits*.

308.5.3 Condition 3. This occupancy condition shall include buildings in which free movement is allowed within individual *smoke compartments*, such as within a residential unit comprised of individual *sleeping units* and group activity spaces, where egress is impeded by remote-controlled release of *means of egress* from such a *smoke compartment* to another *smoke compartment*.

308.5.4 Condition 4. This occupancy condition shall include buildings in which free movement is restricted from an occupied space. Remote-controlled release is provided to permit movement from *sleeping units*, activity spaces and other occupied areas within the *smoke compartment* to other *smoke compartments*.

308.5.5 Condition 5. This occupancy condition shall include buildings in which free movement is restricted

from an occupied space. Staff-controlled manual release is provided to permit movement from *sleeping units*, activity spaces and other occupied areas within the *smoke compartment* to other *smoke compartments*.

308.6 Institutional Group I-4, day care facilities. Institutional Group I-4 occupancy shall include buildings and structures occupied by more than five persons of any age who receive *custodial care* for fewer than 24 hours per day by persons other than parents or guardians, relatives by blood, marriage or adoption, and in a place other than the home of the person cared for. This group shall include, but not be limited to, the following:

- Adult day care
- Child day care

308.6.1 Classification as Group E. A child day care facility that provides care for more than five but not more than 100 children 2½ years or less of age, where the rooms in which the children are cared for are located on a *level of exit discharge* serving such rooms and each of these child care rooms has an *exit door* directly to the exterior, shall be classified as Group E.

308.6.2 Within a place of religious worship. Rooms and spaces within *places of religious worship* providing such care during religious functions shall be classified as part of the primary occupancy.

308.6.3 Five or fewer persons receiving care. A facility having five or fewer persons receiving *custodial care* shall be classified as part of the primary occupancy.

308.6.4 Five or fewer persons receiving care in a dwelling unit. A facility such as the above within a *dwelling unit* and having five or fewer persons receiving *custodial care* shall be classified as a Group R-3 occupancy or shall comply with the *Florida Building Code, Residential*.

SECTION 309 MERCANTILE GROUP M

309.1 Mercantile Group M. Mercantile Group M occupancy includes, among others, the use of a building or structure or a portion thereof for the display and sale of merchandise, and involves stocks of goods, wares or merchandise incidental to such purposes and accessible to the public. Mercantile occupancies shall include, but not be limited to, the following:

- Department stores
- Drug stores
- Markets
- Motor fuel-dispensing facilities
- Retail or wholesale stores
- Sales rooms

309.2 Quantity of hazardous materials. The aggregate quantity of nonflammable solid and nonflammable or non-combustible liquid hazardous materials stored or displayed in a single *control area* of a Group M occupancy shall not exceed the quantities in Table 414.2.5(1).

SECTION 310 RESIDENTIAL GROUP R

310.1 Residential Group R. Residential Group R includes, among others, the use of a building or structure, or a portion thereof, for sleeping purposes when not classified as an Institutional Group I or when not regulated by the *Florida Building Code, Residential*.

310.2 Definitions. The following terms are defined in Chapter 2:

BOARDING HOUSE.

CONGREGATE LIVING FACILITIES.

DORMITORY.

GROUP HOME.

GUEST ROOM.

LODGING HOUSE.

PERSONAL CARE SERVICE.

TRANSIENT.

310.3 Residential Group R-1. Residential Group R-1 occupancies containing *sleeping units* where the occupants are primarily *transient* in nature, including:

- Boarding houses (transient)* with more than 10 occupants
- Congregate living facilities (transient)* with more than 10 occupants
- Hotels (*transient*)
- Motels (*transient*)

310.4 Residential Group R-2. Residential Group R-2 occupancies containing *sleeping units* or more than two *dwelling units* where the occupants are primarily permanent in nature, including:

- Apartment houses
- Boarding houses* (nontransient) with more than 16 occupants
- Congregate living facilities* (nontransient) with more than 16 occupants
- Convents
- Dormitories*
- Fraternities and sororities
- Hotels (nontransient)
- Live/work units*
- Monasteries
- Motels (nontransient)
- Vacation timeshare properties

310.5 Residential Group R-3. Residential Group R-3 occupancies where the occupants are primarily permanent in nature and not classified as Group R-1, R-2, R-4 or I, including:

- Buildings that do not contain more than two *dwelling units*
- Boarding houses* (nontransient) with 16 or fewer occupants
- Boarding houses (transient)* with 10 or fewer occupants
- Care facilities that provide accommodations for five or fewer persons receiving care
- Congregate living facilities* (nontransient) with 16 or fewer occupants
- Congregate living facilities (transient)* with 10 or fewer

occupants

Lodging houses with five or fewer *guest rooms*

310.5.1 Care facilities within a dwelling. Care facilities for five or fewer persons receiving care that are within a single-family dwelling are permitted to comply with the *Florida Building Code, Residential* provided an *automatic sprinkler system* is installed in accordance with Section 903.3.1.3 or Section P2904 of the *Florida Building Code, Residential*.

310.5.2 Lodging houses. Owner-occupied *lodging houses* with five or fewer *guest rooms* shall be permitted to be constructed in accordance with the *Florida Building Code, Residential*.

310.6 Residential Group R-4. Residential Group R-4 occupancy shall include buildings, structures or portions thereof for more than five but not more than 16 persons, excluding staff, who reside on a 24-hour basis in a supervised residential environment and receive *custodial care*. Buildings of Group R-4 shall be classified as one of the occupancy conditions specified in Section 310.6.1 or 310.6.2. This group shall include, but not be limited to, the following:

- Alcohol and drug centers
- Assisted living facilities
- Congregate care facilities
- Group homes*
- Halfway houses
- Residential board and *custodial care* facilities
- Social rehabilitation facilities

Group R-4 occupancies shall meet the requirements for construction as defined for Group R-3, except as otherwise provided for in this code or shall comply with the *Florida Building Code, Residential* provided the building is protected by an automatic sprinkler system installed in accordance with Section 903.2.8.

310.6.1 Condition 1. This occupancy condition shall include buildings in which all persons receiving custodial care, without any assistance, are capable of responding to an emergency situation to complete building evacuation.

310.6.2 Condition 2. This occupancy condition shall include buildings in which there are any persons receiving custodial care who require limited verbal or physical assistance while responding to an emergency situation to complete building evacuation.

SECTION 311 STORAGE GROUP S

311.1 Storage Group S. Storage Group S occupancy includes, among others, the use of a building or structure, or a portion thereof, for storage that is not classified as a hazardous occupancy.

311.1.1 Accessory storage spaces. A room or space used for storage purposes that is less than 100 square feet (9.3 m²) in area and accessory to another occupancy shall be classified as part of that occupancy. The aggregate area of such rooms or spaces shall not exceed the allowable area limits of Section 508.2.

7

Special Conditions



ARTICLE 700 Emergency Systems

I. General

700.1 Scope

The provisions of this article apply to the electrical safety of the installation, operation, and maintenance of emergency systems consisting of circuits and equipment intended to supply, distribute, and control electricity for illumination, power, or both, to required facilities when the normal electrical supply or system is interrupted.

Informational Note No. 1: For further information regarding wiring and installation of emergency systems in health care facilities, see [Article 517](#).

Informational Note No. 2: For further information regarding performance and maintenance of emergency systems in health care facilities, see [NFPA 99-2012, Health Care Facilities Code](#).

Informational Note No. 3: For specification of locations where emergency lighting is considered essential to life safety, see [NFPA 101-2012, Life Safety Code](#).

Informational Note No. 4: For further information regarding performance of emergency and standby power systems, see [NFPA 110-2013, Standard for Emergency and Standby Power Systems](#).

Emergency systems are designed and installed to maintain a specific degree of illumination or to provide power for essential equipment, such as emergency lighting for means of egress, if the normal power supply fails.

[Article 700](#) applies to the installation of emergency systems that are essential for safety to human life and are legally required by municipal, state, federal, or other codes or by a governmental agency having jurisdiction. [Article 700](#) does not dictate whether emergency systems are required or where emergency or exit lights should be located. These determinations may rely on [NFPA 101®](#), [Life Safety Code®](#).

[Article 708](#) provides requirements for power facilities that must be kept continuously operational throughout the duration

of an emergency. Critical operations power systems (COPS) are generally installed in vital infrastructure facilities – those that, if destroyed or incapacitated, would disrupt national security, the economy, public health, or safety – and in areas where enhanced electrical infrastructure for continuity of operation has been deemed necessary by governmental authority.

700.2 Definitions

Emergency Systems. Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction. These systems are intended to automatically supply illumination, power, or both, to designated areas and equipment in the event of failure of the normal supply or in the event of accident to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life.

Informational Note: Emergency systems are generally installed in places of assembly where artificial illumination is required for safe exiting and for panic control in buildings subject to occupancy by large numbers of persons, such as hotels, theaters, sports arenas, health care facilities, and similar institutions. Emergency systems may also provide power for such functions as ventilation where essential to maintain life, fire detection and alarm systems, elevators, fire pumps, public safety communications systems, industrial processes where current interruption would produce serious life safety or health hazards, and similar functions.

Relay, Automatic Load Control. A device used to set normally dimmed or normally-off switched emergency lighting equipment to full power illumination levels in the event of a loss of the normal supply by bypassing the dimming/switching controls, and to return the emergency lighting equipment to normal status when the device senses the normal supply has been restored.

Informational Note: See [ANSI/UL 924, Emergency Lighting and Power Equipment](#), for the requirements covering automatic load control relays.

One use of automatic load control relays is in a lighting branch circuit supplied by the emergency system where the load is controlled by an energy management system. The automatic load control relay functions to restore the required level of emergency lighting where the lighting has either been dimmed or completely

turned off by an energy management system. When the emergency loads are transferred from the normal source to the alternate source, the relay overrides the energy management mode and provides full power to the load. Upon restoration of the normal source, the relay returns the load to the normal operating mode that is controlled by the energy management system.

700.3 Tests and Maintenance

(A) Conduct or Witness Test. The authority having jurisdiction shall conduct or witness a test of the complete system upon installation and periodically afterward.

(B) Tested Periodically. Systems shall be tested periodically on a schedule acceptable to the authority having jurisdiction to ensure the systems are maintained in proper operating condition.

(C) Battery Systems Maintenance. Where battery systems or unit equipments are involved, including batteries used for starting, control, or ignition in auxiliary engines, the authority having jurisdiction shall require periodic maintenance.

(D) Written Record. A written record shall be kept of such tests and maintenance.

(E) Testing Under Load. Means for testing all emergency lighting and power systems during maximum anticipated load conditions shall be provided.

Informational Note: For information on testing and maintenance of emergency power supply systems (EPSSs), see NFPA 110-2013, *Standard for Emergency and Standby Power Systems*.

Emergency system testing can be divided into two general categories – acceptance testing and operational testing. **Section 700.3** requires both types of testing as well as written records of each and of maintenance performance.

Acceptance testing is performed after the emergency system has been installed but before the system is used. Acceptance testing ensures that the emergency system meets or exceeds the original installation specification.

Operational testing, which is performed during the life of the system, ensures that the emergency system remains functional and that maintenance is performed adequately. One method of operational testing is running the generating system to power the load of the facility. Generally, actual emergency system loads are smaller than the design capacity of the emergency generator system. Actual peak loads of the emergency system should be kept as part of the written record.

Further information on tests and maintenance may be found in NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*; NFPA 99, *Standard for Health Care Facilities*; NFPA 101®, *Life Safety Code*®; NFPA 110, *Standard for Emergency and Standby Power Systems*; and NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*.

700.4 Capacity

(A) Capacity and Rating. An emergency system shall have adequate capacity and rating for all loads to be operated

simultaneously. The emergency system equipment shall be suitable for the maximum available fault current at its terminals.

The emergency system must be designed with adequate capacity and rating to safely carry, at one time, the entire load connected to the emergency system. It must be capable of restarting emergency loads that have been interrupted, such as motors that may have stopped, and it must be suitable for the available fault current.

(B) Selective Load Pickup, Load Shedding, and Peak Load Shaving. The alternate power source shall be permitted to supply emergency, legally required standby, and optional standby system loads where the source has adequate capacity or where automatic selective load pickup and load shedding is provided as needed to ensure adequate power to (1) the emergency circuits, (2) the legally required standby circuits, and (3) the optional standby circuits, in that order of priority. The alternate power source shall be permitted to be used for peak load shaving, provided these conditions are met.

Peak load shaving operation shall be permitted for satisfying the test requirement of **700.3(B)**, provided all other conditions of **700.3** are met.

A portable or temporary alternate source shall be available whenever the emergency generator is out of service for major maintenance or repair.

Where a generator is used for peak load shaving, supplying backup power, and other uses, priority loads must be properly and reliably served. Selective load pickup and load shedding are not required where the generator has the capacity to supply all loads served.

If a generator is used for peak load shaving or in a cogeneration system, the increase in wear and tear will likely result in an increase in downtime for maintenance. Also, using the emergency generator on a regular basis for nonemergency loads provides assurance that the emergency generator will supply emergency power when it is needed. The requirement for a portable or temporary alternate source is intended to provide emergency power when the generator set is out of service for major maintenance. A major maintenance or repair procedure is one that keeps the generator set out of service for more than a few hours.

700.5 Transfer Equipment

Double-throw automatic transfer switches (ATS) are typically used for emergency and standby power generation systems rated 600 volts or less. These transfer switches do not normally incorporate overcurrent protection. ATS are available in ratings up to 38 kV. For reliability, those used for emergency and legally required standby systems must be electrically operated and mechanically held. System grounding is determined by the type of transfer switch employed. See **250.30** and associated commentary regarding separately derived systems.

It is desirable to locate transfer switches close to the load and to keep the operation of the transfer switches independent of

overcurrent protection. It may be advantageous to use multiple transfer switches of lower current rating located near the load rather than one large transfer switch at the point of incoming service.

Time-Delay Devices on Automatic Transfer Switches

The normal power source is usually a service, and the emergency power source is an automatically started engine generator set that starts when the normal source fails. Time-delay controls are essential to the operation of the ATS.

To avoid unnecessary starting and transfer to the alternate supply, a time delay can override momentary interruptions and temporary reductions in normal source voltage but still allow starting and transfer if the reduction or outage is sustained. However, the time delay should be set fast enough to effectively operate the transfer switch and provide backup power for long-term outages.

This delay is generally set at 1 second but may be set higher if reclosers or circuit breakers on the utility power lines take longer to operate or if momentary power dips exceed 1 second. If longer delay settings are used, care must be taken to ensure that sufficient time remains to meet 10-second power restoration requirements. The AHJ may determine that an outage is not a longer-term power failure until the utility automatic protective devices fail to restore power to the facility. For example, the 10-second power restoration requirements would become effective after the 2-second recloser cycle.

Once the load is transferred to the alternate source, another timer delays retransfer to the normal source until that source has time to stabilize. Another important function of this timer required by 700.12(B)(1) is to allow an engine generator to operate under load for at least 15 minutes to ensure continued good performance of the set and its starting system. This delay should be automatically nullified if the alternate source fails and the normal source is available.

Engine generator manufacturers often recommend a cool-down period for their sets that allows them to run unloaded after the load is retransferred to the normal source. A third time delay, usually 5 minutes, is provided for this purpose. Running an unloaded engine longer is usually not recommended, because it can cause deterioration in engine performance.

If more than one ATS is connected to the same engine generator, it is sometimes recommended that transfer of the loads be sequenced to the alternate source. Using a sequencing scheme can reduce starting kW capacity requirements of the generator. A fourth timer, adjustable from 0 to 5 minutes, will delay transfer to the emergency supply source for this and other similar requirements.

(A) General. Transfer equipment, including automatic transfer switches, shall be automatic, identified for emergency use, and approved by the authority having jurisdiction. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and emergency sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation

in parallel with the normal source shall meet the requirements of Article 705.

Traditional ATS are not designed to permit parallel operation of generation equipment and the normal source. Therefore, traditional ATS need not comply with Article 705. However, certain ATS configurations are intentionally designed to briefly (for a few cycles) parallel the generation equipment with the normal source upon load transfer from generator to normal source. This load transfer method may result in minimal disturbance or effect on the load. Transfer switches that employ this type of paralleling must comply with Article 705.

If continuous parallel operation of generation equipment and the source is desired, paralleling switchgear or paralleling equipment with appropriate protection is required. (See Article 705.)

(B) Bypass Isolation Switches. Means shall be permitted to bypass and isolate the transfer equipment. Where bypass isolation switches are used, inadvertent parallel operation shall be avoided.

(C) Automatic Transfer Switches. Automatic transfer switches shall be electrically operated and mechanically held. Automatic transfer switches, rated 1000 VAC and below, shall be listed for emergency system use.

Relay contacts are required to be mechanically held so that if a coil fails, the generator will not drop offline. Transfer switches rated 1000 volts ac and below are required to be listed for emergency systems use.

When emergency systems are tested, both the normal and the emergency system are energized. If the two sources are not synchronized, as much as twice the rated voltage may exist across the transfer switch contacts. Some listed transfer switches are designed and tested to be suitable for switching between out-of-phase power sources. Other protection methods may be employed, such as a mechanical interlock that prevents inadvertent interconnection, or an electronic method that prevents both systems from being interconnected. A typical emergency system transfer switch is shown in Exhibit 700.1.

(D) Use. Transfer equipment shall supply only emergency loads.

The alternate power source can supply emergency loads as well as other loads. However, the emergency system transfer switch is limited to supplying emergency loads. Legally required standby loads or optional standby loads (covered by Articles 701 and 702) require separate transfer switches.

700.6 Signals

Audible and visual signal devices shall be provided, where practicable, for the purpose described in 700.6(A) through (D).

(A) Derangement. To indicate derangement of the emergency source.

(B) Carrying Load. To indicate that the battery is carrying load.



EXHIBIT 700.1 An emergency system transfer switch. (Courtesy of the International Association of Electrical Inspectors)

(C) Not Functioning. To indicate that the battery charger is not functioning.

The major causes of emergency equipment failure are inadequate testing and maintenance. Installing signal devices that annunciate trouble where attendants or other personnel familiar with the operation of the emergency equipment can see or hear them allows action to be taken to maintain system function.

Battery-operated unit equipment generally has a test switch that simulates failure of the normal system, and an indicating light that glows brightly while charging and dims when ready. Transparent cases for lead-acid batteries allow easy viewing of electrolyte levels.

(D) Ground Fault. To indicate a ground fault in solidly grounded wye emergency systems of more than 150 volts to ground and circuit-protective devices rated 1000 amperes or more. The sensor for the ground-fault signal devices shall be located at, or ahead of, the main system disconnecting means for the emergency source, and the maximum setting of the signal devices shall be for a ground-fault current of 1200 amperes. Instructions on the course of action to be taken in event of indicated ground fault shall be located at or near the sensor location.

Informational Note: For signals for generator sets, see NFPA 110-2013, *Standard for Emergency and Standby Power Systems*.

Automatic ground-fault protection is not required on emergency systems (see 700.27), because it could interrupt the system when it is needed. However, ground faults must be detected and indicated so that the ground fault can be cleared as soon as practical.

700.7 Signs

(A) Emergency Sources. A sign shall be placed at the service-entrance equipment, indicating type and location of on-site emergency power sources.

Exception: A sign shall not be required for individual unit equipment as specified in 700.12(F).

(B) Grounding. Where removal of a grounding or bonding connection in normal power source equipment interrupts the grounding electrode conductor connection to the alternate power source(s) grounded conductor, a warning sign shall be installed at the normal power source equipment stating:

WARNING
SHOCK HAZARD EXISTS IF GROUNDING
ELECTRODE CONDUCTOR OR BONDING JUMPER
CONNECTION IN THIS EQUIPMENT IS REMOVED
WHILE ALTERNATE SOURCE(S) IS ENERGIZED.

The warning sign(s) or label(s) shall comply with 110.21(B).

Emergency and standby systems that have a solid (unswitched) neutral in the transfer equipment (non-separately derived system) rely on the grounding and bonding connections in the normal source supply equipment to ensure that the ground-fault current path is completed from a ground fault to the alternate source. If a main or system bonding jumper is removed (for example, to perform testing on GFPE systems), an electrician or other service personnel could inadvertently become part of the current path if a ground fault occurs while the alternate source is supplying power to loads. This poses a significant shock hazard to personnel who may not be aware of the grounding and bonding configuration for the alternate source.

700.8 Surge Protection

A listed SPD shall be installed in or on all emergency systems switchboards and panelboards.

II. Circuit Wiring

700.10 Wiring, Emergency System

(A) Identification. All boxes and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system.

The required marking can be by color code, the words "emergency system," or any other method that identifies the box or enclosure as a component of the emergency system.

(B) Wiring. Wiring of two or more emergency circuits supplied from the same source shall be permitted in the same raceway, cable, box, or cabinet. Wiring from an emergency source or emergency source distribution overcurrent protection to

emergency loads shall be kept entirely independent of all other wiring and equipment, unless otherwise permitted in 700.10(B)(1) through (5):

- (1) Wiring from the normal power source located in transfer equipment enclosures
- (2) Wiring supplied from two sources in exit or emergency luminaires
- (3) Wiring from two sources in a listed load control relay supplying exit or emergency luminaires, or in a common junction box, attached to exit or emergency luminaires
- (4) Wiring within a common junction box attached to unit equipment, containing only the branch circuit supplying the unit equipment and the emergency circuit supplied by the unit equipment

Where an alternate power source supplies a switchboard from a single feeder or feeders in parallel, that switchboard may further distribute and provide power for the emergency, legally required, and optional standby systems, provided separate vertical switchboard sections are used.

Separate vertical switchboard sections provide the physical separation requirements of both system and wiring from a common power source. This physical separation cannot occur within a panelboard enclosure because of its open design. The supply tap box on generators equipped with disconnects with or without overcurrent protection is not generally designed or manufactured for the installation of multiple transfer switches to serve separate circuits for emergency systems, fire pump loads, legally required standby systems, and optional standby systems. In addition, large systems may employ multiple generators. Any combination of these systems may be supplied from a single feeder or multiple feeders, or from separate vertical sections of a switchboard that are either supplied by a common bus or supplied individually.

Where generators operate in parallel, frequency and voltage must be synchronized and can supply a common bus array. From this bus, emergency, legally required, and optional standby transfer switches can be supplied.

Except as noted in this section, wiring for the emergency circuits must be completely independent of all other wiring and equipment. This practice ensures that a fault in any other system wiring will not affect the performance of the emergency wiring or equipment.

Sections 700.10(B)(2) and (B)(3) permit the use of two-lamp exit or two-lamp emergency fixtures, where one lamp is connected to the normal supply and one lamp is connected to the alternate supply. Both lamps may be illuminated as part of the regular lighting operation.

Wiring on the load side of a transfer switch serves as both the emergency circuit wiring and the normal circuit wiring. Two sets of wiring are not required to supply emergency loads from the load side of the transfer switch to the emergency load distribution panel or from these emergency distribution panels to the emergency loads. See Exhibits 700.2, 700.3, and 700.4 for illustrations of feeder configurations.

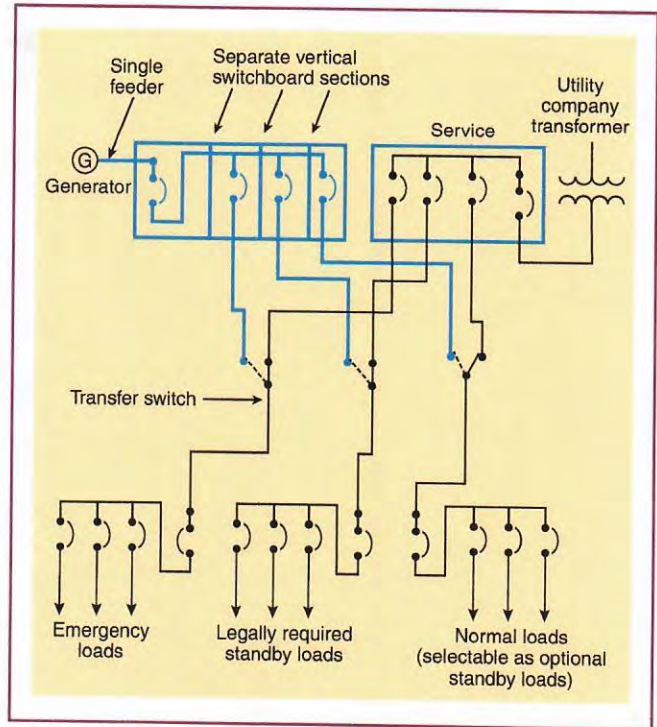


EXHIBIT 700.2 Illustration of a single feeder that supplies separate vertical sections of the switchboard.

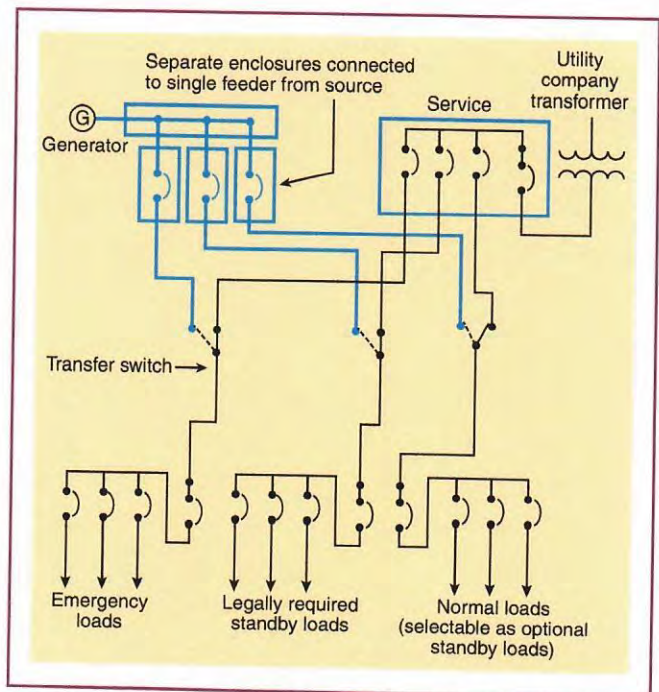


EXHIBIT 700.3 Illustration of a single feeder that supplies multiple transfer switches.

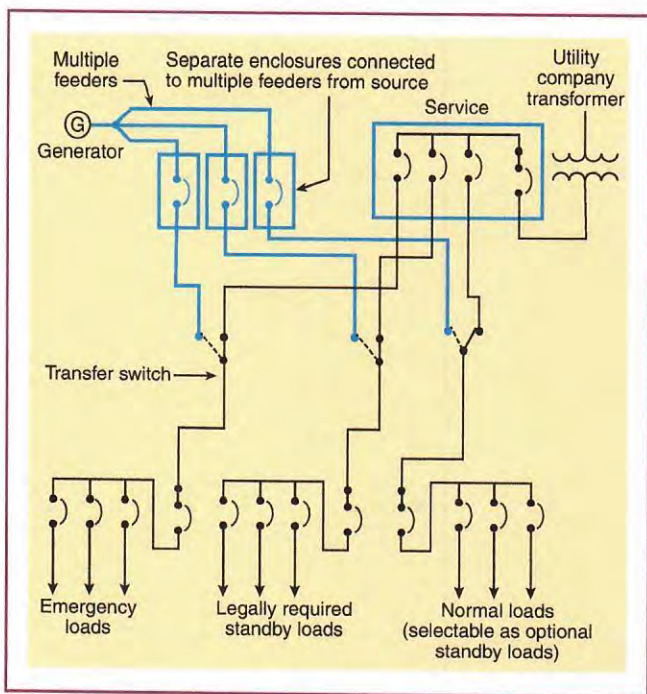


EXHIBIT 700.4 Illustration of a generator that supplies multiple feeders at its terminals.

(5) Wiring from an emergency source to supply emergency and other loads in accordance with 700.10(B)(5)a, b, c, and d as follows:

- a. Separate vertical switchgear sections or separate vertical switchboard sections, with or without a common bus, or individual disconnects mounted in separate enclosures shall be used to separate emergency loads from all other loads.
- b. The common bus of separate sections of the switchgear, separate sections of the switchboard, or the individual enclosures shall be permitted to be supplied by single or multiple feeders without overcurrent protection at the source.

Exception to (5)b: Overcurrent protection shall be permitted at the source or for the equipment, provided that the overcurrent protection complies with the requirements of 700.28.

- c. Emergency circuits shall not originate from the same vertical switchgear section, vertical switchboard section, panelboard enclosure, or individual disconnect enclosure as other circuits.
- d. It shall be permissible to utilize single or multiple feeders to supply distribution equipment between an emergency source and the point where the emergency loads are separated from all other loads.

A single common feeder is permitted to be installed between the alternate source and the point in the distribution system at which the physical separation of the emergency, legally required standby, and optional standby system conductors occurs, such as at a switchboard or other distribution equipment. Many large campus facilities with multiple buildings, such as medical centers, colleges or universities, prisons, and shopping malls, rely on central generation of emergency power. See the commentary following 700.10(B).

(C) Wiring Design and Location. Emergency wiring circuits shall be designed and located so as to minimize the hazards that might cause failure due to flooding, fire, icing, vandalism, and other adverse conditions.

(D) Fire Protection. Emergency systems shall meet the additional requirements in (D)(1) through (D)(3) in assembly occupancies for not less than 1000 persons or in buildings above 23 m (75 ft) in height.

- (1) **Feeder-Circuit Wiring.** Feeder-circuit wiring shall meet one of the following conditions:

(1) Be installed in spaces or areas that are fully protected by an approved automatic fire suppression system

Where emergency system feeders are installed above a suspended ceiling, for the system to be fully protected by a fire suppression system, sprinklers must be provided above the suspended ceilings even though sprinklers might be installed below the ceiling.

(2) Be a listed electrical circuit protective system with a minimum 2-hour fire rating

Informational Note: UL guide information for electrical circuit protective systems (FHIT) contains information on proper installation requirements to maintain the fire rating.

(3) Be protected by a listed thermal barrier system for electrical system components with a minimum 2-hour fire rating

Where emergency system wiring is installed in a listed fire-rated assembly, no other wiring is permitted within the assembly. If a fire-rated assembly is needed for normal circuits, it must be a separate fire-rated assembly from the one used for the emergency system.

(4) Be protected by a listed fire-rated assembly that has a minimum fire rating of 2 hours and contains only emergency wiring circuits

(5) Be encased in a minimum of 50 mm (2 in.) of concrete

If feeders are not located in building spaces that are fully protected by a fire suppression system, other fire protection techniques to comply with 700.10(D)(1) include the following.

Listed electrical circuit protective systems are described in the *UL White Book*. The four-letter code (shown in parentheses) is the UL product category guide designation. Examples of these systems include electrical circuit protective systems (FHIT), electrical circuit protective materials (FHIY), and fire-resistive cables (FHJR). Circuit integrity cable is covered under category FHJR.

Listed thermal barrier systems (XCLF) are described in the *UL White Book*. An example of the thermal barrier protection technique is batts and blankets (XCLR) wrapped over the wiring method to achieve a predetermined fire rating.

Fire-rated assemblies are described in the *UL Fire Resistance Directory*, Volumes 1 and 2. Volume 1 includes hourly ratings for beams, floors, roofs, columns, and walls and partitions. Volume 2A and 2B include hourly ratings for joint, through-penetration firestops, and electrical circuit protective systems. All fire ratings and fire resistance ratings are based on the assumption that the structural supports for the assembly are not impaired by the fire.

Encasement in concrete has been successful for many years in protecting premises from faults in service conductors per 230.6. Encasement in 2 inches of concrete is possible after original construction.

There is a difference between a 2-hour fire rating of an electrical circuit, such as a conduit with wires, and a 2-hour fire resistance rating of a structural member, such as a wall. At the end of a 2-hour fire test on an electrical conduit with wires, its insulation must be intact and the circuit must function electrically; no short circuits, grounds, or opens are permitted. A wall subjected to a 2-hour fire resistance test must only prevent a fire from passing through or past the wall, regardless of damage to the wall.

(2) Feeder-Circuit Equipment. Equipment for feeder circuits (including transfer switches, transformers, and panelboards) shall be located either in spaces fully protected by approved automatic fire suppression systems (including sprinklers, carbon dioxide systems) or in spaces with a 2-hour fire resistance rating.

Fire protection requirements for both emergency system feeder circuits and equipment ensure the integrity as well as the performance of the emergency electrical system. If feeders and equipment are located in building spaces that are fully protected by an approved fire suppression system, no further fire protection techniques are generally required.

Sprinkler systems are the most common fire suppression systems. Building spaces that are fully protected by automatic sprinkler systems meet the requirements of 700.10(D). Requirements for fire suppression systems are included in the following standards:

- NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*
- NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*
- NFPA 13, *Standard for the Installation of Sprinkler Systems*

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*

NFPA 17, *Standard for Dry Chemical Extinguishing Systems*

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*

If feeder-circuit equipment is not located in a space that is fully protected by a fire suppression system, the space must have a 2-hour fire resistance rating. See the commentary following 700.10(D)(1) regarding fire-rated assemblies.

(3) Generator Control Wiring. Control conductors installed between the transfer equipment and the emergency generator shall be kept entirely independent of all other wiring and shall meet the conditions of 700.10(D)(1).

III. Sources of Power

General Requirements for Emergency Lighting Systems

At least two sources of power must be provided – one normal supply and one or more of the emergency systems described in 700.12. The sources (see Exhibits 700.5 and 700.6.) may be one of the following:

1. Two services – one normal supply and one emergency supply (preferably from separate utility stations)
2. One normal service and a storage battery (or unit equipment) system
3. One normal service and a generator set

A means must be provided to transfer the emergency loads to the alternate supply when the normal source of supply is interrupted. If a separate service is used, both may operate normally, but equipment for emergency lighting and power must be arranged to be energized from either service.

If the alternate or emergency source of supply is a storage battery or generator set, the single emergency system is usually operated on the normal service, and the battery (or batteries) or generator operates only if the normal service fails. However, a generator may be used for peak load shaving and other standby systems in accordance with 700.4.

Two or more separate and complete systems may provide power for emergency lighting, but means must be provided for energizing one system if the other one fails.

Disconnecting means and overcurrent protection (see Exhibits 700.5 and 700.6) must be provided for emergency systems as required by Articles 225 and 230.

700.12 General Requirements

Current supply shall be such that, in the event of failure of the normal supply to, or within, the building or group of buildings concerned, emergency lighting, emergency power, or both shall be available within the time required for the application but not to exceed 10 seconds. The supply system for emergency purposes, in addition to the normal services to the building and meeting

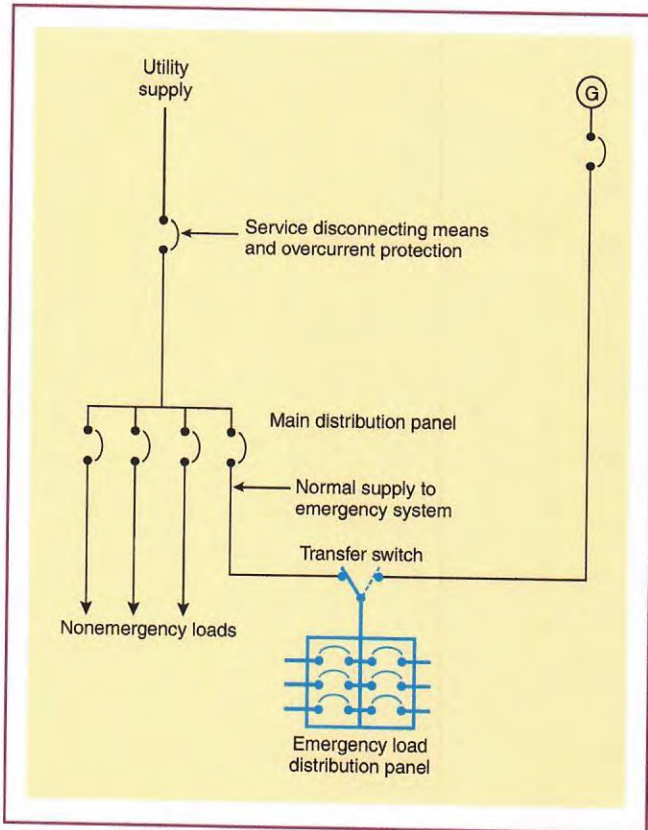


EXHIBIT 700.5 Emergency load arranged to be supplied from a generator, as permitted by 700.12(B).

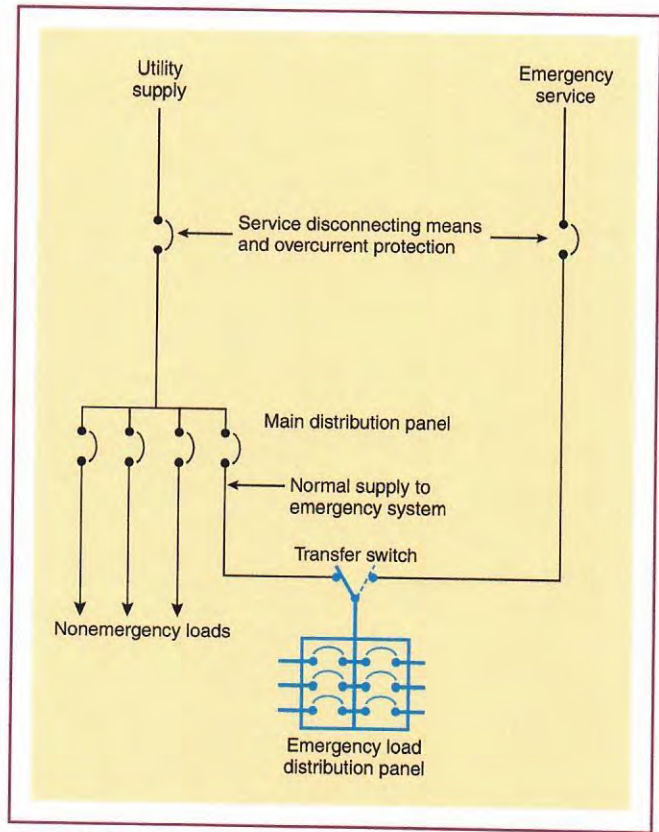


EXHIBIT 700.6 Emergency load arranged to be supplied from two widely separated services, as permitted by 700.12(D).

the general requirements of this section, shall be one or more of the types of systems described in 700.12(A) through (E). Unit equipment in accordance with 700.12(F) shall satisfy the applicable requirements of this article.

In selecting an emergency source of power, consideration shall be given to the occupancy and the type of service to be rendered, whether of minimum duration, as for evacuation of a theater, or longer duration, as for supplying emergency power and lighting due to an indefinite period of current failure from trouble either inside or outside the building.

Equipment shall be designed and located so as to minimize the hazards that might cause complete failure due to flooding, fires, icing, and vandalism.

The design and selection of a location must consider hazards that could impair reliability. See Exhibit 700.7.

Equipment for sources of power as described in 700.12(A) through (E) where located within assembly occupancies for greater than 1000 persons or in buildings above 23 m (75 ft) in height with any of the following occupancy classes — assembly, educational, residential, detention and correctional, business, and mercantile — shall be installed either in spaces fully protected



EXHIBIT 700.7 Alternate source of power in a heated and secure enclosure that is located in an area not subject to flooding. (Courtesy of the International Association of Electrical Inspectors)

by approved automatic fire suppression systems (sprinklers, carbon dioxide systems, and so forth) or in spaces with a 1-hour fire rating.

Informational Note No. 1: For the definition of *Occupancy Classification*, see Section 6.1 of NFPA 101-2012, *Life Safety Code*.

Informational Note No. 2: For further information, see ANSI/IEEE 493-2007, *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems*.

(A) Storage Battery. Storage batteries used as a source of power for emergency systems shall be of suitable rating and capacity to supply and maintain the total load for a minimum period of 1½ hours, without the voltage applied to the load falling below 87½ percent of normal.

Batteries, whether of the acid or alkali type, shall be designed and constructed to meet the requirements of emergency service and shall be compatible with the charger for that particular installation.

For a sealed battery, the container shall not be required to be transparent. However, for the lead acid battery that requires water additions, transparent or translucent containers shall be furnished. Automotive-type batteries shall not be used.

An automatic battery charging means shall be provided.

(B) Generator Set.

(1) Prime Mover-Driven. For a generator set driven by a prime mover acceptable to the authority having jurisdiction and sized in accordance with 700.4, means shall be provided for automatically starting the prime mover on failure of the normal service and for automatic transfer and operation of all required electrical circuits. A time-delay feature permitting a 15-minute setting shall be provided to avoid retransfer in case of short-time reestablishment of the normal source.

(2) Internal Combustion Engines as Prime Movers. Where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours' full-demand operation of the system. Where power is needed for the operation of the fuel transfer pumps to deliver fuel to a generator set day tank, this pump shall be connected to the emergency power system.

Engine-driven generators that use an electric fuel transfer pump might not start or continue operating if the fuel pump is not operating. These pumps, which transfer fuel into a day tank, must be supplied by the emergency system.

(3) Dual Supplies. Prime movers shall not be solely dependent on a public utility gas system for their fuel supply or municipal water supply for their cooling systems. Means shall be provided for automatically transferring from one fuel supply to another where dual fuel supplies are used.

Exception: Where acceptable to the authority having jurisdiction, the use of other than on-site fuels shall be permitted where

there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company.

(4) Battery Power and Dampers. Where a storage battery is used for control or signal power or as the means of starting the prime mover, it shall be suitable for the purpose and shall be equipped with an automatic charging means independent of the generator set. Where the battery charger is required for the operation of the generator set, it shall be connected to the emergency system. Where power is required for the operation of dampers used to ventilate the generator set, the dampers shall be connected to the emergency system.

(5) Auxiliary Power Supply. Generator sets that require more than 10 seconds to develop power shall be permitted if an auxiliary power supply energizes the emergency system until the generator can pick up the load.

(6) Outdoor Generator Sets. Where an outdoor housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18, and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a building or structure, the disconnecting means shall meet the requirements of 225.36.

The disconnecting means on the generator can be used as the disconnecting means required in 225.31, provided the disconnecting means is readily accessible and is within sight of the building. (See the definitions of *readily accessible* and *in sight from* in Article 100.) Where an additional disconnecting means is necessary, it must be suitable for use as service equipment in accordance with 225.36.

Exception: For installations under single management, where conditions of maintenance and supervision ensure that only qualified persons will monitor and service the installation and where documented safe switching procedures are established and maintained for disconnection, the generator set disconnecting means shall not be required to be located within sight of the building or structure served.

The circuit between the generator and the building or structure is a feeder. Therefore, the requirements for outdoor feeders contained in Article 225 must be followed, including those covering disconnecting means for outdoor branch circuits and feeders. Section 700.12(B)(6) modifies the requirement in 225.32 for the location of disconnecting means. The feeder disconnecting means is permitted to be located at the generator location provided the disconnecting means is within sight and readily accessible from the building being supplied.

(C) **Uninterruptible Power Supplies.** Uninterruptible power supplies used to provide power for emergency systems shall comply with the applicable provisions of 700.12(A) and (B).

(D) **Separate Service.** Where approved by the authority having jurisdiction as suitable for use as an emergency source of power, an additional service shall be permitted. This service shall be in accordance with the applicable provisions of Article 230 and the following additional requirements:

- (1) Separate overhead service conductors, service drops, underground service conductors, or service laterals shall be installed.
- (2) The service conductors for the separate service shall be installed sufficiently remote electrically and physically from any other service conductors to minimize the possibility of simultaneous interruption of supply.

(E) **Fuel Cell System.** Fuel cell systems used as a source of power for emergency systems shall be of suitable rating and capacity to supply and maintain the total load for not less than 2 hours of full-demand operation.

Installation of a fuel cell system shall meet the requirements of Parts II through VIII of Article 692.

Where a single fuel cell system serves as the normal supply for the building or group of buildings concerned, it shall not serve as the sole source of power for the emergency standby system.

Emergency systems can be designed using one or more of the following systems:

1. One storage battery or a group of storage batteries provided with an automatic battery-charging means. (See Article 480.)
2. A generator set driven by a prime mover, acceptable to the AHJ, and with adequate capacity to carry the maximum load connected. Prime movers may be internal-combustion engines, steam or gas turbines, or other approved types of mechanical drivers. A storage battery used to start the prime mover must be provided with an automatic battery-charging means. An on-site fuel supply that is sufficient to operate internal-combustion engines at full load for 2 hours must also be available.

Off-site fuel supplies such as natural gas or piped steam may be used where experience has demonstrated their reliability. Off-site fuel supplies may also be used where they provide greater reliability than gasoline or diesel engines or in isolated areas where maintenance or refueling could be a problem.

Some types of drivers, particularly large ones, may take longer than 10 seconds to accelerate and develop generator voltage. Gas and steam turbines and large internal-combustion engines may have prolonged starting times. Depending on the specific loads, short-time supply could be provided by an uninterruptible power supply; a generator shared with other loads; or a generator with limited emergency supply, such as an expander, a steam turbine, or a waste heat system.

3. Uninterruptible power supplies (UPS), which generally include a rectifier, a storage battery, and an inverter to ac. Uninterruptible power supplies may be very complex systems with redundant components and high-speed solid-state switching. A common practice is to include an automatic bypass for UPS malfunction to permit maintenance.
4. The use of a separate service, which requires a judgment by the AHJ. Such judgment should be based on the nature of the emergency loads and the expected reliability of the other available sources.

(F) **Unit Equipment.**

(1) **Components of Unit Equipment.** Individual unit equipment for emergency illumination shall consist of the following:

- (1) A rechargeable battery
- (2) A battery charging means
- (3) Provisions for one or more lamps mounted on the equipment, or shall be permitted to have terminals for remote lamps, or both
- (4) A relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment

Unit equipment must be permanently fixed in place, usually by mounting screws that are accessible only from within the unit. One or more lamps may be mounted on or remote from the unit. The unit should be located where it can be readily checked or tested for proper performance. See Exhibit 700.8.

Unit equipment is intended to provide illumination for the area where it is installed. For instance, if a unit is located in a corridor, it must be connected to the branch circuit supplying the



EXHIBIT 700.8 Self-contained, fully automatic unit equipment for operating emergency lighting located on the unit or for remotely located exit signs or lighting heads. (Courtesy of the International Association of Electrical Inspectors)

normal corridor lights (on the line side of any switching arrangements). If normal power fails, the unit automatically energizes the unit lamps, restoring illumination to the corridor. A separate circuit is not permitted for unit equipment [except as noted in the exception to 700.12(F)(2)(3)] because failure of the normal corridor circuit would not affect the unit equipment, and the corridor would remain dark. The branch circuit feeding the unit must be identified at the panelboard.

(2) Installation of Unit Equipment. Unit equipment shall be installed in accordance with 700.12(F)(2)(1) through (6).

- (1) The batteries shall be of suitable rating and capacity to supply and maintain at not less than 87½ percent of the nominal battery voltage for the total lamp load associated with the unit for a period of at least 1½ hours, or the unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1½ hours. Storage batteries, whether of the acid or alkali type, shall be designed and constructed to meet the requirements of emergency service.
- (2) Unit equipment shall be permanently fixed in place (i.e., not portable) and shall have all wiring to each unit installed in accordance with the requirements of any of the wiring methods in Chapter 3. Flexible cord-and-plug connection shall be permitted, provided that the cord does not exceed 900 mm (3 ft) in length.
- (3) The branch circuit feeding the unit equipment shall be the same branch circuit as that serving the normal lighting in the area and connected ahead of any local switches.

Exception: In a separate and uninterrupted area supplied by a minimum of three normal lighting circuits that are not part of a multiwire branch circuit, a separate branch circuit for unit equipment shall be permitted if it originates from the same panelboard as that of the normal lighting circuits and is provided with a lock-on feature.

- (4) The branch circuit that feeds unit equipment shall be clearly identified at the distribution panel.
- (5) Emergency luminaires that obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment as required by 700.10 and by one of the wiring methods of Chapter 3.
- (6) Remote heads providing lighting for the exterior of an exit door shall be permitted to be supplied by the unit equipment serving the area immediately inside the exit door.

Prior to the 2011 Code, outside unit equipment was required to be supplied from the outside lighting circuit. Unit equipment serving the area immediately inside the exit door is allowed to supply remote emergency luminaires installed outside the exit door. The normal lighting branch circuit for the area inside the exit door can

be used to supply unit equipment that in turn supplies emergency luminaires installed inside and outside the exit door. If the power to the normal lighting branch circuit for this area is interrupted, the indoor and outdoor emergency luminaires will activate, even if the normal branch circuit for exterior lighting remains energized.

IV. Emergency System Circuits for Lighting and Power

700.15 Loads on Emergency Branch Circuits

No appliances and no lamps, other than those specified as required for emergency use, shall be supplied by emergency lighting circuits.

700.16 Emergency Illumination

Emergency illumination shall include all required means of egress lighting, illuminated exit signs, and all other lights specified as necessary to provide required illumination.

Emergency lighting systems shall be designed and installed so that the failure of any individual lighting element, such as the burning out of a lamp, cannot leave in total darkness any space that requires emergency illumination.

Where high-intensity discharge lighting such as high- and low-pressure sodium, mercury vapor, and metal halide is used as the sole source of normal illumination, the emergency lighting system shall be required to operate until normal illumination has been restored.

Where an emergency system is installed, emergency illumination shall be provided in the area of the disconnecting means required by 225.31 and 230.70, as applicable, where the disconnecting means are installed indoors.

Exception: Alternative means that ensure that the emergency lighting illumination level is maintained shall be permitted.

High-intensity discharge (HID) fixtures take some time to start once they are energized. Therefore, if HID fixtures are the sole source of normal illumination in an area, the Code requires that the emergency lighting system operate not only until the normal system is returned to service but also until the HID fixtures provide illumination. This does not apply if another type of fixture, such as an incandescent one, also normally illuminates the area.

For unit equipment, a second lamp ensures that the area is not left in total darkness. This section does not require redundant batteries or control circuitry.

700.17 Branch Circuits for Emergency Lighting

Branch circuits that supply emergency lighting shall be installed to provide service from a source complying with 700.12 when the normal supply for lighting is interrupted. Such installations shall provide either of the following:

- (1) An emergency lighting supply, independent of the normal lighting supply, with provisions for automatically

transferring the emergency lights upon the event of failure of the normal lighting branch circuit

- (2) Two or more branch circuits supplied from separate and complete systems with independent power sources. One of the two power sources and systems shall be part of the emergency system, and the other shall be permitted to be part of the normal power source and system. Each system shall provide sufficient power for emergency lighting purposes.

Unless both systems are used for regular lighting purposes and are both kept lighted, means shall be provided for automatically energizing either system upon failure of the other. Either or both systems shall be permitted to be a part of the general lighting of the protected occupancy if circuits supplying lights for emergency illumination are installed in accordance with other sections of this article.

The terms *normal* and *branch circuit* indicate that the emergency lighting supply must be independent of the normal lighting supply and that it must automatically operate when there is a failure of the branch circuit(s) supplying the normal lighting.

Section 700.17(2) requires emergency lighting to be supplied by a minimum of two branch circuits from separate systems with different power sources. Where a failure of the normal lighting branch circuit activates the emergency lighting supply, an area supplied by only one lighting branch circuit will be in total darkness if that branch circuit fails. For example, if a single branch circuit, supplied by an emergency circuit panelboard, supplies the lighting in a stairwell (means of egress), a failure of that branch circuit plunges that stairwell into total darkness. If two branch circuits from separate systems are run to the stairwell, it is unlikely that both circuits to the stairway would fail simultaneously; therefore the risk to occupants created by total darkness is minimized.

700.18 Circuits for Emergency Power

For branch circuits that supply equipment classed as emergency, there shall be an emergency supply source to which the load will be transferred automatically upon the failure of the normal supply.

700.19 Multiwire Branch Circuits

The branch circuit serving emergency lighting and power circuits shall not be part of a multiwire branch circuit.

V. Control — Emergency Lighting Circuits

700.20 Switch Requirements

The switch or switches installed in emergency lighting circuits shall be arranged so that only authorized persons have control of emergency lighting.

Exception No. 1: Where two or more single-throw switches are connected in parallel to control a single circuit, at least one of these switches shall be accessible only to authorized persons.

Exception No. 2: Additional switches that act only to put emergency lights into operation but not disconnect them shall be permissible.

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

700.21 Switch Location

All manual switches for controlling emergency circuits shall be in locations convenient to authorized persons responsible for their actuation. In facilities covered by Articles 518 and 520, a switch for controlling emergency lighting systems shall be located in the lobby or at a place conveniently accessible thereto.

In no case shall a control switch for emergency lighting be placed in a motion-picture projection booth or on a stage or platform.

Exception: Where multiple switches are provided, one such switch shall be permitted in such locations where arranged so that it can only energize the circuit but cannot de-energize the circuit.

700.22 Exterior Lights

Those lights on the exterior of a building that are not required for illumination when there is sufficient daylight shall be permitted to be controlled by an automatic light-actuated device.

700.23 Dimmer and Relay Systems

A dimmer or relay system containing more than one dimmer or relay and listed for use in emergency systems shall be permitted to be used as a control device for energizing emergency lighting circuits. Upon failure of normal power, the dimmer or relay system shall be permitted to selectively energize only those branch circuits required to provide minimum emergency illumination. All branch circuits supplied by the dimmer or relay system cabinet shall comply with the wiring methods of Article 700.

Dimmer systems that are listed for emergency system use include a method to sense failure of normal power and selectively energize branch circuits fed from the dimmer cabinet, regardless of the setting of control switches or panels normally used to control the dimmer system. Dimmer systems are usually supplied by a feeder that is transferred from the normal system to the emergency system by a transfer switch. See Exhibit 700.9.

700.24 Directly Controlled Luminaires

Where emergency illumination is provided by one or more directly controlled luminaires that respond to an external control input to bypass normal control upon loss of normal power, such luminaires and external bypass controls shall be individually listed for use in emergency systems.



EXHIBIT 700.9 An example of a label for a dimmer system that is listed for emergency system use. (Courtesy of Electronic Theatre Controls, Inc.)

700.25 Automatic Load Control Relay

If an emergency 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.

Automatic load control relays were traditionally part of emergency unit equipment, but stand-alone devices are now listed under ANSI/UL 924, *Standard for Emergency Lighting and Power Equipment*. Proper application of these devices depends upon their function in an emergency circuit.

Load control relays listed to UL 924 are not to be used to transfer a load between two nonsynchronous power sources; only transfer equipment listed to UL 1008 is suitable for this application. These power sources might be out of phase with one another. Load control relays do not have mechanisms required by UL 1008 to prevent inadvertent connection of the normal and emergency sources, and they do not undergo the fault-current evaluation that is required of UL 1008 for transfer switches.

In addition, the UL *White Book* differentiates automatic transfer switches (product category WPWR) from automatic load control relays (product category FTBR).

VI. Overcurrent Protection

700.26 Accessibility

The branch-circuit overcurrent devices in emergency circuits shall be accessible to authorized persons only.

700.27 Ground-Fault Protection of Equipment

The alternate source for emergency systems shall not be required to have ground-fault protection of equipment with automatic

disconnecting means. Ground-fault indication of the emergency source shall be provided in accordance with 700.6(D) if ground-fault protection of equipment with automatic disconnecting means is not provided.

700.28 Selective Coordination

Emergency system(s) overcurrent devices shall be selectively coordinated with all supply-side overcurrent protective devices.

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.

The term *coordination (selective)*, as defined in Article 100, indicates that a selectively coordinated system is one where the operation of the overcurrent protective scheme localizes an overcurrent condition to the circuit conductors or equipment in which an overload or fault (short circuit or ground fault) has occurred. Because the purpose of an emergency system is to provide power to essential life safety systems in a building or facility, a selectively coordinated overcurrent protection scheme that localizes and minimizes the extent of an interruption of power due to the opening of a protective device is a critical safety element.

Continuity of operation of illumination for occupant evacuation or maintaining continuity of operation of essential safety equipment such as smoke evacuation systems is necessary for occupant safety. This prohibits an overload, short circuit, or ground fault in a 20-ampere branch circuit from causing the feeder protective device supplying the branch-circuit panelboard to open. Coordination must be carried through each level of distribution that supplies power to the emergency system.

Design and verification of electrical system coordination can be achieved only through a coordination study. A coordination study entails detailed analysis of electrical supply system fault-current characteristics. The design must integrate overcurrent protective devices that interact by localizing the overcurrent problem and isolating that part of the emergency system. Modifications to the electrical system after the initial design and installation can affect the original implementation of the coordinated system. For additional discussion on selective coordination, see the commentary for 620.62 and Exhibit 620.8.

The exception to 700.28 recognizes devices that are in series where the upstream device has no other loads. A typical example would be a series-rated system where the device immediately upstream is designed to open before the downstream device under short-circuit conditions.



ARTICLE 701 Legally Required Standby Systems

I. General

701.1 Scope

The provisions of this article apply to the electrical safety of the installation, operation, and maintenance of legally required standby systems consisting of circuits and equipment intended to supply, distribute, and control electricity to required facilities for illumination or power, or both, when the normal electrical supply or system is interrupted.

The systems covered by this article consist only of those that are permanently installed in their entirety, including the power source.

Informational Note No. 1: For additional information, see NFPA 99-2012, *Health Care Facilities Code*.

Informational Note No. 2: For further information regarding performance of emergency and standby power systems, see NFPA 110-2013, *Standard for Emergency and Standby Power Systems*.

Informational Note No. 3: For further information, see ANSI/IEEE 446-1995, *Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications*.

Legally required standby systems are intended to provide electric power to aid in fire fighting, rescue operations, control of health hazards, and similar operations. In comparison, emergency systems (see Article 700) are those systems essential for safety to life. Optional standby systems (see Article 702) are those in which failure can cause physical discomfort, interruption of an industrial process, damage to process equipment, or disruption of business, for example.

The requirements for legally required standby systems are much the same as for emergency systems, except for a few differences. When normal power is lost, legally required systems must be able to supply standby power in 60 seconds or less, instead of the 10 seconds or less required of emergency systems. Wiring for legally required standby systems may occupy the same raceways, cables, boxes, and cabinets as other general wiring, whereas wiring for emergency systems must be kept entirely independent of other wiring. Legally required standby systems take second priority to emergency systems if they are involved in sharing an alternate supply and/or load shedding or peak shaving schemes.

701.2 Definition

Legally Required Standby Systems. Those systems required and so classed as legally required standby by municipal, state, federal, or other codes or by any governmental agency having

jurisdiction. These systems are intended to automatically supply power to selected loads (other than those classed as emergency systems) in the event of failure of the normal source.

Informational Note: Legally required standby systems are typically installed to serve loads, such as heating and refrigeration systems, communications systems, ventilation and smoke removal systems, sewage disposal, lighting systems, and industrial processes, that, when stopped during any interruption of the normal electrical supply, could create hazards or hamper rescue or fire-fighting operations.

701.3 Tests and Maintenance

(A) **Conduct or Witness Test.** The authority having jurisdiction shall conduct or witness a test of the complete system upon installation.

(B) **Tested Periodically.** Systems shall be tested periodically on a schedule and in a manner acceptable to the authority having jurisdiction to ensure the systems are maintained in proper operating condition.

(C) **Battery Systems Maintenance.** Where batteries are used for control, starting, or ignition of prime movers, the authority having jurisdiction shall require periodic maintenance.

(D) **Written Record.** A written record shall be kept on such tests and maintenance.

(E) **Testing Under Load.** Means for testing legally required standby systems under load shall be provided.

Informational Note: For information on testing and maintenance of emergency power supply systems (EPSSs), see NFPA 110-2013, *Standard for Emergency and Standby Power Systems*.

701.4 Capacity and Rating

A legally required standby system shall have adequate capacity and rating for the supply of all equipment intended to be operated at one time. Legally required standby system equipment shall be suitable for the maximum available fault current at its terminals.

The legally required standby alternate power source shall be permitted to supply both legally required standby and optional standby system loads under either of the following conditions:

- (1) Where the alternate source has adequate capacity to handle all connected loads
- (2) Where automatic selective load pickup and load shedding is provided that will ensure adequate power to the legally required standby circuits

Selective load pickup and load shedding are not required if the generator has sufficient capacity to supply all connected loads.

701.5 Transfer Equipment

(A) **General.** Transfer equipment, including automatic transfer switches, shall be automatic and identified for standby use and

approved by the authority having jurisdiction. Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and alternate sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of **Article 705**.

Parallel operation of the generation equipment with the normal source is permitted as long as the requirements of **Article 705** are met. Traditional automatic transfer switches (ATS) are not designed to permit parallel operation of generation equipment and the normal source. Therefore, traditional ATS need not comply with **Article 705**. However, certain ATS configurations are intentionally designed to briefly (for a few cycles) parallel the generation equipment with the normal source upon load transfer. This load transfer can occur with minimal disturbance or effect on the load. Transfer switches that employ this type of paralleling must comply with **Article 705**.

(B) Bypass Isolation Switches. Means to bypass and isolate the transfer switch equipment shall be permitted. Where bypass isolation switches are used, inadvertent parallel operation shall be avoided.

(C) Automatic Transfer Switches. Automatic transfer switches shall be electrically operated and mechanically held. Automatic transfer switches, rated 1000 VAC and below, shall be listed for emergency use.

The intent is to ensure that relay contacts are mechanically held in the event of coil failure. This requirement also correlates with NFPA 110, *Standard for Emergency and Standby Power Systems*.

When standby systems are tested, both the normal and the standby system are energized. If the two sources are not synchronized, as much as twice the rated voltage may exist across the transfer switch contacts. Some listed transfer switches are designed and tested to be suitable for switching between out-of-phase power sources. Other protection methods may be employed, such as a mechanical interlock that prevents inadvertent interconnection or an electronic method that prevents both systems from being interconnected.

701.6 Signals

Audible and visual signal devices shall be provided, where practicable, for the purposes described in 701.6(A), (B), (C), and (D).

(A) Derangement. To indicate derangement of the standby source.

(B) Carrying Load. To indicate that the standby source is carrying load.

(C) Not Functioning. To indicate that the battery charger is not functioning.

Informational Note: For signals for generator sets, see NFPA 110-2013, *Standard for Emergency and Standby Power Systems*.

(D) Ground Fault. To indicate a ground fault in solidly grounded wye, legally required standby systems of more than 150 volts to ground and circuit-protective devices rated 1000 amperes or more. The sensor for the ground-fault signal devices shall be located at, or ahead of, the main system disconnecting means for the legally required standby source, and the maximum setting of the signal devices shall be for a ground-fault current of 1200 amperes. Instructions on the course of action to be taken in event of indicated ground fault shall be located at or near the sensor location.

Informational Note: For signals for generator sets, see NFPA 110-2013, *Standard for Emergency and Standby Power Systems*.

Ground-fault indication is required for legally required standby systems. Although 701.26 specifies that automatic ground-fault protection of equipment is not required to be provided on the alternate source, ground faults can occur on such systems, and they can result in equipment burndown. Because of the importance of legally required systems, automatic disconnect in the event of a ground fault is inappropriate. Detection of such a fault, however, is required so that the condition can be corrected.

701.7 Signs

(A) Mandated Standby. A sign shall be placed at the service entrance indicating type and location of on-site legally required standby power sources.

Exception: A sign shall not be required for individual unit equipment as specified in 701.12(G).

(B) Grounding. Where removal of a grounding or bonding connection in normal power source equipment interrupts the grounding electrode conductor connection to the alternate power source(s) grounded conductor, a warning sign shall be installed at the normal power source equipment stating:

WARNING
SHOCK HAZARD EXISTS IF GROUNDING
ELECTRODE CONDUCTOR OR BONDING JUMPER
CONNECTION IN THIS EQUIPMENT IS REMOVED
WHILE ALTERNATE SOURCE(S) IS ENERGIZED.

The warning sign(s) or label(s) shall comply with 110.21(B).

See the commentary following 700.7(B). Removal of grounding and bonding connections presents the same hazard in the normal supply equipment for legally required standby systems as in the normal supply equipment for an emergency system.

II. Circuit Wiring

701.10 Wiring Legally Required Standby Systems

The legally required standby system wiring shall be permitted to occupy the same raceways, cables, boxes, and cabinets with other general wiring.

III. Sources of Power

701.12 General Requirements

Current supply shall be such that, in the event of failure of the normal supply to, or within, the building or group of buildings concerned, legally required standby power will be available within the time required for the application but not to exceed 60 seconds. The supply system for legally required standby purposes, in addition to the normal services to the building, shall be permitted to comprise one or more of the types of systems described in 701.12(A) through (F). Unit equipment in accordance with 701.12(G) shall satisfy the applicable requirements of this article.

In selecting a legally required standby source of power, consideration shall be given to the type of service to be rendered, whether of short-time duration or long duration.

Consideration shall be given to the location or design, or both, of all equipment to minimize the hazards that might cause complete failure due to floods, fires, icing, and vandalism.

Informational Note: For further information, see ANSI/IEEE 493-2007, *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems*.

(A) Storage Battery. A storage battery shall be of suitable rating and capacity to supply and maintain at not less than 87½ percent of system voltage the total load of the circuits supplying legally required standby power for a period of at least 1½ hours.

Batteries, whether of the acid or alkali type, shall be designed and constructed to meet the service requirements of emergency service and shall be compatible with the charger for that particular installation.

For a sealed battery, the container shall not be required to be transparent. However, for the lead acid battery that requires water additions, transparent or translucent containers shall be furnished. Automotive-type batteries shall not be used.

An automatic battery charging means shall be provided.

(B) Generator Set.

(1) Prime Mover-Driven. For a generator set driven by a prime mover acceptable to the authority having jurisdiction and sized in accordance with 701.4, means shall be provided for automatically starting the prime mover upon failure of the normal service and for automatic transfer and operation of all required electrical circuits. A time-delay feature permitting a 15-minute setting shall be provided to avoid retransfer in case of short-time re-establishment of the normal source.

(2) Internal Combustion Engines as Prime Mover. Where internal combustion engines are used as the prime mover, an on-site fuel supply shall be provided with an on-premises fuel supply sufficient for not less than 2 hours of full-demand operation of the system. Where power is needed for the operation of the fuel transfer pumps to deliver fuel to a generator set day tank, the pumps shall be connected to the legally required standby power system.

When power is needed for the operation of the fuel transfer pumps, they must be connected to the legally required standby system for the continued delivery of fuel.

(3) Dual Supplies. Prime movers shall not be solely dependent on a public utility gas system for their fuel supply or on a municipal water supply for their cooling systems. Means shall be provided for automatically transferring one fuel supply to another where dual fuel supplies are used.

Exception: Where acceptable to the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery system and power from the outside electrical utility company.

(4) Battery Power. Where a storage battery is used for control or signal power or as the means of starting the prime mover, it shall be suitable for the purpose and shall be equipped with an automatic charging means independent of the generator set.

(5) Outdoor Generator Sets. Where an outdoor housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18, and the disconnecting means is located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a building or structure, the disconnecting means shall meet the requirements of 225.36.

The disconnecting means on an outdoor generator set can be used as the disconnecting means required in 225.31, provided the disconnecting means is readily accessible and is within sight of the building. When an additional disconnecting means is necessary, it must be suitable for use as service equipment in accordance with 225.36. See the definitions of the terms *readily accessible* and *in sight from* in Article 100.

(C) Uninterruptible Power Supplies. Uninterruptible power supplies used to provide power for legally required standby systems shall comply with the applicable provisions of 701.12(A) and (B).

(D) Separate Service. Where approved, a separate service shall be permitted as a legally required source of standby power. This service shall be in accordance with the applicable provisions of Article 230, with a separate service drop or lateral or a separate set of overhead or underground service conductors sufficiently remote electrically and physically from any other service to minimize the possibility of simultaneous interruption of supply from an occurrence in another service.

(E) Connection Ahead of Service Disconnecting Means. Where acceptable to the authority having jurisdiction, connections located ahead of and not within the same cabinet, enclosure, vertical switchgear section, or vertical switchboard section as the service disconnecting means shall be permitted.

The legally required standby service shall be sufficiently separated from the normal main service disconnecting means to minimize simultaneous interruption of supply through an occurrence within the building or groups of buildings served.

Informational Note: See 230.82 for equipment permitted on the supply side of a service disconnecting means.

Where a legally required standby system is supplied by conductors tapped to the normal service conductors (connection required to be on line side of the normal service disconnecting means), 230.82 requires that the tapped conductors be installed in accordance with all of the requirements for service-entrance conductors and that the conductors terminate in equipment suitable for use as service equipment. These requirements help ensure that the legally required standby system disconnecting means can safely interrupt the fault current available from the utility and that the tapped conductors, which do not have short-circuit and ground-fault protection, are not run through the interior of a building.

(F) Fuel Cell System. Fuel cell systems used as a source of power for legally required standby systems shall be of suitable rating and capacity to supply and maintain the total load for not less than 2 hours of full-demand operation.

Installation of a fuel cell system shall meet the requirements of Parts II through VIII of Article 692.

Where a single fuel cell system serves as the normal supply for the building or group of buildings concerned, it shall not serve as the sole source of power for the legally required standby system.

(G) Unit Equipment. Individual unit equipment for legally required standby illumination shall consist of the following:

- (1) A rechargeable battery
- (2) A battery charging means
- (3) Provisions for one or more lamps mounted on the equipment and shall be permitted to have terminals for remote lamps
- (4) A relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment

The batteries shall be of suitable rating and capacity to supply and maintain at not less than 87½ percent of the nominal battery voltage for the total lamp load associated with the unit for a period of at least 1½ hours, or the unit equipment shall supply and maintain not less than 60 percent of the initial legally required standby illumination for a period of at least 1½ hours. Storage batteries, whether of the acid or alkali type, shall be designed and constructed to meet the requirements of emergency service.

Unit equipment shall be permanently fixed in place (i.e., not portable) and shall have all wiring to each unit installed in accordance with the requirements of any of the wiring methods in Chapter 3. Flexible cord-and-plug connection shall be permitted, provided that the cord does not exceed 900 mm (3 ft) in length. The branch circuit feeding the unit equipment shall be the same

branch circuit as that serving the normal lighting in the area and connected ahead of any local switches. Legally required standby luminaires that obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment by one of the wiring methods of Chapter 3.

Exception: In a separate and uninterrupted area supplied by a minimum of three normal lighting circuits, a separate branch circuit for unit equipment shall be permitted if it originates from the same panelboard as that of the normal lighting circuits and is provided with a lock-on feature.

IV. Overcurrent Protection

701.25 Accessibility

The branch-circuit overcurrent devices in legally required standby circuits shall be accessible to authorized persons only.

701.26 Ground-Fault Protection of Equipment

The alternate source for legally required standby systems shall not be required to have ground-fault protection of equipment with automatic disconnecting means. Ground-fault indication of the legally required standby source shall be provided in accordance with 701.6(D) if ground-fault protection of equipment with automatic disconnecting means is not provided.

701.27 Selective Coordination

Legally required standby system(s) overcurrent devices shall be selectively coordinated with all supply-side overcurrent protective devices.

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.

See the commentary regarding selective coordination for emergency systems following 700.28.



ARTICLE 702 Optional Standby Systems

I. General

702.1 Scope

The provisions of this article apply to the installation and operation of optional standby systems.


705.1

Article 705 • Interconnected Electric Power Production Sources

disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. Where the generator supply conductors terminate at a disconnecting means in or on a building or structure, the disconnecting means shall meet the requirements of 225.36.

The disconnecting means on an outdoor generator set can be used as the disconnecting means required in 225.31, provided the disconnecting means is readily accessible and is within sight of the building. When an additional disconnecting means is necessary, it must be suitable for use as service equipment in accordance with 225.36.

(B) Portable Generators 15 kW or Less. Where a portable generator, rated 15 kW or less, is installed using a flanged inlet or other cord- and plug-type connection, a disconnecting means shall not be required where ungrounded conductors serve or pass through a building or structure.



**ARTICLE 705
Interconnected Electric Power
Production Sources**

I. General

705.1 Scope

This article covers installation of one or more electric power production sources operating in parallel with a primary source(s) of electricity.

Informational Note: Examples of the types of primary sources include a utility supply or an on-site electric power source(s).

Article 705 sets forth basic safety requirements for interconnecting generators and other types of power production sources that operate in parallel as distributed generation. Power sources include any systems that produce electric power, including electric utility sources and on-premises sources ranging from rotating generators (see Article 445) to solar photovoltaic systems (see Article 690) to fuel cells (see Article 692) to wind power systems (see Article 694).

Article 705 addresses the basic safety requirements specifically related to parallel operation for the generators and other power sources, the power system that interconnects the power sources, and the equipment connected to these systems.

705.2 Definitions

Multimode Inverter. Equipment having the capabilities of both the utility-interactive inverter and the stand-alone inverter.

Power Production Equipment. The generating source, and all distribution equipment associated with it, that generates electricity from a source other than a utility supplied service.

Informational Note: Examples of power production equipment include such items as generators, solar photovoltaic systems, and fuel cell systems.

The power production equipment covered by this definition does not include the utility-supplied service.

Utility-Interactive Inverter Output Circuit. The conductors between the utility interactive inverter and the service equipment or another electric power production source, such as a utility, for electrical production and distribution network.

705.3 Other Articles

Interconnected electric power production sources shall comply with this article and also with the applicable requirements of the articles in Table 705.3.

705.4 Equipment Approval

All equipment shall be approved for the intended use. Utility-interactive inverters for interconnection systems shall be listed and identified for interconnection service.

705.6 System Installation

Installation of one or more electrical power production sources operating in parallel with a primary source(s) of electricity shall be installed only by qualified persons.

Interconnected power production sources introduce hazards unique to systems operating in parallel. A qualified person must have the skills and knowledge to recognize the hazards associated with these systems. Special training for persons working on interconnected systems is key to ensuring that personnel can work safely on these systems.

Informational Note: See Article 100 for the definition of *Qualified Person*.

TABLE 705.3 Other Articles

Equipment/System	Article
Generators	445
Solar photovoltaic systems	690
Fuel cell systems	692
Wind electric systems	694
Emergency systems	700
Legally required standby systems	701
Optional standby systems	702

Transfer equipment shall be required for all standby systems subject to the provisions of this article and for which an electric utility supply is either the normal or standby source.

Parallel operation of the generation equipment with the normal source is permitted as long as the requirements of Article 705 are met. Traditional automatic transfer switches (ATS) are not designed to permit parallel operation of generation equipment and the normal source. Therefore, traditional ATS need not comply with Article 705. However, certain ATS configurations are intentionally designed to briefly (for a few cycles) parallel the generation equipment with the normal source upon load transfer from generator to normal source. This load transfer can occur with minimal disturbance or effect on the load. Transfer switches that employ this type of paralleling must comply with Article 705.

Exception: Temporary connection of a portable generator without transfer equipment shall be permitted where conditions of maintenance and supervision ensure that only qualified persons service the installation and where the normal supply is physically isolated by a lockable disconnecting means or by disconnection of the normal supply conductors.

The exception provides requirements for the connection of loads to a generator without the use of a transfer switch. Such applications often occur when necessary for equipment maintenance or when an extended power outage occurs. In such instances, a portable generator can be brought to a facility and connected to the existing distribution system. Supervision by qualified personnel is critical to ensuring that a dangerous backfeed condition is not created by connecting the generator to the system without the benefit of transfer equipment.

702.6 Signals

Audible and visual signal devices shall be provided, where practicable, for the following purposes:

- (1) **Derangement.** To indicate derangement of the optional standby source.
- (2) **Carrying Load.** To indicate that the optional standby source is carrying load.

Exception: Signals shall not be required for portable standby power sources.

702.7 Signs

(A) **Standby.** A sign shall be placed at the service-entrance equipment that indicates the type and location of on-site optional standby power sources. A sign shall not be required for individual unit equipment for standby illumination.

(B) **Grounding.** Where removal of a grounding or bonding connection in normal power source equipment interrupts the grounding electrode conductor connection to the alternate power

source(s) grounded conductor, a warning sign shall be installed at the normal power source equipment stating:

WARNING

SHOCK HAZARD EXISTS IF GROUNDING ELECTRODE CONDUCTOR OR BONDING JUMPER CONNECTION IN THIS EQUIPMENT IS REMOVED WHILE ALTERNATE SOURCE(S) IS ENERGIZED.

The warning sign(s) or label(s) shall comply with 110.21(B).

See the commentary following 700.7(B). Removal of grounding and bonding connections presents the same hazard in the normal supply equipment for optional standby systems as in the normal supply equipment for an emergency system.

(C) **Power Inlet.** Where a power inlet is used for a temporary connection to a portable generator, a warning sign shall be placed near the inlet to indicate the type of derived system that the system is capable of based on the wiring of the transfer equipment. The sign shall display one of the following warnings:

WARNING:

FOR CONNECTION OF A SEPARATELY DERIVED (BONDED NEUTRAL) SYSTEM ONLY

or

WARNING:

FOR CONNECTION OF A NONSEPARATELY DERIVED (FLOATING NEUTRAL) SYSTEM ONLY

II. Wiring

702.10 Wiring Optional Standby Systems

The optional standby system wiring shall be permitted to occupy the same raceways, cables, boxes, and cabinets with other general wiring.

702.11 Portable Generator Grounding

(A) **Separately Derived System.** Where a portable optional standby source is used as a separately derived system, it shall be grounded to a grounding electrode in accordance with 250.30.

(B) **Nonseparately Derived System.** Where a portable optional standby source is used as a nonseparately derived system, the equipment grounding conductor shall be bonded to the system grounding electrode.

702.12 Outdoor Generator Sets

(A) **Permanently Installed Generators and Portable Generators Greater Than 15 kW.** Where an outdoor housed generator set is equipped with a readily accessible disconnecting means in accordance with 445.18, and the disconnecting means is located within sight of the building or structure supplied, an additional



EXHIBIT 702.1 A trailer (vehicle)-mounted portable generator. (Courtesy of the International Association of Electrical Inspectors)

The systems covered by this article consist of those that are permanently installed in their entirety, including prime movers, and those that are arranged for a connection to a premises wiring system from a portable alternate power supply.

Article 702 applies not only to permanently installed generators and prime movers but also to portable alternate power supplies that can be connected to an optional standby system. For example, upon failure of an optional standby generator at a frozen food processing plant, a vehicle-mounted generator can be brought in and connected to the plant's optional standby system, which has provisions for such a connection. Events such as carnivals and fairs require the use of portable generators. See **Exhibit 702.1**.

Optional standby systems are those that upon failing can cause physical discomfort, interruption of an industrial process, damage to process equipment, or disruption of business, whereas emergency systems (see **Article 700**) are those systems essential for safety to life and legally required standby systems (see **Article 701**) are intended to provide electric power to aid fire fighting, rescue operations, control of health hazards, and similar operations.

The installation of optional standby systems at one-family dwelling units has increased in recent years. Spikes in the increased use of these systems can be directly related to natural disasters, resulting in prolonged outages of utility power.

702.2 Definition

Optional Standby Systems. Those systems intended to supply power to public or private facilities or property where life safety does not depend on the performance of the system. These systems are intended to supply on-site generated power to selected loads either automatically or manually.

Informational Note: Optional standby systems are typically installed to provide an alternate source of electric power for such facilities as industrial and commercial buildings, farms, and residences and to serve loads such as heating and refrigeration systems, data processing and communications systems, and industrial processes that, when stopped during any power outage, could cause discomfort, serious interruption of the process, damage to the product or process, or the like.

702.4 Capacity and Rating

(A) Available Short-Circuit Current. Optional standby system equipment shall be suitable for the maximum available short-circuit current at its terminals.

(B) System Capacity. The calculations of load on the standby source shall be made in accordance with **Article 220** or by another approved method.

(1) Manual Transfer Equipment. Where manual transfer equipment is used, an optional standby system shall have adequate capacity and rating for the supply of all equipment intended to be operated at one time. The user of the optional standby system shall be permitted to select the load connected to the system.

(2) Automatic Transfer Equipment. Where automatic transfer equipment is used, an optional standby system shall comply with (2)(a) or (2)(b).

(a) Full Load. The standby source shall be capable of supplying the full load that is transferred by the automatic transfer equipment.

(b) Load Management. Where a system is employed that will automatically manage the connected load, the standby source shall have a capacity sufficient to supply the maximum load that will be connected by the load management system.

The standby source must have the capacity to supply all of the loads connected to it, unless an automatic load management system is used to ensure that the transferred load does not overload the source. This requirement applies only to systems where the switching between power sources occurs automatically.

702.5 Transfer Equipment

Transfer equipment shall be suitable for the intended use and designed and installed so as to prevent the inadvertent interconnection of normal and alternate sources of supply in any operation of the transfer equipment. Transfer equipment and electric power production systems installed to permit operation in parallel with the normal source shall meet the requirements of **Article 705**.

Transfer equipment, located on the load side of branch circuit protection, shall be permitted to contain supplemental overcurrent protection having an interrupting rating sufficient for the available fault current that the generator can deliver. The supplementary overcurrent protection devices shall be part of a listed transfer equipment.

**Item 1c: New Fire Uniform Generator
Provisions F-124**

BOARD JOINT MEETING FIRE AND ELECTRICAL COMMITTEE MEETING

PROPOSED NEW GENERATOR CODE

For inclusion in the Broward Local Fire Code

Definitions:

K. AHCA: Agency for Health Care Administration

L. APD: Agency for Persons with Disabilities.

M. 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.

N. Residential Board and Care Occupancy: An occupancy used for lodging and boarding of residents, not related by blood or marriage to the owners or operators, for the purpose of providing personal care services.

O. Legally Required Standby Generator: Those systems required and so classed as legally required standby secondary power sources by municipal, state, federal, or other codes or by any governmental agency having jurisdiction. These systems are intended to automatically supply power to selected loads (other than those classed as emergency systems) in the event of failure of the normal source.

P. Emergency Generators Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction. Those systems are intended to automatically supply illumination, power, or both, to designated areas and equipment in the event of failure of the normal supply or in the event of accident to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life.

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

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

S. Permit: A document issued by the AHJ for the purpose of authorizing performance of a specified activity.

T. Plans: Where required by the AHJ for new construction, modification, or rehabilitation, construction documents and shop drawings shall be submitted, reviewed and approved prior to the start of such work.

U. Qualified Person: One who has skills and knowledge related to the operation, maintenance, repair, and testing of the EPSS equipment and installations and has received safety training to recognize and avoid the hazards involved.

F-124 Uniform Generator Code

F-124.1 Scope The purpose of this document is to provide uniform procedures for the AHJs' in Broward County as it pertains to secondary power sources. Any Board and Care occupancy as defined by the provisions of this code that is required to receive an inspection from an AHJ as per Florida State Statute or the Florida Administrative Code, shall comply with the provisions of this code.

F-124.2 Referenced Publications:

NFPA 1, Fire Code

NFPA 30, Flammable and Combustible Liquids Code

NFPA 37, Standard for the Installation of and Use of Stationary Combustion Engines and Gas Turbines

NFPA 54, National Fuel Gas Code

NFPA 58, Liquefied Petroleum Gas Code

NFPA 70, National Electrical Code

NFPA 72, National Fire Alarm and Signaling Code

NFPA 110, Standard for Emergency and Standby Power Systems

NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems

NFPA 720, Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment

Florida Administrative Code 58A-5.036 for Assisted Living Facilities

Florida Administrative Code 59A-4.1265 for Nursing Homes

Florida Building Code

F-124.3 General:

F-124.3.1 Existing approved, non-conforming installations shall become compliant with this code as approved by the AHJ.

F-124.3.2 All facilities shall store a minimum of seventy-two (72) hours of fuel onsite and be able to show proof (such as a fuel service contract) of a reliable method to obtain the additional twenty-four (24) hours of fuel within forty-eight (48) hours of a declared State of Emergency.

F-124.3.3 If local ordinances or other regulations limit the amount of onsite fuel storage at the location of the facility, then the owner/operator shall develop a plan that includes maximum onsite fuel storage allowable by the ordinance or regulation and a reliable method to obtain the maximum additional fuel at least 24 hours prior to the depletion of the onsite fuel.

F-124.3.4 Storage of any fuels shall be compliant with the applicable National Fire Protection Association's (NFPA) codes and standards.

F-124.4 Minimum Permit Submittal Requirements:

F-124.3.5 Other fuel sources shall be permitted in conformance with the NFPA 54 and 58 as currently adopted.

F-124.4.1 The following is a list of the minimum required information that shall be submitted to the AHJ for review:

- A) Plans shall be submitted for permitting, with details and manufacturer specifications that demonstrate compliance with all applicable NFPA codes and standards. The submittal shall be made by a qualified and licensed contractor.
- B) All generators shall be NFPA 110 compliant.
- C) Plans shall clearly identify the class, type, and level of the generator.
- D) A site plan shall be provided indicating the location of the emergency generator in relation to the building openings as well as adjacent building openings, exit discharges, the fuel source type, and the automatic transfer switch.
- E) The location of the manual emergency shut off shall be clearly identified on the plans. The emergency shut off shall be readily accessible at all times, identified with permanent weatherproof signage, shall be readily visible to emergency responders, and the location shall be approved by the AHJ.
- F) Plans shall demonstrate that the fuel supply can accommodate the specific EPS class and time duration identified on the plans.
- G) Physical protection of the fuel source and generator when located in areas subject to vehicular traffic shall be clearly identified.
- H) A remote generator annunciator shall be installed at a continuously attended location and indicated on the plans, approved by the AHJ.
- I) A signed generator maintenance contract shall be submitted, maintained, and made available to the AHJ upon request.
- J) Carbon monoxide protection shall be installed in accordance with NFPA 720. Carbon Monoxide alarms shall be installed outside of each separate dwelling unit, sleeping area in the immediate vicinity of the bedrooms, on every occupiable level, and other locations where required by applicable laws, codes, or standards. The location(s) of Carbon Monoxide Alarms shall be indicated on the plans.

F-124.5 Inspection and Testing

- A) Emergency Power Supply Systems' (EPSS), including all appurtenant components, shall be inspected weekly and exercised under load at least monthly.
- B) The facility owner shall ensure that the EPSS is properly maintained and serviced not less than annually by a qualified person or contractor in accordance with the manufacturer's specifications.

F-124.6 Records Retention

- A) Each facility shall provide a binder which contains a log of weekly inspections and monthly load exercise.
- B) The binder shall also include a copy of the annual service agreement as well as the most current annual service report.
- C) This binder shall be made readily accessible to the AHJ upon request.

Reference: NFPA 110, 2013

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NFPA 110
Standard for
Emergency and Standby Power Systems

2013 Edition

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

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

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

Chapter 1 Administration

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

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

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

1.1.3 This standard does not cover the following:

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

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

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

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

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

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

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

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

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

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

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

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

Chapter 2 Referenced Publications

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

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

NFPA 30, *Flammable and Combustible Liquids Code*, 2012 edition.

NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, 2010 edition.

NFPA 54, *National Fuel Gas Code*, 2012 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2011 edition.

NFPA 70®, *National Electrical Code®*, 2011 edition.

NFPA 72®, *National Fire Alarm and Signaling Code*, 2013 edition.

NFPA 99, *Health Care Facilities Code*, 2012 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2011 edition.

2.3 Other Publications.

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

ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*, 2010.

2.3.2 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

(Reserved)

Chapter 3 Definitions

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

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

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

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

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

3.2.5 Shall. Indicates a mandatory requirement.

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

3.2.7 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the *Manual of Style for NFPA Technical Committee Documents*.

3.3 General Definitions.

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

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

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

3.3.4* Emergency Power Supply System (EPSS). A complete functioning EPS system coupled to a system of conductors, disconnecting means and overcurrent protective devices, transfer switches, and all control, supervisory, and support devices up to and including the load terminals of the transfer

equipment needed for the system to operate as a safe and reliable source of electric power.

3.3.5 Fuel Tank.

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

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

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

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

3.3.6 Lamp. An illuminating indicator.

3.3.7 Lead-Acid Battery.

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

3.3.7.2 Vented (Flooded). A lead-acid battery consisting of cells that have electrodes immersed in liquid electrolyte. Flooded lead-acid batteries may have a provision for the user to add water to the cell and are equipped with a flame-arresting vent which permits the escape of hydrogen and oxygen gas from the cell in a diffused manner such that a spark, or other ignition source, outside the cell will not ignite the gases inside the cell.

3.3.8 Occupancy Category. See ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*.

3.3.9 Qualified Person. One who has skills and knowledge related to the operation, maintenance, repair, and testing of the EPSS equipment and installations and has received safety training to recognize and avoid the hazards involved.

3.3.10 Switch.

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

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

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

Chapter 4 Classification of Emergency Power Supply Systems (EPSSS)

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

Table 4.1(a) Classification of EPSSs

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

Table 4.1(b) Types of EPSSs

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

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

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

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

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

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

4.4.3 All equipment shall be permanently installed.

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

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

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

5.1 Energy Sources.

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

- (1)*Liquid petroleum products at atmospheric pressure as specified in the appropriate ASTM standards and as recommended by the engine manufacturer

- (2)*Liquefied petroleum gas (liquid or vapor withdrawal) as specified in the appropriate ASTM standards and as recommended by the engine manufacturer

- (3)*Natural or synthetic gas

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

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

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

5.2 Energy Converters — General.

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

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

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

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

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

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

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

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

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

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

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

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

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

5.3 Energy Converters — Temperature Maintenance.

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

5.3.2 All prime mover heaters shall be automatically deactivated while the prime mover is running. (*For combustion turbines, see 5.3.5.*)

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

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

5.3.4 Ether-type starting aids shall not be permitted.

5.3.5 The ambient air temperature in the EPS equipment room or outdoor housing containing Level I rotating equipment shall be not less than 4.5°C (40°F).

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

5.5 Energy Converters — Fuel Supply.

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

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

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

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

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

5.6 Rotating Equipment.

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

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

5.6.3 Prime Mover Accessories.

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

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

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

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

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

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

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

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

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

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

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

5.6.3.6 The generator set shall be fitted with an integral accessory battery charger, driven by the prime mover and automatic voltage regulator, and capable of charging and maintaining the

starting battery unit (and control battery, where used) in a fully charged condition during a running condition.

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

5.6.4 Prime Mover Starting Equipment.

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

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

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

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

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

Table 5.6.4.2 Starting Equipment Requirements

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5.6.5 Control Functions.

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

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

5.6.5.2 Where a control panel is mounted on the energy converter, it shall be mounted by means of antivibration shock mounts, if required, to maximize reliability. An automatic control and safety panel shall be a part of the EPS containing the following equipment or possess the following characteristics, or both:

- (1) Cranking control equipment to provide the complete cranking cycle described in 5.6.4.2 and required by Table 5.6.4.2
- (2) Panel-mounted control switch(es) marked "run-off-automatic" to perform the following functions:
 - (a) Run: Manually initiate, start, and run prime mover
 - (b) Off: Stop prime mover or reset safeties, or both
 - (c) Automatic: Allow prime mover to start by closing a remote contact and stop by opening the remote contact
- (3) Controls to shut down and lock out the prime mover under any of the following conditions:
 - (a) Failing to start after specified cranking time
 - (b) Overspeed
 - (c) Low lubricating-oil pressure
 - (d) High engine temperature (An automatic engine shutdown device for high lubricating-oil temperature shall not be required.)
 - (e) Operation of remote manual stop station
- (4) Individual alarm indication to annunciate any of the conditions listed in Table 5.6.5.2 and with the following characteristics:
 - (a) Battery powered
 - (b) Visually indicated
 - (c) Have additional contacts or circuits for a common audible alarm that signals locally and remotely when any of the itemized conditions occurs
 - (d) Have a lamp test switch(es) to test the operation of all alarm lamps
- (5) Controls to shut down the prime mover upon removal of the initiating signal or manual emergency shutdown
- (6) The ac instruments listed in 5.6.9.9

5.6.5.3 Engines equipped with a maintaining shutdown device (air shutdown damper) shall have a set of contacts that monitor the position of this device, with local alarm indication and remote annunciation in accordance with Table 5.6.5.2.

5.6.5.4 The control panel in 5.6.5.2(4) shall be specifically approved for either a Level 1 or a Level 2 EPS consistent with the installation.

5.6.5.5 The cranking cycle shall be capable of being initiated by any of the following:

- (1) Manual start initiation as specified in 5.6.5.2(2)(a).
- (2) Loss of normal power at any automatic transfer switch (ATS) considered a part of the EPSS. Prime mover shall start upon closing of a remote switch or contacts and shall stop, after appropriate time delays, when switch or contacts are opened.
- (3) Clock exerciser located in an ATS or in the control panel.
- (4) Manually operated (test) switch located in each ATS that simulates a loss of power and causes automatic starting

and operation until this switch is reset, to cause the engine circuit to duplicate its functions in the same manner commercial power is restored after a true commercial power failure.

5.6.5.6* All installations shall have a remote manual stop station of a type to prevent inadvertent or unintentional operation located outside the room housing the prime mover, where so installed, or elsewhere on the premises where the prime mover is located outside the building.

5.6.5.6.1 The remote manual stop station shall be labeled.

5.6.6* Remote Controls and Alarms. A remote, common audible alarm shall be provided as specified in 5.6.5.2(4).

5.6.6.1 Alarms and annunciation shall be powered by the prime mover starting battery unless operational constraints make this impracticable. In that circumstance an alternate source from the EPS, such as a storage battery, UPS, or branch circuit supplied by the EPSS, shall be permitted.

5.6.6.2 The following annunciation shall be provided at a minimum:

- (1) For Level 1 EPS, local annunciation and facility remote annunciation, or local annunciation and network remote annunciation
- (2) For Level 2 EPS, local annunciation

5.6.6.3 For the purposes of defining the types of annunciation in 5.6.6.2, 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.

5.6.6.4 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.

5.6.6.5 In lieu of the requirement in 5.6.6.4, 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.

5.6.7 Prime Mover Cooling Systems. Cooling systems for prime movers shall be either forced-air or natural convection, liquid-cooled, or a combination thereof.

5.6.7.1 Forced-air-cooled diesel or otto cycle engines shall have an integral fan selected to cool the prime mover under full load conditions.

5.6.7.2 Liquid-cooled prime movers for Level 1 applications shall be arranged for closed-loop cooling and consist of one of the following types:

- (1) Unit-mounted radiator and fan
- (2) Remote radiator
- (3) Heat exchanger (liquid-to-liquid)

5.6.7.3 Cooling systems shall prevent overheating of prime movers under conditions of highest anticipated ambient temperature at the installed elevation (above sea level) when fully loaded.

Table 5.6.5.2 Safety Indications and Shutdowns

Indicator Function (at Battery Voltage)	Level 1			Level 2		
	CV	S	RA	CV	S	RA
(a) Overcrank	X	X	X	X	X	O
(b) Low water temperature	X	NA	X	X	NA	O
(c) High engine temperature pre-alarm	X	NA	X	O	NA	NA
(d) High engine temperature	X	X	X	X	X	O
(e) Low lube oil pressure	X	X	X	X	X	O
(f) Overspeed	X	X	X	X	X	O
(g) Low fuel main tank	X	NA	X	O	NA	O
(h) Low coolant level	X	O	X	X	O	X
(i) EPS supplying load	X	NA	NA	O	NA	NA
(j) Control switch not in automatic position	X	NA	X	X	NA	X
(k) High battery voltage	X	NA	NA	O	NA	NA
(l) Low cranking voltage	X	NA	X	O	NA	O
(m) Low voltage in battery	X	NA	NA	O	NA	NA
(n) Battery charger ac failure	X	NA	NA	O	NA	NA
(o) Lamp test	X	NA	NA	X	NA	NA
(p) Contacts for local and remote common alarm	X	NA	X	X	NA	X
(q) Audible alarm silencing switch	NA	NA	X	NA	NA	O
(r) Low starting air pressure	X	NA	NA	O	NA	NA
(s) Low starting hydraulic pressure	X	NA	NA	O	NA	NA
(t) Air shutdown damper when used	X	X	X	X	X	O
(u) Remote emergency stop	NA	X	NA	NA	X	NA

CV: Control panel-mounted visual. S: Shutdown of EPS indication. RA: Remote audible. X: Required. O: Optional. NA: Not applicable.

Notes:

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

5.6.7.4* Power for fans and pumps on remote radiators and heat exchangers shall be supplied from a tap at the EPS output terminals or ahead of the first load circuit overcurrent protective device.

5.6.7.5 The secondary side of heat exchangers shall be a closed-loop cycle, that is, one that recycles the cooling agent.

5.6.7.6 The installed EPS cooling system shall be designed to cool the prime mover at full-rated load while operating in the particular installation circumstances of each EPS.

5.6.7.7 A full-load on-site test shall not result in activation of high-temperature pre-alarm or high-temperature shutdown.

5.6.7.8 For EPSS cooling systems requiring intermittent or continuous waterflow or pressure, or both, a utility, city, or other water supply service shall not be used.

5.6.7.9 The EPSS cooling system shall be permitted to use utility or city water for filling or makeup water.

5.6.7.10 Design of the EPS cooling system shall consider the following factors:

- (1) Remote radiator or heat exchanger sizing
- (2) Pipe sizing
- (3) Pump sizing
- (4) Sufficient shutoffs to isolate equipment to facilitate maintenance
- (5) The need for and sizing of de-aeration and surge tanks
- (6) Drain valves for cleaning and flushing the cooling system
- (7) Type of flexible hoses between the prime mover and the cooling system piping

5.6.8 Prime Mover Exhaust Piping. Where applicable, the exhaust system shall include a muffler or silencer sized for the unit and a flexible exhaust section.

5.6.9 Generators, Exciters, and Voltage Regulators. Generators shall comply with Article 445 of *NFPA 70, National Electrical Code*, and with the requirements of 5.6.9.1 through 5.6.9.9.

5.6.9.1* The generator shall be of dripproof construction and have amortisseur windings.

5.6.9.2 The generator shall be suitable for the environmental conditions at the installation location.

5.6.9.3 The generator systems shall be factory tested as a unit to ensure operational integrity of all of the following:

- (1) Generator
- (2) Exciter
- (3) Voltage regulator

5.6.9.4 EPS voltage output, or the output of the transformer immediately down-line from the EPS, at full load shall match the nominal voltage of the normal source at the transfer switch(es).

5.6.9.5 Exciters, where furnished, shall be of either the rotating type or the static type.

5.6.9.6 Voltage regulators shall be capable of responding to load changes to meet the system stability requirements of 5.6.9.8.

5.6.9.7 If the system stability requirements of 5.6.9.8 cannot be accomplished, anti-hunt provisions shall be included.

5.6.9.8 Generator system performance (i.e., prime mover, generator, exciter, and voltage regulator, as applicable when prototype tested as specified in 5.2.1.2) shall be as follows:

- (1) Stable voltage and frequency at all loads shall be provided to full-rated loads.
- (2) Values consistent with the user's needs for frequency droop and voltage droop shall be maintained.
- (3) Voltage dip at the generator terminals for the maximum anticipated load change shall not cause disruption or relay dropout in the load.
- (4) Frequency dip and restoration to steady state for any sudden load change shall not exceed the user's specified need.

5.6.9.9 The generator instrument panel for Level 1 applications shall contain the following:

- (1) An ac voltmeter(s) for each phase or a phase selector switch
- (2) An ac ammeter(s) for each phase or a phase selector switch
- (3) A frequency meter
- (4) A voltage-adjusting rheostat to allow ± 5 percent voltage adjustment

5.6.10 Miscellaneous Requirements.

5.6.10.1 Where applicable, the prime mover and generator shall be factory mounted on a common base, rigid enough to maintain the dynamic alignment of the rotating element of the system prior to shipment to the installation site.

5.6.10.2 A certification shall be supplied with the unit that verifies the torsional vibration compatibility of the rotating element of the prime mover and generator for the intended use of the energy converter.

5.6.10.3* Vibration isolators shall be furnished where necessary to minimize vibration transmission to the permanent structure.

5.6.10.4 The manufacturer of the EPS shall submit complete schematic, wiring, and interconnection diagrams showing all ter-

minal and destination markings for all EPS equipment, as well as the functional relationship between all electrical components.

5.6.10.5 The energy converter supplier shall stipulate compliance and performance with this standard for the entire unit when installed.

5.6.10.6 Where requested, the short circuit current capability at the generator output terminals shall be furnished.

Chapter 6 Transfer Switch Equipment

6.1 General.

6.1.1* Switches shall transfer electric loads from one power source to another.

6.1.2* The electrical rating shall be sized for the total load that is designed to be connected.

6.1.3 Each switch shall be in a separate enclosure or compartment.

6.1.4 The switch, including all load current-carrying components, shall be listed for all load types to be served.

6.1.5 The switch, including all load current-carrying components, shall be designed to withstand the effects of available fault currents.

6.1.6* Where available, each switch shall be listed for emergency service as a completely factory-assembled and factory-tested apparatus. Medium voltage transfer of central plant or mechanical equipment not including life safety, emergency, or critical branch loads shall be permitted to be transferred by electrically interlocked medium voltage circuit breakers.

6.2 ATS Features.

6.2.1* General. Automatic transfer switches shall be capable of all of the following:

- (1) Electrical operation and mechanical holding
- (2) Transfer and retransfer of the load automatically
- (3) Visual annunciation when "not-in-automatic"

6.2.2 Source Monitoring.

6.2.2.1* Undervoltage-sensing devices shall be provided to monitor all ungrounded lines of the primary source of power 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 EPS.
- (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 primary power shall be initiated.

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

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

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

6.2.2.3.2 Frequency-sensing equipment shall not be required for monitoring the public utility source where used as an EPS, as permitted by 5.1.3.

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

6.2.4* Manual Operation. Instruction and equipment shall be provided for safe manual nonelectric transfer in the event the transfer switch malfunctions.

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

6.2.6 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.

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

6.2.7.1 Time Delay Commencement. The time delay shall commence when proper EPS voltage and frequency are achieved.

6.2.7.2 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.

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

6.2.9 Time Delay Bypass If EPS Fails. The time delay shall be automatically bypassed if the EPS fails.

6.2.9.1 The transfer switch shall be permitted to be programmed for a manually initiated retransfer to the primary source to provide for a planned momentary interruption of the load.

6.2.9.2 If used, the arrangement in 6.2.9.1 shall be provided with a bypass feature to allow automatic retransfer in the event that the EPS fails and the primary source is available.

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

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

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

6.2.11 Engine Generator Exercising Timer. A program timing device shall be provided to exercise the EPS as described in Chapter 8.

6.2.11.1 Transfer switches shall transfer the connected load to the EPS and immediately return to primary power automatically in case of an EPS failure.

6.2.11.2 Exercising timers shall be permitted to be located at the engine control panel in lieu of in the transfer switches.

6.2.11.3 A program timing device shall not be required in health care facilities that provide scheduled testing in accordance with NFPA 99, *Health Care Facilities Code*.

6.2.12 Test Switch. A test means shall be provided on each ATS that simulates failure of the primary power source and then transfers the load to the EPS.

6.2.13* 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.

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

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

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

6.2.16.1 Interlocking. Reliable mechanical interlocking or an approved alternate method shall prevent the inadvertent interconnection of the primary power source and the EPS.

6.2.16.2 Indication of Transfer Switch Position. Two pilot lights with identification nameplates or other approved position indicators shall be provided to indicate the switch position.

6.3 Load Switching (Load Shedding). When two or more engine generator sets are paralleled for emergency power, the paralleled system shall be arranged to inhibit connection of EPS-damaging loads.

6.3.1 Each transfer switch shall have a continuous current rating and interrupting rating for all classes of loads to be served.

6.3.2 The transfer switch shall be capable of withstanding the available fault current at the point of installation.

6.3.3 The transfer of loads to the EPS shall be sequenced as follows:

- (1) First-priority loads shall be switched to the emergency bus upon sensing the availability of emergency power on the bus.
- (2) Each time an additional engine generator set is connected to the bus, a remaining load shall be connected in order of priority until all emergency loads are connected to the bus.
- (3) The system shall be designed so that, upon failure of one or more engine generator sets, the load is automatically reduced, starting with the load of least priority and proceeding in ascending priority, so that the last load affected is the highest-priority load.

6.4 Bypass-Isolation Switches.

6.4.1 Bypassing and Isolating Transfer Switches. Bypass-isolation switches shall be permitted for bypassing and isolating the transfer switch and shall be installed in accordance with 6.4.2, 6.4.3, and 6.4.4.

6.4.2 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.

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

6.4.4* 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.

6.4.5 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.

6.5 Protection.

6.5.1* General. The overcurrent protective devices in the EPSS shall be coordinated to optimize selective tripping of the circuit overcurrent protective devices when a short circuit occurs.

6.5.2 Short Circuit Current. The maximum available short circuit current from both the utility source and the emergency energy source shall be evaluated for the ability to satisfy this coordination capability.

6.5.3* Overcurrent Protective Device Rating. The overcurrent protective device shall have an interrupting rating equal to or greater than the maximum available short circuit current at its location.

6.5.4 Accessibility. Overcurrent devices in EPSS circuits shall be accessible to authorized persons only.

Chapter 7 Installation and Environmental Considerations

7.1 General.

7.1.1* This chapter shall establish minimum requirements and considerations relative to the installation and environmental conditions that have an effect on the performance of the EPSS equipment such as the following:

- (1) Geographic location
- (2) Building type
- (3) Classification of occupancy
- (4) Hazard of contents

7.1.2* Minimizing the probability of equipment or cable failure within the EPSS shall be a design consideration to reduce the disruption of loads served by the EPSS.

7.1.3 The EPSS equipment shall be installed as required to meet the user's needs and to be in accordance with all of the following:

- (1) This standard
- (2) The manufacturer's specifications
- (3) The authority having jurisdiction

7.1.4 EPSS equipment installed for the various levels of service defined in this standard shall be designed and assembled for such service.

7.1.5 When the normal power source is not available, the EPS shall be permitted to serve optional loads other than system loads, provided that the EPS has adequate capacity or auto-

matic selective load pickup and load shedding are provided as needed to ensure adequate power to (1) the Level 1 loads, (2) the Level 2 loads, and (3) the optional loads, in that order of priority. When normal power is available, the EPS shall be permitted to be used for other purposes such as peak load shaving, internal voltage control, load relief for the utility providing normal power, or cogeneration.

7.2 Location.

7.2.1 Indoor EPS Installations. The EPS shall be installed in a separate room for Level 1 installations.

7.2.1.1 The EPS room shall be separated from the rest of the building by construction with a 2-hour fire resistance rating.

7.2.1.2 EPSS equipment shall be permitted to be installed in the EPS room.

7.2.1.3 No other equipment, including architectural appurtenances, except those that serve this space, shall be permitted in the EPS room.

7.2.2 Outdoor EPS Installations.

7.2.2.1 The EPS 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.

7.2.2.2 EPSS equipment shall be permitted to be installed in the EPS enclosure.

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

7.2.3* Level 1 EPSS equipment shall not be installed in the same room with the normal service equipment, where the service equipment is rated over 150 volts to ground and equal to or greater than 1000 amperes.

7.2.4* The rooms, enclosures, or separate buildings housing Level 1 or Level 2 EPSS equipment shall be designed and located to minimize damage from flooding, including that caused by the following:

- (1) Flooding resulting from fire fighting
- (2) Sewer water backup
- (3) Other disasters or occurrences

7.2.5* Minimizing the possibility of damage resulting from interruptions of the emergency source shall be a design consideration for EPSS equipment.

7.2.6 The EPS 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.

7.2.7 Design considerations shall minimize the effect of the failure of one energy converter on the continued operation of other units.

7.3 Lighting.

7.3.1 The Level 1 or Level 2 EPS 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.

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

7.3.3* 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.

7.4 Mounting.

7.4.1 Rotating energy converters shall be installed on solid foundations to prohibit sagging of fuel, exhaust, or lubricating-oil piping and damage to parts resulting in leakage at joints.

7.4.1.1 Such foundations or structural bases shall raise the engine at least 150 mm (6 in.) above the floor or grade level and be of sufficient elevation to facilitate lubricating-oil drainage and ease of maintenance.

7.4.2 Foundations shall be of the size (mass) and type recommended by the energy converter manufacturer.

7.4.3 Where required to prevent transmission of vibration during operation, the foundation shall be isolated from the surrounding floor or other foundations, or both, in accordance with the manufacturer's recommendations and accepted structural engineering practices.

7.4.4 The EPS shall be mounted on a fabricated metal skid base of the type that shall resist damage during shipping and handling. After installation, the base shall maintain alignment of the unit during operation.

7.5* Vibration. Vibration isolators, as recommended by the manufacturer of the EPS, shall be installed either between the rotating equipment and its skid base or between the skid base and the foundation or inertia base.

7.6* Noise. Design shall include consideration of noise control regulations.

7.7 Heating, Cooling, and Ventilating.

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

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

7.7.2 Air shall be supplied to the EPS equipment for combustion.

7.7.2.1* For EPS 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.

7.7.2.2 For EPS 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.

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

7.7.3 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.

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

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

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

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

7.7.6 Units housed outdoors shall be heated as specified in 5.3.5.

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

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

7.8 Installed EPS Cooling System.

7.8.1 Makeup water hose bibs and floor drains, where required by other codes and standards, shall be installed in EPS equipment rooms.

7.8.2 Where duct connections are used between the prime mover radiator and air-out louvers, the ducts shall be connected to the prime movers by means of flexible sections.

7.9 Fuel System.

7.9.1 Fuel tanks shall be sized to accommodate the specific EPS class.

7.9.1.1 All fuel tanks and systems shall be installed and maintained in accordance with NFPA 30, *Flammable and Combustible Liquids Code*, NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, NFPA 54, *National Fuel Gas Code*, and NFPA 58, *Liquefied Petroleum Gas Code*.

7.9.1.2* Fuel system design shall provide for a supply of clean fuel to the prime mover.

7.9.1.3 Tanks shall be sized so that the fuel is consumed within the storage life, or provisions shall be made to remediate fuel that is stale or contaminated or to replace stale or contaminated fuel with clean fuel.

7.9.2 Fuel tanks shall be close enough to the prime mover for the fuel lift (suction head) of the prime mover fuel pump to meet the fuel system requirements, or a fuel transfer pump and day tank shall be provided.

7.9.2.1 If the engine manufacturer's fuel pump static head pressure limits are exceeded when the level of fuel in the tank is at a maximum, a day tank shall be utilized.

7.9.3 Fuel piping shall be of compatible metal to minimize electrolysis and shall be properly sized, with vent and fill pipes located to prevent entry of groundwater or rain into the tank.

7.9.3.1* Galvanized fuel lines shall not be used.

7.9.3.2 Approved flexible fuel lines shall be used between the prime mover and the fuel piping.

7.9.4 Day tanks on diesel systems shall be installed below the engine fuel return elevation.

7.9.4.1 The return line to the day tank shall be below the fuel return elevation.

7.9.4.2 Gravity fuel oil return lines between the day tank and the main supply tank shall be sized to handle the potential fuel flow and shall be free of traps so that fuel can flow freely to the main tank.

7.9.5 Integral tanks of the following capacities shall be permitted inside or on roofs of structures, or as approved by the authority having jurisdiction:

- (1) Maximum of 2498 L (660 gal) diesel fuel
- (2) Maximum of 95 L (25 gal) gasoline fuel

7.9.6* The fuel supply for gas-fueled and liquid-fueled prime movers shall be installed in accordance with applicable standards.

7.9.7* Where the gas supply is connected to the building gas supply system, it shall be connected on the supply side of the main gas shutoff valve and marked as supplying an emergency generator.

7.9.8 The building's main gas shutoff valve shall be marked or tagged to indicate the existence of the separate EPS shutoff valve.

7.9.9 The fuel supply for gas-fueled and liquid-fueled prime movers shall be designed to meet the demands of the prime mover for all of the following factors:

- (1) Sizing of fuel lines
- (2) Valves, including manual shutoff
- (3) Battery-powered fuel solenoids
- (4) Gas regulators
- (5) Regulator vent piping
- (6) Flexible fuel line section
- (7) Fuel line filters
- (8) Fuel vaporizers (LP-Gas)
- (9) Ambient temperature effect of fuel tank vaporization rates of LP-Gas where applicable

7.9.10 The fuel storage and supply lines for an EPSS shall be in accordance with this standard or with the specific authority having jurisdiction, or both.

7.9.11 All manual fuel system valves shall be of the indicating type.

7.9.12 Listed generator subbase secondary containment fuel tanks of 2498 L (660 gal) capacity and below shall be permitted to be installed outdoors or indoors without diking or remote impounding.

7.9.12.1 A minimum clearance of 0.9 m (36 in.) shall be maintained on all sides.

7.10 Exhaust System.

7.10.1 The exhaust system equipment and installation, including piping, muffler, and related accessories, shall be in accordance with NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, and other applicable standards.

7.10.2 Exhaust system installation shall be gastight to prevent exhaust gas fumes from entering inhabited rooms or buildings and terminate in such a manner that toxic fumes cannot reenter a building or structure, particularly through windows, air ventilation inlets, or the engine air-intake system.

7.10.3* Exhaust piping shall be connected to the prime mover by means of a flexible connector and shall be independently supported thereafter so that no damaging weight or stress is applied to the engine exhaust manifold or turbocharger.

7.10.3.1 A condensate trap and drain valve shall be provided at the low point(s) of the piping unless the piping is self-draining.

7.10.3.2 Design consideration shall be given to thermal expansion and the resultant movement of the piping.

7.10.3.3 For reciprocating engines, mufflers shall be placed as close as practicable to the engine, in a horizontal position if possible.

7.10.3.4 An approved thimble(s) shall be used where exhaust piping passes through combustible walls or partitions.

7.10.3.5 For reciprocating engines, the piping shall terminate in any of the following:

- (1) Rain cap
- (2) Tee
- (3) Ell, pointing downwind from the prevailing wind
- (4) Vertically upward-oriented stack with suitable provisions for trapping and draining rain and snow water

7.10.3.6 Design consideration shall be given to the potential heat effect due to proximity to all of the following:

- (1) Conduit runs
- (2) Fuel piping
- (3) Lighting fixtures

7.10.3.7 Design consideration shall be given to insulating the engine exhaust systems in buildings after the flexible section.

7.10.4 For maximum efficiency, operation economy, and prevention of engine damage, the exhaust system shall be designed to eliminate excessive backpressure on the engine by properly selecting, routing, and installing the piping size, connections, and muffler.

7.10.4.1 Exhaust systems shall be installed to ensure satisfactory EPS operation and meet the requirements of the manufacturer.

7.11 Protection.

7.11.1 The room in which the EPS equipment is located shall not be used for other purposes that are not directly related to the EPS. Parts, tools, and manuals for routine maintenance and repair shall be permitted to be stored in the EPS room.

7.11.2* Where fire suppression systems are installed in EPS equipment rooms or separate buildings, the following systems shall not be used:

- (1) Carbon dioxide or halon systems, unless prime mover combustion air is taken from outside the structure
- (2) An automatic dry chemical system, unless the manufacturers of the EPS certify that the dry chemical system cannot damage the EPS system, hinder its operation, or reduce its output

7.11.3 Where the EPS rooms or separate buildings are equipped with fire detection systems, the installation shall be in accordance with *NFPA 72, National Fire Alarm and Signaling Code*.

7.11.4 Where outdoor and/or rooftop Level 1 EPS installations are required to be protected from lightning, the lightning protection system(s) shall be installed in accordance with *NFPA 780, Standard for the Installation of Lightning Protection Systems*.

7.11.5* In recognized seismic risk areas, EPS and EPSS components, such as electrical distribution lines, water distribution lines, fuel distribution lines, and other components that serve the EPS, shall be designed to minimize damage from earthquakes and to facilitate repairs if an earthquake occurs.

7.11.6* For systems in seismic risk areas, the EPS, transfer switches, distribution panels, circuit breakers, and associated controls shall be capable of performing their intended function during and after being subjected to the anticipated seismic shock.

7.12 Distribution.

7.12.1 The distribution and wiring systems within EPSS shall be installed in accordance with *NFPA 70, National Electrical Code*.

7.12.2 When EPSSs are installed in health care facilities, the installation of the EPSS shall also be in compliance with *NFPA 99, Health Care Facilities Code*.

7.12.3 The wiring between the EPS output terminals and the first distribution overcurrent protective device terminals within the EPSS shall be located at a minimal distance to ensure system reliability and safety.

7.12.4 If the conduit's point of attachment to the EPS is on the forcing function side of the EPS vibration isolation system, a flexible conduit section(s) shall be installed between the EPS unit(s) and any of the following, so attached:

- (1) The transfer switch
- (2) The control and annunciator wiring
- (3) Any accessory supply wiring such as jacket water heaters

7.12.4.1 Stranded wire of adequate size shall be used to minimize breakage due to vibration.

7.12.4.2 Bushings shall be installed to protect wiring from abrasion with conduit terminations.

7.12.5 All ac-powered support and accessory equipment necessary to the operation of the EPS shall be supplied from the load side of the ATSS, or the output terminals of the EPS, ahead of the main EPS overcurrent protection to ensure continuity of the EPSS operation and performance.

7.12.6 The starting battery units shall be located next to the prime mover starter to minimize voltage drop.

7.12.6.1 Battery cables shall be sized to minimize voltage drop in accordance with the manufacturer's recommendations and accepted engineering practices.

7.12.6.2 Battery charger output wiring shall be permanently connected to the primary side of the starter solenoid (positive) and the EPS frame (negative), or other grounding location.

7.13 Installation Acceptance.

7.13.1 Upon completion of the installation of the EPSS, the EPSS shall be tested to ensure conformity to the requirements of the standard with respect to both power output and function.

7.13.2 An on-site acceptance test shall be conducted as a final approval test for all EPSSs.

7.13.2.1 For new Level 1 installations, the EPSS shall not be considered as meeting this standard until the acceptance tests have been conducted and test requirements met.

7.13.2.2 The test shall be conducted after completion of the installation with all EPSS accessory and support equipment in place and operating.

7.13.3 The authority having jurisdiction shall be given advance notification of the time at which the acceptance test is to be performed so that the authority can witness the test.

7.13.4 The EPSS shall perform within the limits specified in this standard.

7.13.4.1 The on-site installation acceptance test shall be conducted in accordance with 7.13.4.1.1 through 7.13.4.1.3.

7.13.4.1.1* In a new and unoccupied building or facility, with the prime mover in a cold start condition and the emergency load at operating level, a normal power failure shall be initiated by opening all switches or circuit breakers supplying the normal power to the building or facility.

7.13.4.1.2* In an existing occupied building or facility, with the prime mover in a cold start condition and the emergency load at operating level, a normal power failure shall be simulated by operating at least one transfer switch test function or initiated by opening all switches or breakers supplying normal power to all ATSS that are part of the EPSS being commissioned by this initial acceptance test.

7.13.4.1.3 The tests conducted in accordance with 7.13.4.1.1 and 7.13.4.1.2 shall be performed in accordance with (1) through (12).

- (1) When the EPSS consists of paralleled EPSs, the quantity of EPSs intended to be operated simultaneously shall be tested simultaneously with building load for the test period identified in 7.13.4.1.3(10).
- (2) The test load shall be all loads that are served by the EPSS. There is no minimum loading requirement for this portion of the test.
- (3) The time delay on start shall be observed and recorded.
- (4) The cranking time until the prime mover starts and runs shall be observed and recorded.
- (5) The time taken to reach operating speed shall be observed and recorded.
- (6)*The engine start function shall be confirmed by verifying operation of the initiating circuit of all transfer switches supplying EPSS loads.
- (7) The time taken to achieve a steady-state condition with all switches transferred to the emergency position shall be observed and recorded.
- (8) The voltage, frequency, and amperes shall be recorded.

- (9) Where applicable, the prime mover oil pressure and water temperature shall be recorded.
- (10) The load test with building load, or other loads that simulate the intended load as specified in Section 5.4, shall be continued for not less than 1.5 hours, and the run time shall be recorded.
- (11) When normal power is restored to the building or facility, the time delay on retransfer to normal power for each switch with a minimum setting of 5 minutes shall be recorded.
- (12) The time delay on the prime mover cooldown period and shutdown shall be recorded.

7.13.4.2 After completion of the test performed in 7.13.4.1, the prime mover shall be allowed to cool for not less than 5 minutes.

7.13.4.3* A load shall be applied for a 2-hour, full-load test. The building load shall be permitted to serve as part or all of the load, supplemented by a load bank of sufficient size to provide a load equal to 100 percent of the nameplate kW rating of the EPS, less applicable derating factors for site conditions.

7.13.4.3.1* This full-load test shall be initiated after the test specified in 7.13.4.1.3 by any method that starts the prime mover and, upon reaching rated rpm, picks up not less than 30 percent of the nameplate kW rating for the first 30 minutes, not less than 50 percent of the nameplate kW rating for the next 30 minutes, and 100 percent of the nameplate kW rating for the next 60 minutes, less applicable derating factors for site conditions.

7.13.4.3.2 A unity power factor shall be permitted for on-site testing, provided that rated load tests at the rated power factor have been performed by the manufacturer of the EPS prior to shipment.

7.13.4.3.3 Where the EPS is a paralleled multi-unit EPS, each unit shall be permitted to be tested individually at its rating.

7.13.4.3.4 The data specified in 7.13.4.1.3(4), (5), (7), (8), and (9) shall be recorded at first load acceptance and every 15 minutes thereafter until the completion of the test period identified in 7.13.4.1.3(10).

7.13.4.4 Any method recommended by the manufacturer for the cycle crank test shall be utilized to prevent the prime mover from running.

7.13.4.4.1 The control switch shall be set at "run" to cause the prime mover to crank.

7.13.4.4.2 The complete crank/rest cycle specified in 5.6.4.2 and Table 5.6.4.2 shall be observed.

7.13.4.4.3 The battery charge rate shall be recorded at 5-minute intervals for the first 15 minutes or until charge rate stabilization.

7.13.4.5 All safeties specified in 5.6.5 and 5.6.6 shall be tested on site as recommended by the manufacturer.

Exception: It shall be permitted for the manufacturer to test and document overcrank, high engine temperature, low lube oil pressure and overspeed safeties prior to shipment.

7.13.4.6 Items (1) through (4) shall be made available to the authority having jurisdiction at the time of the acceptance test:

- (1) Evidence of the prototype test as specified in 5.2.1.2 (for Level 1 systems)

- (2) A certified analysis as specified in 5.6.10.2
- (3) A letter of compliance as specified in 5.6.10.5
- (4) A manufacturer's certification of a rated load test at rated power factor with the ambient temperature, altitude, and fuel grade recorded

Chapter 8 Routine Maintenance and Operational Testing

8.1* General.

8.1.1 The routine maintenance and operational testing program shall be based on all of the following:

- (1) Manufacturer's recommendations
- (2) Instruction manuals
- (3) Minimum requirements of this chapter
- (4) The authority having jurisdiction

8.1.2 Consideration shall be given to temporarily providing a portable or alternate source whenever the emergency generator is out of service and the criteria set forth in Section 4.3 cannot be met.

8.2* Manuals, Special Tools, and Spare Parts.

8.2.1 At least two sets of instruction manuals for all major components of the EPSS shall be supplied by the manufacturer(s) of the EPSS and shall contain the following:

- (1) A detailed explanation of the operation of the system
- (2) Instructions for routine maintenance
- (3) Detailed instructions for repair of the EPS and other major components of the EPSS
- (4) An illustrated parts list and part numbers
- (5) Illustrated and schematic drawings of electrical wiring systems, including operating and safety devices, control panels, instrumentation, and annunciators

8.2.2 For Level 1 systems, instruction manuals shall be kept in a secure, convenient location, one set near the equipment, and the other set in a separate location.

8.2.3 Special tools and testing devices necessary for routine maintenance shall be available for use when needed.

8.2.4 Replacement for parts identified by experience as high mortality items shall be maintained in a secure location(s) on the premises.

8.2.4.1 Consideration shall be given to stocking spare parts as recommended by the manufacturer.

8.3 Maintenance and Operational Testing.

8.3.1* The EPSS shall be maintained to ensure to a reasonable degree that the system is capable of supplying service within the time specified for the type and for the time duration specified for the class.

8.3.2 A routine maintenance and operational testing program shall be initiated immediately after the EPSS has passed acceptance tests or after completion of repairs that impact the operational reliability of the system.

8.3.2.1 The operational test shall be initiated at an ATS and shall include testing of each EPSS component on which maintenance or repair has been performed, including the transfer of each automatic and manual transfer switch to the alternate

power source, for a period of not less than 30 minutes under operating temperature.

8.3.3 A written schedule for routine maintenance and operational testing of the EPSS shall be established.

8.3.4 A permanent record of the EPSS inspections, tests, exercising, operation, and repairs shall be maintained and readily available.

8.3.4.1 The permanent record shall include the following:

- (1) The date of the maintenance report
- (2) Identification of the servicing personnel
- (3) Notation of any unsatisfactory condition and the corrective action taken, including parts replaced
- (4) Testing of any repair for the time as recommended by the manufacturer

8.3.5* Transfer switches shall be subjected to a maintenance and testing program that includes all of the following operations:

- (1) Checking of connections
- (2) Inspection or testing for evidence of overheating and excessive contact erosion
- (3) Removal of dust and dirt
- (4) Replacement of contacts when required

8.3.6 Paralleling gear shall be subject to an inspection, testing, and maintenance program that includes all of the following operations:

- (1) Checking of connections
- (2) Inspection or testing for evidence of overheating and excessive contact erosion
- (3) Removal of dust and dirt
- (4) Replacement of contacts when required

8.3.7* Storage batteries, including electrolyte levels or battery voltage, used in connection with systems shall be inspected weekly and maintained in full compliance with manufacturer's specifications.

8.3.7.1 Maintenance of lead-acid batteries shall include the monthly testing and recording of electrolyte specific gravity. Battery conductance testing shall be permitted in lieu of the testing of specific gravity when applicable or warranted.

8.3.7.2 Defective batteries shall be replaced immediately upon discovery of defects.

8.3.8* A fuel quality test shall be performed at least annually using appropriate ASTM standards.

8.4 Operational Inspection and Testing.

8.4.1* EPSSs, including all appurtenant components, shall be inspected weekly and exercised under load at least monthly.

8.4.1.1 If the generator set is used for standby power or for peak load shaving, such use shall be recorded and shall be permitted to be substituted for scheduled operations and testing of the generator set, providing the same record as required by 8.3.4.

8.4.2* Diesel generator sets in service shall be exercised at least once monthly, for a minimum of 30 minutes, using one of the following methods:

- (1) Loading that maintains the minimum exhaust gas temperatures as recommended by the manufacturer
- (2) Under operating temperature conditions and at not less than 30 percent of the EPS standby nameplate kW rating

8.4.2.1 The date and time of day for required testing shall be decided by the owner, based on facility operations.

8.4.2.2 Equivalent loads used for testing shall be automatically replaced with the emergency loads in case of failure of the primary source.

8.4.2.3* Diesel-powered EPS installations that do not meet the requirements of 8.4.2 shall be exercised monthly with the available EPSS load and shall be exercised annually with supplemental loads at not less than 50 percent of the EPS nameplate kW rating for 30 continuous minutes and at not less than 75 percent of the EPS nameplate kW rating for 1 continuous hour for a total test duration of not less than 1.5 continuous hours.

8.4.2.4 Spark-ignited generator sets shall be exercised at least once a month with the available EPSS load for 30 minutes or until the water temperature and the oil pressure have stabilized.

8.4.2.4.1 The date and time of day for required testing shall be decided by the owner, based on facility operations.

8.4.2.4.2 Equivalent loads used for testing shall be automatically replaced with the emergency loads in case of failure of the primary source.

8.4.3 The EPS test shall be initiated by simulating a power outage using the test switch(es) on the ATs or by opening a normal breaker. Opening a normal breaker shall not be required.

8.4.4 Load tests of generator sets shall include complete cold starts.

8.4.5 Time delays shall be set as follows:

- (1) Time delay on start:
 - (a) 1 second minimum
 - (b) 0.5 second minimum for gas turbine units
- (2) Time delay on transfer to emergency: no minimum required
- (3) Time delay on restoration to normal: 5 minutes minimum
- (4) Time delay on shutdown: 5 minutes minimum

8.4.6 Transfer switches shall be operated monthly.

8.4.6.1 The monthly test of a transfer switch shall consist of electrically operating the transfer switch from the primary position to the alternate position and then a return to the primary position.

8.4.6.2 The criteria set forth in Section 4.3 and in Table 4.1(b) shall not be required during the monthly testing of the EPSS. If the criteria are not met during the monthly test, a process shall be provided to annually confirm the capability of the system to comply with Section 4.3.

8.4.7* EPSS circuit breakers for Level 1 system usage, including main and feed breakers between the EPS and the transfer switch load terminals, shall be exercised annually with the EPS in the "off" position.

8.4.7.1 Circuit breakers rated in excess of 600 volts for Level 1 system usage shall be exercised every 6 months and shall be tested under simulated overload conditions every 2 years.

8.4.8 EPSS components shall be maintained and tested by qualified person(s).

8.4.9* Level 1 EPSS shall be tested at least once within every 36 months.

8.4.9.1 Level 1 EPSS shall be tested continuously for the duration of its assigned class (*see Section 4.2*).

8.4.9.2 Where the assigned class is greater than 4 hours, it shall be permitted to terminate the test after 4 continuous hours.

8.4.9.3 The test shall be initiated by operating at least one transfer switch test function and then by operating the test function of all remaining ATs, or initiated by opening all switches or breakers supplying normal power to all ATs that are part of the EPSS being tested.

8.4.9.4 A power interruption to non-EPSS loads shall not be required.

8.4.9.5 The minimum load for this test shall be as specified in 8.4.9.5.1, 8.4.9.5.2, or 8.4.9.5.3.

8.4.9.5.1* For a diesel-powered EPS, loading shall be not less than 30 percent of the nameplate kW rating of the EPS. A supplemental load bank shall be permitted to be used to meet or exceed the 30 percent requirement.

8.4.9.5.2 For a diesel-powered EPS, loading shall be that which maintains the minimum exhaust gas temperatures as recommended by the manufacturer.

8.4.9.5.3 For spark-ignited EPSSs, loading shall be the available EPSS load.

8.4.9.6 The test required in 8.4.9 shall be permitted to be combined with one of the monthly tests required by 8.4.2 and one of the annual tests required by 8.4.2.3 as a single test.

8.4.9.7* Where the test required in 8.4.9 is combined with the annual load bank test, the first 3 hours shall be at not less than the minimum loading required by 8.4.9.5 and the remaining hour shall be at not less than 75 percent of the nameplate kW rating of the EPS.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1.4 See NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*.

A.1.1.5(3) See Chapter 4.

A.1.4.1 Assignment of degree of reliability of the recognized EPSS, or equivalency of other methods, depends on the careful evaluation of the variables at each particular installation. One source of information on quantitative methods for assessing power system reliability is ANSI/IEEE 493, *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems*.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is

thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.1 Battery Certification. One such certifier of batteries is the American Association of Battery Manufacturers.

A.3.3.3 Emergency Power Supply (EPS). For rotary energy converters, components of an EPS include the following:

- (1) Prime mover
- (2) Cooling system
- (3) Generator
- (4) Excitation system
- (5) Starting system
- (6) Control system
- (7) Fuel system
- (8) Lube system, if required

The EPS includes all the related electrical and mechanical components of the proper size and/or capacity required for the generation of the required electrical power at the EPS output terminals.

A.3.3.4 Emergency Power Supply System (EPSS). See Annex B for diagrams of typical systems.

A.4.1 This standard specifies requirements for the EPSS as a complete functioning system in terms of types, classes, and levels. It is not the intent of this standard to recommend the EPSS most suitable for any given application. The terms *emergency power supply systems* and *standby power supply systems* as used in this standard include, but are not limited to, such terms as the following:

- (1) Alternate power systems
- (2) Standby power systems
- (3) Legally required standby systems
- (4) Alternate power sources

Since this standard specifies the installation, performance, maintenance, and test requirements in terms of types, classes, and levels, any of these terms might be appropriate for describing the application or use, depending on the need and the preference of the parties involved.

A.4.2 Selection of the class of the EPSS should take into account past outage records and fuel delivery problems due to

weather, shortages, and other geographic and environmental conditions. Class "X" is a calculated value that usually represents between 48 and 96 hours of fuel for a Level 1 facility. Where the seismic design category is C, D, E, or F, as determined in accordance with ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*, the EPS supplying a Level 1 EPSS should be capable of a minimum 96 hours of operation without refueling if it is determined that EPS operation is necessary for this period.

A.4.4 It is recognized that EPSSs are utilized in many different locations and for many different purposes. The requirement for one application might not be appropriate for other applications.

A.4.4.1 Typically, Level 1 systems are intended to automatically supply illumination or power, or both, to critical areas and equipment in the event of failure of the primary supply or in the event of danger to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life. Other NFPA codes and standards, such as NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, NFPA 99, *Health Care Facilities Code*, and NFPA 101, *Life Safety Code*, provide specific requirements on where Level 1 systems are required.

Essential electrical systems can provide power for the following essential functions:

- (1) Life safety illumination
- (2) Fire detection and alarm systems
- (3) Elevators
- (4) Fire pumps
- (5) Public safety communications systems
- (6) Industrial processes where current interruption would produce serious life safety or health hazards
- (7) Essential ventilating and smoke removal systems

A.4.4.2 Typically, Level 2 systems are intended to supply power automatically to selected loads (other than those classed as emergency systems) in the event of failure of the primary source.

Level 2 systems typically are installed to serve loads, such as the following, that, when stopped due to any interruption of the primary electrical supply, could create hazards or hamper rescue or fire-fighting operations:

- (1) Heating and refrigeration systems
- (2) Communications systems
- (3) Ventilation and smoke removal systems
- (4) Sewage disposal
- (5) Lighting
- (6) Industrial processes

A.4.4.4 It is important to recognize that an EPSS might react substantially differently from commercial power during transient and short circuit conditions due to the relatively small capacities of the EPSS compared to the primary commercial power source. [See ANSI C 84.1, *Standard for Electric Power Systems and Equipment — Voltage Ratings (60 hertz)*.]

A.5.1.1 Examples of probability of interruption could include the following: earthquake, flood damage, or a demonstrated utility unreliability.

A.5.1.1(1) The grade of diesel fuel selected for use in a prime mover should be based on recommendations from the diesel engine manufacturer and ASTM D 975, *Standard Specification for Diesel Fuel Oils*. Where possible, the purchaser of fuel for the

prime mover should specify a diesel fuel that does not contain biodiesel, which can accelerate the degradation of the diesel fuel if stored longer than 6 months. If diesel fuel is stored outside for long-term storage, it may be necessary to use a winter or arctic grade of diesel fuel or to take precautions such as insulating and heat-tracing fuel tanks and lines to ensure that fuel will flow to the prime mover under the coldest possible conditions.

A.5.1.1(2) ASTM D 1835, *Standard Specification for Liquefied Petroleum (LP) Gases*, is a recognized standard covering LP-Gas.

A.5.1.1(3) ASTM does not have a standard specification for natural or synthetic gas. Industry generally uses pipeline specifications for natural gas quality.

A.5.1.3 On-site energy conversion is not restricted to rotating-type generating systems. Other types of continuous energy conversion systems can be used, including fuel-cell systems.

A.5.2.2 The following devices are typical of energy converters and energy sources that should be reviewed carefully as part of Level 1 EPSSs:

- (1) Motor-generator/engine
- (2) Motor-generator/flywheel
- (3) Steam turbine

Connection to the primary power source ahead of the primary source main service disconnect and a separate service should be excluded as a sole source of EPS.

A.5.4 It is recognized that in some installations, part or all of the output of the EPS might be used for peak shaving or part of the output might be used for driving nonessential loads during loss of the primary power source. Load shedding of these loads when the output of the energy converter is needed is one way of meeting the requirements of Section 5.4. The load should be reviewed to ascertain that load growth has not exceeded EPS capability.

A.5.5.2 The low-fuel alarm point for liquid-fueled engines is defined as the point when the main fuel tank contains insufficient fuel to meet the required full load operating hours and is the point at which this condition is signaled.

A.5.5.3 Consideration should be given to sizing tanks in order to meet minimum fuel supplier delivery requirements, particularly for small tanks. Consideration also should be given to oversizing tanks. More important, biodiesel blends up to B5 (ASTM D 975, *Standard Specification for Diesel Fuel Oils*) have much shorter shelf lives than conventional diesel fuel [ultra-low sulfur diesel (ULSD)] and can accelerate degradation processes, endangering the entire diesel fuel supply. Where fuel is stored for extended periods of time (e.g., more than 12 months), it is recommended that fuels be periodically pumped out and used in other services and replaced with fresh fuel. Prudent disaster management could require much larger on-site temporary or permanent fuel storage, and several moderate-sized tanks can be preferable to a single very large tank.

A.5.6.4.2 See Figure A.5.6.4.2 for a diagram of cranking cycles.

A.5.6.4.3 A battery unit is one or more batteries or a group of cells, a series, or a parallel series connected to provide the required battery unit voltage and capacity.

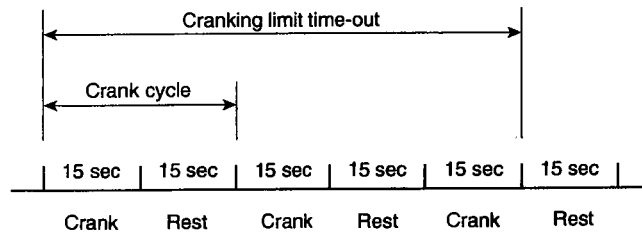


FIGURE A.5.6.4.2 Diagram of Cranking Cycles.

A.5.6.4.4 Cold-cranking amperes, or cranking performance, are the number of amperes a fully charged battery at -17.8°C (0°F) can continuously deliver for 30 seconds while maintaining 1.2 V per cell.

A.5.6.4.5.1 It is recommended that lead-acid starting batteries be replaced every 24 to 30 months.

A.5.6.4.6 It is intended that the battery charger be factory-built, adjusted, and approved for the specific type, construction, and capacity of the battery. For lead-acid batteries, the battery charger should be tested for the specific gravity, type, and concentration of grid alloys, such as high or low gravity, high or low antimony, calcium, or none.

A.5.6.5.6 For systems located outdoors, the manual shutdown should be located external to the weatherproof enclosure and should be appropriately identified.

A.5.6.6 The minimum "remote alarm annunciation" is to alert personnel at a constantly attended station somewhere on the site when the facility is in use as a Level 1 system. If the site is not continuously occupied, "network remote" should allow people at another site to know the operating status of the equipment.

The preferred method of remote annunciation is to notify personnel both somewhere on the site and at other locations via a network such as LAN, WAN, or Internet, including the ability to initiate auto-dial and send predefined text messages.

A.5.6.7.4 Adding remote parasitic equipment loads into the overall load to be supplied by the EPS is a factor that should be included in the overall EPSS design.

A.5.6.9.1 See ANSI/NEMA MG1, *Standard for Motors and Generators*, and ANSI/NEMA MG2, *Safety Standard and Guide for Selection, Installation and Use of Electric Motors and Generators*.

A.5.6.10.3 Where unusual vibration conditions are anticipated, adequate isolation treatment should be supplied.

A.6.1.1 Electrical switching is electrical equipment or devices used to do any or all of the following:

- (1) Transfer connected electrical loads from one power source to another
- (2) Perform load-switching functions
- (3) Bypass, isolate, and test the transfer switch

A.6.1.2 Electrical protection equipment is sensing and overcurrent protective devices used to protect against damage due to fault or overload to conductors and equipment connected to the output of the emergency energy source, up to and including the load terminals of the transfer switch(es).

A.6.1.6 See Section 695.10 of *NFPA 70, National Electrical Code*, and Section 10.8 of *NFPA 20, Standard for the Installation of*

Stationary Pumps for Fire Protection, for listing and installation requirements for transfer switches used with fire pumps.

A.6.2.1 For most applications in this standard, the automatic transfer switch (ATS) is used to transfer a load from a primary source of supply to an engine generator set.

An ATS might include circuit breakers, contactors, switches, or vacuum and solid-state power devices operating in conjunction with automatic-sensing and logic devices to perform the defined function.

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

A.6.2.2.1(2) See 6.2.5 and 6.2.7.

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

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

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

A.6.2.13 For maintenance purposes, consideration should be given to a transfer switch counter.

A.6.2.15 ATSs can be provided with accessory controls that provide a signal to operate remote motor controls that disconnect motors prior to transfer and to reconnect them after transfer when the residual voltage has been substantially reduced. Another method is to provide in-phase monitors within the ATS in order to prevent retransfer to the primary source until both sources are nearly synchronized. A third method is to use a programmed neutral position transfer switch. See Section 230.95 of *NFPA 70, National Electrical Code*.

A.6.2.16 Standards for nonautomatic transfer switches are similar to those for ATSs, as defined in 3.3.10.1 and 3.3.10.3, with the omission of automatic controls.

A.6.4.3 See Section 700.6 of *NFPA 70, National Electrical Code*.

A.6.4.4 Consideration should be given to the effect that load interruption could have on the load during maintenance and service of the transfer switch.

A.6.5.1 It is important that the various overcurrent devices be coordinated, as far as practicable, to isolate faulted circuits and to protect against cascading operation on short circuit faults. In many systems, however, full coordination is not practicable without using equipment that could be prohibitively costly or undesirable for other reasons. Primary consideration also should be given to prevent overloading of equipment by limiting the possibilities of large current inrushes due to instantaneous reestablishment of connections to heavy loads.

A.6.5.3 See 9.6.5 of NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*.

A.7.1.1 The performance of the EPS and the EPSS is dependent on many factors, one of which is correct initial installation, primarily as the installation relates to the location and environmental conditions. Although this standard is not intended to serve as a design standard for EPSS installation and environmental considerations, certain minimum standards are recognized as essential for successful startup and performance, safe operation, and utilization of the EPSS where required.

A.7.1.2 The environmental conditions to be considered in the EPSS design should include, but not be limited to, heating, ventilating, and air-conditioning systems; protection from floods, fire, vandalism, wind, earthquakes, lightning, and other similar or applicable environmental conditions common to geographic locations; and other factors affecting the location of the EPSS equipment.

The probability and frequency of power failures that do or can occur as a result of lightning, wind, and rain produced by thunderstorms, hurricanes, tornadoes, and similar weather conditions associated with the user's geographic location should be considered.

A.7.2.3 The intent of this requirement is to provide maximum fire protection to the most critical, high energy systems. Consideration should be given to the potential fire hazard when locating Level 2 EPSS equipment in the normal electrical service room, or to Level 1 systems below 1000 amperes and 150 volts to ground.

A.7.2.4 EPSS equipment should be located above known previous flooding elevations where possible.

A.7.2.5 When installing the EPSS equipment and related auxiliaries, environmental considerations should be given, particularly with regard to the installation of the fuel tanks (*see A.7.9.1.2 for further discussion*) and exhaust lines, or the EPS building, or both.

To protect against disruption of power in the facility, it is recommended that the transfer switch be located as close to the load as possible. The following are examples of external influences:

- (1) Natural conditions
 - (a) Storms
 - (b) Floods
 - (c) Earthquakes
 - (d) Tornadoes
 - (e) Hurricanes
 - (f) Lightning
 - (g) Ice storms
 - (h) Wind
 - (i) Fire
- (2) Human-caused conditions
 - (a) Vandalism
 - (b) Sabotage
 - (c) Other similar occurrences
- (3) Material and equipment failures

For natural conditions, EPSS design should consider the "100-year storm" flooding level or the flooding level predicted by the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) models for a Class 4 hurricane.

A.7.3.3 Where units housed outdoors are used, it is recommended that a flashlight or battery-powered light with a flexible cord be maintained in the housing.

A.7.5 Generally, integral rubber vibration isolators are used on the rotating energy converters, and spring-type or pad-type isolators are used on the larger energy converter units. In some cases, high deflection spring-type isolators should be used where a high degree of vibration attenuation is required. The EPS manufacturer should be consulted during consideration of the specific type of vibration control. Inertia bases should be considered where unusual vibration conditions are anticipated.

A.7.6 Generally, exhaust noises can be attenuated by using the proper mufflers. The mufflers used should be in accordance with the EPS manufacturer's recommendations. Depending on the degree of silencing required, the muffler should be rated accordingly for "commercial," "semicritical," and "critical" (high degree of silencing) service. To attenuate other noises, line-of-sight barriers having acoustical treatment or total acoustical enclosures can be used. The EPS should be installed away from critical areas.

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

A.7.7.2.1 The ventilation calculation for an EPS should consider the following:

- (1) Radiator airflow (when installed in the EPS room)
- (2) Combustion airflow consumed by the engine
- (3) Maximum potential ambient temperature of air entering the EPS room for ventilation
- (4) Radiated heat load from the EPS
- (5) Radiated heat load from EPS exhaust system whether it is insulated or not insulated
- (6) Other heat loads in the room
- (7) Maximum allowed airflow pressure drop through the ventilation supply into the room and through the ventilation discharged from the radiator

A.7.9.1.2 To optimize the long-term storage of fuels for prime movers, the fuel tanks should be kept cool and dry, and the tank as full as possible. Tanks that are subject to temperature variations can experience accelerated fuel degradation, especially if the tanks are outside and above ground or close to an extreme heat source if stored inside a structure. The more constant and cooler the tank temperatures, the less likely temperature-related fuel degradation will occur. Tank ullage (air space) should be kept to a minimum. Excess air space allows for warm, humid air to enter the tank and condense moisture during the cool evening. Also, prolonged exposure to ambient air, which is 20 percent oxygen, can facilitate oxidative degradation of the fuel. Fuel storage tanks should be kept as dry as possible and have provisions for water drainage on a regular basis. The presence of water can lead to microbiological contamination and growth, which in turn can lead to general or pitting corrosion of steel tanks and components, possibly resulting in filter plugging, operational issues, or a hydrocarbon release to the environment. Regularly scheduled surveillance of the fuel allows the operator(s) to evaluate the condition of the fuel and make important decisions regarding

the quality of the fuel dedicated to reliable operation of the prime mover. Fuel maintenance and testing should begin the day of installation and first fill in order to establish a benchmark guideline for future comparison. Laboratory testing services should always be sought from a qualified or certified petroleum laboratory.

A.7.9.3.1 Fuel lines containing copper, copper-containing alloys, and zinc (including galvanized piping or containers) should be avoided. Copper can promote fuel degradation and can produce mercaptide gels. Zinc coatings can react with water or organic acids in the fuel to form gels that rapidly plug filters.

A.7.9.6 See NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*; NFPA 54, *National Fuel Gas Code*; and NFPA 58, *Liquefied Petroleum Gas Code*.

A.7.9.7 Valving for natural gas-fueled prime movers should be configured so that the gas supply to the prime mover cannot be inadvertently or intentionally shut off by anyone other than qualified personnel such as the gas supplier. If valves are placed in an isolated area, a secure area or locking the valve(s) open is recommended.

A.7.10.3 Consideration should also be given to utilizing dampening supports where it is necessary to reduce exhaust noise vibration transmission.

A.7.11.2 If a fire suppression system is used in EPS rooms or separate buildings housing EPS equipment, consideration should be given to preaction-type suppression systems.

A.7.11.5 Consideration should be given to the location of the EPS equipment, both as it relates to the building structure and to the effects of an earthquake.

All emergency power equipment support or sub-support systems should be designed and constructed so that they can withstand static or anticipated seismic forces, or both, in any direction, with the minimum force value used being equal to the equipment weight.

Bolts, anchors, hangers, braces, and other restraining devices should be provided to limit earthquake-generated differential movements between the EPS nonstructural equipment and the building structure. However, the degree of isolation required for vibration and acoustical control of the EPS equipment and other equipment should be maintained.

Suspended items such as piping, conduit, ducts, and other auxiliary equipment related to the EPSS should be braced in two directions to resist swaying and excessive movement in earthquake risk areas.

Battery racks for EPS equipment and electrical items or related auxiliaries, or both, should be designed to resist internal damage and damage at the equipment supports resulting from earthquake-generated motion. Battery racks should be capable of withstanding seismic forces equal to the supported weight in any direction. Batteries should be restrained to their support to prevent vibration damage, and electrical interconnections should be provided with adequate slack to accommodate all relative deflections.

Transfer switch enclosures should be mounted so that their anchors and support structures can withstand static forces equal to the anticipated seismic shock in any direction.

Transfer switch components should be of the type that resists malfunction during dynamic excitation and should be designed to resist the anticipated seismic shock.

Where possible, EPS equipment and associated cooling systems and controls should be mounted on a single frame. The

frame, in turn, should be rigidly attached to its foundation so that its anchorage can withstand static forces equal to the equipment weight in any direction. Where engine generator sets and associated cooling systems' controls cannot be mounted as an integral unit, each should be secured to meet the floating requirements previously described. Equipment not using the preferred rigid mounting should have vibration isolators with restraints capable of withstanding static forces equal to twice the weight of the supported equipment in any direction. In addition, interconnecting power, fuel, and cooling lines should be provided with adequate flexibility to allow maximum anticipated excursions without damage.

Appendages to the EPS equipment, such as day tanks, should be mounted to withstand static forces equal to the anticipated seismic shock in any direction.

A.7.11.6 Seismic shock should be simulated at the factory or in a testing laboratory on a prototype unit. Simulation should consist of a test(s) approximating actual time-history records of known seismic shocks applied to the equipment under test. Subassemblies of the total equipment could be tested separately where it is neither practical nor feasible to test the complete unit.

A.7.13.4.1.1 Cold start is typical standby condition under normal ambient conditions with coolant heaters functioning normally.

A.7.13.4.1.2 Cold start is typical standby condition under normal ambient conditions with coolant heaters functioning normally.

A.7.13.4.1.3(6) Verification of the engine start function can be accomplished by actual starting of the engine or by testing of the ATS start circuit.

A.7.13.4.3 Connection of the load bank (or a portable generator) is facilitated by providing permanently installed equipment or connection points such as spare circuit breakers or switches.

The generator set manufacturer should be consulted where the nameplate data do not indicate rating type. There is a difference between prime and standby ratings. For example, there are usually two kW nameplate ratings found on most engine-driven generators: "standby" and "prime." There can be a significant difference between the resulting kW figures when calculating 30 percent of nameplate — for example, a 100 kW standby generator is normally considered an 80 kW set for prime power: $100 \text{ kW} \times 30\% = 30 \text{ kW}$, but $80 \text{ kW} \times 30\% = 24 \text{ kW}$. A permanent record of the rating should be maintained and readily available.

A.7.13.4.3.1 The generator set manufacturer should be consulted where the nameplate data do not indicate rating type. There is a difference between prime and standby ratings. For example, there are usually two kW nameplate ratings found on most engine-driven generators: "standby" and "prime." There can be a significant difference between the resulting kW figures when calculating 30 percent of nameplate — for example, a 100 kW standby generator is normally considered an 80 kW set for prime power: $100 \text{ kW} \times 30\% = 30 \text{ kW}$, but $80 \text{ kW} \times 30\% = 24 \text{ kW}$. A permanent record of the rating should be maintained and readily available.

A.8.1 The continuing reliability and integrity of the EPSS are dependent on an established program of routine maintenance and operational testing. For more detailed information on electrical equipment maintenance, refer to NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*.

A.8.2 Where adequately secured from public access, it is desirable to locate an instruction manual, special tools and testing devices, and spare parts in the room in which the EPS is located. The articles should be mounted at a convenient location on a wall and should be enclosed in a metal or other suitable cabinet. The cabinet should accommodate the instruction manual on the inside of the door.

A.8.3.1 The suggested maintenance procedure and frequency should follow those recommended by the manufacturer. In the absence of such recommendations, Figure A.8.3.1 (a) and Figure A.8.3.1 (b) indicate alternate suggested procedures.

A.8.3.5 Where sealed devices are used, replacement of the complete device might be necessary. Maintenance should be performed according to manufacturer's recommendations. In the absence of such recommendations, the list given in 8.3.5 suggests minimal procedures.

Transfer switches should be subjected to an annual maintenance program including (one) major maintenance and (three) quarterly inspections. Programs should include all of the following operations. Note: Due to the critical nature of these devices, permission should be gained to perform these tasks since some of the following recommendations could cause disruption of power to the load. The following tasks should be carefully reviewed with facility management personnel to ensure agreement and plan for contingencies.

Major Maintenance

- (1) Check connections.
 - (a) A thermographic or temperature scan should be done prior to this visit, while the ATS is under normal (peak) load. This thermographic scan should be repeated during the EPSS load test. Results should be available to the maintenance provider so that suspect conditions can be addressed during this activity.
 - (b) With power connected to the normal source, measure and record millivolt drop levels across each pole. Note: Any reading that is greater than 25 percent of the average of all poles should be carefully inspected when the ATS is de-energized.
 - (c) With power connected to the emergency source, measure and record millivolt drop levels across each pole. Note: Any reading that is greater than 25 percent of the average of all poles should be carefully inspected when the ATS is de-energized.
 - (d) If the ATS is equipped with a bypass isolation feature, operate the bypass to the connected source (emergency or normal) and repeat the steps in (a), (b), and (c). Levels should drop to approximately 50 percent of initial levels and be uniform relative to initial readings. This step verifies that the bypass feature is properly connected and that the connected load will not be affected when the automatic portion is isolated for maintenance.
 - (e) With power secured and both the emergency and normal sources properly locked out and tagged out, measure the micro-ohm resistance levels across the following connection points:
 - i. Emergency source cabling lug to bus
 - ii. Normal source cabling lug to bus
 - iii. Load cabling lug to bus
 - iv. Neutral cabling lug to bus
 - v. Load connected to normal across each pole
 - vi. Load connected to emergency across each pole
- (2) Inspect or test for evidence of overheating or excessive contact corrosion.
 - (a) With power from both sources secured and properly locked out and tagged out, remove all protective pole covers and arc chutes.
 - (b) Carefully inspect main contacts and other current-carrying parts for signs of corrosion or overheating. Note: Observation should correlate with previous results (i.e., thermographic or temperature evidence of higher than normal temperatures or heat migration, abnormal millivolt drop readings as previously noted, or abnormal micro-ohm (DLRO) readings as previously noted).
 - (c) Carefully inspect insulating materials or standoff insulators for signs of contamination (dirt, grime, oil, etc.). The combination of contaminants and possible introduction of high humidity or moisture could lead to insulation breakdown and subsequent destructive faults. Clean contaminated surfaces with a solvent approved for this purpose.
 - (d) Inspect control connection, plugs, and harnesses for signs of corrosion, heat, contamination, and so forth.
 - (e) Using a vacuum, remove all dust and debris from the ATS cabinet, transfer switch mechanism, bus, and so forth. Note: Never use compressed air to blow out dust. Doing so can blow dust and debris into controls and the transfer switch mechanism.
 - (f) Inspect cabinets for proper sealing. Open conduit knockouts or other penetrations should be properly sealed to prevent the introduction of dust, moisture, or other alien matter. Enclosures installed outside should be inspected for proper seal and appropriate gasketing. Ensure that enclosure door securing devices are intact and properly secured.
 - (g) Replace and secure all protective pole covers and chutes. Remove lockout devices and resupply normal power. If the ATS is of the bypass isolation type, reconnect the transfer switch mechanism. Observe proper manufacturer's procedures.
- (3) Verify control and feature setpoints and operation.
 - (a) Measure and record the following data and setpoints:
 - i. Normal source voltage phase to phase, phase to ground, and phase to neutral
 - ii. Engine start time (from crank start to source available light or relay pickup)
 - iii. Emergency source voltage phase to phase, phase to ground, and phase to neutral
 - iv. Load current each phase
 - v. Momentary override normal deviation where provided
 - vi. Transfer time delay where provided
 - vii. Return to normal source time delay where provided
 - viii. Engine cooldown where provided

EPSS Maintenance Schedule							
Component (as applicable)	Procedure					Frequency	
	Visual Inspection	Check	Change	Clean	Test	Level 1	Level 2
1. Fuel							
(a) Main supply tank level		X				W	M
(b) Day tank level	X	X				W	M
(c) Day tank float switch	X				X	W	Q
(d) Supply or transfer pump operation	X				X	W	Q
(e) Solenoid valve operation	X				X	W	Q
(f) Strainer, filter, dirt leg, or combination				X		Q	Q
(g) Water in system		X		X		W	Q
(h) Flexible hose and connectors	X		R			W	M
(i) Tank vents and overflow piping unobstructed		X			X	A	A
(j) Piping	X					A	A
(k) Gasoline in main tank (when used)			R			A	A
2. Lubrication System							
(a) Oil level	X	X				W	M
(b) Oil change			R			50 or A	50 or A
(c) Oil filter(s)			R			50 or A	50 or A
(d) Lube oil heater		X				W	M
(e) Crankcase breather	X		R	X		Q	S
3. Cooling System							
(a) Level	X	X				W	M
(b) Antifreeze protection level					X	S	A
(c) Antifreeze			R			A	A
(d) Adequate cooling water to heat exchanger		X				W	M
(e) Rod out heat exchanger				X		A	A
(f) Adequate fresh air through radiator		X				W	M
(g) Clean exterior of radiator				X		A	A
(h) Fan and alternator belt	X	X				M	Q
(i) Water pump(s)	X					W	Q
(j) Condition of flexible hoses and connection	X	X				W	M
(k) Jacket water heater		X				W	M
(l) Inspect duct work, clean louvers	X	X		X		A	A
(m) Louver motors and controls	X			X	X	A	A
4. Exhaust System							
(a) Leakage	X	X				W	M
(b) Drain condensate trap		X				W	M

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FIGURE A.8.3.1(a) Suggested Maintenance Schedule for Emergency Power Supply Systems (EPSSs).

EPSS Maintenance Schedule (continued)

Component (as applicable)	Procedure					Frequency	
	X — Action R — Replace, if needed					W — Weekly	S — Semiannually
	Visual Inspection	Check	Change	Clean	Test	M — Monthly	A — Annually
						Q — Quarterly	Nos. indicate hours
						Level 1	Level 2
(c) Insulation and fire hazards	X					Q	Q
(d) Excessive backpressure					X	A	A
(e) Exhaust system hangers and supports	X					A	A
(f) Flexible exhaust section	X					S	S
5. Battery System							
(a) Electrolyte level		X				W	M
(b) Terminals clean and tight	X	X				Q	Q
(c) Remove corrosion, case exterior clean and dry	X			X		M	M
(d) Specific gravity or state of charge					X	M	M
(e) Charger and charge rate	X					M	M
(f) Equalize charge		X				M	M
6. Electrical System							
(a) General inspection	X					W	M
(b) Tighten control and power wiring connections		X				A	A
(c) Wire chafing where subject to movement	X	X				Q	S
(d) Operation of safeties and alarms		X			X	S	S
(e) Boxes, panels, and cabinets				X		S	S
(f) Circuit breakers, fuses Note: Do not break manufacturer's seals or perform internal inspection on these devices.	X	X	R	X	X	M	A
(g) Transfer switch main contacts	X			X		A	A
(h) Calibration of voltage-sensing relays/devices		X			X	A	A
(i) Wire insulation breakdown					X	5/500 ^a	3/500 ^b
7. Prime Mover							
(a) General inspection	X					W	M
(b) Service air cleaner			R	X		S	S
(c) Governor oil level and linkage	X	X				M	M
(d) Governor oil			R			A	A
(e) Ignition system — plugs, points, coil, cap, rotor, secondary wire insulation	X	X	R	X	X	A	A
(f) Choke setting and carburetor adjustment		X				S	S
(g) Injector pump and injectors for flow rate pressure and/or spray pattern					X	A	A
(h) EPS at minimum of 30% nameplate rating					X	3/4 ^c	3/4 ^c

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FIGURE A.8.3.1(a) Continued

EPSS Maintenance Schedule (continued)							
Component (as applicable)	Procedure X — Action R — Replace, if needed					Frequency W — Weekly S — Semiannually M — Monthly A — Annually Q — Quarterly Nos. indicate hours	
	Visual Inspection	Check	Change	Clean	Test	Level 1	Level 2
(i) Valve clearance					X	3/500 ^b	3/500 ^b
(j) Torque bolts					X	3/500 ^b	3/500 ^b
8. Generator							
(a) Brush length, appearance, free to move in holder	X	X		X		S	S
(b) Commutator and slip rings	X			X		A	A
(c) Rotor and stator	X			X		A	A
(d) Bearing(s)	X		R			A	A
(e) Bearing grease		X	R			A	A
(f) Exciter	X	X		X		A	A
(g) Voltage regulator	X	X		X		A	A
(h) Measure and record resistance readings of windings with insulation tester (Megger)					X	A	A
9. (a) General condition of EPSS, any unusual condition of vibration, leakage, noise, temperature, or deterioration	X			X		W	M
(b) Service room or housing house-keeping	X			X		W	M
10. Restore system to automatic operation condition	X					W	M

^a Every 5 years or 500 hours
^b Every 3 years or 500 hours
^c Every 3 years for 4 hours

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FIGURE A.8.3.1(a) *Continued*

- (b) If the connection is to a multiple-source EPS, verify the load priority of the ATS being tested and confirm this is correct given the criticality of the connected load.
- (c) Verify proper operation of all indicator lights and meters and controls.
- (d) Return ATS to normal service.

Quarterly Inspections

- (1) Visually inspect the transfer switch control mechanism, control panel, harnesses, and cable connections for signs of moisture, corrosion, or heating.
- (2) Measure and record the following data and setpoints:
 - (a) Normal source voltage phase to phase, phase to ground, and phase to neutral
 - (b) Engine start time (from crank start to source available light or relay pickup)
 - (c) Emergency source voltage phase to phase, phase to ground, and phase to neutral
 - (d) Load current each phase
 - (e) Momentary override normal deviation where provided

(f) Transfer time delay where provided

(g) Return to normal source time delay where provided

(h) Engine cooldown where provided

- (3) If the connection is to a multiple-source EPS, verify the load priority of the ATS being tested and confirm this is correct given the criticality of the connected load.
- (4) Verify proper operation of all indicator lights and meters and controls.
- (5) Inspect cabinets for proper sealing. Open conduit knock-outs or other penetrations should be properly sealed to prevent the introduction of dust, moisture, or other alien matter. Enclosures installed outside should be inspected for proper seal and appropriate gasketing. Ensure that enclosure door securing devices are intact and properly secured.
- (6) Perform a load test using the test switch if permitted. Note: This will cause the emergency power source to start and the ATS to transfer. Be sure to gain permission from the facility management prior to performing this test.

EPSS Maintenance Log				Frequency											
				W — Weekly S — Semiannually M — Monthly A — Annually Q — Quarterly Nos. indicate hours											
Component	Service Frequency		Performed by												
	Level 1	Level 2	Date												
			Fill in Appropriate Readings												
1. Fuel															
(a) Main supply tank level	W	M													
(b) Day tank level	W	M													
(c) Day tank float switch	W	Q													
(d) Supply or transfer pump operation	W	Q													
(e) Solenoid valve operation	W	Q													
(f) Strainer, filter, dirt leg, or combination	Q	Q													
(g) Water in system	W	Q													
(h) Flexible hose and connectors	A	A													
(i) Tank vents and overflow piping unobstructed	A	A													
(j) Piping	A	A													
(k) Gasoline in main tank (when used)	A	A													
2. Lubrication System															
(a) Oil level	W	M													
(b) Oil change	50 or A	50 or A													
(c) Oil filter(s)	50 or A	50 or A													
(d) Lube oil heater	W	M													
(e) Crankcase breather	Q	S													
3. Cooling System															
(a) Level	W	M													
(b) Antifreeze protection level	S	A													
(c) Antifreeze	A	A													
(d) Adequate cooling water to heat exchanger	W	M													
(e) Rod out heat exchanger	A	A													
(f) Adequate fresh air through radiator	W	M													
(g) Clean exterior of radiator	A	A													
(h) Fan and alternator belt	M	Q													
(i) Water pump(s)	W	Q													
(j) Condition of flexible hoses and connection	W	M													
(k) Jacket water heater	W	M													
(l) Inspect duct work, clean louvers	A	A													
(m) Louver motors and controls	A	A													
4. Exhaust System															
(a) Leakage	W	M													
(b) Drain condensate trap	W	M													

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FIGURE A.8.3.1(b) Sample Maintenance Log — Routine Maintenance, Operation, and Testing (RMOT).

EPSS Maintenance Log (continued)			Frequency																	
			Performed by						Nos. indicate hours											
Component	Service Frequency		Date																	
	Level 1	Level 2	Fill in Appropriate Readings																	
(i) Valve clearance	3/500 ^b	3/500 ^b																		
(j) Torque bolts	3/500 ^b	3/500 ^b																		
8. Generator																				
(a) Brush length, appearance, free to move in holder	W	M																		
(b) Commutator and slip rings	S	S																		
(c) Rotor and stator	A	A																		
(d) Bearing(s)	A	A																		
(e) Bearing grease	A	A																		
(f) Exciter	A	A																		
(g) Voltage regulator	A	A																		
(h) Measure and record resistance readings of windings with insulation tester (Megger)	A	A																		
9. (a) General condition of EPSS, any unusual condition of vibration, leakage, noise, temperature, or deterioration																				
(b) Service room or housing house-keeping	W	M																		
10. Restore system to automatic operation condition																				
^a Every 5 years or 500 hours ^b Every 3 years or 500 hours ^c Every 3 years for 4 hours																				

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FIGURE A.8.3.1(b) Continued

A.8.3.7 A battery load test should be performed quarterly.

A.8.3.8 Limited fuel quality testing performed annually using appropriate ASTM standard test methods is recommended as a means to determine that existing fuel inventories are suitable for continued long-term storage. Special attention should be paid to sampling the bottom of the storage tank to verify that the stored fuel is as clean and dry as practicable and that water, sediment, or microbial growth on the tank bottom is minimized. ASTM D 975, *Standard Specification for Diesel Fuel Oils*, contains test methods for existing diesel fuel.

A.8.4.1 Weekly inspection does not require running of the EPS. Running unloaded generators as part of this weekly inspection can result in long-term problems such as wet stacking. See Figure A.8.4.1(a) and Figure A.8.4.1(b).

A.8.4.2 Light loading creates a condition termed *wet stacking*, indicating the presence of unburned fuel or carbon, or both, in the exhaust system. Its presence is readily indicated by the presence of continuous black smoke during engine-run op-

eration. The testing requirements of 8.4.2 are intended to reduce the possibility of wet stacking. If equivalent loads are used for exercising, it is suggested that all essential loads be energized first, with the equivalent load used only to supplement the test. If the normal power were to fail during the exercise period, it would negate the urgency to automatically remove the equivalent load as described in 8.4.2.2.

The generator set manufacturer should be consulted where the nameplate data do not indicate rating type. There is a difference between prime and standby ratings. For example, there are usually two kW nameplate ratings found on most engine-driven generators: "standby" and "prime." There can be a significant difference between the resulting kW figures when calculating 30 percent of nameplate—for example, a 100 kW standby generator is normally considered an 80 kW set for prime power: 100 kW × 30% = 30 kW, but 80 kW × 30% = 24 kW. A permanent record of the rating should be maintained and readily available.

Suggested Operation and Testing Procedures

Item*	Procedure	Item*	Procedure
1.	Perform maintenance per Maintenance Schedule	8.	Record initial oil pressure and battery-charging rate.
2.	Record running time meter (RTM) reading at start and end of test.	9.	Record oil pressure, battery-charging rate, and water or air temperature after 15 minutes running time.
3.	Simulate normal power failure from a "cold start" by use of the test switch in automatic transfer switch or by opening normal power supply to EPSS.	10.	Return test switch to normal or reestablish normal power supply at such time to cause a minimum running time of 30 minutes under load.
4.	Observe and record time delay (T/D) on start.	11.	Record prime mover and ac instruments just prior to transfer.
5.	Record cranking time (terminates when engine starts).	12.	Record time delay on retransfer.
6.	Transfer load to EPS.	13.	Record time delay on shutdown for units so equipped.
7.	Record ac voltage, frequency, amperage, kW.	14.	Place unit in automatic operation mode.

*See Operation and Testing Log.

FIGURE A.8.4.1(b) Operation and Testing Procedures Suggested for Rotating Equipment.

A.8.4.2.3 The generator set manufacturer should be consulted where the nameplate data do not indicate rating type. There is a difference between prime and standby ratings. For example, there are usually two kW nameplate ratings found on most engine-driven generators: "standby" and "prime." There can be a significant difference between the resulting kW figures when calculating 30 percent of nameplate — for example, a 100 kW standby generator is normally considered an 80 kW set for prime power: $100 \text{ kW} \times 30\% = 30 \text{ kW}$, but $80 \text{ kW} \times 30\% = 24 \text{ kW}$. A permanent record of the rating should be maintained and readily available.

A.8.4.7 Circuit breakers should be tested under simulated overload conditions every 2 years.

A.8.4.9 The intent of this requirement is to provide reasonable assurance that the EPSS with all of its auxiliary subsystems is capable of running for the duration of its assigned class with its running load. A full facility power outage is not intended for this test but is recommended where a total facility power outage has not occurred within the last 36 months. Supplemental load banks are not required. After the test, the fuel supply should be replenished if necessary.

A.8.4.9.5.1 The generator set manufacturer should be consulted where the nameplate data do not indicate rating type. There is a difference between prime and standby ratings. For example, there are usually two kW nameplate ratings found

on most engine-driven generators: "standby" and "prime." There can be a significant difference between the resulting kW figures when calculating 30 percent of nameplate — for example, a 100 kW standby generator is normally considered an 80 kW set for prime power: $100 \text{ kW} \times 30\% = 30 \text{ kW}$, but $80 \text{ kW} \times 30\% = 24 \text{ kW}$. A permanent record of the rating should be maintained and readily available.

A.8.4.9.7 The generator set manufacturer should be consulted where the nameplate data do not indicate rating type. There is a difference between prime and standby ratings. For example, there are usually two kW nameplate ratings found on most engine-driven generators: "standby" and "prime." There can be a significant difference between the resulting kW figures when calculating 30 percent of nameplate — for example, a 100 kW standby generator is normally considered an 80 kW set for prime power: $100 \text{ kW} \times 30\% = 30 \text{ kW}$, but $80 \text{ kW} \times 30\% = 24 \text{ kW}$. A permanent record of the rating should be maintained and readily available.

Annex B Diagrams of Typical Systems

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Typical Power Supply Systems. See Figure B.1(a) through Figure B.1(d) for examples.

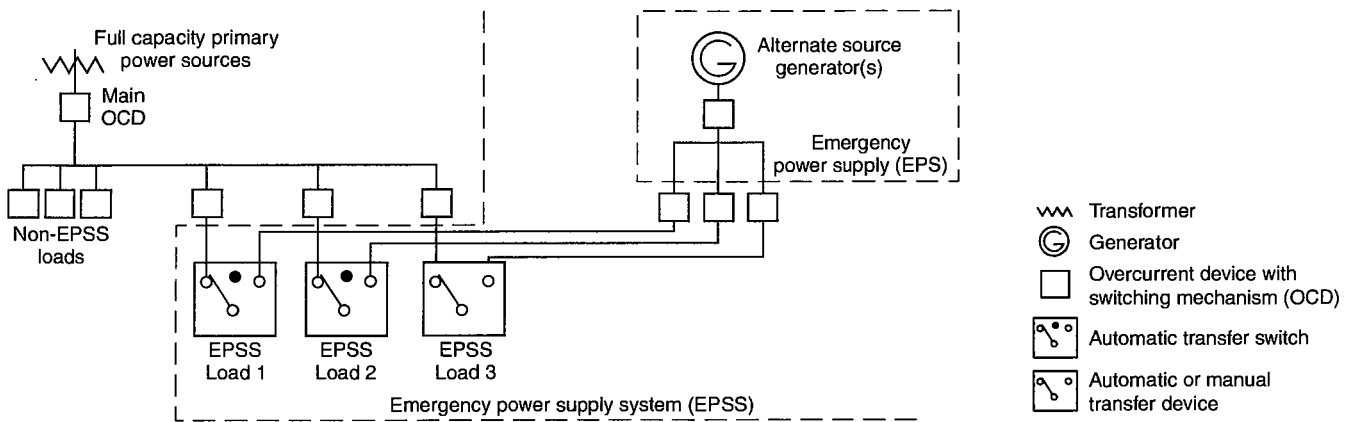
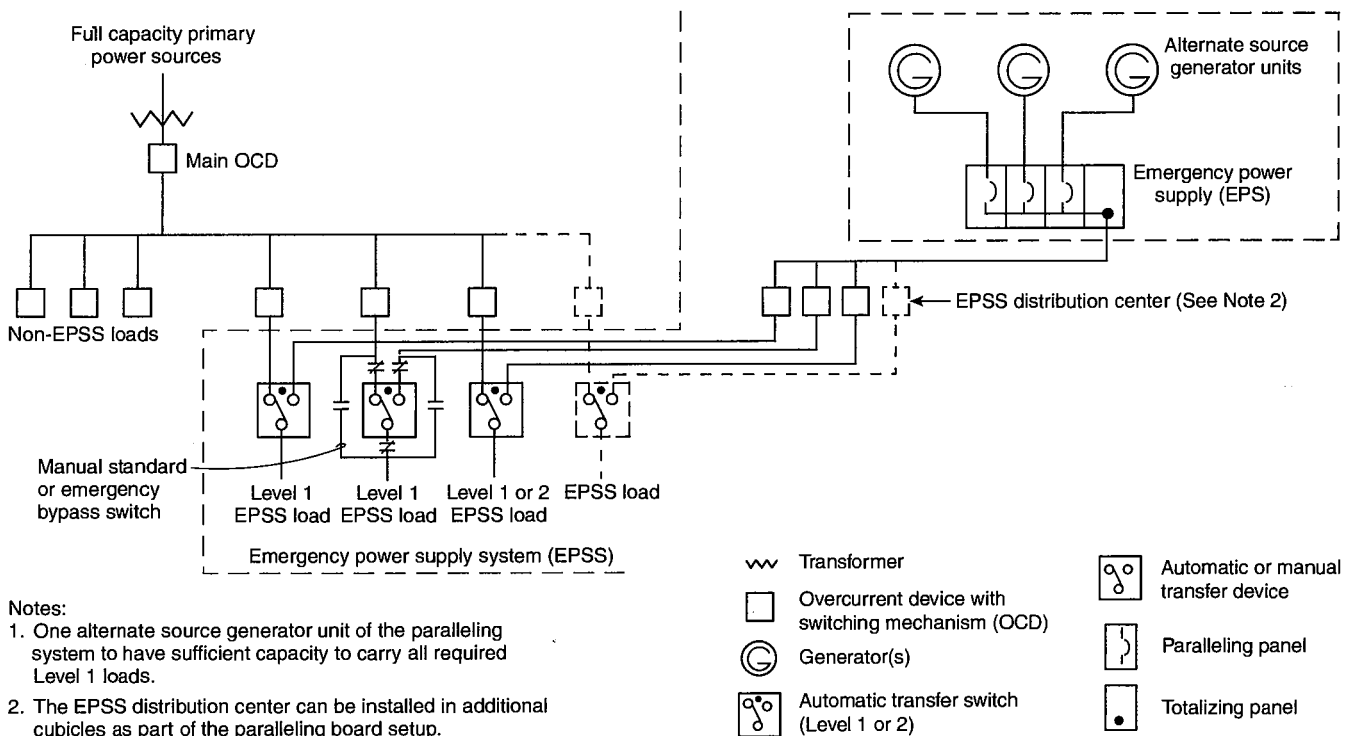


FIGURE B.1(a) Typical Rotating Emergency Power Supply System.



Notes:

1. One alternate source generator unit of the paralleling system to have sufficient capacity to carry all required Level 1 loads.
2. The EPSS distribution center can be installed in additional cubicles as part of the paralleling board setup.

FIGURE B.1(b) Typical Multiple-Unit Emergency Power Supply System.

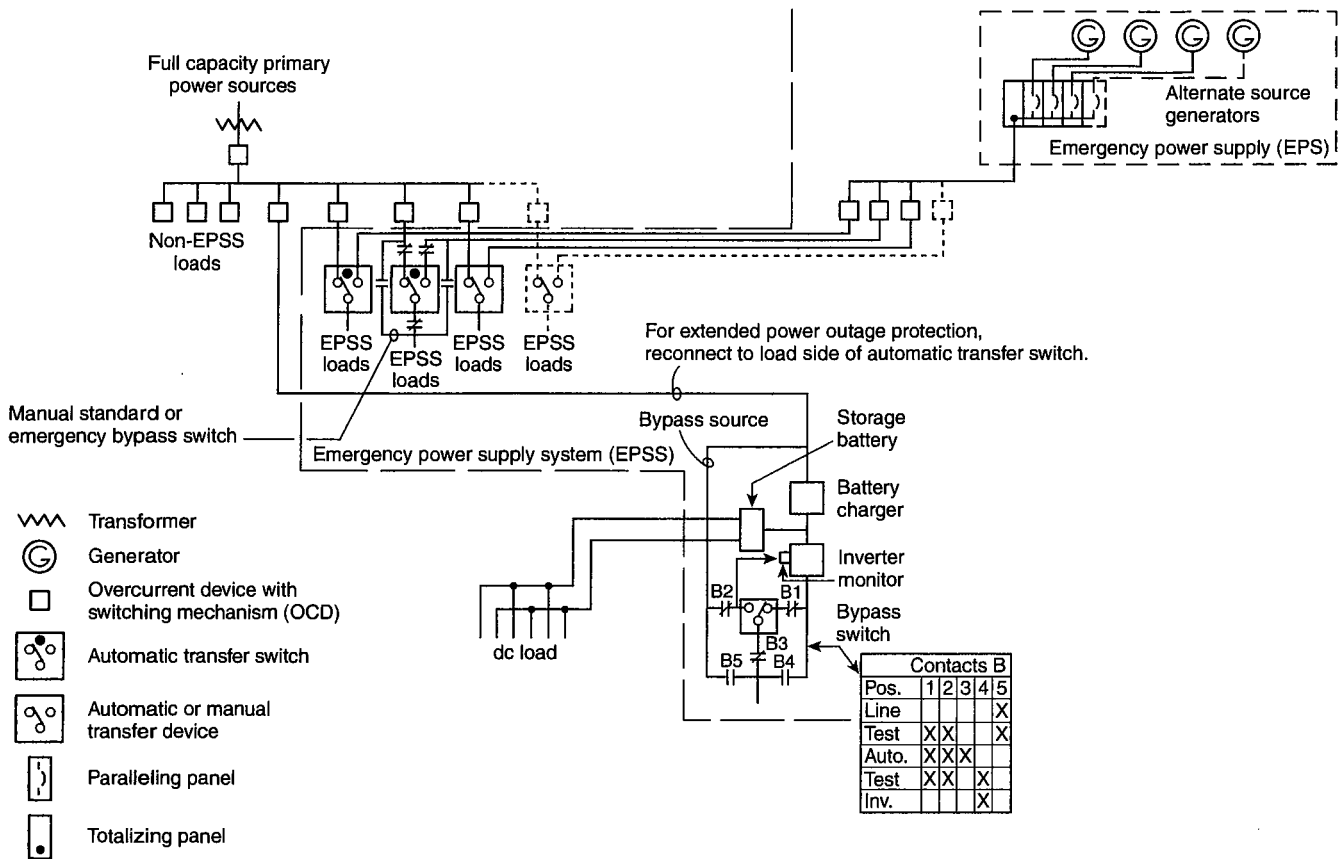


FIGURE B.1(c) Typical Composite Emergency Power Supply System.

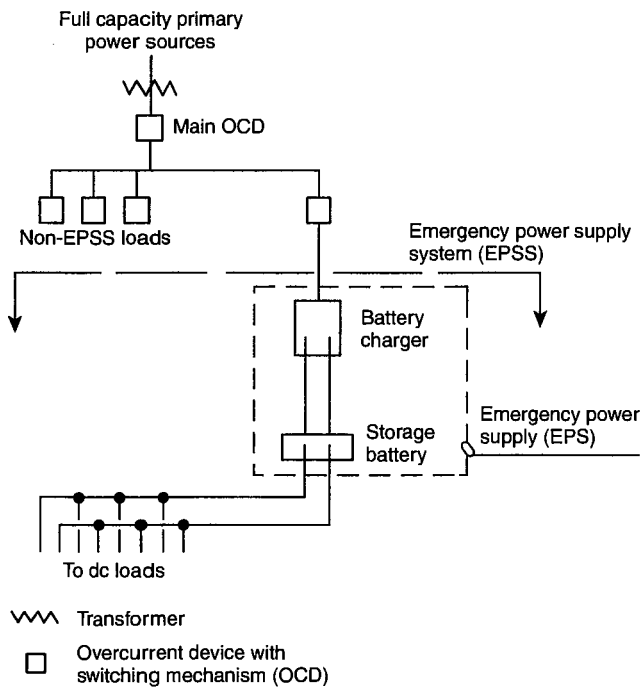


FIGURE B.1(d) Typical Uninterruptible Power Supply (UPS) System.

Annex C Informational References

C.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

C.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2013 edition.

NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, 2010 edition.

NFPA 54, *National Fuel Gas Code*, 2012 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2011 edition.

NFPA 70®, *National Electrical Code®*, 2011 edition.

NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*, 2010 edition.

NFPA 99, *Health Care Facilities Code*, 2012 edition.

NFPA 101®, *Life Safety Code®*, 2012 edition.

NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, 2013 edition.

C.1.2 Other Publications.

C.1.2.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI C 84.1, *Standard for Electric Power Systems and Equipment — Voltage Ratings (60 hertz)*, 2006.

C.1.2.2 ASCE Publications. American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA 20191.

ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*, 2010.

C.1.2.3 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM D 975, *Standard Specification for Diesel Fuel Oils*, 2011b.

ASTM D 1835, *Standard Specification for Liquefied Petroleum (LP) Gases*, 2011.

C.1.2.4 IEEE Publications. IEEE, Three Park Avenue, 17th Floor, New York, NY 10016-5997.

ANSI/IEEE 493, *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems*, 2007.

C.1.2.5 NEMA Publications. National Electrical Manufacturers Association, 1300 North 17th Street, Suite, 1847, Rosslyn, VA 22209.

ANSI/NEMA MG 1, *Standard for Motors and Generators*, 2009.

ANSI/NEMA MG 2, *Safety Standard and Guide for Selection, Installation and Use of Electric Motors and Generators*, 2001, Revision 1, 2007.

C.1.2.6 National Hurricane Center, 11691 SW 17th Street, Miami, FL 33165-2149.

SLOSH (Sea, Lake and Overland Surges from Hurricanes) Model.

C.2 Informational References. The following documents or portions thereof are listed here as informational resources only. They are not a part of the requirements of this document.

C.2.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 72[®], *National Fire Alarm and Signaling Code*, 2013 edition.

C.3 References for Extracts in Informational Sections. (Reserved)

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- 3.3.154* Site of Intentional Expulsion.** All points within 0.3 m (1 ft) of a point at which an oxygen-enriched atmosphere is intentionally vented to the atmosphere. (MED)
- 3.3.155 Space.** A portion of the health care facility designated by the governing body that serves a specific purpose.
- 3.3.156 Standard Cubic Feet per Minute (SCFM).** Volumetric flow rate of gas in units of standard cubic feet per minute. (PIP)
- 3.3.157 Station Inlet.** An inlet point in a piped medical/surgical vacuum distribution system at which the user makes connections and disconnections. (PIP)
- 3.3.158 Station Outlet.** An outlet point in a piped medical gas distribution system at which the user makes connections and disconnections. (PIP)
- 3.3.159 Supply Source.**
- 3.3.159.1 Operating Supply.** The portion of the supply system that normally supplies the piping systems. The operating supply consists of a primary supply or a primary and secondary supply. (PIP)
 - 3.3.159.2 Primary Supply.** That portion of the source equipment that actually supplies the system. (PIP)
 - 3.3.159.3 Reserve Supply.** Where provided, that portion of the source equipment that automatically supplies the system in the event of failure of the primary and secondary operating supply. (PIP)
 - 3.3.159.4 Secondary Supply.** Where provided, that portion of the source equipment that automatically supplies the system when the primary supply becomes exhausted. (PIP)
- 3.3.160* Surface-Mounted Medical Gas Rail Systems.** A surface-mounted gas delivery system intended to provide ready access for two or more gases through a common delivery system to provide multiple gas station outlet locations within a single patient room or critical care area. (PIP)
- 3.3.161 Task Illumination.** Provisions for the minimum lighting required to carry out necessary tasks in the areas described in Chapter 6, including safe access to supplies and equipment and access to exits. (ELS)
- 3.3.162 Terminal.** The end of a flexible hose or tubing used in a manufactured assembly where the user is intended to make connection and disconnection. (PIP)
- 3.3.163 Touch Current.** Leakage current flowing from the enclosure or from parts thereof, excluding patient connections, accessible to any operator or patient in normal use, through an external path other than the protective grounding (earth) conductor to earth or to another part of the enclosure. (MED)
- 3.3.164 Transfilling.** The process of transferring a medical gas in gaseous or liquid state from one container or cylinder to another container or cylinder. (MED)
- 3.3.165 Tube.**
- 3.3.165.1* Endotracheal Tube.** A tube for insertion through the mouth or nose into the upper portion of the trachea (windpipe). (MED)
- 3.3.166 Use Point.** A location with any number of station outlets and inlets arranged for access by a practitioner during treatment of a patient. (PIP)
- 3.3.167 Vaporizer.** A heat exchange unit designed to convert cryogenic liquid into the gaseous state. (PIP)
- 3.3.168 Ventilation.** The mechanical or natural movement of air. (MEC)
- 3.3.169 Waste Anesthetic Gas Disposal (WAGD).** The process of capturing and carrying away gases vented from the patient breathing circuit during the normal operation of gas anesthesia or analgesia equipment. (PIP)
- 3.3.170 Waste Water.**
- 3.3.170.1 Black Waste Water.** Grossly contaminated and contain pathogenic, toxicogenic, or other harmful agents.
 - 3.3.170.2 Clear Waste Water.** Originates from a sanitary water source and does not pose substantial risk from dermal, ingestion, or inhalation exposure.
 - 3.3.170.3 Gray Waste Water.** Contains significant contamination and has the potential to cause discomfort or sickness if contacted or consumed by humans. Can contain potentially unsafe levels of microorganisms or nutrients for microorganisms, as well as other organic or inorganic matter (chemical or biological).
- 3.3.171* Wet Procedure Locations.** The area in a patient care space where a procedure is performed that is normally subject to wet conditions while patients are present, including standing fluids on the floor or drenching of the work area, either of which condition is intimate to the patient or staff. (FUN)
- 3.4 BICSI Definitions.** These terms are defined in *The BICSI Information Transport Systems (ITS) Dictionary*. (HES)
- 3.4.1 Telecommunications Entrance Facility (EF).** An entrance to a building for both public and private network service cables that includes the building entrance point and the entrance room or space at the point of demarcation between campus or utility service and building interior distribution of communications systems. (ELS)
- 3.4.2 Telecommunications Equipment Room (TER).** An environmentally controlled centralized space for telecommunications equipment, typically including main or intermediate cross-connect equipment and cabling. (ELS)
- 3.4.3 Telecommunications Room (TR).** An enclosed architectural space for housing telecommunications equipment, cable terminations, and cross-connect cabling, serving a floor or an area of a floor. (ELS)

Chapter 4 Fundamentals

4.1* Risk Categories. Activities, systems, or equipment shall be designed to meet Category 1 through Category 4 requirements, as detailed in this code.

4.1.1* Category 1. Activities, systems, or equipment whose failure is likely to cause major injury or death of patients, staff, or visitors shall be designed to meet Category 1 requirements, as detailed in this code.

4.1.2* Category 2. Activities, systems, or equipment whose failure is likely to cause minor injury of patients, staff, or visitors shall be designed to meet Category 2 requirements, as detailed in this code.

4.1.3 Category 3. Activities, systems, or equipment whose failure is not likely to cause injury to patients, staff, or visitors, but

- (2) The final tests required by 5.3.12.2.11 through 5.3.12.2.15 shall be performed by one or more of the following, who shall be experienced with the installation, operation, and testing of Category 3 gas-powered device supply systems and vacuum systems:
- (a) Installer
 - (b) Representative of the system supplier
 - (c) Representative of the system manufacturer
 - (d) ASSE 6030 medical gas system's verifier
- (3) The test gas shall be oil-free, dry nitrogen NF or the system gas or vacuum.

5.3.12.2.11 Final Standing Pressure Test (Category 3 Dental Air and Nitrogen). Each gas-powered device piping system shall be subjected to a 10-minute standing pressure test at operating line pressure using the following procedures:

- (1) After the system is filled with oil-free, dry nitrogen NF or the system gas, the source valve shall be closed.
- (2) The piping system downstream of the valve shall show no decrease in pressure after 10 minutes.
- (3) Any leaks found shall be located, repaired (unless prohibited) or replaced (if required) by the installer, and retested.

5.3.12.2.12 Final Standing Vacuum Test (Category 3 Vacuum Systems). Each Category 3 vacuum piping system shall be subjected to a 10-minute standing vacuum test at operating line vacuum using the following procedures:

- (1) After the system has stabilized at the operating line vacuum, the source valve and any zone valves shall be closed.
- (2) The piping system upstream of the valves shall show no decrease in vacuum after 10 minutes.
- (3) Leaks, if any, shall be located, repaired (unless prohibited) or replaced (if required) by the installer, and retested.

5.3.12.2.13 Final Cross-Connection Test (Category 3 Gas-Powered Devices and Vacuum and Scavenging Systems). After closing of walls and completion of the requirements of 5.3.12.2, it shall be determined that no cross-connections exist between the piping systems for Category 3 gas-powered devices and vacuum and scavenging systems using the following method:

- (1) Test each piping system independently, starting with the vacuum systems first, and check that the test vacuum is present only at inlets of the system being tested.
- (2) Reduce all piping systems to atmospheric pressure.
- (3) Operate the Category 3 vacuum or scavenging system being tested at the normal system vacuum, using the source equipment.
- (4) Test each gas outlet and vacuum inlet using appropriate adapters to verify that vacuum is present only at the vacuum inlets in the system being tested, and not at any gas outlets or inlets.
- (5) Shut down the vacuum source equipment and slowly break the vacuum in the vacuum piping system, increasing its pressure to atmospheric.
- (6) Test each Category 3 vacuum system until all are determined to be free of cross-connections.
- (7) Using oil-free, dry nitrogen NF or the system gas, pressurize the gas piping system to a gauge pressure of 345 kPa (50 psi).
- (8) Test each gas-powered device gas outlet using appropriate adapters to verify that the test gas pressure is present

only at the outlets in the gas-powered device system being tested.

- (9) After it has been determined that a gas-powered device piping system is free of cross-connections, disconnect the source of test gas and reduce the piping to atmospheric pressure.
- (10) Proceed to test each gas-powered device piping system until all are determined to be free of cross-connections.

5.3.12.2.14 Final Piping Purge Test (Category 3 Gas-Powered Devices). To remove any traces of particulate matter deposited in the pipelines as a result of construction, a heavy, intermittent purging of each gas-powered device pipeline shall be done.

- (1) The appropriate adapter shall be obtained from the facility or manufacturer, and high purge rates shall be put on each outlet.
- (2) After the purge is started, it shall be rapidly interrupted several times until the purge produces no discoloration in a white cloth loosely held over the adapter during the purge.
- (3) To avoid possible damage to the outlet and its components, the test shall not be conducted using any implement other than the correct adapter.

5.3.12.2.15 Final Tie-In Test (Category 3 Dental Air, Nitrogen, and Vacuum Systems).

- (1) Prior to the connection of any new piping in extensions or additions to an existing piping system, the final tests in 5.3.12.2 shall be successfully performed on the new work.
- (2) Each joint in the final connection between the new work and the existing system shall be leak-tested, with the gas of system designation or vacuum at the normal operating pressure or vacuum, by means of a leak detectant that is safe for use with oxygen and does not contain ammonia.
- (3) For gas piping, immediately after a final connection is made and leak-tested, the specific altered zone and components in the immediate zone or area that is downstream from the point or area of intrusion shall be purged per 5.3.12.2.14.

5.3.12.2.16 Source Equipment Testing (Category 3 Dental Air, Nitrogen, and Vacuum Systems). Source equipment testing shall be conducted as follows:

- (1) Source equipment checks shall be performed following the installation of the interconnecting pipelines, accessories, and source equipment.
- (2) Where the source equipment and system gas or vacuum is used for testing of the distribution piping, the source equipment shall be checked out and placed in operation prior to testing the distribution piping.
- (3) The source equipment shall be checked out and placed in operation according to the manufacturer's instructions.

5.3.13 Reserved.

5.3.14 Operation and Management of Category 3 Systems. Category 3 systems shall comply with 5.2.14.

Chapter 6 Electrical Systems

6.1* Applicability.

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

6.1.2 The following paragraphs of this chapter shall apply to new and existing health care facilities:

- (1) 6.3.2.2.4.2
- (2) 6.3.2.2.6.1
- (3) 6.3.2.2.6.2(F)
- (4) 6.3.2.2.8.5(B)(2) and (3)
- (5) 6.3.2.2.8.7
- (6) 6.3.4
- (7) 6.4.1.1.18.7
- (8) 6.4.2.2.6.2(C)
- (9) 6.4.2.2.6.3
- (10) 6.4.4
- (11) 6.5.4

6.1.3 Paragraph 6.3.2.2.2.3 shall apply only to existing facilities.

6.2 Nature of Hazards.

6.2.1* Fire and Explosions.

6.2.2 Shock. (Reserved)

6.2.3 Thermal. (Reserved)

6.3 Electrical System.

6.3.1 **Sources.** Each health care appliance requiring electrical line power for operation shall be supported by power sources that provide power adequate for each service.

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 **Electrical Installation.** Installation shall be in accordance with *NFPA 70, National Electrical Code*.

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

6.3.2.2 All Patient Care Rooms.

6.3.2.2.1* **Branch circuit wiring 600 V or less** shall comply with the requirements in 6.3.2.2.1.1 through 6.3.2.2.1.4.

6.3.2.2.1.1* Circuits.

(A) Branch circuits serving a given patient bed location shall be fed from not more than one normal branch-circuit distribution panel.

(B) When required, branch circuits serving a given patient bed location shall be permitted to be fed from more than one critical branch-circuit distribution panel.

6.3.2.2.1.2 **Category 1 Spaces.** 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.

6.3.2.2.1.3 Access to Overcurrent Protective Devices.

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

(B) Overcurrent protective devices serving Category 1 and Category 2 spaces shall not be permitted to be located in public access spaces.

(C) Where used in locations such as in Category 1 spaces, isolated power panels shall be permitted in those locations.

6.3.2.2.1.4 **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 6.3.2.2.1.2.

6.3.2.2.2 **Grounding requirements** shall comply with the requirements in 6.3.2.2.2.1 through 6.3.2.2.2.4.

6.3.2.2.2.1 **Grounding Circuitry Integrity.** Grounding circuits and conductors in patient care spaces shall be installed in such a way that the continuity of other parts of those circuits cannot be interrupted nor the resistance raised above an acceptable level by the installation, removal, and replacement of any installed equipment, including power receptacles.

6.3.2.2.2.2 **Reliability of Grounding.** The grounding conductor shall conform to *NFPA 70, National Electrical Code*.

6.3.2.2.2.3 **Separate Grounding Conductor.** When existing construction does not have a separate grounding conductor, the continued use of the system shall be permitted, provided that it meets the performance requirements in 6.3.3.1.

6.3.2.2.2.4 **Metal Receptacle Boxes.** Where metal receptacle boxes are used, the performance of the connection between the receptacle grounding terminal and the metal box shall be equivalent to the performance provided by copper wire no smaller than 12 AWG.

6.3.2.2.3* **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.

6.3.2.2.4 Protection Against Ground Faults.

6.3.2.2.4.1* **Equipment Protection.** The main and downstream ground-fault protective devices (where required) shall be coordinated as required in 6.3.2.5.

6.3.2.2.4.2 **Personnel Protection.** If used, ground-fault circuit interrupters (GFCIs) shall be listed.

6.3.2.2.5 **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, provided that 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, provided that load currents are not carried in the grounding conductors.

6.3.2.2.6 Receptacles.

6.3.2.2.6.1* Types of Receptacles.

(A) Each power receptacle shall provide at least one separate, highly dependable grounding pole capable of maintaining low-contact resistance with its mating plug, despite electrical and mechanical abuse. 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
- (3) Where required for reduction of electrical noise on the grounding circuit, receptacles in which the grounding terminals are purposely insulated from the receptacle yoke

(C) All single, duplex, or quadruplex type receptacles, or any combination thereof, located at patient bed locations in Category 1 spaces shall be listed hospital grade.

6.3.2.2.6.2 Minimum Number of Receptacles. The number of receptacles shall be determined by the intended use of the spaces in accordance with 6.3.2.2.6.2(A) through 6.3.2.2.6.2(F).

(A) **Receptacles for Patient Bed Locations in Category 2 Spaces.** Each patient bed location shall be provided with a minimum of eight receptacles. They shall be permitted to be of the locking or nonlocking type, single, duplex, or quadruplex type, or any combination of the three. All receptacles shall be listed hospital grade.

(B) **Receptacles for Patient Bed Locations in Category 1 Spaces.** Each patient bed location shall be provided with a minimum of 14 receptacles. They shall be permitted to be of the locking or nonlocking type, single, duplex, or quadruplex type, or any combination of the three. All receptacles shall be listed hospital grade.

(C) **Receptacles for Operating Rooms.** Operating rooms shall be provided with a minimum of 36 receptacles. They shall be permitted to be of the locking or nonlocking type, single, duplex, or quadruplex type, or any combination of the three. All receptacles shall be listed hospital grade.

(D) **Receptacles for Bathrooms or Toilets.** 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).

(F) **Designated Pediatric Locations.** Receptacles that are located within the patient rooms, bathrooms, playrooms, and activity rooms of pediatric units or spaces with similar risk as determined by the governing body, other than nurseries, shall be listed tamper-resistant or shall employ a listed tamper-resistant cover.

6.3.2.2.6.3 Polarity of Receptacles. Each receptacle shall be wired in accordance with *NFPA 70, National Electrical Code*, to ensure correct polarity.

6.3.2.2.6.4 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.

6.3.2.2.7 Special Grounding.

6.3.2.2.7.1* 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 herein.

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

6.3.2.2.7.2 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.

6.3.2.2.7.3* 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.

6.3.2.2.8 Wet Procedure Locations.

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

6.3.2.2.8.2 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

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

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

6.3.2.2.8.5 In existing construction, the requirements of 6.3.2.2.8.1 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, National Electrical Code*, and the applicable performance requirements of this chapter.

(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

6.3.2.2.8.6 The use of an isolated power system (IPS) shall be permitted as a protective means capable of limiting ground-fault current without power interruption. When installed, such a power system shall conform to the requirements of 6.3.2.6.

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

6.3.2.2.8.8 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.

6.3.2.2.9 Isolated Power.

6.3.2.2.9.1 An isolated power system shall not be required to be installed in any patient care space, except as specified in 6.3.2.2.8.

6.3.2.2.9.2 The system shall be permitted to be installed where it conforms to the performance requirements specified in 6.3.2.6.

6.3.2.2.10 Essential Electrical Systems (EES).

6.3.2.2.10.1 Category 1 spaces shall be served only by a Type 1 EES.

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

6.3.2.2.10.3 A Type 1 EES serving a Category 1 space shall be permitted to serve Category 2 spaces in the same facility.

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

6.3.2.2.11 Battery-Powered Lighting Units.

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

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

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

6.3.2.2.11.4 Units shall be capable of providing lighting for 1½ hours.

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

6.3.2.3 Laboratories. Outlets with two to four receptacles, or an equivalent power strip, 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.

6.3.2.4 Other Nonpatient Areas. (Reserved)**6.3.2.5 Ground-Fault Protection.**

6.3.2.5.1 Applicability. The requirements of 6.3.2.5.2 shall apply to hospitals and other buildings housing Category 1 spaces or utilizing life-support equipment and buildings that provide essential utilities or services for the operation of Category 1 spaces or electrical life-support equipment.

6.3.2.5.2 When ground-fault protection is provided for operation of the service or feeder disconnecting means, an additional step of ground-fault protection shall be provided in the next level of feeder downstream toward the load.

6.3.2.5.3 Ground-fault protection for operation of the service and feeder disconnecting means shall be fully selective such that the downstream device and not the upstream device shall open for downstream ground faults.

6.3.2.6* Isolated Power Systems.**6.3.2.6.1 Isolation Transformer.**

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

6.3.2.6.1.2 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.

6.3.2.6.1.3 Wiring of isolated power systems shall be in accordance with 517.160 of *NFPA 70, National Electrical Code*.

6.3.2.6.2 Impedance of Isolated Wiring.

6.3.2.6.2.1* 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 6.3.2.6.3*) 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.

6.3.2.6.2.2 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.

6.3.2.6.3 Line Isolation Monitor.

6.3.2.6.3.1* 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.

6.3.2.6.3.2 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.

6.3.2.6.3.3* 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 maxi-

imum 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.

6.3.2.6.3.4* 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.

6.3.2.6.3.5 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.

6.3.2.6.3.6 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.

6.3.2.6.3.7 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 10^4 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 10^4 . 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.

6.3.2.6.4 Identification of Conductors for Isolated (Un-grounded) Systems. The isolated conductors shall be identified in accordance with 517.160(A)(5) of *NFPA 70, National Electrical Code*.

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 ± 20 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 ± 20 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).

6.3.3.3 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 $200 \times V$ (ohms), where V equals measured line voltage. The visual and audible alarms (see 6.3.2.6.3.2) shall be activated.

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 6.3.2.5.

6.3.4* Administration of Electrical System.

6.3.4.1 Maintenance and Testing of Electrical System.

6.3.4.1.1 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.

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

6.3.4.1.3 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.

6.3.4.1.4 The LIM circuit shall be tested at intervals of not more than 1 month by actuating the LIM test switch (see 6.3.2.6.3.6). 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.

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

6.3.4.2 Record Keeping.

6.3.4.2.1* General.

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

6.3.4.2.1.2 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.

6.3.4.2.2 Isolated Power System (Where Installed). A permanent record shall be kept of the results of each of the tests.

6.4 Essential Electrical System Requirements — Type 1.

6.4.1 Sources (Type 1 EES).

6.4.1.1 On-Site Generator Set.

6.4.1.1.1* Design Considerations. Dual sources of normal power shall not constitute an alternate source of power as described in this chapter.

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

6.4.1.1.1.2 The following factors shall be considered in the design of the distribution system:

- (1) Abnormal voltages, such as single phasing of three-phase utilization equipment; switching or lightning surges, or both; voltage reductions; and so forth
- (2) Capability of achieving the fastest possible restoration of any given circuit(s) after clearing a fault
- (3) Effects of future changes, such as increased loading or supply capacity, or both
- (4) Stability and power capability of the prime mover during and after abnormal conditions
- (5)*Sequence reconnection of loads to avoid large current inrushes that trip overcurrent devices or overload the generator(s)
- (6) Bypass arrangements to allow testing and maintenance of system components that could not otherwise be maintained without disruption of important hospital functions
- (7) Effects of any harmonic currents on neutral conductors and equipment

6.4.1.1.2 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.

6.4.1.1.3 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 critical care areas, medical air compressors, medical-surgical vacuum pumps, fire pumps, the pressure maintenance (jockey) pump(s) for water-based fire protection systems, generator fuel pumps, or other generator accessories.

6.4.1.1.4 Essential electrical systems shall have a minimum of the following two independent sources of power: a normal source generally supplying the entire electrical system and one or more alternate sources for use when the normal source is interrupted.

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

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

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

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

6.4.1.1.7 Fuel Cell Systems. Fuel cell systems shall be permitted to serve as the alternate source for all or part of an essential electrical system, provided the following conditions apply:

6.4.1.1.7.1 Installation shall comply with NFPA 853, *Standard for Installation of Stationary Fuel Cell Power Systems*.

6.4.1.1.7.2 N+1 units shall be provided where N units have sufficient capacity to supply the demand load of the portion of the system served.

6.4.1.1.7.3* System shall be able to assume loads within 10 seconds of loss of normal power source.

6.4.1.1.7.4 System shall have a continuing source of fuel supply, together with sufficient on-site fuel storage for the essential system type.

6.4.1.1.7.5 A connection shall be provided for a portable diesel generator to supply life safety and critical portions of the distribution system (if present).

6.4.1.1.8 Uses for Essential Electrical System.

6.4.1.1.8.1 The generating equipment used shall be either reserved exclusively for such service or normally used for other purposes of peak demand control, internal voltage control, load relief for the external utility, or cogeneration. If normally used for such other purposes, two or more sets shall be installed, such that the maximum actual demand likely to be produced by the connected load of the life safety and critical branches, as well as medical air compressors, medical-surgical vacuum pumps, electrically operated fire pumps, jockey pumps, fuel pumps, and generator accessories, shall be met by a multiple generator system, with the largest generator set out of service (not available). The alternate source of emergency power for illumination and identification of means of egress shall be the essential electrical system. The alternate power source for fire protection signaling systems shall be the essential electrical system.

6.4.1.1.8.2 A single generator set that operates the essential electrical system shall be permitted to be part of the system supplying the other purposes as specified in 6.4.1.1.8.1, provided that any such use will not decrease the mean period between service overhauls to less than 3 years.

6.4.1.1.8.3* Optional loads shall be permitted to be served by the essential electrical system generating equipment. Optional loads shall be served by their own transfer means, such that these loads shall not be transferred onto the generating equipment if the transfer will overload the generating equipment and shall be shed upon a generating equipment overload. Use of the generating equipment to serve optional loads shall not constitute "other purposes" as described in 6.4.1.1.8.1 and, therefore, shall not require multiple generator sets.

6.4.1.1.8.4 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, *Life Safety Code*; Article 700 of NFPA 70, *National Electrical Code*; and other applicable NFPA requirements for emergency egress under load-shed conditions.

6.4.1.1.9 Work Space or Room.

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

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

(B) The rooms, enclosures, or separate buildings housing Level 1 or Level 2 EPSS equipment shall be designed and located to minimize damage from flooding, including that caused by the following:

- (1) Flooding resulting from fire fighting
- (2) Sewer water backup
- (3) Other disasters or occurrences

[110:7.2.3]

6.4.1.1.9.2 The EPS 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. [110:7.2.6]

6.4.1.1.10* Capacity and Rating. The generator set(s) shall have the capacity and rating to meet the maximum actual demand likely to be produced by the connected load of the essential electrical system(s).

6.4.1.1.11 Load Pickup. The energy converters shall have the required capacity and response to pick up and carry the load within the time specified in Table 4.1 (b) of NFPA 110, *Standard for Emergency and Standby Power Systems*, after loss of primary power.

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

6.4.1.1.13* Heating, Cooling, and Ventilating. With the EPS running at rated load, ventilation airflow shall be provided to limit the maximum air temperature in the EPS room or the enclosure housing the unit to the maximum ambient air temperature required by the EPS manufacturer. [110:7.7.1]

6.4.1.1.13.1 Consideration shall be given to all the heat emitted to the EPS equipment room by the energy converter, un-insulated or exhaust pipes, and other heat-producing equipment. [110:7.7.1.1]

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

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

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

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

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

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

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

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

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

6.4.1.1.13.6 The ambient air temperature in the EPS equipment room or outdoor housing containing Level 1 rotating equipment shall be not less than 4.5°C (40°F). [110:5.3.5]

6.4.1.1.13.7 Units housed outdoors shall be heated as specified in 5.3.1 [of NFPA 110, *Standard for Emergency and Standby Power Systems*]. [110:7.7.7]

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

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

[110:7.7.7]

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

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

- (1) Where two complete periods of cranking cycles are completed without replacement of the stored energy
- (2) Where a means for automatic restoration from the emergency source of the stored energy is provided
- (3) Where the stored energy system has the cranking capacity specified in 5.6.4.2.1 of NFPA 110, *Standard for Emergency and Standby Power Systems*
- (4) Where the stored energy system has a "black start" capability in addition to normal discharge capability

[110:5.6.4.1.2]

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

6.4.1.1.17 Requirements for Safety Devices.

6.4.1.1.17.1 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 6.4.1.1.12
- (2) Sensor devices plus visual pre-alarm 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 pre-alarm or alarm conditions exist

6.4.1.1.17.2 Safety indications and shutdowns shall be in accordance with Table 6.4.1.1.17.2.

6.4.1.1.18 Alarm Annunciator. 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 (*see 700.12 of NFPA 70, National Electrical Code*). The annunciator shall be hard-wired to indicate alarm conditions of the emergency or auxiliary power source as follows:

- (1) Individual visual signals shall indicate the following:
 - (a) When the emergency or auxiliary power source is operating to supply power to load
 - (b) When the battery charger is malfunctioning
- (2) Individual visual signals plus a common audible signal to warn of an engine-generator alarm condition shall indicate the following:
 - (a) Low lubricating oil pressure
 - (b) Low water temperature (below that required in 6.4.1.1.12)
 - (c) Excessive water temperature
 - (d) Low fuel when the main fuel storage tank contains less than a 4-hour operating supply
 - (e) Overcrank (failed to start)
 - (f) Overspeed

6.4.1.1.18.1* A remote, common audible alarm shall be provided as specified in 6.4.1.1.18.6. [110:5.6.6]

6.4.1.1.18.2 The following annunciation shall be provided at a minimum:

- (1) For Level 1 EPS, local annunciation and facility remote annunciation, or local annunciation and network remote annunciation
- (2) For Level 2 EPS, local annunciation

[110:5.6.6.2]

6.4.1.1.18.3 For the purposes of defining the types of annunciation in 6.4.1.1.18.2, 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]

Table 6.4.1.1.17.2 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 pre-alarm	X	—	X
(d) High engine temperature	X	X	X
(e) Low lube oil pressure pre-alarm	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) shall be provided, but a separate remote audible signal shall not be required when the regular work site in 5.6.6 of NFPA 110, *Standard for Emergency and Standby Power Systems*, 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 shall be permitted for this function.
- (5) All required CV functions shall be visually annunciated by a remote, common visual indicator.
- (6) All required functions indicated in the RA column shall 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.

6.4.1.1.18.4 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]

6.4.1.1.18.5 In lieu of the requirement of 5.6.6.4 of NFPA 110, a manual alarm-silencing means shall be permitted that silences the audible alarm after the occurrence of the alarm condition, provided such means do not inhibit any subsequent alarms from sounding the audible alarm again without further manual action. [110: 5.6.6.5]

6.4.1.1.18.6 Individual alarm indication to annunciate any of the conditions listed in Table 6.4.1.1.17.2 shall have the following characteristics:

- (1) It shall be battery powered.
- (2) It shall be visually indicated.
- (3) It shall have additional contacts or circuits for a common audible alarm that signals locally and remotely when any of the itemized conditions occurs.

- (4) It shall have a lamp test switch(es) to test the operation of all alarm lamps.

6.4.1.1.18.7 A centralized computer system (e.g., building automation system) shall not be permitted to be substituted for the alarm annunciator in 6.4.1.1.18 but shall be permitted to be used to supplement the alarm annunciator.

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

6.4.2* Distribution (Type 1 EES).

6.4.2.1 General Requirements.

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

6.4.2.1.2* Coordination.

6.4.2.1.2.1 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.

6.4.2.1.2.2 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

6.4.2.1.3 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.

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

6.4.2.1.5 Automatic Transfer Switch Features.

6.4.2.1.5.1 Source Monitoring.

(A)* Undervoltage-sensing devices shall be provided to monitor all ungrounded lines of the primary source of power 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 emergency power supply (EPS).
- (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 primary power shall be initiated.

[110:6.2.2.1]

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

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

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

(E) Frequency-sensing equipment shall not be required for monitoring the public utility source where used as an EPS, as permitted by 5.1.3 of NFPA 110. [110:6.2.2.3.2]

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

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

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

6.4.2.1.5.5 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]

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

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

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

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

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

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

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

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

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

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

6.4.2.1.5.10 Engine Generator Exercising Timer. A program timing device shall be provided to exercise the EPS as described in Chapter 8 of NFPA 110. [110:6.2.11]

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

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

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

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

6.4.2.1.5.12* 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]

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

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

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

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

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

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

6.4.2.1.7 Nonautomatic Transfer Device Features.

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

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

6.4.2.1.7.3 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]

6.4.2.1.8 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]

6.4.2.1.8.1 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]

6.4.2.1.8.2 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]

6.4.2.1.8.3* 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]

6.4.2.1.8.4 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]

6.4.2.2 Branches.

6.4.2.2.1* General.

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

- (1) Life safety
- (2) Critical
- (3) Equipment

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

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

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

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

(B) 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.

6.4.2.2.1.5 For the purposes of this code, the provisions for emergency systems in Article 700 of *NFPA 70, National Electrical Code*, shall be applied only to the life safety branch.

6.4.2.2.1.6 The following portions of Article 700 of *NFPA 70* shall be amended as follows:

(A) 700.4 shall not apply.

(B) 700.10(D)(1) through (3) shall not apply.

(C) 700.17 Branch Circuits for Emergency Lighting. Branch circuits that supply emergency lighting shall be installed to provide service from a source complying with 700.12 when the normal supply for lighting is interrupted or where single circuits supply luminaires containing secondary batteries.

(D) 700.28 shall not apply.

6.4.2.2.2 Feeders from Alternate Source.

6.4.2.2.2.1 A single feeder supplied by a local or remote alternate source shall be permitted to supply the essential electrical system to the point at which the life safety, critical, and equipment branches are separated.

6.4.2.2.2.2 Installation of the transfer equipment shall be permitted at other than the location of the alternate source.

6.4.2.2.3 Life Safety Branch.

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

6.4.2.2.3.2 The life safety branch shall supply power as follows:

- (1) Illumination of means of egress in accordance with *NFPA 101, Life Safety Code*
- (2) Exit signs and exit directional signs in accordance with *NFPA 101, Life Safety Code*
- (3) *Hospital communications systems, where used for issuing instruction during emergency conditions
- (4) Generator set location as follows:
 - (a) Task illumination
 - (b) Battery charger for emergency battery-powered lighting unit(s)
 - (c) Select 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, National Fire Alarm and Signaling Code*

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

6.4.2.2.3.4 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 over-current protective devices.

6.4.2.2.3.5 No functions other than those in 6.4.2.2.3.2, 6.4.2.2.3.3, and 6.4.2.2.3.4 shall be connected to the life safety branch, except as specifically permitted in 6.4.2.2.3.

6.4.2.2.4* Critical Branch.

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

6.4.2.2.4.2 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) Critical care spaces that utilize anesthetizing gases, task illumination, select receptacles, and fixed equipment
- (2) Isolated power systems in special environments
- (3) 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)
- (4) Additional specialized patient care task illumination and receptacles, where needed
- (5) Nurse call systems
- (6) Blood, bone, and tissue banks
- (7)*Telephone equipment rooms and closets
- (8) Task illumination, select receptacles, and select power circuits for the following areas:
 - (a) General care beds with at least one duplex receptacle per patient bedroom, and task illumination as required by the governing body of the health care facility
 - (b) Angiographic labs
 - (c) Cardiac catheterization labs
 - (d) Coronary care units
 - (e) Hemodialysis rooms or areas
 - (f) Emergency room treatment areas (select)
 - (g) Human physiology labs
 - (h) Intensive care units
 - (i) Postoperative recovery rooms (select)
- (9) 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

6.4.2.2.5 Equipment Branch.

6.4.2.2.5.1 General. The equipment branch shall be connected to equipment described in 6.4.2.2.5.3 through 6.4.2.2.5.4.

6.4.2.2.5.2 Connection to Alternate Power Source.

(A) The equipment branch shall be installed and connected to the alternate power source, such that equipment described in 6.4.2.2.5.3 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 alternate power source shall also provide for the subsequent connection of equipment described in 6.4.2.2.5.4.

6.4.2.2.5.3* Equipment for Delayed-Automatic Connection.

(A) The following equipment shall be permitted to be arranged for delayed-automatic connection to the alternate power source:

- (1) Central suction systems serving medical and surgical functions, including controls, 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 6.4.2.2.5.3(A)(6) shall be permitted to be placed on the critical branch.

6.4.2.2.5.4* Equipment for Delayed-Automatic or Manual Connection. The following equipment shall be permitted to be arranged for either delayed-automatic or manual connection to the alternate power source (*also see A.6.4.2.2.5.3*):

- (1) Heating equipment used to provide heating for operating, delivery, labor, recovery, intensive care, coronary care, nurseries, infection/isolation rooms, emergency treatment spaces, and general patient rooms; and pressure maintenance (jockey or make-up) pump(s) for water-based fire protection systems
- (2)*Heating of general patient rooms during disruption of the normal source shall not be required under any of the following conditions:
 - (a) Outside design temperature is higher than -6.7°C ($+20^{\circ}\text{F}$)
 - (b) Outside design temperature is lower than -6.7°C ($+20^{\circ}\text{F}$), 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, coronary care, 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 6.4.2.2.4
- (9)*Other selected equipment

6.4.2.2.6 Wiring Requirements.

6.4.2.2.6.1* Separation from Other Circuits. The life safety branch and critical branch shall be kept independent of all other wiring and equipment.

6.4.2.2.6.2 Receptacles. The requirements for receptacles shall comply with 6.4.2.2.6.2(A), 6.4.2.2.6.2(B), and 6.4.2.2.6.2(C).

(A) The number of receptacles on a single branch circuit for areas described in 6.4.2.2.4.2(8) shall be minimized to limit the effects of a branch-circuit outage.

(B) Branch-circuit overcurrent devices shall be readily accessible to authorized personnel.

(C)* 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.

6.4.2.2.6.3 Switches. Switches of all types shall be permitted in the lighting circuits connected to the essential electrical system that do not serve as the illumination of egress as required by NFPA 101, *Life Safety Code*.

6.4.2.2.6.4 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, *National Electrical Code*.

6.4.2.2.6.5 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.

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

6.4.3 Performance Criteria and Testing (Type 1 EES).

6.4.3.1 Source. The life safety and critical branches shall be installed and connected to the alternate power source specified in 6.4.1.1.4 and 6.4.1.1.5 so that all functions specified herein for the life safety and critical branches are automatically restored to operation within 10 seconds after interruption of the normal source.

6.4.3.2 Transfer Switches.

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

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

6.4.3.2.3 Failure of the normal source shall automatically start the alternate source generator after a short delay, as described in 6.4.2.1.5.4. When the alternate power source has attained a voltage and frequency that satisfies minimum operating requirements of the essential electrical system, the load shall be connected automatically to the alternate power source.

6.4.3.2.4 Upon connection of the alternate power source, the loads comprising the life safety and critical branches shall be automatically re-energized. The load comprising the equipment system shall be connected either automatically after a time delay, as described in 6.4.2.1.5.6, or nonautomatically and in such a sequential manner as not to overload the generator.

6.4.3.2.5 When the normal power source is restored, and after a time delay, as described in 6.4.2.1.5.7, the automatic transfer switches shall disconnect the alternate source of power and connect the loads to the normal power source. The alternate power source generator set shall continue to run unloaded for a preset time delay, as described in 6.4.2.1.5.9.

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

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

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

6.4.4 Administration (Type 1 EES).

6.4.4.1 Maintenance and Testing of Essential Electrical System.

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

6.4.4.1.1.1 Maintenance of Alternate Power Source. The generator set or other alternate power source and associated equipment, including all appurtenance parts, shall be so maintained as to be capable of supplying service within the shortest time practicable and within the 10-second interval specified in 6.4.1.1.11 and 6.4.3.1.

6.4.4.1.1.2 The 10-second criterion shall not apply during the monthly testing of an essential electrical system. 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 6.4.3.1.

6.4.4.1.1.3 Maintenance shall be performed in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems*, Chapter 8.

6.4.4.1.1.4 Inspection and Testing. Criteria, conditions, and personnel requirements shall be in accordance with 6.4.4.1.1.4(A) through 6.4.4.1.1.4(C).

(A)* **Test Criteria.** Generator sets shall be tested 12 times a year, with testing intervals of not less than 20 days nor more than 40 days. Generator sets serving essential electrical systems shall be tested in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems*, Chapter 8.

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

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

6.4.4.1.2 Maintenance and Testing of Circuitry.

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

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

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

6.4.4.2 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.

6.5 Essential Electrical System Requirements — Type 2.

6.5.1 Sources (Type 2 EES). The requirements for sources for Type 2 essential electrical systems shall conform to those listed in 6.4.1.

6.5.2 Distribution (Type 2 EES).

6.5.2.1 General. The distribution requirements for Type 2 essential electrical systems shall conform to those listed in 6.4.2.1.

6.5.2.1.1* Coordination.

6.5.2.1.1.1 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.

6.5.2.1.1.2 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

6.5.2.2 Specific Requirements.

6.5.2.2.1* General.

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

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

- (1) Life safety branch
- (2) Equipment branch

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

6.5.2.2.1.4 For the purposes of this code, Article 700 shall only be applied to the life safety branch.

6.5.2.2.1.5 The following portions of Article 700 of *NFPA 70* shall be amended as follows:

(A) 700.4 shall not apply.

(B) 700.10(D)(1) through (3) shall not apply.

(C) 700.17 Branch Circuits for Emergency Lighting. Branch circuits that supply emergency lighting shall be installed to provide service from a source complying with 700.12 when the normal supply for lighting is interrupted or where single circuits supply luminaires containing secondary batteries.

(D) 700.28 shall not apply.

6.5.2.2.1.6 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.

6.5.2.2.2 Life Safety Branch.

6.5.2.2.2.1 The life safety branch shall supply power as follows:

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

6.5.2.2.2.2 No functions, other than those listed in 6.5.2.2.2.1(1) through 6.5.2.2.2.1(7), shall be connected to the life safety.

6.5.2.2.3 Equipment Branch.

6.5.2.2.3.1 General.

(A) The equipment branch shall be installed and connected to the alternate power source such that equipment listed in 6.5.2.2.3.2 is automatically restored to operation at appropriate time-lag intervals following the restoration of the life safety branch to operation.

(B) The equipment branch arrangement shall also provide for the additional connection of equipment listed in 6.5.2.2.3.3.

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

6.5.2.2.3.3 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 alternate 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

6.5.2.2.3.4* Delayed-Automatic or Manual Connections to Equipment Branch. The equipment in 6.5.2.2.3.4(A) and 6.5.2.2.3.4(B) 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.

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

- (1)*The outside design temperature is higher than -6.7°C ($+20^{\circ}\text{F}$).
- (2) The outside design temperature is lower than -6.7°C ($+20^{\circ}\text{F}$) and, where a selected room(s) is provided for the needs of all confined patients, then only such room(s) need be heated.
- (3) The facility is served by a dual source of normal power. See A.6.4.1.1.1 for more information.

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

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

(D) Multiple Systems. Where one switch serves multiple systems as permitted in 6.5.2.2, transfer for all loads shall be non-delayed automatic.

6.5.2.2.4 Wiring Requirements.

6.5.2.2.4.1* Separation from Other Circuits. The life safety and equipment branches shall be kept entirely independent of all other wiring and equipment.

6.5.2.2.4.2* 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.

6.5.3 Performance Criteria and Testing (Type 2 EES).

6.5.3.1 Source. The life safety and equipment branches shall be installed and connected to the alternate source of power specified in 6.4.1.1.4 and 6.4.1.1.5 so that all functions specified herein for the life safety and equipment branches are automatically restored to operation within 10 seconds after interruption of the normal source.

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

6.5.3.2.1 Failure of the normal source shall automatically start the alternate source generator after a short delay, as described in 6.4.2.1.5.4. When the alternate power source has attained a voltage and frequency that satisfies minimum operating requirements of the essential electrical system, the load shall be connected automatically to the alternate power source.

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

6.5.3.2.3 Upon connection of the alternate power source, the loads comprising the life safety and equipment branches shall be automatically re-energized. The loads comprising the equipment branch shall be connected either automatically after a time delay, as described in 6.4.2.1.5.6, or nonautomatically and in such a sequential manner as not to overload the generator.

6.5.3.2.4 When the normal power source is restored, and after a time delay as described in 6.4.2.1.5.7, the automatic transfer switches shall disconnect the alternate source of power and connect the loads to the normal power source. The alternate power source generator set shall continue to run unloaded for a preset time delay as described in 6.4.2.1.5.9.

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

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

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

6.5.4 Administration (Type 2 EES).

6.5.4.1 Maintenance and Testing of Essential Electrical System.

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

6.5.4.1.1.1 Maintenance of Alternate Power Source. The generator set or other alternate power source and associated equipment, including all appurtenance parts, shall be so maintained as to be capable of supplying service within the shortest time practicable and within the 10-second interval specified in 6.4.1.1.8 and 6.4.3.1.

6.5.4.1.1.2 Inspection and Testing. Generator sets shall be inspected and tested in accordance with 6.4.4.1.1.4.

6.5.4.1.2 Maintenance and Testing of Circuitry. Circuitry shall be maintained and tested in accordance with 6.4.4.1.2.

6.5.4.1.3 Maintenance of Batteries. Batteries shall be maintained in accordance with 6.4.4.1.3.

6.5.4.2 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.

Chapter 7 Information Technology and Communications Systems

7.1* Applicability. This chapter shall apply to information technology and communications systems in all health care facilities that provide services to human beings.

7.2 Reserved.

7.3 Category 1 Systems.

7.3.1 Information Technology and Communications Systems Infrastructure.

7.3.1.1 Premises Distribution System (Fiber and Copper).

7.3.1.1.1 Cables and installation shall be in compliance with *NFPA 70, National Electrical Code*, and *TIA/EIA 568-B*.