

Fundamentals of Emergency Power Systems



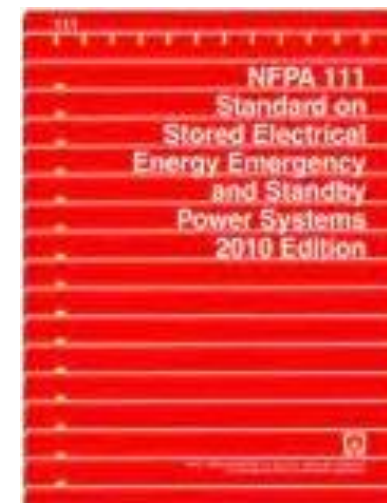
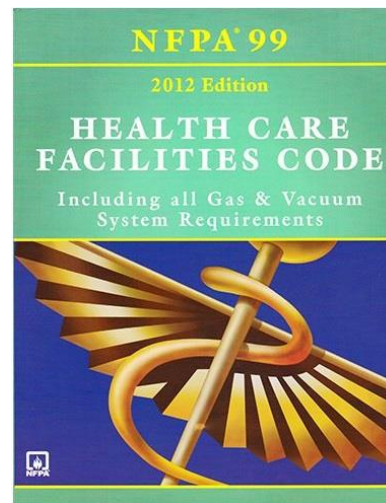
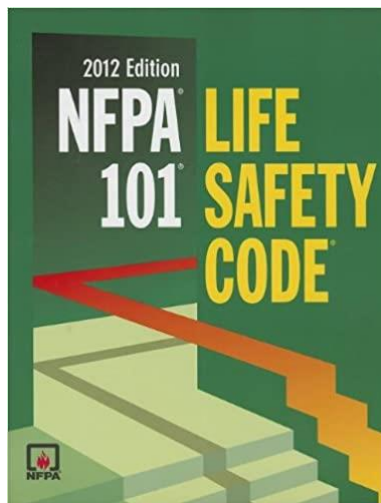
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Referenced Codes and Standards

- NFPA 101 (2012 edition), Life Safety Code
- NFPA 99 (2012 edition), Health Care Facilities Code
- NFPA 110 (2010 edition), Standard for Emergency and Standby Power Systems



Definitions

Essential Electrical System (EES)

- **Designed to ensure continuity of electrical power during the disruption of normal power**
- **Including:**
 - Alternate sources of power
 - Connected distribution systems
 - Ancillary equipment

Emergency Power Supply (EPS)

- **The source of electric power for an emergency power supply system (EPSS)**



Definitions

Emergency Power Supply System (EPSS)

- **A complete and functioning EPS coupled with a system of conductors, disconnecting means and overcurrent protective devices, transfer switches, and all control, supervisory, and support devices.**



Additional Requirements

Shall be in accordance with the following:

- **Minnesota State Fire Code (2020)**
 - Section 1203
- **NFPA 70**
- **NFPA 111**
- **Minnesota State Building Code (2020)**
 - 407.11 (Group I-2)
 - 422.6 (Ambulatory care facilities)

MSFC Requirements

- UL 2200 for stationary units
- ASCE 24 for Group I-2 in flood plains (new or replacement)



Where Emergency Power is Required

- Exit signs must be lit while the building is occupied
 - **90 minutes after power loss**
- Illumination of the means of egress
 - **90 minutes after a power loss**



Where Emergency Power is Required

Fire alarm system

- **How long will yours run without power?**



Where Emergency Power is Required

- Essential patient care-related electrical equipment
- Critical task lighting



Where Emergency Power is Required

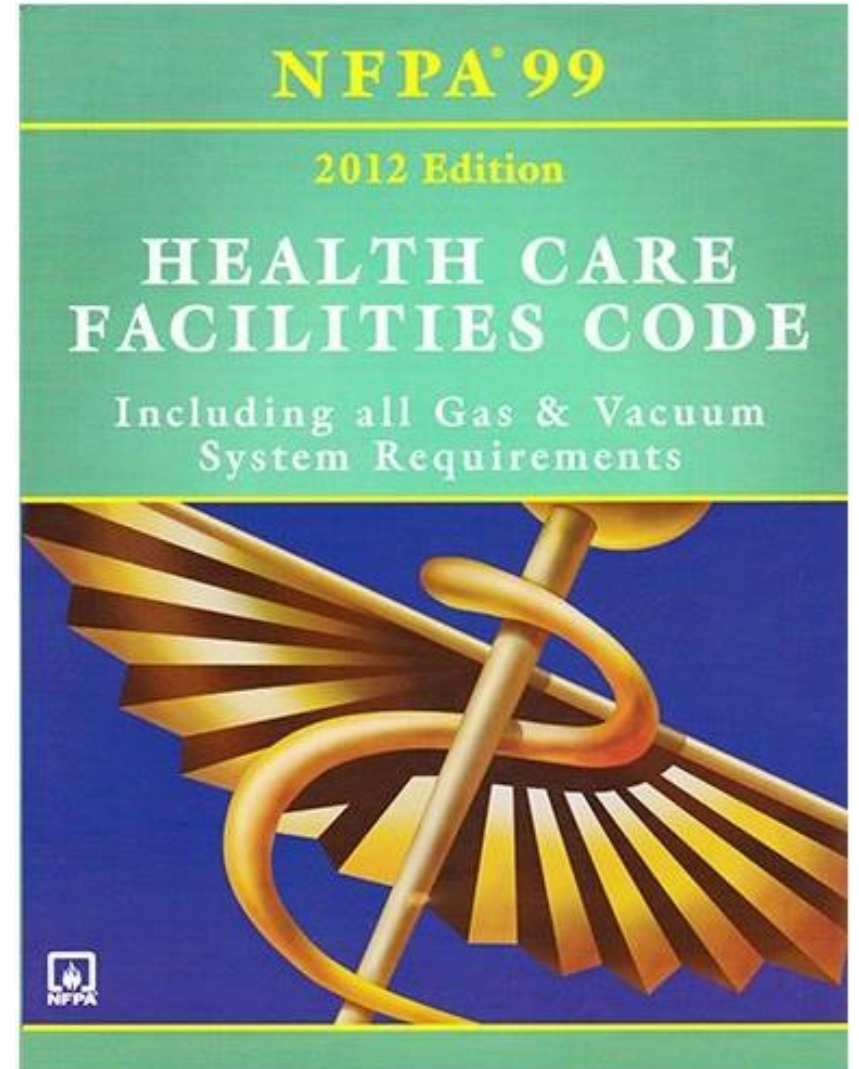
HVAC systems where the outside temperature is less than 20 degrees Fahrenheit.

- **Except where patients can be relocated to other areas of the facility where adequate temperatures can be maintained.**

Types of EES

Essential Electrical Systems (EES)

- **Three types of EES:**
 - Type 1
 - Type 2
 - Type 3



Type 1 EES

Type 1

- **Source:**
 - On-site generator
- **Distribution is divided:**
 - Life Safety Branch
 - Critical Branch
 - Equipment Branch



Type 1 - Life Safety Branch

- Illumination
- Exit signs
- Alarm and Alert Systems
 - **Fire Alarm System**
 - **Alarms required for piping of non-flammable medical gases**
- Hospital Communications Systems used during emergency conditions

Type 1 - Life Safety Branch

- Generator Set Location
 - **Task illumination, battery charger, selected receptacles**
- Elevator Cab
 - **Lighting, control, communications, signal systems**
- Automatically operated doors used for egress
- Auxiliary functions of Fire Alarm System

NO OTHER FUNCTIONS THAN THOSE LISTED !

Type 1 – Critical Branch

- Critical Care Areas
- Isolated Power Systems in Special Environments
- Patient Care Areas
- Specialized Care Areas
- Nurses' Call System
- Blood, Bone, and Tissue Banks
- Telephone Equipment Rooms
- Task illumination, receptacles, and power circuits

Type 1 – Equipment Branch

- Certain generator accessories
- Central suction systems serving medical and surgical functions
- Sump pumps and other equipment required to operate for the safety of the major apparatus
- Compressed air systems serving medical and surgical functions

Type 1 – Equipment Branch

- Smoke control and stair pressurization systems
- Kitchen hood supply and exhaust systems
- Supply, return, and exhaust ventilating systems for airborne infectious and isolation rooms
- Heating equipment for critical care rooms

Type 1 – Equipment Branch

- Elevators
- Supply, return, and exhaust system for:
- Hyperbaric / Hypobaric facilities
- Autoclaving equipment
- Controls for equipment
- Other selective equipment

Type 2 EES

Type 2

- **Source:**
 - On-site generator
- **Distribution is divided:**
 - Life Safety Branch
 - Includes Critical Branch
 - Equipment Branch



Type 2 – Life Safety Branch

- Illumination of means of egress
- Exit signs
- Alarm and alerting systems – including :
 - **Fire Alarms**
 - **Alarms required for piping of nonflammable medical gases**
- Communications systems – used for issuing instructions during emergency conditions

Type 2 – Life Safety Branch

- Sufficient lighting in Dining and Recreational areas
 - **Providing illumination to exits**
 - **Task illumination and selected receptacles at the generator location**
- Elevator cab
 - **Lighting, control, communication, and signal systems**

- **NO OTHER FUNCTIONS THAN THOSE LISTED !**

Type 2 – Equipment Branch

Type 2 Equipment Branch is similar to Type 1

Type 3 EES

Type 3

- **Source:**
 - Generator
 - Stored energy systems (NFPA 111)
- **Distribution:**
 - Not required to be divided

Classification of EPSS – NFPA 110

Level 1

- Shall be installed when failure of the equipment to perform could result in loss of human life or serious injuries

Level 2

- Shall be installed when failure of the EPSS is less critical to human life and safety
- Where Authority Having Jurisdiction (AHJ) shall permit a higher degree of flexibility

Classification of EPSS – NFPA 110

Power transfer designation:

- Type U Uninterruptible (UPS System)
- Type 10 10 seconds
- Type 60 60 seconds
- Type 120 120 seconds
- Type M Manual Stationary or Non-automatic
(no time limit)

Classification of EPSS – NFPA 110

Length of time it needs to operate:

- Class 0.083 5 minutes
- Class 0.25 15 minutes
- Class 2 2 hours
- Class 6 6 hours
- Class 48 48 hours
- Class X indefinitely based on use, code,
or application

Let's Put it Together

Type 10

- 10-second start time

Class X

- Indefinite run time (shelter-in-place)

Level 1

- Failure of the equipment to perform could result in loss of human life or serious injuries

Health Care Facility Requirements

Hospitals:

- Type 1 EES
- Type 10, Class X, Level 1 Generator

Nursing Homes:

- Type 2 EES
- Type 10, Class X, Level 1 Generator

Requirements For Facility Engineers and Maintainers



Remote Manual Stop Station

- Prevents unintended or inadvertent use
- Must be remote from the prime mover
- It must be outside the generator room



Acceptable?



Remote Annunciator

- Remote, common audible alarm
- Shall be battery powered
- Located outside the EPS room
- Must be at an observable worksite
- Shall have alarm silencing



REMOTE ANNUNCIATOR

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.

Emergency Task Lighting

- Level 1 and Level 2 EPS shall have battery-powered emergency lighting
 - **Not required for outdoor units without walk-in access**
- Lighting shall be 32.3 lux or 3-foot-candle power

Emergency Task Lighting



Question:

Is it acceptable to use a flashlight as the emergency light?

Answer

Yes, for outdoor locations without walk-in access

Emergency Task Lighting

Question:

Is the facility's transfer switch required to be lighted by battery-operated emergency lighting?

Answer

**No, the requirement is for the EPS.
The transfer switch is part of the
EPSS.**

Maintenance

Routine maintenance and operational testing shall be based on the following:

- Manufacturer's recommendations
- Minimum requirements NFPA 110 - Chapter 8
- The Authority Having Jurisdiction

Manuals

For Level 1 EPS:

- **Manual shall be kept in a secure location and convenient location**
- **Second manual shall be kept near the equipment**

Maintenance and Testing

- A written schedule shall be established for the EPSS for all maintenance and operational testing.
- A permanent record of the EPSS shall be kept:
 - **Inspections**
 - **Tests**
 - **Exercising**
 - **Repairs**

Maintenance and Testing

- The permanent records shall include:
 - **The date of the report**
 - **Identification of servicing personnel**
 - **All deficiencies or unsatisfactory conditions**
 - **Testing of all repairs**

Inspection - EPSS

- Transfer Switch
 - **Connections**
 - **Excessive heat or contact erosion**
 - **Remove dust and dirt**
- Make repairs when required

Inspection

- EPSS and all appurtenances inspected weekly per the manufacturer's recommendation
 - **Checklist in NFPA 110 Annex is acceptable**

Testing - Batteries

- Weekly checks on electrolyte levels
 - **Conductance testing allowed in lieu of specific gravity**
- Inspect terminals for corrosion
 - **Replace immediately if unsatisfactory**

Testing - Monthly

- Monthly testing under load
- The test must be initiated at the ATS
 - **Record transfer time**
- Monthly load test for at least 30 minutes
 - **Regardless of fuel type**

Testing - Monthly

- Diesel-powered generators tested monthly for not less than 30 minutes
 - **Must achieve at least 30% of EPS nameplate KW rating**
 - **-Or- minimum exhaust gas temperature per manufacturer recommendation**
- An annual 1.5-hour load bank can be performed in lieu of 30% monthly
 - **50% for 30 minutes continuously**
 - **75% for 1 hour continuously**

Testing - Monthly

Question:

If I do an annual load bank, does the 30% monthly recording matter?

Answer

No, the annual load bank is in lieu of the 30% monthly. You must show proof of one or the other.

Testing - Monthly

Question:

Does the 30% or annual load bank apply to my natural gas or LP gas generator?

Answer

No, NFPA 110 specifically states it is for diesel (kerosene) generators.

Testing - Monthly

- Spark-ignited generators must be tested monthly with the available EPSS load
 - **At least 30**
 - **-Or- until water temp and oil pressure stabilize**

Testing - Monthly

Monthly EPS test shall be conducted by simulating a power outage via the ATS test switch.



Testing - Monthly

- Load tests must include a complete cold start.
- The following minimum time delays shall be documented on monthly tests:
 - **1-second start – diesel**
 - **0.5-second start- gas turbine**
 - **5-minute delay in restoring normal power**
 - **5-minute delay on shutdown (cooldown)**

Testing - Fuel

A fuel quality test must be performed annually on diesel and kerosene engines per ASTM standards.

Testing – 36 Months

All Level 1 EPSS shall be tested no less than once every 36 months.

- **Continuously for assigned class**
 - Health care is Class X, minimum of four hours
- **Shall not be less than 30% load for diesel generators**
- **Shall maintain minimum exhaust temperature for diesel generators**

Testing – 36 Months

- Spark-ignited EPS can conduct tests via EPSS load
- Where diesel generators will use the 36-month test for a combined annual load bank:
 - **First 3 hours at minimum of 30% nameplate KW**
 - **Last hours at 75% nameplate KW**

Annual Inspection and Maintenance

Per manufacturers recommendation

This is a requirement per the CMS rules for participation

Final Thought

Generators are an essential component of life safety; neglect can and will result in immediate jeopardy.

- **Ensure proper testing**
- **Have a contingency in place**
- **Communicate failures with SFMD**
- **Plan for emergency evacuation**

SFMD will respond to your emergency to help



Questions

Website: <https://sfm.dps.mn.gov>



Thank you

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