

EMERGENCY POWER SYSTEMS

**Minnesota Health Care Engineers
Conference 2008**

Definitions

● Essential Electrical System

- Designed to ensure continuity of electrical power during disruption of normal power
- Includes
 - alternate sources of power
 - all connected distribution
 - ancillary equipment

NFPA 99 2-2

● Emergency Power Supply (EPS)

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

NFPA 110 3.3.2



Definitions

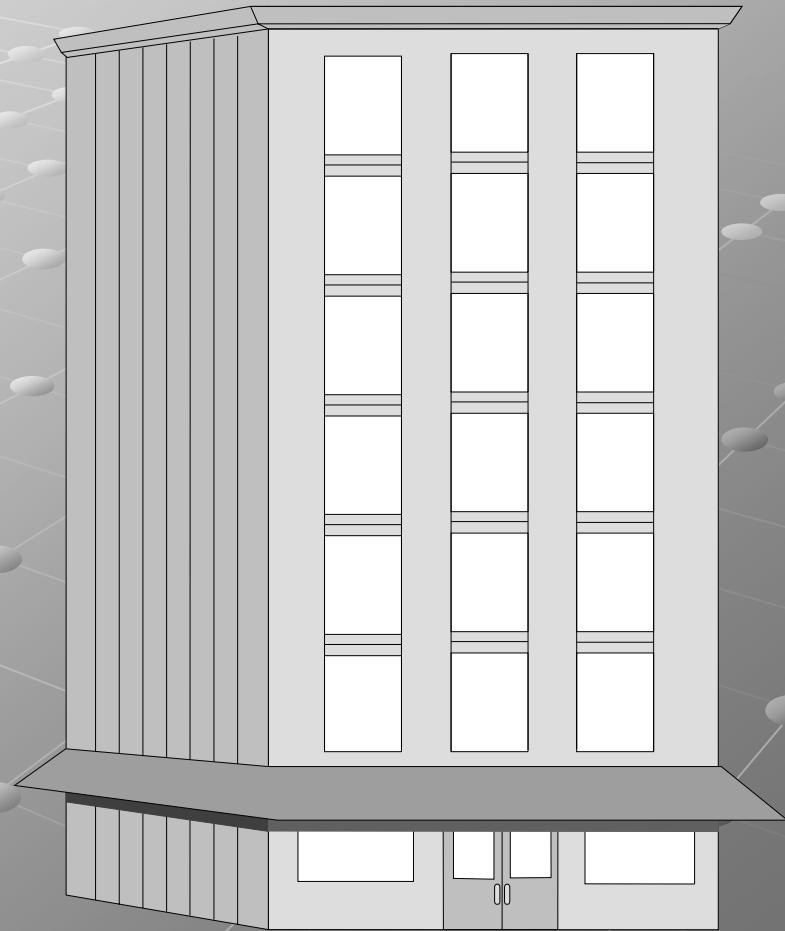


- Emergency Power Supply System (EPSS)
 - A EPS coupled to a system of conductors, disconnecting means and over current protective devices, transfer switches, and all control, supervisory, and support devices

NFPA 110 3.3.3

Definitions

- **High Rise**
 - 75 feet above fire department access
- **Inspections**
 - Equipment Off
- **Testing**
 - Equipment On and Running
- **Maintenance**



This Presentation Is Based on

- The Minnesota State Fire Code (MSFC) 2007 ed
- National Fire Protection Association (NFPA)
 - NFPA 101 The Life Safety Code © 2000 ed
 - NFPA 99 Health Care Facilities 1999 ed
 - NFPA 110 Standard on Stored Electrical Energy Emergency and Standby Power Systems 1999 ed

Emergency Power Systems

- Shall be installed in accordance:
 - MSFC Chapter 604
 - NFPA 101 Chapters 18 and 19 (2.8 & 2.9.1)
Requires meeting section 7.9.2.3
Which requires meeting
 - NFPA 110
 - NFPA 111
- Existing installations shall be maintained in accordance with the original approval **MSFC 604.1**

MSFC Stationary Generators

- Stationary emergency and standby power generators shall be listed in accordance with UL 2200

MSFC 604.1.1



Emergency Power Shall Be Provided



- **Exit Signs** in accordance with Section 1011.5.3
(illuminated at all times) **MSFC 604.2.3**
- **Means of Egress Illumination** in accordance
with Section 1006.3 **604.2.4**

Means of Egress Illumination

● For Two or more exits

- Aisles and enclosed egress stairways
- Corridors, exit enclosures and exit passageways
- Exterior egress components other than level of exit
- Interior exit discharges
- Exterior landings
- Must Last for 90 minutes

MSFC 1006.3

Emergency Power for High-rise Buildings



- **Exit signs, exit illumination**
- **Elevator car lighting**

MSFC 604.2.15.3

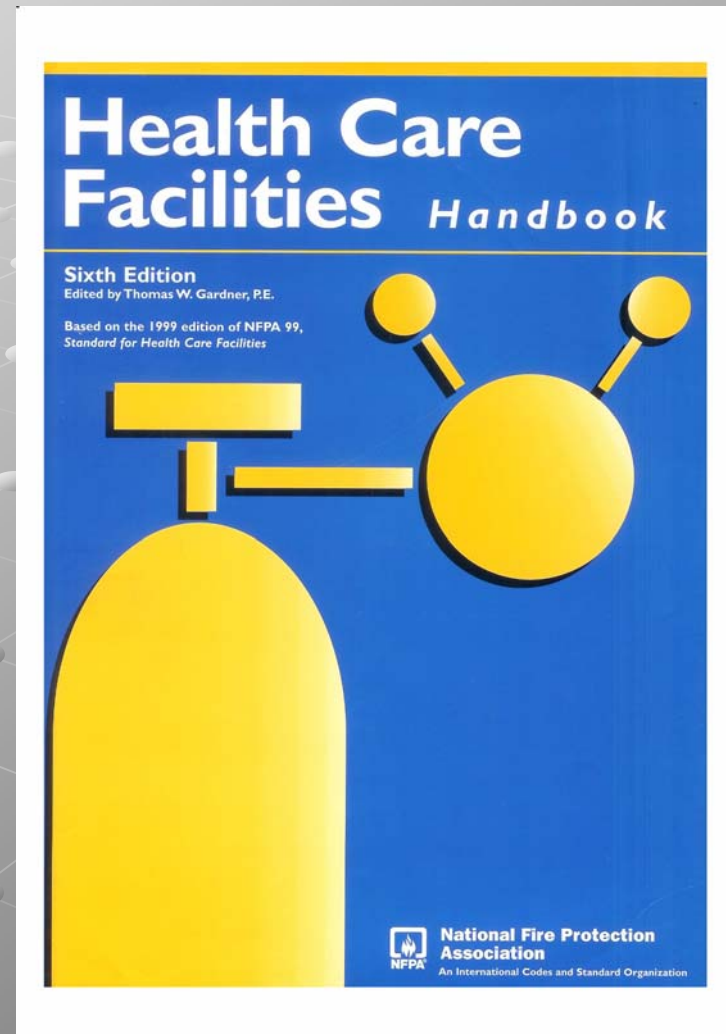
Emergency Power for High-rise Buildings

- It shall operate within 10 seconds of failure of the normal power
- It shall be capable of being transferred to the standby source
- Power and lighting facilities for the fire command center and elevators

MSFC 604.2.15.3

NFPA 99

- **Essential Electrical System (EES)**
 - One of three types based on
 - Source of power
 - Distribution System
 - Performance of system



Types of EESs



● Type 1

- Source
 - On-site Generator
- Distribution is divided
 - Emergency System
 - Life Safety Branch
 - Critical Branch
 - Equipment System

Emergency – 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
- Hospital communication systems used during emergency conditions

3-4.2.2.2

Emergency - Life Safety Branch

- **Generator Set Location**
 - Task illumination, battery charger and selected receptacles
- **Elevator cab**
 - lighting, control, communication, and signal systems
- **Automatically operated doors used for egress**
- **Auxiliary functions of fire alarms**
- **No other functions than those listed!**

Emergency - Critical Branch

● Critical Care Areas need

- Task illumination, Receptacles & Fixed equipment

● Isolated Power Systems in Special environment

● Patient Care Areas

- Need Task Illumination and receptacles in the following areas:
 - Infant Nurseries
 - Pharmacy Dispensing areas
 - Psychiatric bed areas
 - Nurses' Stations
 - Medication preparation areas
 - Acute Nursing Areas
 - Ward Treatment rooms

Emergency - Critical Branch

- Specialized care
 - Task illumination & receptacles
- Nurses' call systems
- Blood, Bone and Tissue Banks
- Telephone Equipment Rooms

Emergency - Critical Branch

- Task Illumination, receptacles and power circuits in the following areas:
 - General care beds (1 duplex outlet per room)
 - Angiographic labs
 - Cardiac catheterization labs
 - Coronary Units
 - Hemodialysis rooms
 - Emergency Rooms
 - Human Physiology Labs
 - Intensive Care Units
 - Postoperative Recovery Rooms

Equipment Systems For Automatic Connection

- Generator accessories including, but not limited to:
 - the transfer fuel pump,
 - electrically operated louvers,
 - other generator accessories essential for generator operation

NFPA 99 3-4.2.2.3

Equipment Systems

For Delayed-Automatic Connection

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

3-4.2.2.3

Equipment Systems

For Delayed-Automatic Connection

- Smoke control and stair pressurization systems
- Kitchen hood supply and exhaust systems
 - if required to operate during a fire
- Supply, return, and exhaust ventilating systems for airborne infectious/isolation rooms

3-4.2.2.3

Equipment Systems

For Manual Connection

● Heating equipment for:

- Operating rooms
- Delivery
- Labor
- Recovery
- Intensive care
- Coronary care
- Nurseries
- Infection/isolation rms
- Emergency treatment spaces
- General patient rooms
- Pressure maintenance pumps for fire protection

Equipment Systems

For Manual Connection

- Elevators
- Supply, return and exhaust systems for
 - Surgical suites, delivery suites, intensive care, coronary care, nurseries and emergency treatment spaces, isolation rooms, lab fume hoods, nuclear medicine, ethylene oxide evacuation and anesthesia evacuation
- Hyperbaric and Hypobaric facilities
- Autoclaving equipment
- Controls for equipment
- Other selected equipment

Types of EESs

- **Type 2**

- **Source**

- On-site Generator

- **Distribution is divided**

- Emergency System

- Critical System



Emergency System (Type 2)

- Illumination of means of egress
- Exit signs
- Alarm and alerting systems, including:
 - Fire alarms
 - Alarms required for the piping of nonflammable medical gases
- Communication systems, where used for issuing instructions during emergency conditions

NFPA 99 3-5.2.2.2

Emergency System (Type 2)

- ◆ Sufficient lighting in dining and recreation areas
 - to provide illumination to exits of 5 ft-candles.
- ◆ Task illumination and selected receptacles at the generator location
- ◆ Elevator cab
 - lighting, control, communication, and signal systems
- ◆ **No other functions** **NFPA 99 3-5.2.2.2**

Critical System (Type 2)

● Delayed-Automatic Connections

- Patient care areas

- Task Illumination and receptacles in

- Medication preparation areas
 - Pharmacy dispensing areas
 - Nurses' stations

- Supply, return, and exhaust systems for airborne infectious isolation rooms 3-5.2.3.1

Critical System (Type 2)

Delayed-Automatic Connections

- Sump pumps and other equipment required to operate for the safety of major apparatus
- Kitchen hood supply and exhaust systems
 - if required to operate during a fire
- Smoke control and stair pressurization systems

3-5.2.3.1

Critical System (Type 2)

Manual Connections to Critical System

- Heating of general patient rooms
- Elevator Service
- The facility is served by a dual source of normal power

3-5.2.2.3



Types of EESs

● Type 3

■ Source

● Generator, battery or battery integral to device

■ Distribution

● Not required to be divided

Level of EPS Equipment 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 the authority having jurisdiction shall permit a higher degree of flexibility [NFPA 110](#)

NFPA 99 Health Care Facilities

- Hospitals section 12-3.3.2 requires a
 - Type 1 EES as in Chapter 3 (NFPA 99)
 - Chapter 3 Section 3-4.1.1.4 requires a
 - Type 10 Class X Level 1 generator
- Nursing Homes 16-3.3.2 requires a
 - Type 2 EES as in Chapter 3 *
 - Chapter 3 section 3-5.1 requires meeting 3-4.1
 - Section 3-4.1.1.4 requires a
 - Type 10 Class X Level 1 generator

Types of EPSS

- Time to start and pick up power
 - Type U Uninterruptible (UPS Systems)
 - Type 10 10 seconds
 - Type 60 60 seconds
 - Type 120 120 seconds
 - Type M Manual stationary or nonautomatic — no time limit

NFPA 110

Classification of EPSS

● Length of time it needs to operate

- Class 0.083 5 min
- Class 0.25 15 min
- Class 2 2 hours
- Class 6 6 hours
- Class 48 48 hours
- Class X Other time
in hours NFPA 110



S0000

- **Type 10**

- 10 seconds to start

- **Class X**

- Other hours to operate

- **Level 1**

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

Class X

- Lighting requires 90 minutes (1 ½ hrs)
 - NFPA 101 7.9.2.1
- Low fuel alarm required when 3 hrs left
 - NFPA 99 3-4.1.1.14 (c)
- Fire alarm requires 24 to 60 hr operation
 - NFPA 72 1-5.2.6

Generator installation



Generator NFPA 110

- ◆ Fuel Supply Not used for any other purpose
- ◆ Low fuel sensing switch (Class X)
- ◆ Main fuel tank is 133% of low fuel switch
- ◆ Must meet NFPA 37
- ◆ Must have a battery charger
- ◆ Instrument panel

Work Space or Room

- Shall be located in a separate room dedicated to the generating equipment
- Separate from the rest of the building by a minimum 2-hour fire rating, or
- Located in an enclosure outside the building

NFPA 99 3-4.1.6

Remote Annunciator

- Individual visual signals shall indicate:
 - When the emergency or auxiliary power source is operating to supply power to load
 - When the battery charger is malfunctioning

3-5.5.2



Remote Annunciator

◆ Individual visual signals plus a common audible signal for:

- Low lubricating oil pressure
- Low water temperature
- Excessive water temperature
- Low fuel — when the main fuel storage tank contains less than a 4-hour* operating supply
- Overcrank (failed to start)
- Overspeed

Generators

- Shall pick up the load and meet frequency and voltage requirements within 10 seconds

3-4.1.1.8

- The generator room must be maintained at not less than 50°F or the engine water-jacket at not less than 90°F

3-4.1.1.9

- Provision shall provide air for cooling and combustion air

3-.4.1.1.10

Light for Emergency Generators



QUESTION:

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

Answer

- NFPA 110 5-3.2 the intensity of illumination in the separate building or room housing the EPS equipment for Level 1 system shall be 30 ft candles
 - Unless otherwise specified by the AHJ
- A Mag light with 2AA batteries has 15.2 lumen and 2952 peak candle power (from web site)
- The AHJ is CMS
 - CMS is requiring battery operated lighting

The exception to that section does not require emergency lighting of the genset if it is outside

Emergency Generator Lighting

Question:

- Is the facility's transfer switch required to be lighted by battery operated emergency lighting?
- The Level 1 or Level 2 EPS equipment location(s) shall be provided with battery-powered emergency lighting

Maintenance of Emergency Power Systems

- **EPS Must be in accordance with NFPA 110 and NFPA 111**
- **Inspection, testing and maintenance shall be in accordance with an established approved schedule**
 - **Exception: emergency power system used for peak load shaving, such use shall be recorded and shall be allowed to be substituted for scheduled testing**

MSFC 604.3

NFPA 110

- Routine maintenance and operational testing shall be based on:

- Manufacturer's recommendations
- Instruction manuals
- Minimum requirements of this chapter
- The authority having jurisdiction **NFPA 110 6-1.1**

- Consideration shall be given to temporarily providing an alternate source when the emergency generator is out of service

6-1.2

Generator Testing

- The scheduled test under load
 - shall include a complete simulated cold start and automatic and manual transfer of EES
- The tests shall be conducted by competent personnel
- The tests are needed to keep the machines ready to function and, in addition, serve to detect causes of malfunction and to train personnel in operating procedures

Written Record

● Shall Include

- The date of service
- The name of the servicing technician
- A summary of conditions noted
- A detailed description of any conditions requiring correction and what corrective action was taken
- Testing of any repair as recommended by manufacturer

● Records shall be kept on the premises

● Be available for inspection by the fire code official

NFPA 110 6-3.4 & MSFC 604.3.2

Emergency Generator Inspections (In Code Appendix)

● Prime Mover (engine)

- General Inspection

● Fuel

- Check Fuel Tank Level
- Inspect for and remove water in fuel
- Inspect Float Switch
- Inspect Transfer Pump Operation
- Inspect Solenoid Valve Operation
- Inspect Flexible hoses and connections

Emergency Generator Inspections (In Code Appendix)

● Lubrication Oil

- Check Oil level
- Check Oil Heater

● Cooling System

- Check coolant level
- Check adequate cooling water to heat exchanger
- Check adequate fresh air through radiator
- Inspect Water Pump
- Inspect Flexible hoses and connections

● Exhaust

- Inspect and check for Leakage
- Check Drain Condensation (Trap)

Emergency Generator Inspections (In Code Appendix)

- Batteries
 - Check Electrolyte Level

- Electrical System
 - General Inspection

- Inspect and clean General Condition of EPSS
 - Check for vibration, leakage, noise, temperature or deterioration

- Inspect and clean service room

- Check that system is in automatic condition

Storage Batteries

- Used in Level 1 and Level 2 systems shall be:
 - Inspected at intervals of not more than 7 days (including electrolyte)
 - Maintained in full compliance with manufacturer's specifications
- Defective batteries shall be replaced immediately upon discovery of defects

NFPA 110 6-3.6

Emergency Generator Inspections (In Code Appendix)

● Monthly in Addition to weekly

- Inspect Fan Belt
- Inspect and Clean Battery Case
- Inspect Charge and rate
- Inspect Equalize Charger
- Inspect Alternator Belt
- Inspect Governor Oil level and linkage

Emergency Generator Testing

● Monthly

- Run at least 30 minutes under load

- Under operating temperature conditions and not less than 30 % of the EPS nameplate rating OR
- Loading that maintains the minimum exhaust temp recommended by the manufacturer

● Diesel EPS can be exercised monthly with the available EPSS load and exercised yearly with supplemental loads at 25% of name plate for 30 minutes, than 50% for 30 minutes, than 75% for 60 minutes for a continuous 2 hours

NFPA 110 6-4.2

Emergency Generator Testing (Recommended)

● Document

- Date
- Name of staff conducting test
- Start time
- Time to take over load (10 seconds max)
- Gauge readings including
engine temp, oil pressure, amps
- Stop Time
- Total elapsed time
- Percent of generator that is loaded when running

Special Tools and Spare Parts

- Special tools and testing devices for routine maintenance shall be available **NFPA 110 6-2.3**
- Replacement parts identified by experience as high mortality items shall be maintained in a secure location(s) on the premises
- Consideration shall be given to stocking spare parts, recommended by the manufacturer

NFPA 110 6-2.4

Time delays shall be set as follows:

- On start
 - 1 second minimum for diesel powered units
 - 0.5 second minimum for gas turbine units
- On transfer to emergency
 - no minimum
- On restoration to normal
 - 5 minutes minimum
- On shutdown
 - 5 minutes minimum

NFPA 110 6-4.4

Transfer Switches

- Transfer switches shall be inspected, tested and have a maintenance schedule
- Transfer switches shall be maintained free from accumulated dust and dirt
- Inspection shall include examination of the transfer switch contacts for evidence of deterioration
 - When evidence of deterioration, the contacts shall be replaced **MSFC 604.3.3**



Transfer Switches - Inspections

● Shall include:

- Checking of connections
- Inspection for evidence of overheating
- Inspection for evidence of excessive contact erosion
- Removal of dust and dirt
- Replacement of contacts when required

NFPA 110 6-3.5

Transfer Switches - Testing

● Transfer switches shall be operated monthly

NFPA 110 6-4.5 & MSFC 604.4.1

- Switches electrically operated from auto to on and back to auto positions

● Main breakers and feeder breakers tested annually with EPS off

NFPA 110 6-4.6

Manuals

- Two sets of instruction manuals shall be supplied and shall contain the following:
 - A detailed explanation of the EPSS's operation
 - Instructions for routine maintenance
 - Instructions for repair of the EPS and the EPSS
 - An illustrated parts list and part numbers
 - Illustrated and schematic drawings of electrical wiring
 - including operating and safety devices, control panels, instrumentation, and annunciators **NFPA 110 6-2.1**

Manuals

● For Level 1 systems

- Instruction manuals shall be kept in a secure, convenient location
- one set near the equipment
- the other in a separate location

NFPA 110 6-2.2

Operational Testing

- The EPSS shall be maintained to ensure that to a reasonable degree that the system is capable of supplying service within the time and for the duration specified **MSFC 6-3.1**
- Shall be initiated immediately after the EPSS has passed acceptance tests or after completion of repairs that impact the operational reliability of the system **6-3.2**
- A written schedule for routine maintenance and operational testing of the EPSS shall be created **6-3.3**

EPSS

Shall Have A Written Record

- Of all inspections, tests, exercising, operation, and repairs
- Record shall be maintained on the premises
- The written record shall include:
 - The date of the maintenance
 - Identification of the servicing personnel
 - Notation of any unsatisfactory condition and the corrective action taken, including parts replaced
 - Testing of any repair for the time as recommended by the manufacturer

6-3.4

Questions

