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 99 Health Care Facilities 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
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
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
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
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
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
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

Consideration shall be given to temporarily providing an alternate source when the emergency generator is out of service.
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
- Switches electrically operated from auto to on and back to auto positions

Main breakers and feeder breakers tested annually with EPS off

NFPA 110 6-4.5 & MSFC 604.4.1
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.  
  \hspace{1cm} \textit{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.  
  \hspace{1cm} 6-3.2

- A written schedule for routine maintenance and operational testing of the EPSS shall be created.  
  \hspace{1cm} 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