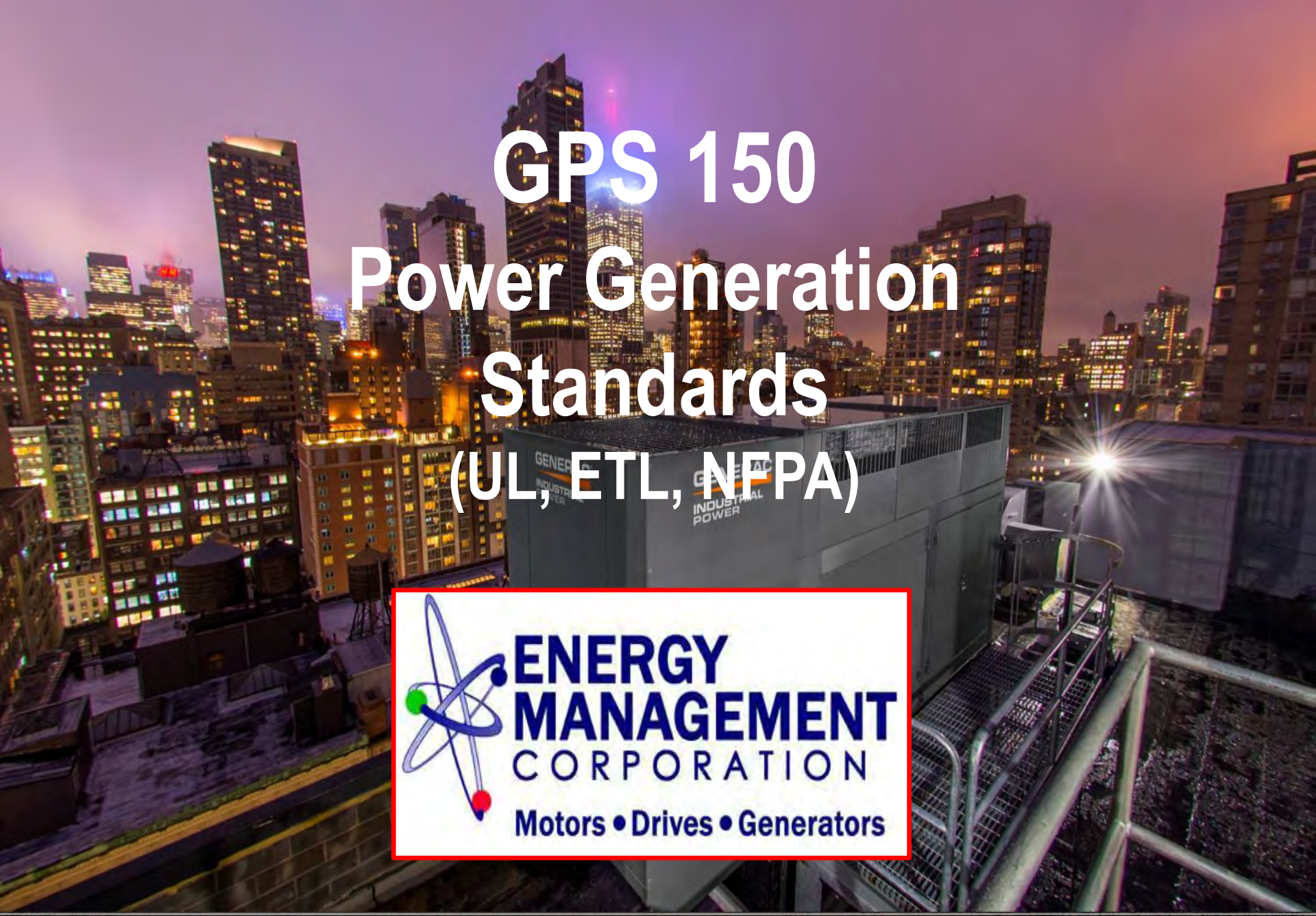
GPS 150
Power Generation Standards
(UL, ETL, NFPA)



PROFESSIONAL DEVELOPMENT
SEMINAR SERIES

Standby Generator
Standards & Codes

UL & ETL

- **Listing Agencies**
  - National Recognized Testing Laboratory (NRTL)
    - Underwriters Laboratories (UL)
    - Intertek ETL SEMKO division (ETL)

  - Develops standards and test procedures
  - Administers the application of the UL & ETL mark
  - Focused on product safety and usability
  - UL & ETL does not “approve”
  - AHJ often use UL & ETL listing as “approved for use”

Standard Listings Relative to Power Generation

- **Tanks**
  - UL 142 (Steel Aboveground Tanks for Flammable and Combustible Liquids)
  - UL 2085 (Protected Aboveground Tanks for Flammable and Combustible Liquids)

- **Switching Equipment**
  - UL 1008 (Transfer Switches)
  - UL 891 (Dead-Front Switchboard)
  - UL 1558 (Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear)

- **Generators**
  - UL 2200 (Stationary Engine Generator Assemblies)

Note: ETL validates (labels and lists) to the UL standards

UL 142 Standard for Base Tanks

- **Typical sub-base fuel tank**
  - Secondary containment (double wall)
  - Various heights and capacities
  - Various functional connections
  - Stub-ups
  - Production tested to 3 psi
  - Prototype tested to 15 psi

UL 2085 Standard for Tanks

UL 1008 Standard for Transfer Switch Equipment

- **Covers transfer equipment**
  - Rated 600V and 6000A or less
  - Operation requirements
  - Short Circuit requirements

Switchboards and Switchgear Standards

- **Switchboards and Switchgear**
  - Low-Voltage Dead-Front Switchboards – UL 891
  - Low-Voltage Metal-Enclosed Power Circuit Breaker Switchgear – UL 1558
  - Medium-Voltage Metal-Clad Switchgear - ANSI C.37.20.3

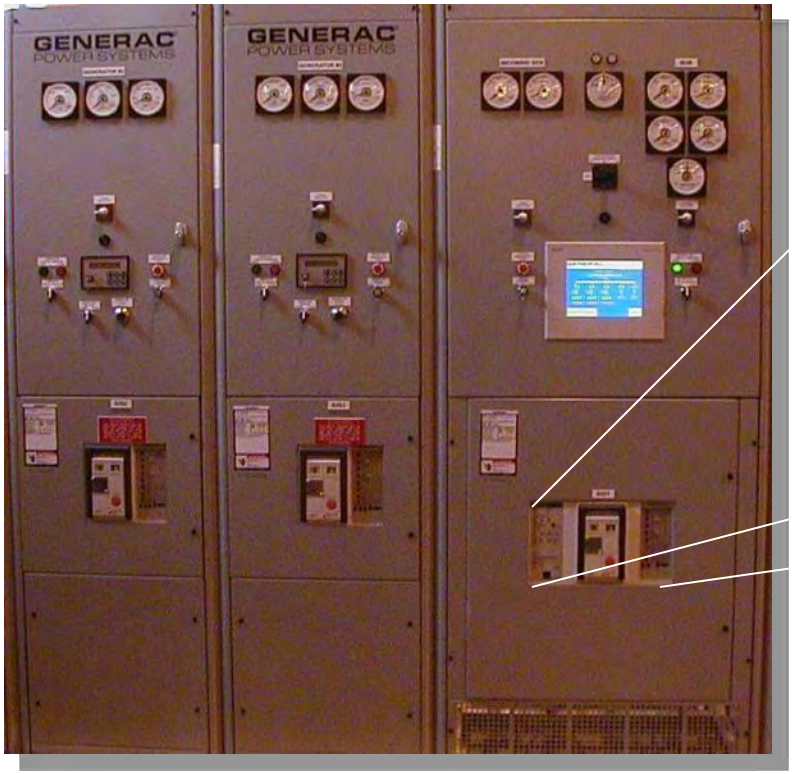
These are <u>not functional</u> standards.
These <u>are equipment</u> standards.

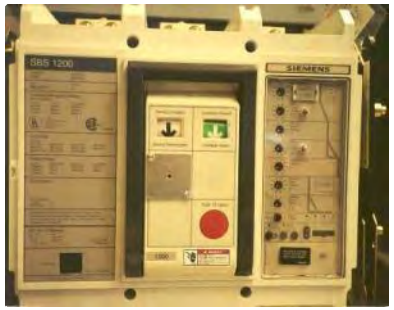
For example:
Coffee pots are UL 1082
Microwave ovens are UL 923
If a microwave is used to make coffee, it doesn't turn it into a UL 1082 coffee pot.

Generators are UL 2200
Switchboards are UL 891
If a generator system internally parallels, it doesn't turn it into a UL 891 switchboard.

UL 891 Standard for Dead-Front Switchboards

- **Rated 600 volts**
- **Front access or front and rear access (shown below)**
- **Traditionally used for generator paralleling**
- **Insulated case circuit breakers (limited operations)**





UL 1558 Standard
Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

- Rated 600 volts
- Metal barriers between sections
- Complete compartment isolation
- Power Circuit Breakers

UL 2200 Standard
Stationary Engine Generators Assemblies

- **Scope**
  - Engine generators
  - Safe operation
  - Stationary locations
  - Ordinary locations
  - Rated 600 volts or less

UL 2200 Standard

- **Peace of mind**
  - Equipment is **listed for intended use**.
  - Places importance on **entire unit**, not just single component.
  - Recognizes that **fuel systems** are vital component.
  - Safety insurance of **product construction**.
  - **Required performance tests** for uniform quality and durability.

UL 2200 Standard

- **Safety Assurance of Product Construction**
  - **Guarding**, and labeling of hazardous components.
  - Minimum standards for **raw material quality.**
  - **Corrosion** protection and fabrication (enclosures, etc).
  - **Assembly standards** (i.e., torque specs, etc).
  - Components must be **UL recognized**.
    - Air filters, controls, battery chargers, switches, etc.

UL 2200 Standard

- **Tests for uniform quality and durability**
  - Temperature test
    - Engine, alternator, surfaces and control standards
  - Alternator tests
    - Dielectric voltage withstand, harmonic distortion
  - Enclosure
    - Salt spray, impact
  - Air Flow
    - Blocked inlet test, ignitable fluid spill test

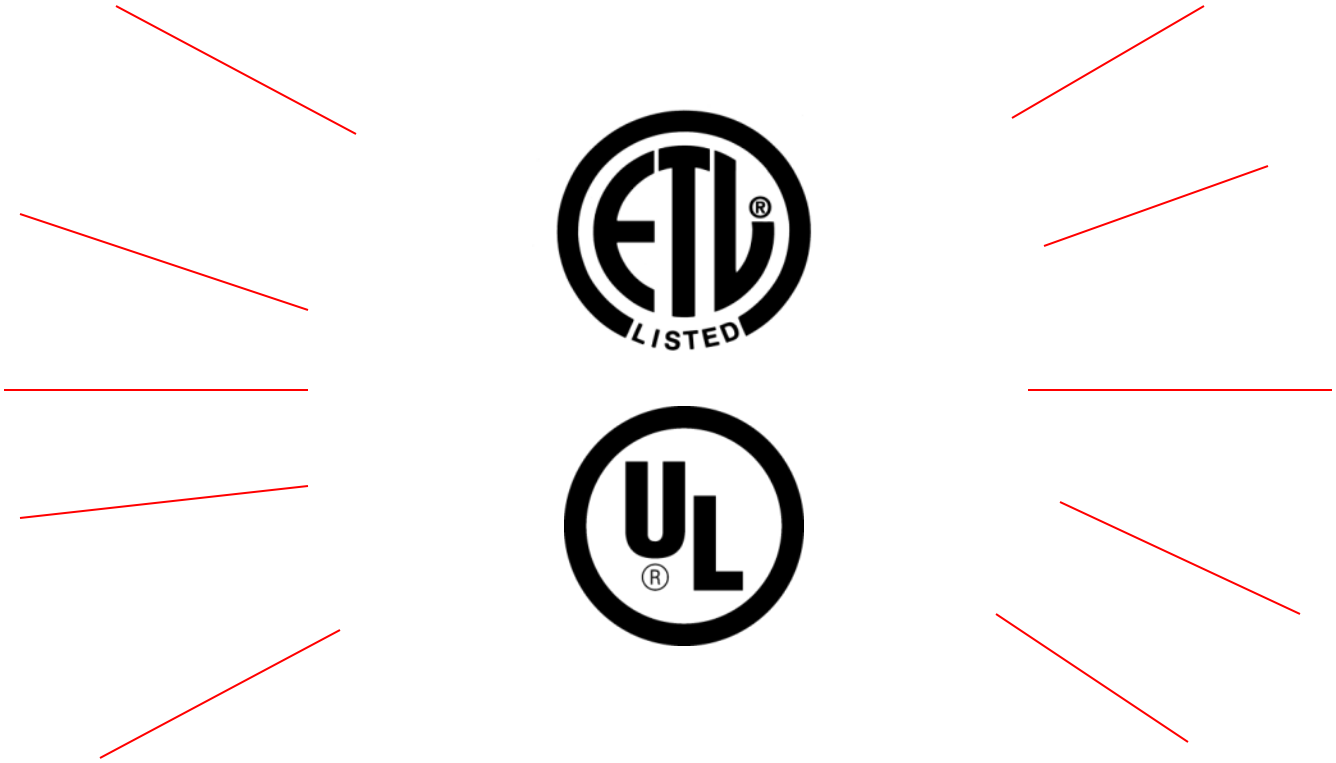
System Testing

- **Units tested with enclosures**
  - Second-party enclosures not UL 2200 verified
    unless submitted and tested as system

- **Rain Tests**
  - No water leakage into electrical boxes
  - Water spray at 30-degree angle to enclosure surface

- **Parallel Testing**
  - UL2200 scope includes integrated paralleling

UL 2200 Standard Visual Identifiers



PROFESSIONAL DEVELOPMENT
SEMINAR SERIES

NFPA Standards

NFPA 110 2013
NFPA 37 2010
NFPA 20 2013

Key NFPA standards for generators

- **National Fire Protection Association (NFPA)**
  - Independent standards organization
  - Mission is to reduce fire risks
  - Standards developed with the ANSI process
  - Standards typically adopted into state statutes
  - Require compliance for AHJ approval

- **Generator related NFPA standards**
  - 20 Installation of Fire Pumps
  - 37 Installation and Use of Stationary Engines
  - 54 National Fuel Gas Code
  - 58 LP Gas Code
  - 70 National Electric Code
  - 99 Healthcare Facilities
  - 101 Life Safety Code
  - 110 Standard for Emergency and Standby Power Systems

Applicable Standards

- **Life safety code (NFPA 101) requires NFPA 110**
  - Stair ventilation systems (NFPA 101 7.2.3.12)
  - Emergency lighting (NFPA 101 7.9.2.2, 7.9.2.4)
  - Required emergency and standby systems must be NFPA 110 compliant (NFPA 101 9.1.3)
- **NEC references NFPA 110 with fine print notes (FPN)**
  - Emergency systems (NEC 700.1 Informational Note #3)
  - Legally required standby systems (NEC 701.1 Informational Note #2)
- **Healthcare code (NFPA 99) requires NFPA 110**
  - Type 1 and 2 essential electrical systems (NFPA 99 6.4.1.1.6.1)
  - Type 3 essential electrical systems (NFPA 99 6.4.1.1.6.2)

NFPA 110 Scope

Guideline for the assembly, installation, and performance of electrical power systems to supply critical and essential needs during outages.

The requirements of the standard are considered necessary to **obtain the minimum level of reliability** and performance, particularly where **life safety needs** are involved.

- **Level 1 (4.4.1)**
  - Where failure could result in **loss of human life**
  - Correlates with NEC 700 (emergency systems)
- **Level 2 (4.4.2)**
  - Failure is less critical to human life
  - **Hazards or hampers fire rescue**
  - Scope similar to NEC 701 (legally required standby)

Note: Optional standby (NEC 702) does not require NFPA 110 compliance

NFPA 110 Fuel

- **Fuel options (5.1.1)**
  - Diesel, LP and Natural Gas

- **BUT doesn't the fuel need to be on-site for Level 1 applications?**
  - Most AHJ automatically assume on-site fuel is reliable and NG is unreliable
  - What does the standard actually say?

Exception: (5.1.1)

*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…*

Note: NFPA 110 does not assume off-site fuel is unreliable.

NFPA 110 Fuel Reliability -- Diesel

- **Diesel fuel must be maintained to be reliable**
  - 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.*

  - 8.3.8

    *A **fuel quality test** shall be performed at least **annually** using tests appropriated ASTM standards.*

Would a customer that is not actively managing and maintaining the on-site diesel be better served with off-site natural gas?

NFPA 110 Fuel Reliability -- Diesel

- **Optional standby application with 24-hour fuel tank**
  - Weekly exercise for 20 minutes (using 5% of full-load fuel).
  - Two hours of outage each year (assume 50% of full-load fuel).
  - Given this scenario, one turn on the fuel tank will take **12.9 years**.

- **NFPA 110 Level 1 application with 24-hour tank**
  - Weekly exercise for 20 minutes (using 5% of full load-fuel).
  - Monthly exercise 30 minutes with facility load (assume 40% of full load).
  - Typical annual outages 2 hours.
  - Every 36 months, 4-hour operation with facility load (extend the outage 2 hours).
  - Given this scenario, one turn on the fuel tank will take **5.8 years**.

NFPA 110 Fuel Reliability -- Diesel

- **Diesel fuel must be maintained to be reliable**
  - A.7.9.1.2

    *"Fuel **maintenance** and testing should **begin the day of installation** and first fill to establish a benchmark guideline for further comparison."*

  - Diesel failure modes
    - Moisture
    - Gelling
    - Biomass
    - Fuel instability / varnishing
    - Storage / leakage
    - Fuel transfer system
    - Running out

NFPA 110 Fuel Reliability -- Diesel

- **How much fuel is enough? How much fuel is too much?**
  - NFPA 110 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 **over-sizing tanks**… 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."*

- Fuel Strategies
  - Strong fuel-maintenance or fuel-exchange programs
  - Minimize diesel -- Bi-fuel generators (diesel and natural gas)
  - Replace diesel -- Natural gas generators

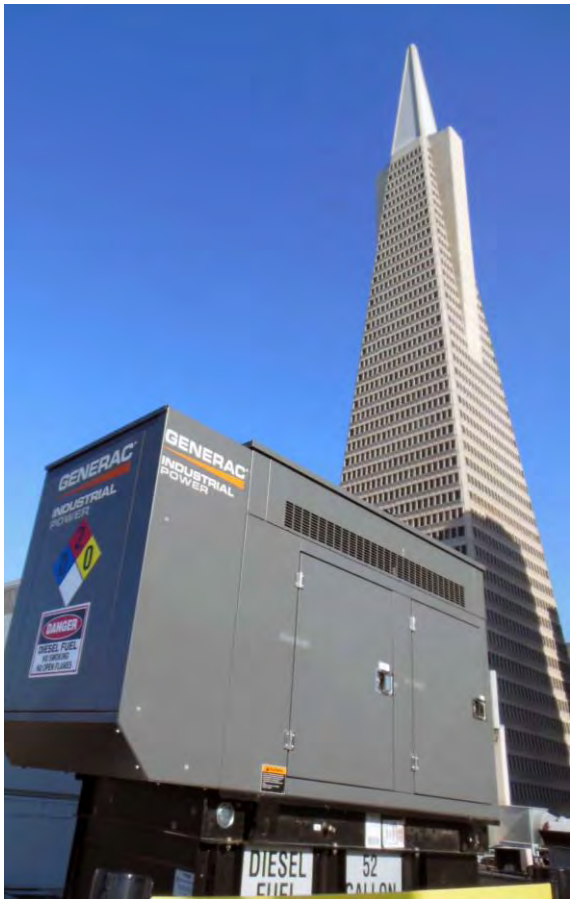
NFPA 110 Fuel Tank Requirements

- **Dedicated tank or minimum draw down for Level 1** (5.5.1)
- **Fuel tank must be 133% of required class** (5.5.3)

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

- **Low-fuel level set at 100% of required class** (5.5.2)
- **Capable of operation after seismic shock** (7.11.6)
- **Inside tanks generally limited to 660 gal** (7.9.5)
- **Greater than 660 gal** (NFPA 37 6.3.5 and 6.3.6)
  - Dedicated fire-rated rooms
  - Spill containment (curbing)



NFPA 110 Fuel Piping Requirements

- **Comply with NFPA 30, 37, 54, 58** (7.9.1.1)
- **Piping protected and supported** (NFPA 37 6.8.2)
- **Remote shutoff valve (away from generator) required** (NFPA 37 5.4.1.3)
- **Clearly identify (diagram at generator) all fuel shutoff valves** (NFPA 37 10.2.2)
- **Solenoid valves shall have manual bypass capability** (5.6.3.2.1)
- **Flexible fuel line between engine and piping** (7.9.3.2)
- **All manual valves should indicate open or closed state** (7.9.11)
  - Locked open or electrically monitored (not required but good idea)
  - Key must be accessible (NFPA 37 5.4.1.2)

NFPA 110 Diesel Fuel Piping Requirements

- **Diesel piping requirements**
  - Piping protected and supported (NFPA 37 6.8.2)
  - No galvanized piping (7.9.3.1)
  - Fuel supply to engine kept below the engine injectors (7.9.4)
  - Fuel fill to terminate outside building (NFPA 37 6.6.3.1)
  - Fuel vent to terminate outside building (NFPA 37 6.7.1.1)
  - No manifolding vent pipes (NFPA 30 5.7.1.2)
  - Tanks should include emergency vents (NFPA 30 4.2.5.2.1)
  - Anti-siphon valve (NFPA 37 6.8.3)
  - Day-tank pumps powered by the emergency system (7.12.5)

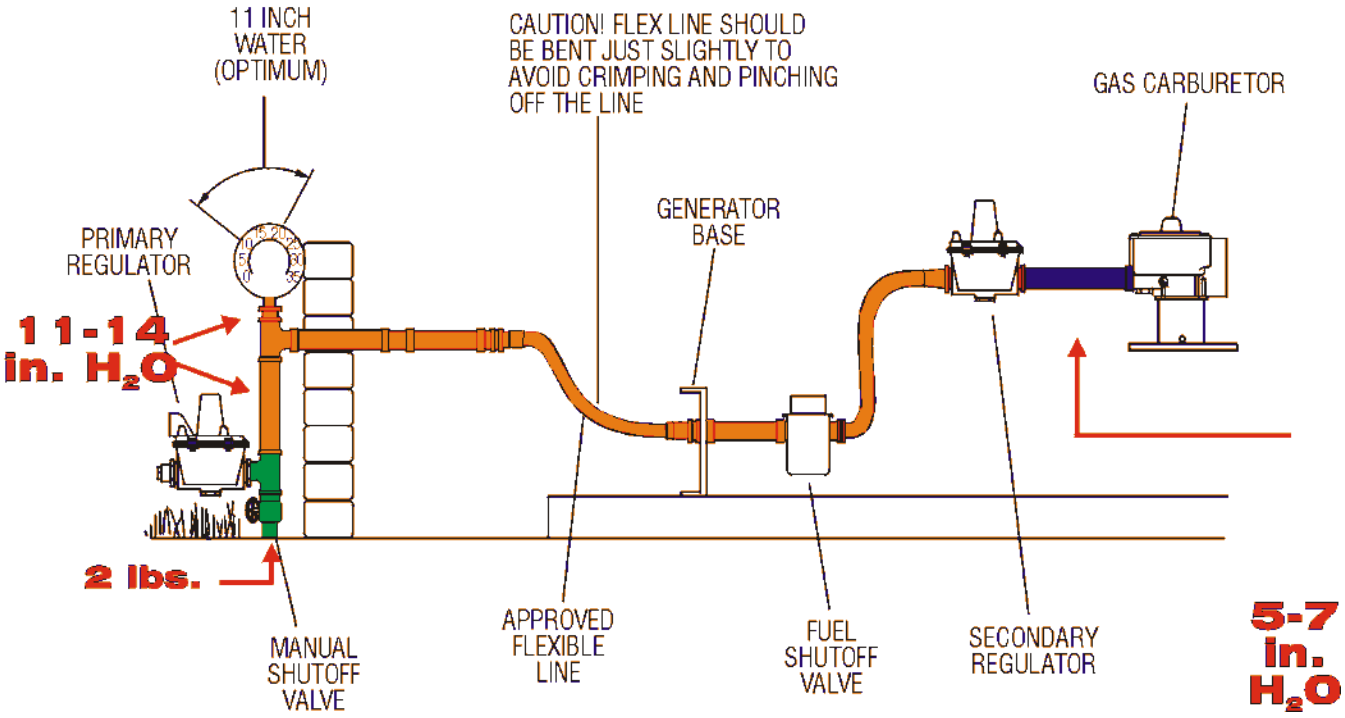
NFPA Tanks


Emergency Relief
NFPA 30 4.2.5.2.1
Normal Vent
NFPA 30 4.2.5.1.1
WARNING

NFPA 110 Secondary Containment Components

NFPA 110 Gas Fuel Piping Requirements

- **Gas piping requirements**
  - Considerations to pressure regulators, pipe sizing, flexible fuel lines, etc. (7.9.9)
  - Tapping ahead of the building's main shutoff (7.9.7)
  - Securing shutoff valves (A.7.9.7)



NFPA 110 Propane Requirements

- **Propane**
  - On-site fuel
  - Considered reliable by AHJ's
  - Often configured as dual fuel
  - Fuel doesn't degrade
  - Fuel level sensing required (5.5.2)
  - Dedicated fuel supply for vapor withdrawal (5.5.1.1)
  - Cold weather boil-off rate considerations (7.9.9 (9))

NFPA 110 Exhaust

- **Flex connection** (7.10.3)
- **Condensate traps** (7.10.3.1)
- **Thermal expansion** (7.10.3.2)
- **Thimble** (7.10.3.4)
- **Acceptable back pressure** (7.10.4)
- **Heat rejection (blanketing consideration)** (7.10.3.7)
- **Common chimney requires calculations** (NFPA 37 8.2.5.1.1)
- **Exhaust clearing area** (NFPA 37, 8.2.3.1)
  - Not near building's air intake
  - Not under platforms

NFPA 110 Equipment Location

- Requires permanent installation (4.4.3)
- Consider potential for flooding (7.2.4, A.7.2.4(3))
- Consider natural and human threats (A.7.2.5)
- Separate room (Level 1) (7.2.1)
- Generator or ATS not installed with electrical service (Level 1, 480V, 1000A) (7.2.3)
- Minimum 36” generator-to-generator separation (7.2.6)
- Adequate ventilation and air flow (7.7)
- Outdoor units require 5’ clearance from building (NFPA 37 4.1.4)

NFPA 110 Fire Considerations

- **Two-hour fire rating** (7.2.1.1)
- **Fire-risk evaluation** (NFPA 37 11.1)
- **Fire protection generalizations** (7.11.2)
  - Not Carbon dioxide or halon
  - Not dry chemical
  - Consideration to preaction-type suppression (A.7.11.2)
  - Consider protection against inadvertent operation (NFPA 37 A.11.4.2.1 (4))

- **If we have a fire, do we automatically shut off the fuel?** (NFPA 37 A.11.4.2.1)
  - Is the engine always attended?
  - Is the generator system redundant?
  - What is the risk of spreading fire or smoke?
  - Most generator operations occur during test, when building power is available.

- **Is an outdoor generator a better option?**

NFPA 110 Failure Consideration

NFPA 110 7.2.7

*"Design considerations shall **minimize the effect of the failure** of one energy converter on the continued operation of other units."*

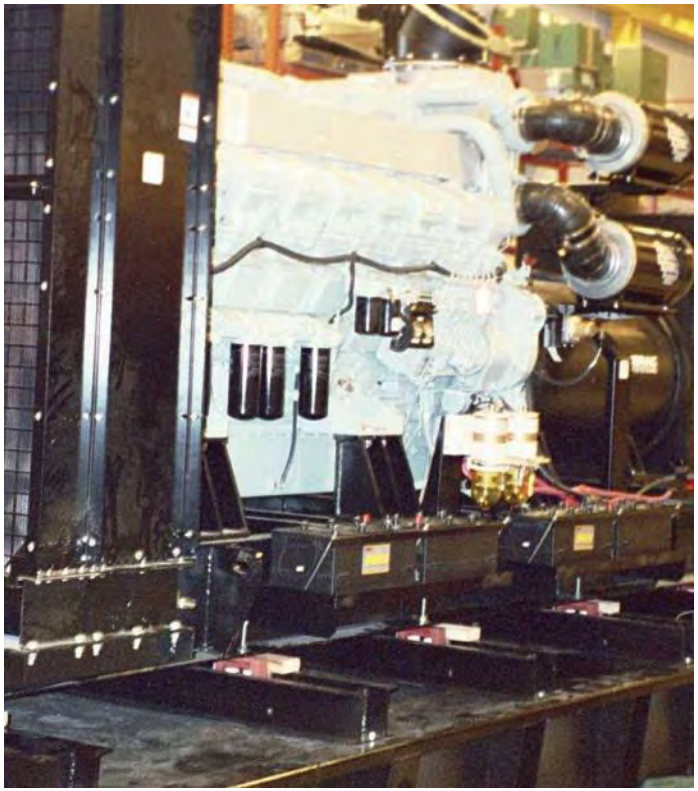
NFPA 110 8.1.2

"*Consideration shall be given to temporarily providing a portable or **alternate source whenever the emergency generator is out of service**".*

Do the above requirements, when combined with fire risk considerations, favor a redundant generator configuration located outside?

NFPA 110 Construction

- **Vibration isolators**
  - Internal pads are OK (A.7.5)
- **Cooling**
  - Closed loop required (5.6.7.2)
  - Maximum restriction .5" H_20 (7.7.4.1)
- **Motor dampers / louvers**
  - Spring open (7.7.5)
  - No fire dampers (7.7.2.3)



NFPA 110 Controls

- **Controller must be NFPA compliant** (5.6.5)
  - Operation
  - Indication
  - Protection
  - Remote annunciator required (NFPA 99 6.4.1.1.17 and NFPA 110 table 5.6.5.2)
  - Remote manual stop (5.6.5.6)

Control Panels

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 pre-alarm	X	NA	X	O	NA	NA
(f) Low lube oil pressure	X	X	X	X	X	O
(g) Overspeed	X	X	X	X	X	O
(h) Low fuel main tank	X	NA	X	O	NA	O
(i) Low coolant level	X	O	X	X	O	X
(j) EPS supplying load	X	NA	NA	O	NA	NA
(k) Control switch not in automatic position	X	NA	X	O	NA	NA
(l) High battery voltage	X	NA	NA	O	NA	NA
(m) Low cranking voltage	X	NA	X	O	NA	O
(n) Low voltage in battery	X	NA	NA	O	NA	NA
(o) Battery charger ac failure	X	NA	NA	O	NA	NA
(p) Lamp test	X	NA	NA	X	NA	NA
(q) Contacts for local and remote common alarm	X	NA	X	X	NA	X
(r) Audible alarm silencing switch	NA	NA	X	NA	NA	O
(s) Low starting air pressure	X	NA	NA	O	NA	NA
(t) Low starting hydraulic pressure	X	NA	NA	O	NA	NA
(u) Air shutdown damper when used	X	X	X	X	X	O
(v) 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:

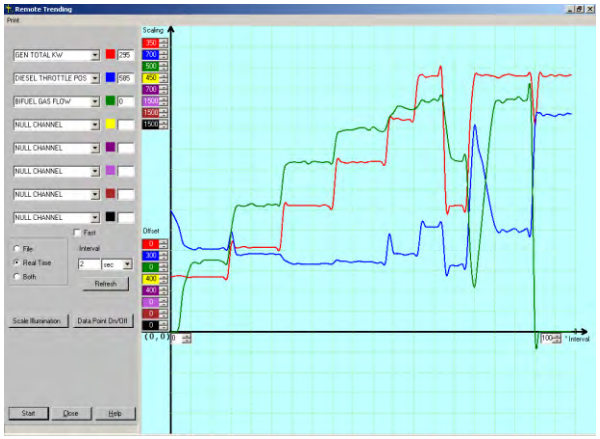
1. Item (p) shall be provided, but a separate remote audible signal shall not be required when the regular work site in 5.6.6 is staffed 24 hours a day.
2. Item (b) is not required for combustion turbines.
3. Item (r) or (s) shall apply only where used as a starting method.
4. Item (j): EPS ac ammeter 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).
7. Item (h) 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.

NFPA 110 Starting

- **Block and battery heaters** (5.3.1)
- **Enclosure heated to 40 F (Level 1)** (7.7.6)
- **Engine-driven charging alternator** (5.6.3.6)
- **Battery charger** (5.6.4.6)
  - Charge time 24 hrs
  - Float equalize type
  - Indication (volts and amps)
- **Batteries** (5.6.4)
  - Lead acid or Nicad
  - Capable of 2 x 45 sec of cranking

NFPA 110 Testing – Commissioning

- **Acceptance testing required** (7.13.4.1)
  - Cold start initiated
  - Start-up time recorded
  - Operating parameters recorded
  - Building load for 1.5 hrs
  - Full load test
    - 30% (30 min), 50% (30 min), 100% (60 min)
    - At rated PF unless factory tested



- **Design points**
  - Method / connections for load bank testing
  - Load bank circuits need automatic disconnect capability (8.4.2.2)

NFPA 110 Testing – Operational

- **Operational testing required** (8.4)

Weekly

- Preventative maintenance (8.1.1 and suggested schedule A.8.3.1)
- Inspect cranking batteries (8.3.7)
- Testing based on manufacturer recommendations (8.1.1)

Monthly

- Exercise generator with load (8.4.2)
- Operate all transfer switches monthly (8.4.6)

Annually

- Generator 1.5 hr load test (if monthly, test 30% of full load) (8.4.2.3)
- Exercise breakers between generator and transfer switches (Level 1 only) (8.4.7)
- Fuel tested to ASTM standards (8.3.8)

Every 36 months

- Generator run with building load for a period of 4 hours (Level 1 only) (8.4.9)

Maintenance Schedule

Maintenance Schedule

Component (as applicable)	Procedure (X — Action, R — Replace, if needed): Visual Inspection	Check	Change	Clean	Test	Frequency (W — Weekly, M — Monthly, Q — Quarterly, S — Semiannually, A — Annually, Nos. indicate hours): 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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(NFPA 110, p. 1 of 3)

FIGURE A.8.3.1(a) Suggested Maintenance Schedule for Emergency Power Supply Systems.

Maintenance Log

Performed by

Frequency (W — Weekly, M — Monthly, Q — Quarterly, S — Semiannually, A — Annually, Nos. indicate hours)

Component	Service Frequency: 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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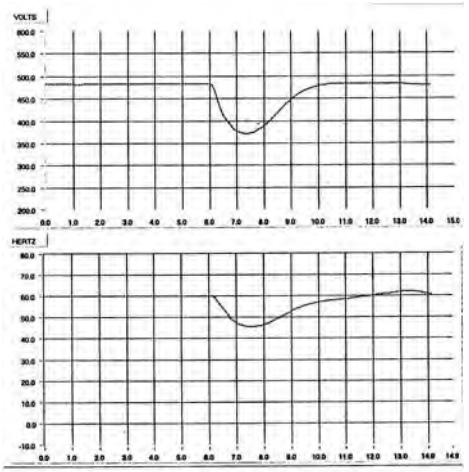
(NFPA 110, p. 1 of 3)

FIGURE A.8.3.1(b) Sample Maintenance Log — Routine Maintenance, Operation, and Testing (RMOT).

NFPA 110 Performance Requirements

- **Start and Load in 10 seconds (type 10)** (4.4.4)
- **Run for the classed time** (4.4.4)
- **Batteries capable of 2 cranking cycles** (5.6.4.4)
- **Voltage dip acceptable to load** (5.6.9.8(3))
- **Frequency dip matches spec** (5.6.9.8(4))
- **Fault current capable (PMG) and selective coordination** (6.5.1)



NFPA 110 On-site Requirements

- **Two sets of manuals (Level 1 only)** (8.2.2)
- **Tools and testing devices for maintenance** (8.2.3)
- **Spare parts** (8.2.4)
- **Training** (NFPA 37 10.3)
- **Documentation** (8.3.4)
  - Inspections
  - Tests
  - Operations
  - Repairs

NFPA 20 Fire Pumps

- **Meet NFPA 110 Level 1, Type 10 requirements** (9.6.2.1)
- **Run time of 8 hours minimum** (9.6.2.3)

- **Maximum voltage dip is 15% during normal motor start** (9.4)
- **Generator sized for normal starting and running** (9.6.1.1)
- **Support an across-the-line start (mechanical backup)** (A.9.6.5)
- **Breaker tap ahead not required** (9.6.1.2)

- **Transfer switch that is fire pump listed** (10.1.2.1)
- **Transfer switch must be in the pump room** (9.6.4)

LOOKING BACK

- **UL compliance facilitates AHJ approval**
- **UL 2200 covers generators including**
  - Enclosures and internal paralleling capabilities

- **NFPA compliance is mandated by state statute**
- **NFPA 37 and 110 bring up some interesting points**
  - Fuel reliability
    - Diesel fuel must be maintained
    - Refueling contingency planning should be considered
    - Bi-fuel (diesel and natural gas) technology minimizes fuel and maximizes run time
    - Code does not preclude natural gas solutions (discuss with AHJ)

Questions?