



**GPS-150 GENERATOR UL LISTING
& NFPA STANDARDS**

LEARNER'S GUIDE

WELCOME

Professional Development Seminar Series

Standby power systems are increasingly in demand. Commercial, industrial, municipal and healthcare facilities are just a few of the markets that require backup power. Understanding UL listings and NFPA standards is a crucial part of the process when designing a system.

The ever-changing requirements of the power generation industry, coupled with requests for additional training, has prompted Generac Power Systems to develop this training program.

Titled the Generac Power Systems Professional Development Seminar Series, this program consists of individual training modules that provide both theoretical and practical information. Each module is 90 minutes in length and each incorporate proven learning methodology to ensure a positive experience. These modules are designed to broaden the learner's understanding of topics such as:

- Current Technologies
- Sizing
- Codes & Standards
- Switching Technologies
- Reliable Design Characteristics
- Paralleling
- Engines and Alternators
- Controls
- Emissions

THE MODULE IN PERSPECTIVE

PURPOSE:

This seminar introduces Underwriters Laboratories (UL) standards and the impact of those standards on standby power generation for both the engine-generator set and transfer switch. Specific NFPA standards will be discussed along with application/installation details for healthcare, life safety, and NFPA Standards.

TIME:

- 90 minutes of Classroom Instruction
- 30 minutes for Final Assessment

LEARNING OBJECTIVES:

Upon completion of this seminar, participants will be familiar with the UL Listings and NFPA standards relative to the installation and operation of standby generators. Specifically, they will be able to:

- Explain the relationship between stated UL Listings and NFPA standards and the Authority Having Jurisdiction (AHJ).
- Explain the term “approved for intended use” as referenced in UL documents.
- List and describe the specific UL Listings relative to generators, switching equipment and fuel tanks.
- Explain the elements of system testing as described in UL 2200.
- Describe and explain the appropriate use of UL Listing labels.
- List and describe the specific NFPA Standards relative to generator applications, installations and operation.
- Describe key-fuel related factors including reliability, storage tanks and piping.
- List and describe critical factors relative to generator exhaust systems.
- Describe the specific fire considerations according to NFPA 110.
- Explain failure and redundancy considerations as described in NFPA 110.
- Identify and describe NFPA 110 construction practices relative to integrating generators into buildings.
- List and describe the controller elements required for NFPA 110 compliancy.
- List and describe the key factors affecting generator starting.
- Describe generator testing and maintenance requirements according to NFPA 110.
- Describe generator performance specifications according to NFPA 110.
- Explain generator performance requirements relative to NFPA Standards.

CONTINUING EDUCATION:

Upon successful completion of this seminar, participants will be awarded a certificate of achievement identifying the seminar title, 2.0 PDHs (Professional Development Hours) and 0.2 CEUs (Continuing Education Units).

Successful completion of a PDSS seminar requires that the participant have:

1. Attended the complete seminar
2. A minimum score of 80% on the Final Assessment

TRAINING AT A GLANCE

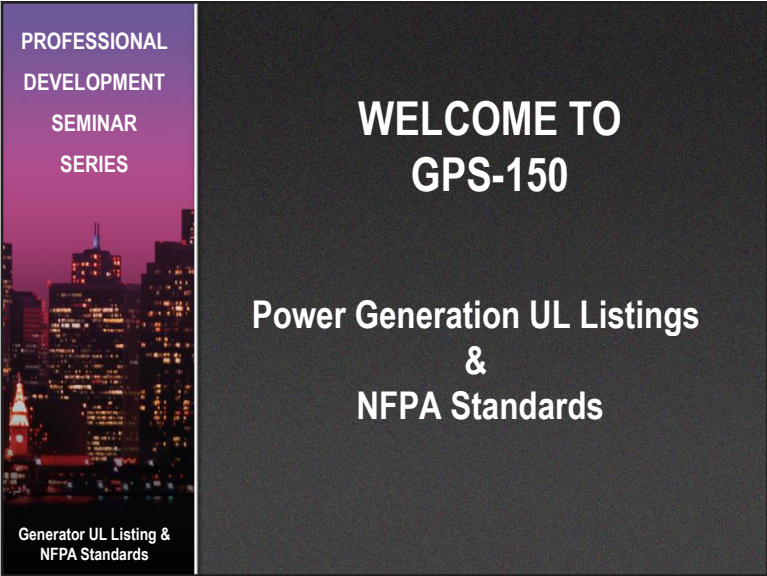
TIME	LESSON	DESCRIPTION
5 minutes	Introductions	Participants and trainer should become briefly acquainted. The trainer welcomes participants and conducts an opening icebreaker activity.
25 minutes	Lesson 1 UL Listing	A discussion of the UL standards and the impact they have on standby power generation.
55 minutes	Lesson 2 NFPA Standards	A discussion of the specific NFPA standards and application/installation details for healthcare, life safety and NFPA Standards.
5 minutes	Conclusion	The trainer will review the objectives of the class and discuss how each objective was accomplished. An evaluation will be given out with which participants can provide feedback about the course. An assessment will also be given to each participant to evaluate the skills and knowledge they received from the course.

INTRODUCTION

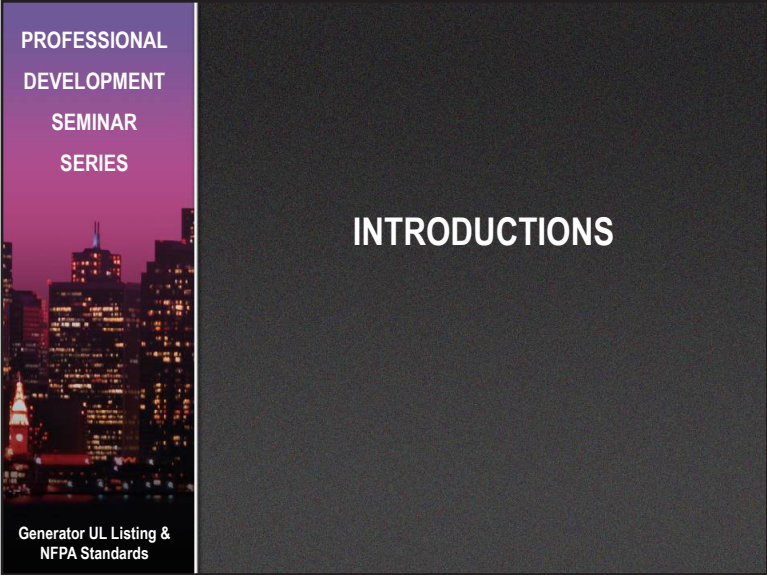
TIME: 5 minutes

OBJECTIVE:

The introduction is an opportunity for the trainer and participants to become familiar with each other. This period will discuss the topics to be covered, capture initial questions and introduce UL Listing and NFPA standards.



NOTES

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INTRODUCTION

ENGINEERING TRIVIA

The Hertz (hz), named after German physicist Heinrich Rudolf Hertz, is the current term used for frequency measurement.

What term was previously used to measure frequency?

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WHAT YOU WILL LEARN

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 - Explain the elements of system testing as described in UL 2200.
 - Describe and explain the appropriate use of UL Listing labels.
 - List and describe the specific NFPA Standards relative to generator applications, installations and operation.
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 - List and describe critical factors relative to generator exhaust systems.
 - Describe the specific fire considerations according to NFPA 110.
 - Explain failure and redundancy considerations as described in NFPA 110.
 - Identify and describe NFPA 110 construction practices relative to integrating generators into buildings.
 - List and describe the controller elements required for NFPA 110 compliance.
 - List and describe the key factors affecting generator starting.
 - Describe generator testing and maintenance requirements according to NFPA 110.
 - Describe generator performance specifications according to NFPA 110.
 - Explain generator performance requirements relative to fire pumps.

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INTRODUCTION

WHAT YOU WILL LEARN

Topics Covered	Estimated Time
Introduction.....	5 min
UL Listing.....	25 min
NFPA Standards.....	55 min
Conclusion.....	5 min

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1. UL Listing

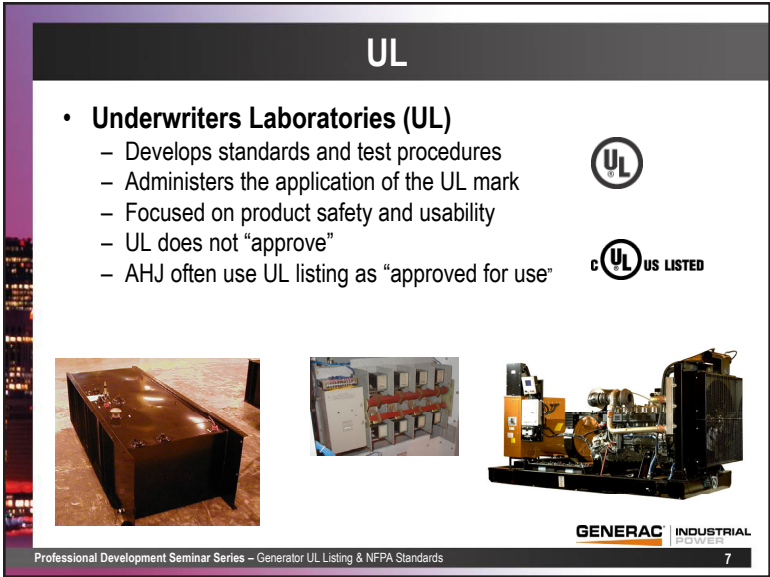
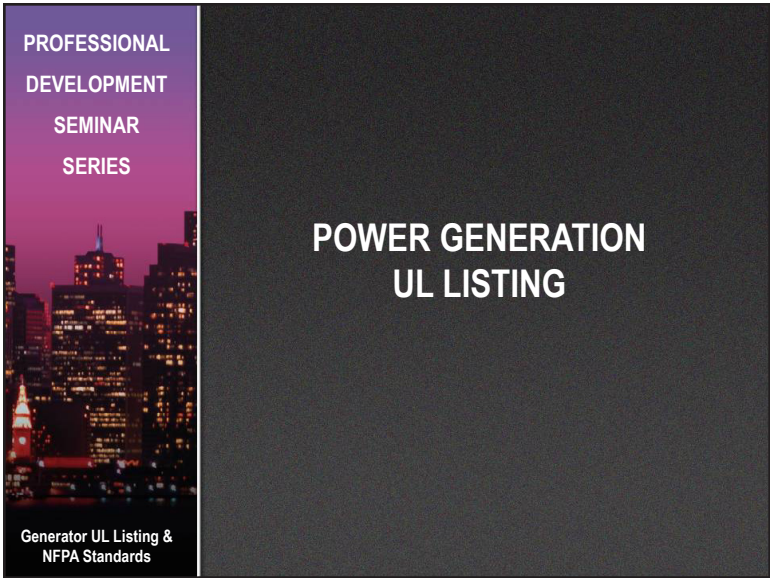
TIME: 25 minutes

OBJECTIVES:

Upon completion of this lesson, participants will be able to:

- Explain the relationship between stated UL Listings, NFPA standards and the Authority Having Jurisdiction (AHJ).
- Explain the term “approved for intended use” as referenced in UL documents.
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- Explain the elements of system testing as described in UL 2200.
- Describe and explain the appropriate use of UL Listing labels.

NOTES



1. UL Listing

UL 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)

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NOTES

UL 142 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



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1. UL Listing

NOTES

Switchboards and Switchgear

- **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 not functional standards.
These are equipment 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.

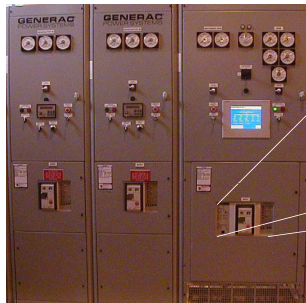
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UL 891 Dead-Front Switchboards

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



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1. UL Listing

NOTES

UL 2200

- **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.

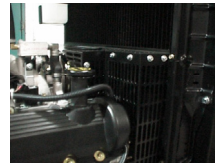
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UL 2200

- **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.



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1. UL Listing

NOTES

UL 2200

- **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



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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**
 - UL is comfortable with integrated paralleling

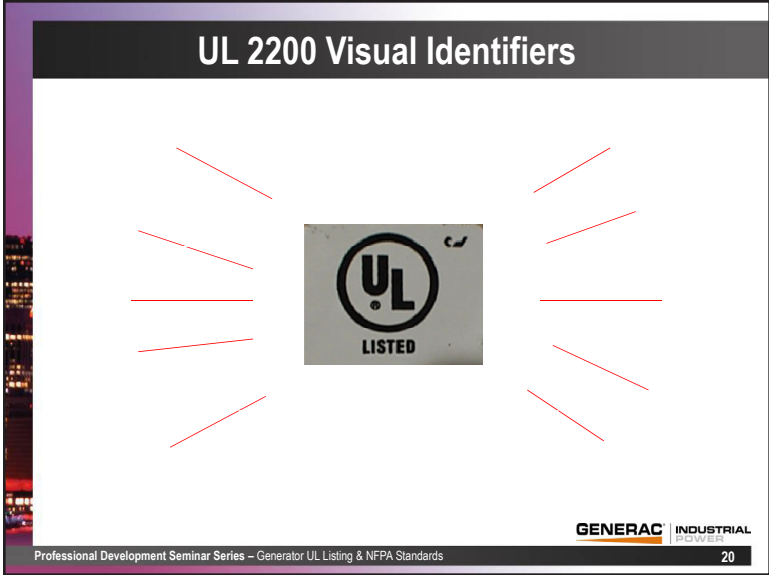


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1. UL Listing



NOTES

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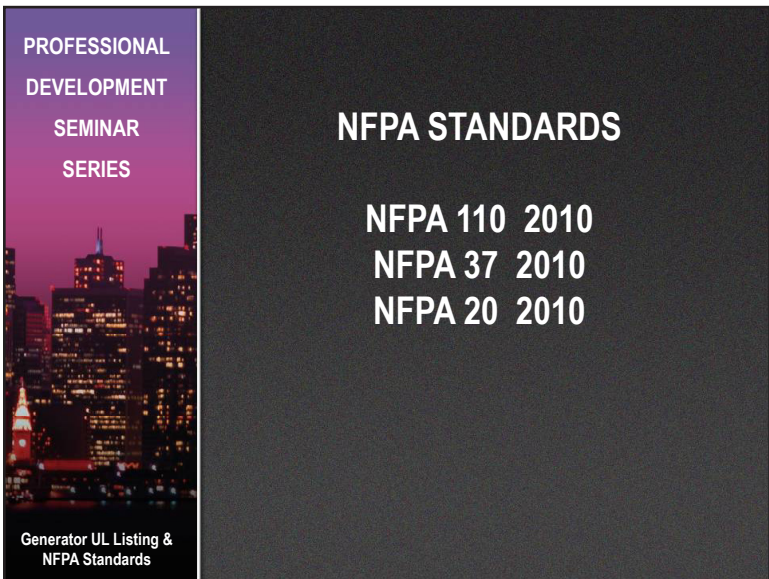
2. NFPA Standards

TIME: 55 minutes

OBJECTIVES:

Upon completion of this lesson, participants will be able to:

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- Describe generator performance specifications according to NFPA 110.
- Explain generator performance requirements relative to fire pumps.



NOTES

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2. NFPA Standards

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



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NOTES

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 FPN #5)
 - Legally required standby systems (NEC 701.1 FPN#2)
- **Healthcare code (NFPA 99) requires NFPA 110**
 - Type 1 and 2 essential electrical systems (NFPA 99 4.4.1.1.6.1)
 - Type 3 essential electrical systems (NFPA 99 4.4.1.1.6.2)

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2. NFPA Standards

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

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NOTES

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.

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2. NFPA Standards

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 provision shall be made to **replace stale fuel with clean fuel**.*
 - 8.3.8
*A **fuel quality test** shall be performed at least **annually** using tests approved by ASTM standards.*

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


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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**.



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2. NFPA Standards

NOTES

NFPA 110 Fuel Reliability -- Diesel

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

*"Sulfur, naturally occurring gums, waxes, soluble metallic soaps, water, dirt and temperature all **degrade fuel** as it is handled and stored. **These effects begin at the time of fuel refinement and continue until consumption**"*

*"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



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NFPA 110 Fuel Reliability -- Diesel

- **How much fuel is enough?**
- **How much fuel is too much?**
 - 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, because many **fuels have a shelf life and deteriorate with age**."*

*"**Prudent disaster management** could require much larger on-site temporary or permanent fuel storage."*
 - Strategies / Considerations
 - ♦ Strong fuel-maintenance or fuel-exchange programs
 - ♦ Minimize diesel -- Bi-fuel generators (diesel and natural gas)
 - ♦ Replace diesel -- Natural gas generators

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2. NFPA Standards

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)

Class	
Class 0.083	0.083 hr
Class 0.25	0.25 hr
Class 2	2 hr
Class 6	6 hr
Class 48	48 hr
Class X	Other than the above

- **Low-fuel level set at 100% of required class** (5.5.2)
- **Seismic zones (c, d, e, and f) require 96 hours of run time** (5.1.2)
- **Inside tanks generally limited to 660 gal** (7.9.5 and NFPA 37 6.3.2.2)
- **Greater than 660 gal** (NFPA 37 6.3.5 and 6.3.6)
 - Dedicated fire-rated rooms
 - Spill containment (curbing)


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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)



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2. NFPA Standards

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)



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NFPA Tanks

Emergency Relief
NFPA 30 4.2.5.2.1

Normal Vent
NFPA 30 4.2.5.1.1

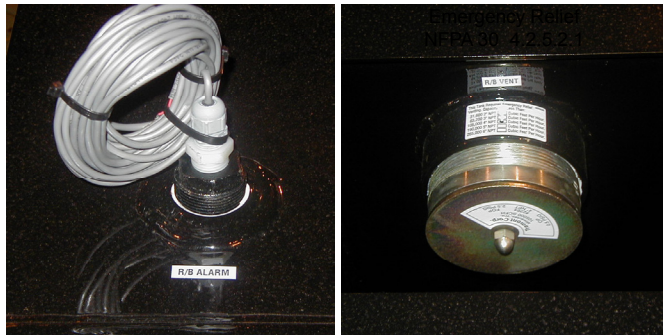
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2. NFPA Standards

NFPA 110 Secondary Containment Components



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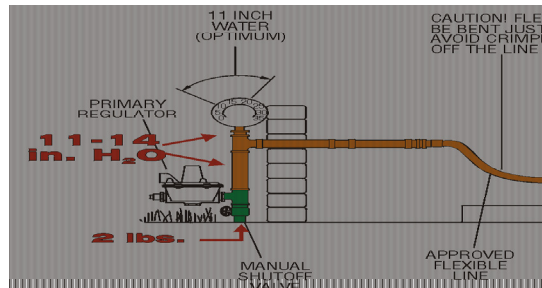
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NOTES

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)



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2. NFPA Standards

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))



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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** (7.10.5)
- **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



The photograph shows a large industrial engine, likely a generator, with a prominent orange exhaust pipe. The engine is mounted on a black base and has various components, including a control panel with a digital display and buttons. The background is a plain, light-colored wall.

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2. NFPA Standards

NFPA 110 Equipment Location

- Requires permanent installation (4.4.3)
- Consider potential for flooding (7.2.3, A.7.2.4(3))
- Consider natural and human threats (A.7.2.4)
- Separate room (Level 1) (7.2.1)
- Generator or ATS not installed with electrical service (Level 1, 480V, 1000A) (7.2.2)
- Minimum 36" generator-to-generator separation (7.2.5)
- Adequate ventilation and air flow (7.7)
- Outdoor units require 5' clearance from building (NFPA 37 4.1.4)



The left photograph shows a large, tan-colored outdoor generator unit installed in a separate enclosure next to a building. The right photograph shows two smaller, tan-colored outdoor generator units installed on a concrete pad with yellow bollards for clearance.

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NFPA 110 Fire Considerations

- **Two-hour fire rating** (7.2.1.1)
- **Fire-risk evaluation** (NFPA 37 10-1)
- **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?**

Generator UL Listing & NFPA Standards

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2. NFPA Standards

NFPA 110 Failure Consideration

NFPA 110 7.2.6

"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?

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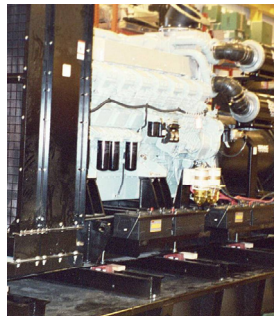
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NOTES

NFPA 110 Construction

- **Vibration isolators**
 - Internal pads are OK (A.7.5)
- **Cooling**
 - Closed loop required (5.6.7.3)
 - Maximum restriction .5" H₂O (7.7.4.1)
- **Motor dampers / louvers**
 - Spring open (7.7.5)
 - No fire dampers (7.7.2.3)



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2. NFPA Standards

NFPA 110 Controls

- **Controller must be NFPA compliant** (5.6.5)
 - Operation
 - Indication
 - Protection
 - Remote annunciator required (NFPA 99 4.4.1.1.17 and NFPA 110 table 5.6.5.2)
 - Remote manual stop (5.6.5.6)



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NOTES

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) Over speed	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 announced by a remote, common visual indicator.

6. All required functions indicated in the RA column shall be announced by a remote, common audible alarm as required in 5.6.5.2(f).

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.

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2. NFPA Standards

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



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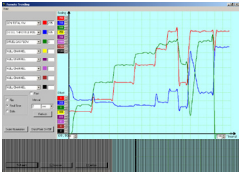
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[illegible]

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)



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2. NFPA Standards

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

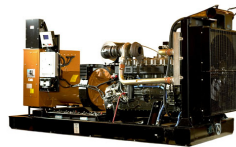
- Exercise generator with load (8.4.2)
- Operate all transfer switches monthly (8.4.6)

Annually

- Generator 1.5 hr full 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)



GENERAC INDUSTRIAL POWER

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NOTES

Maintenance Schedule

Component (see applicable)	Procedure				Frequency			
	Visual Inspection	Check	Change	Clean	Test	Level 1	Level 2	Level 3
1. Fuel								
(a) Fuel supply tank level	X					W	W	
(b) Day tank level	X					W	W	
(c) Day tank fuel switch	X				X	W	W	
(d) Day tank fuel transfer pump operation	X				X	W	W	
(e) Manual valve operation	X				X	W	W	
(f) Breaker (flow, day tag, or maintenance)				X	Q	Q	Q	
(g) Water to system		X			X	W	W	
(h) Pressure hose and connections	X					W	W	
(i) Tank vents and overflow piping	X				X	A	A	
(j) Piping	X					A	A	
(k) Check for leaks (check valves)	X					A	A	
2. Lubrication System								
(a) Oil level	X	X				W	W	
(b) Oil change			X			30 or 4	30 or 4	
(c) Oil filter(s)			X			30 or 4	30 or 4	
(d) Lube oil heater	X					W	W	
(e) Circulation breaker	X			X		Q	Q	
3. Cooling System								
(a) Level	X	X				W	W	
(b) Antifreeze protection level				X		A	A	
(c) Antifreeze		X				A	A	
(d) Adequate cooling water to heat exchanger	X					W	W	
(e) Red ant leak exchange			X			A	A	
(f) Adequate tank air through indicator	X					W	W	
(g) Clean exterior of radiator	X				X	A	A	
(h) Fan and alternator belt	X					W	W	
(i) Water pump(s)	X					W	W	
(j) Connections between hoses and alternator	X					W	W	
(k) Antifreeze heater						W	W	
(l) Inspect that work check function	X			X		A	A	
(m) Lower pressure and control	X			X		A	A	
4. Exhaust System								
(a) Leaking	X					W	W	
(b) Drain condensate trap	X					W	W	

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

NFPA 110, 1.4.10.10

Component	Procedure		Frequency			
	Visual Inspection	Test	Level 1	Level 2	Level 3	Level 4
1. Fuel						
(a) Fuel supply tank level	W	W				
(b) Day tank level	W	W				
(c) Day tank fuel switch	W	W				
(d) Day tank fuel transfer pump operation	W	W				
(e) Manual valve operation	W	W				
(f) Breaker (flow, day tag, or maintenance)	Q	Q				
(g) Water to system	W	W				
(h) Pressure hose and connections	A	A				
(i) Tank vents and overflow piping	A	A				
(j) Piping	A	A				
(k) Check for leaks (check valves)	A	A				
2. Lubrication System						
(a) Oil level	W	W				
(b) Oil change	30 or 4	30 or 4				
(c) Oil filter(s)	30 or 4	30 or 4				
(d) Lube oil heater	W	W				
(e) Circulation breaker	Q	Q				
3. Cooling System						
(a) Level	W	W				
(b) Antifreeze protection level	A	A				
(c) Antifreeze	A	A				
(d) Adequate cooling water to heat exchanger	W	W				
(e) Red ant leak exchange	A	A				
(f) Adequate tank air through indicator	W	W				
(g) Clean exterior of radiator	A	A				
(h) Fan and alternator belt	W	W				
(i) Water pump(s)	W	W				
(j) Connections between hoses and alternator	W	W				
(k) Antifreeze heater	W	W				
(l) Inspect that work check function	A	A				
(m) Lower pressure and control	A	A				
4. Exhaust System						
(a) Leaking	W	W				
(b) Drain condensate trap	W	W				

FIGURE A.8.3.1(b) Sample Maintenance Log – Routine Maintenance, Operation, and Testing (MOT).

NFPA 110, 1.4.10.10

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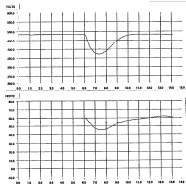
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2. NFPA Standards

NFPA 110 Performance Requirements

- **Start and Load in 10 seconds (type 10)** (4.4.4)
- **Run for the classed time** (4.4.4)
- **Accept 100% block load** (7.13.7)
- **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)



The image contains two line graphs. The top graph shows voltage (V) on the y-axis (ranging from 240 to 260) versus time (s) on the x-axis (ranging from 0 to 120). The voltage starts at approximately 255V, drops sharply to about 245V at 10 seconds, and then gradually recovers back to 255V by 60 seconds. The bottom graph shows frequency (Hz) on the y-axis (ranging from 59.5 to 60.5) versus time (s) on the x-axis (ranging from 0 to 120). The frequency starts at approximately 60.0 Hz, drops sharply to about 59.5 Hz at 10 seconds, and then gradually recovers back to 60.0 Hz by 60 seconds.

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-
- The figure consists of two vertically stacked plots. Both plots show a function $f(t)$ on the y-axis against time t on the x-axis. The x-axis for both plots ranges from 0 to 120 with major ticks every 10 units. The y-axis for both plots ranges from 0.000 to 0.020 with major ticks every 0.002 units. The top plot shows a function that starts at approximately 0.018, remains relatively constant until $t \approx 60$, then drops sharply to a minimum of about 0.008 at $t \approx 70$, before rising back to 0.018 by $t \approx 80$. The bottom plot shows a similar trend but with a much smoother transition, starting at approximately 0.018, dipping to a minimum of about 0.012 at $t \approx 70$, and returning to 0.018 by $t \approx 80$.

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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



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2. NFPA Standards

NFPA 20 Fire Pumps

- **Meet NFPA 110 Level 1, Type 10 requirements** (9.6.2.1)
- **Run time of 8 hours minimum** (9.6.2.2)
- **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)

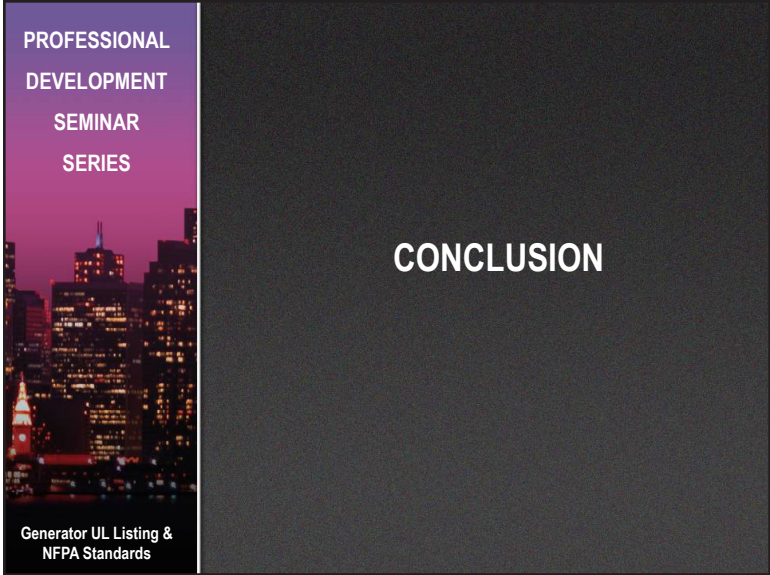


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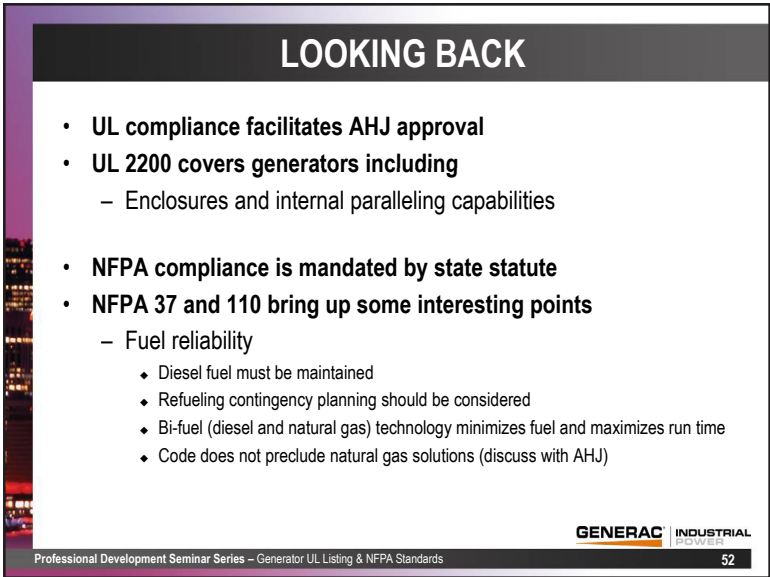
50

[illegible]

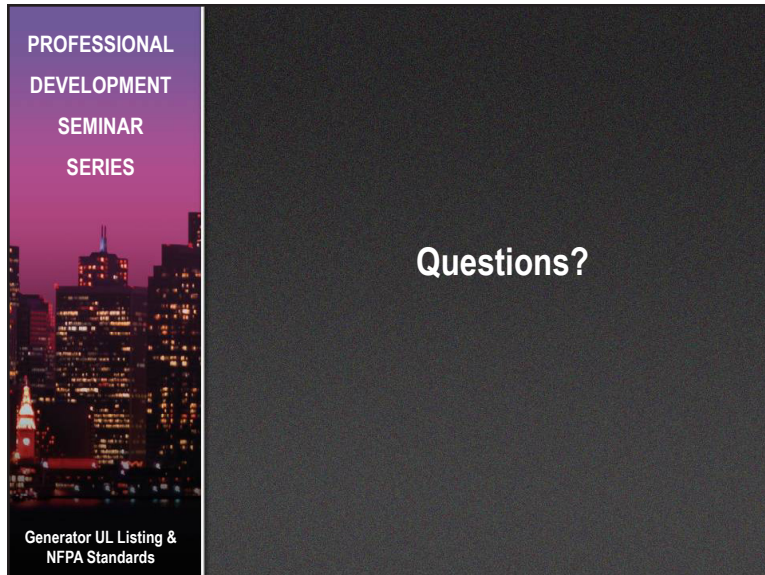
CONCLUSION



NOTES

[illegible]

CONCLUSION



NOTES

ONLINE FINAL ASSESSMENT AND CERTIFICATE REGISTRATION AND LOGIN PROCEDURE

Online Final Assessment

Final assessments are available for each PDSS session. These assessments are Web-based and can be accessed using Generac's online learning system "*The Learning Center*" ([http:// learning.generac.com](http://learning.generac.com)). PDSS participants are required to obtain a score of at least 80% to pass an assessment. Each online assessment also contains a training survey. The survey provides each participant an opportunity to rate various components of the learning experience along with information relative to business development. Instructions for how to register and log in to this system, take the final assessment and print a certificate, are described in the Registering in "*The Learning Center*" section below.

Continuing Education

Upon successful completion of a seminar, participants will be awarded 2.0 PDHs (Professional Development Hours) and 0.2 CEUs (Continuing Education Units). Successful completion of a seminar requires that the participant have:

- Attended the complete seminar
- Received a minimum score of 80% on the Final Assessment

Certificate of Accomplishment

Participants who successfully complete the seminar and receive a passing score on the online final assessment are entitled to a "Certificate of Accomplishment." Certificates are available for printing directly from the participant's account screen on Generac's online training system "*The Learning Center*". Instructions for how to register and log in to this system, take the final assessment and print a certificate, are described beginning in the following section.

Registering in "*The Learning Center*"

To gain access to "*The Learning Center*", you are required to register and set up a user account. During your account setup you will create a *Username* and *Password*. Your username and password can then be used to log in on subsequent visits.

The following pages will aid you in the registration process along with the Final Assessment, Survey and Certificate procedures.

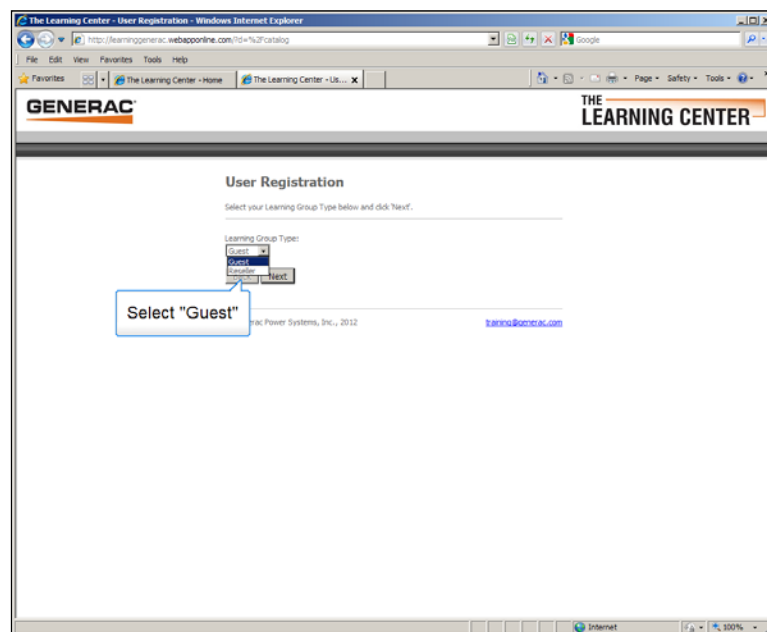
To begin the registration process, open your computer's browser and enter [http:// learning.generac.com](http://learning.generac.com). This should take you to "*The Learning Center*" home page. This page is displayed at the top of the next page. From this point you can follow illustrated steps.

ONLINE FINAL ASSESSMENT AND CERTIFICATE REGISTRATION AND LOGIN PROCEDURE

Begin by entering <http://learning.generac.com> in your computer's browser. The screen below will be displayed. Click on the "register here" link to begin the registration process.

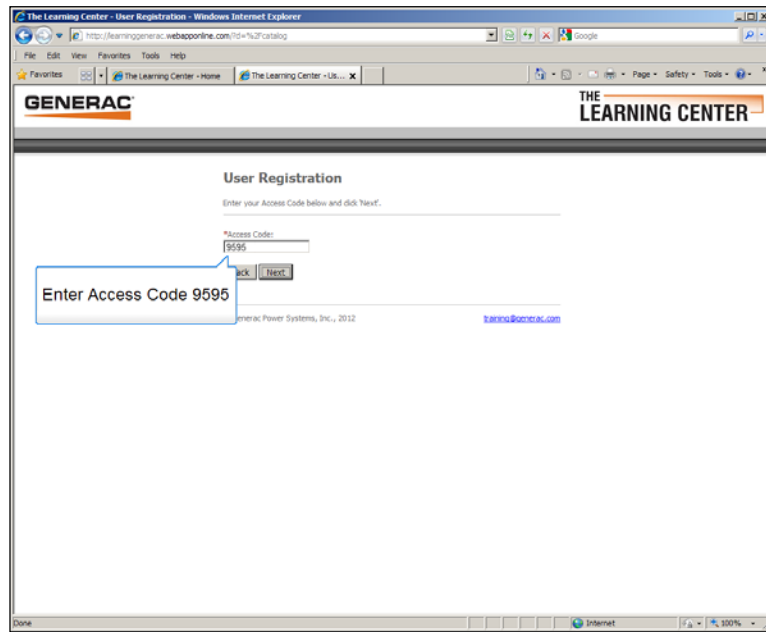


On this screen you will select "Guest" from the drop down box and click the "Next" button.



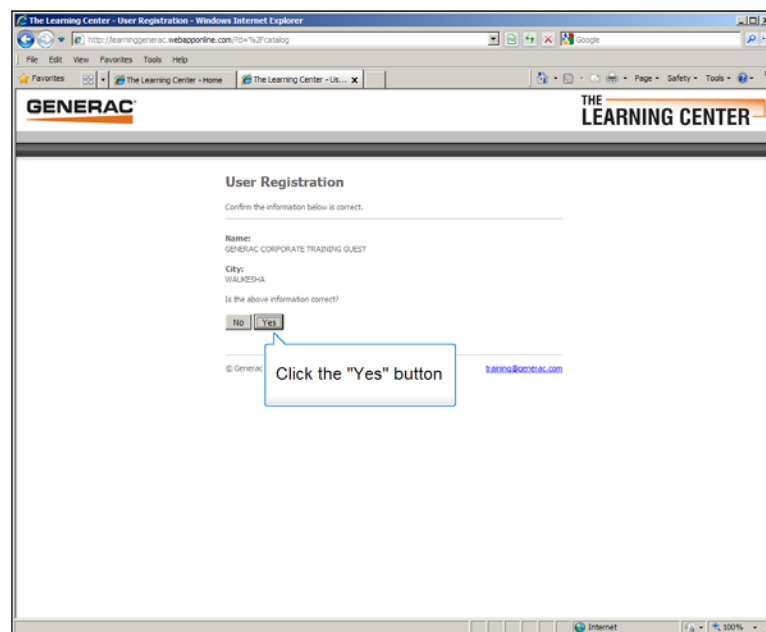
ONLINE FINAL ASSESSMENT AND CERTIFICATE REGISTRATION AND LOGIN PROCEDURE

In this next screen enter **Access Code 9595** and click the “Next” button. Please keep this code private.



The screenshot shows a web browser window titled "The Learning Center - User Registration - Windows Internet Explorer". The address bar shows the URL "http://learninggenerac.webapponline.com/ld=%2Fcatalog". The page header includes the "GENERAC" logo and "THE LEARNING CENTER". The main heading is "User Registration" with the instruction "Enter your Access Code below and click Next!". Below this is a text input field labeled "Access Code" containing the value "9595". To the right of the field are "Back" and "Next" buttons. A blue callout box with the text "Enter Access Code 9595" points to the input field. At the bottom, it says "Generac Power Systems, Inc., 2012" and "training@generac.com".

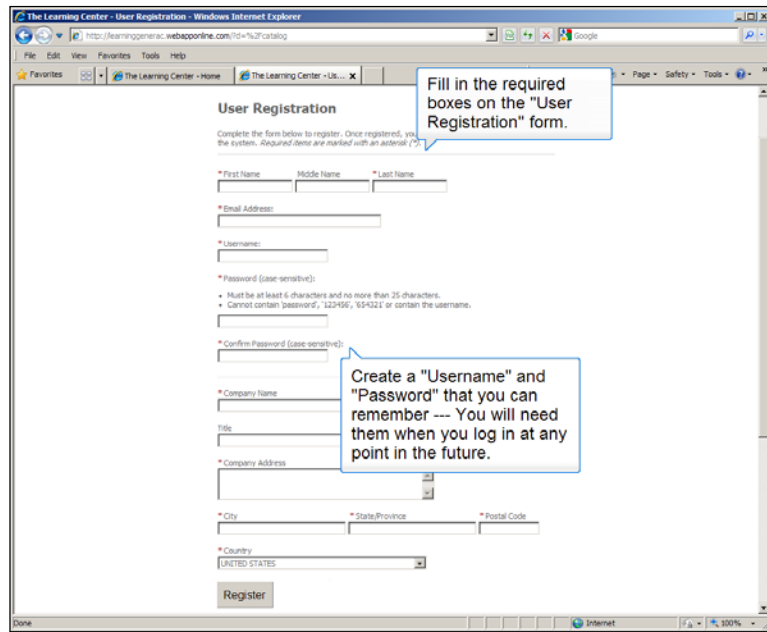
This screen confirms the correct access code entry. Click the “Yes” button to proceed.



The screenshot shows the same web browser window, but the page content has changed. The heading is still "User Registration", but the instruction is now "Confirm the information below is correct.". Below this, the "Name:" field is populated with "GENERAC CORPORATE TRAINING GUEST" and the "City:" field is populated with "WALKER, GA.". Below these fields is the question "Is the above information correct?". To the left of this question are "No" and "Yes" buttons. A blue callout box with the text "Click the 'Yes' button" points to the "Yes" button. At the bottom, it says "© Generac" and "training@generac.com".

ONLINE FINAL ASSESSMENT AND CERTIFICATE REGISTRATION AND LOGIN PROCEDURE

The next screen contains the “User Registration” form. Fill in the required boxes, and then click the “Register” button.

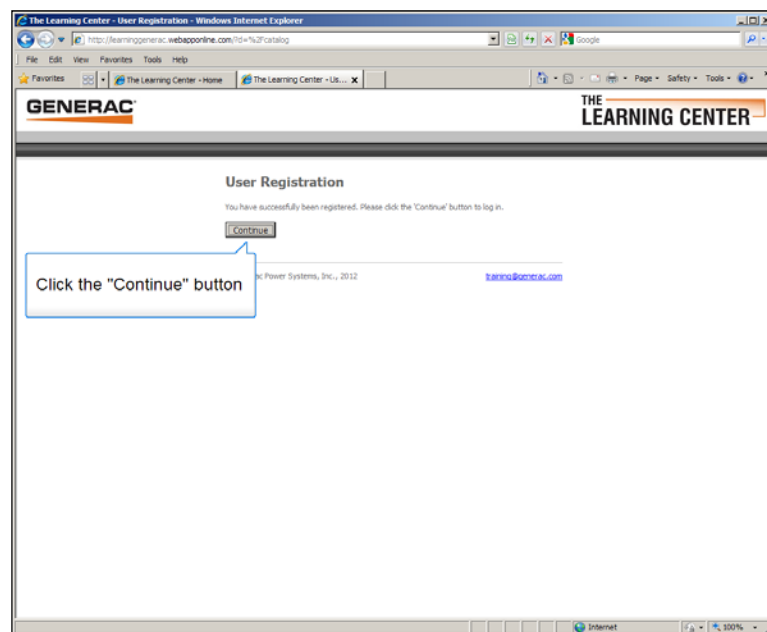


The screenshot shows a web browser window titled "The Learning Center - User Registration". The address bar shows the URL "http://learninggenerac.webapponline.com/10+%2Fcatalog". The page has a header with "The Learning Center" logo and navigation links. The main content area is titled "User Registration" and contains a form with the following fields:

- *First Name, *Middle Name, *Last Name
- *Email Address
- *Username
- *Password (case-sensitive):
 - Must be at least 6 characters and no more than 25 characters.
 - Cannot contain 'password', '123456', '987654321' or contain the username.
- *Confirm Password (case-sensitive)
- *Company Name
- Title
- *Company Address
- City, State/Province, Postal Code
- *Country (dropdown menu showing "UNITED STATES")

At the bottom of the form is a "Register" button. A blue callout box points to the form fields with the text: "Fill in the required boxes on the 'User Registration' form." Another blue callout box points to the Password and Confirm Password fields with the text: "Create a 'Username' and 'Password' that you can remember --- You will need them when you log in at any point in the future."

The next screen confirms your registration. Click the “Continue” button to proceed.



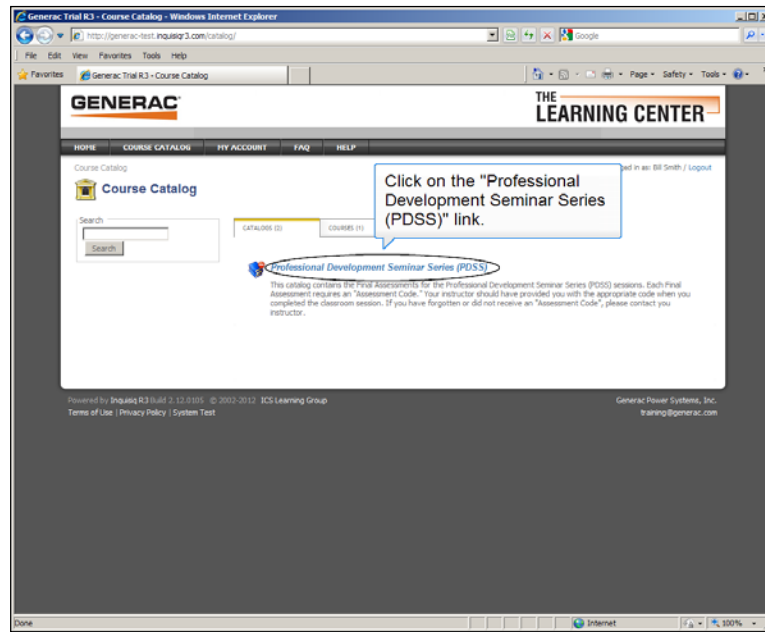
The screenshot shows a web browser window titled "The Learning Center - User Registration". The address bar shows the URL "http://learninggenerac.webapponline.com/10+%2Fcatalog". The page has a header with "GENERAC" and "THE LEARNING CENTER" logos. The main content area is titled "User Registration" and contains the following text:

You have successfully been registered. Please click the "Continue" button to log in.

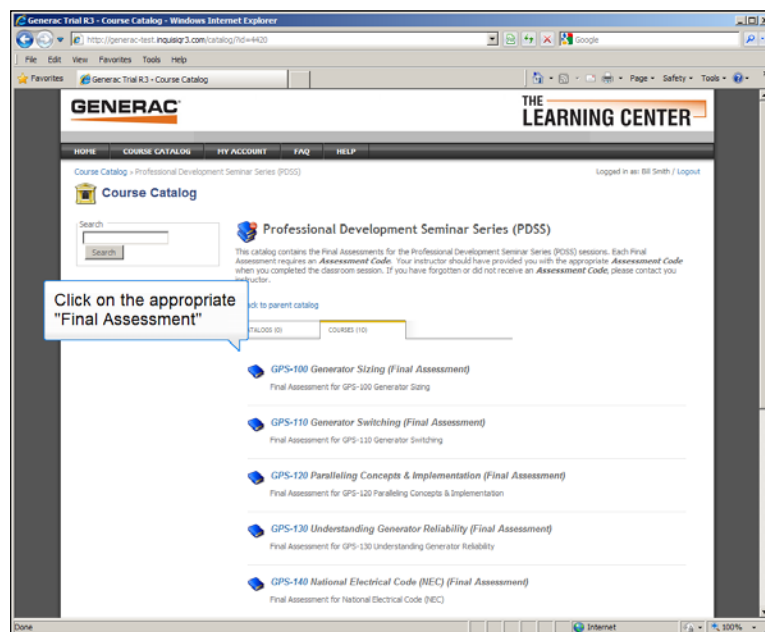
Below the text is a "Continue" button. A blue callout box points to the button with the text: "Click the 'Continue' button". At the bottom of the page, there is a footer with the text "Generac Power Systems, Inc., 2012" and a link "training@generac.com".

ONLINE FINAL ASSESSMENT AND CERTIFICATE REGISTRATION AND LOGIN PROCEDURE

The next screen displays the “Course Catalog.” Click on the “Professional Development Seminar Series” link.

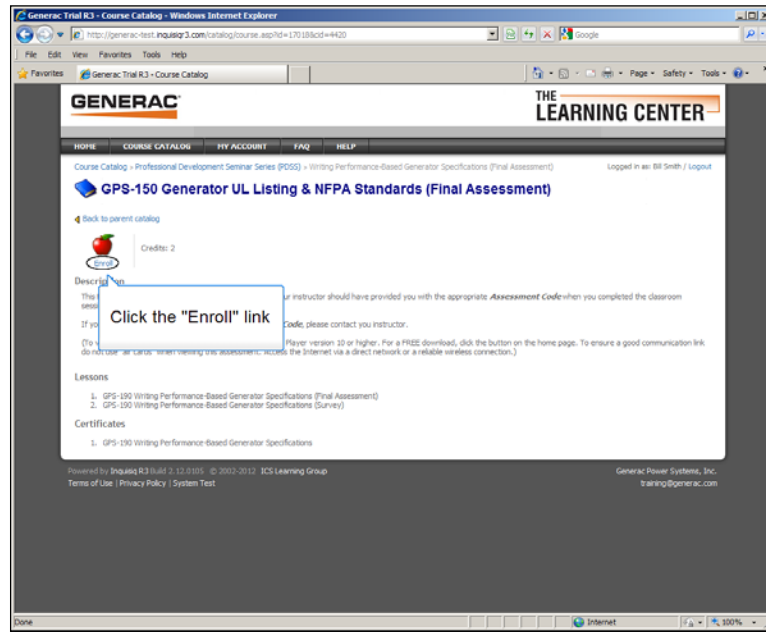


This next screen lists all currently available Final Assessments. Click on the Final Assessment that is tied to the course name and number you completed.

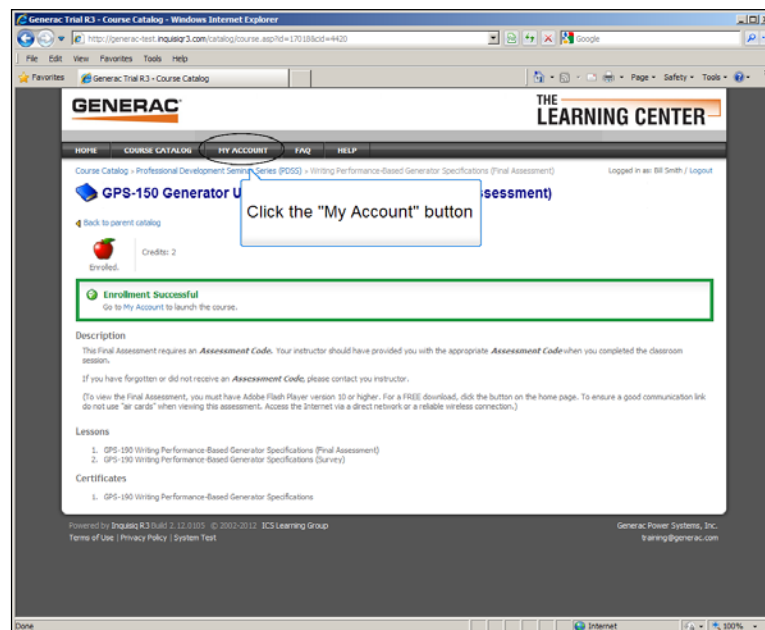


ONLINE FINAL ASSESSMENT AND CERTIFICATE REGISTRATION AND LOGIN PROCEDURE

The next screen is the “Enrollment” screen for the Final Assessment that you selected. Click the “Enroll” link to proceed.

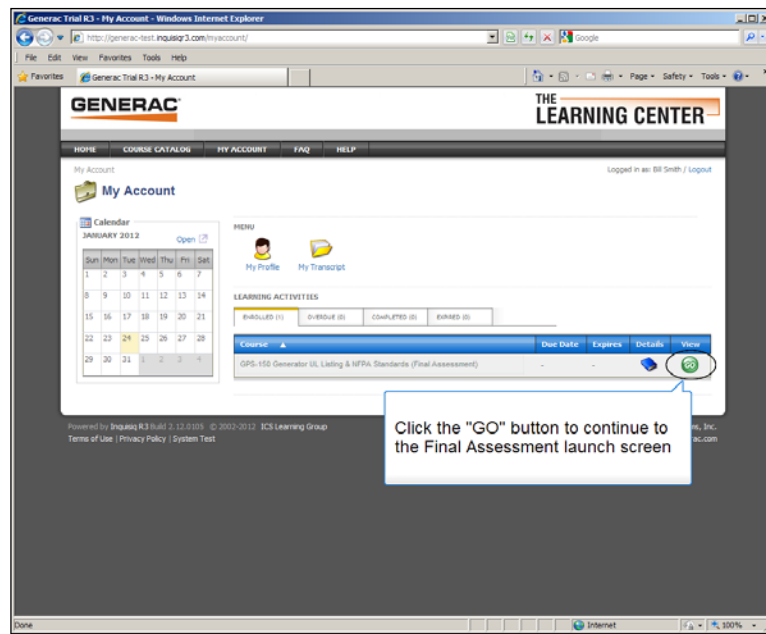


This screen confirms your enrollment. Click the “My Account” button to proceed.

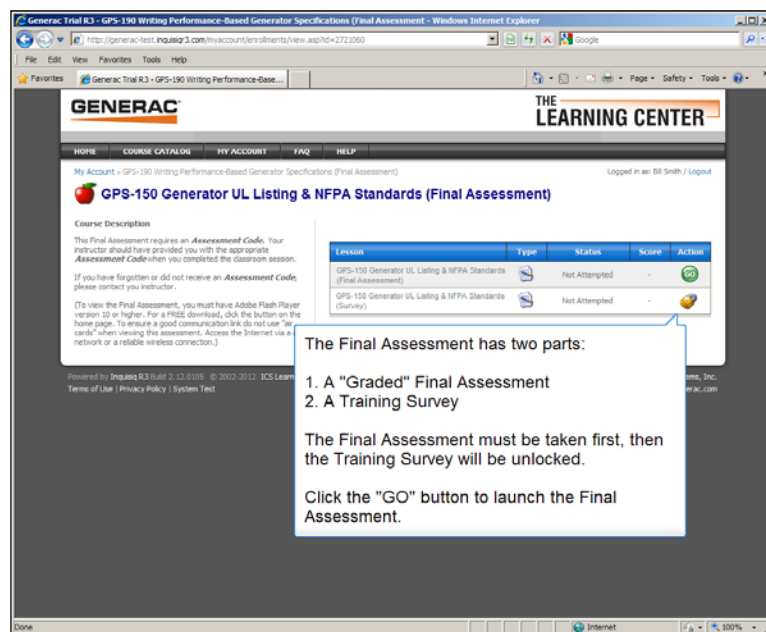


ONLINE FINAL ASSESSMENT AND CERTIFICATE REGISTRATION AND LOGIN PROCEDURE

This is your “My Account” screen. Note that the Final Assessment you selected is displayed under the “Enrollment” tab. Click the “GO” button to proceed.

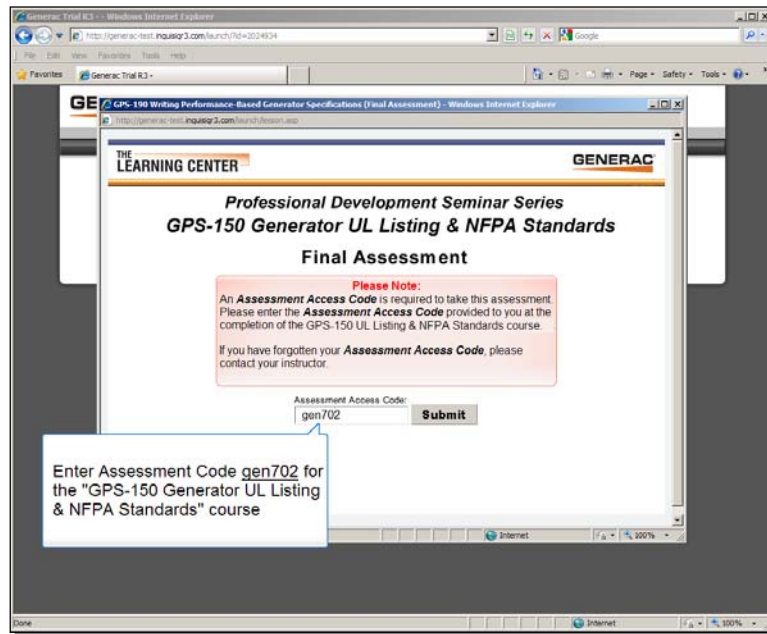


This screen lists the two parts to the Final Assessment. You must take the “Graded” Assessment first, then the Training Survey.

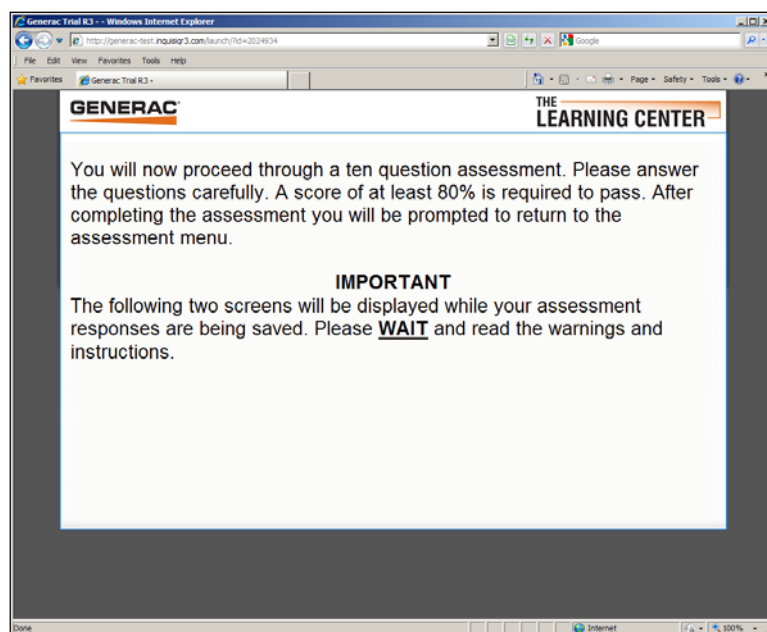


ONLINE FINAL ASSESSMENT AND CERTIFICATE REGISTRATION AND LOGIN PROCEDURE

In the next screen an “Assessment Code” is required before you can continue. The code for GPS-150 Generator UL Listing and NFPA Standards is **gen702**. Enter the code in the box and click the “Submit” button to continue.

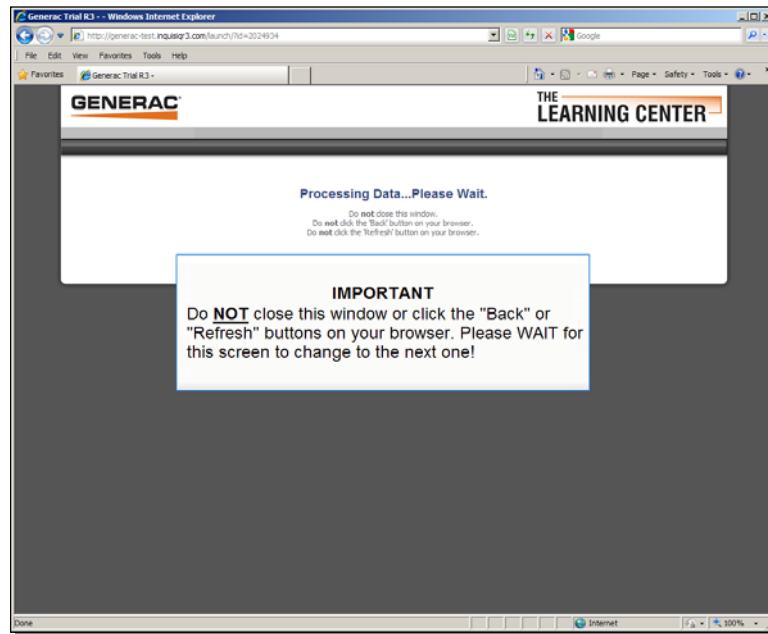


You will now proceed through a ten question assessment. Please read the warnings below.

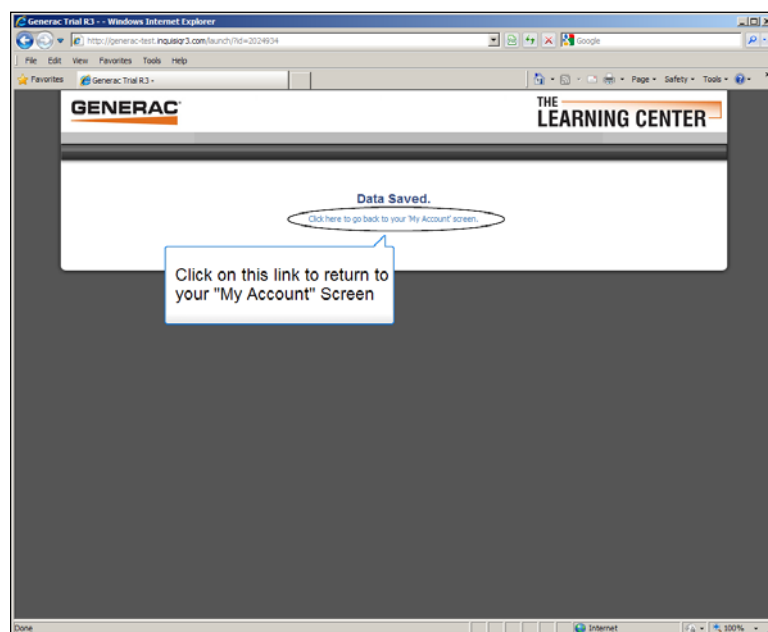


ONLINE FINAL ASSESSMENT AND CERTIFICATE REGISTRATION AND LOGIN PROCEDURE

Please follow the instructions on this screen. You must wait for your assessment data to be saved. Do not close this window or click the 'Back' or 'Refresh' buttons on your browser.

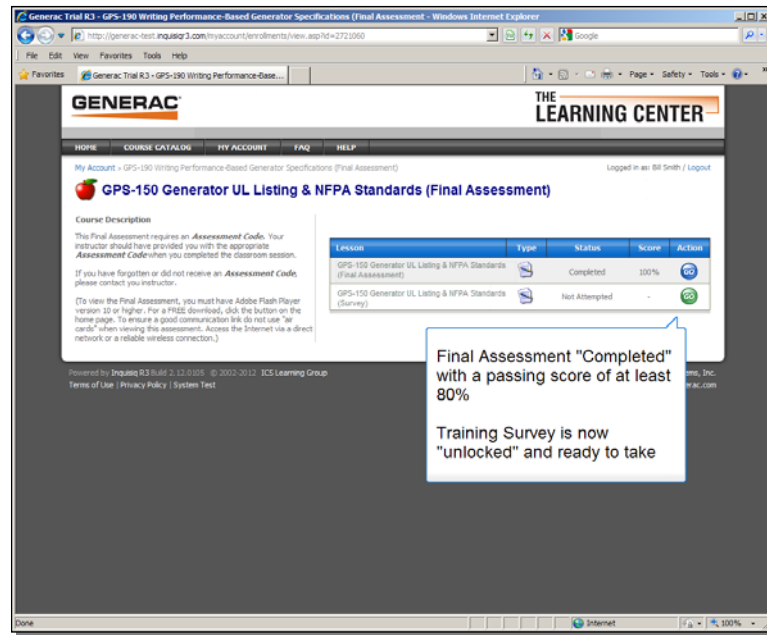


This screen confirms that your data was saved. Click on the link shown here to proceed.

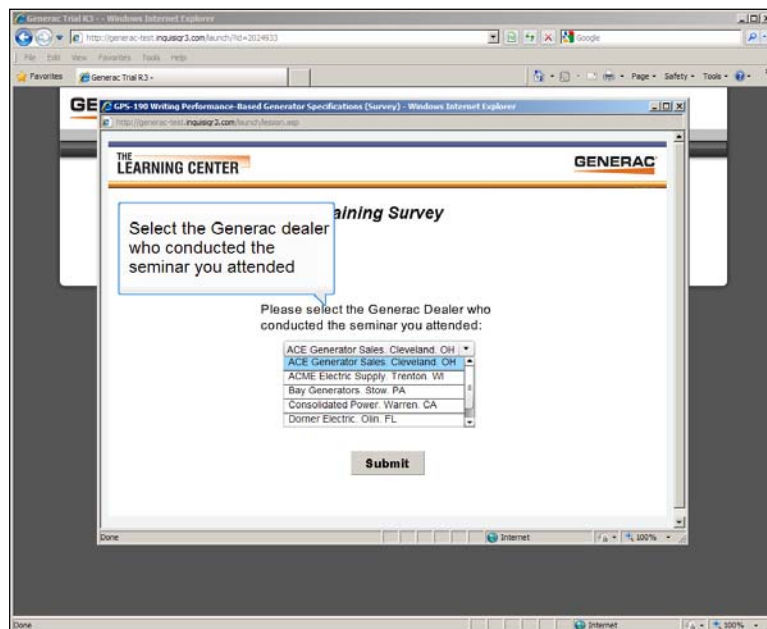


ONLINE FINAL ASSESSMENT AND CERTIFICATE REGISTRATION AND LOGIN PROCEDURE

This screen will be displayed after your assessment data is saved. Note that in this example the assessment was passed with a score of 100% and the Survey is unlocked and ready to launch.

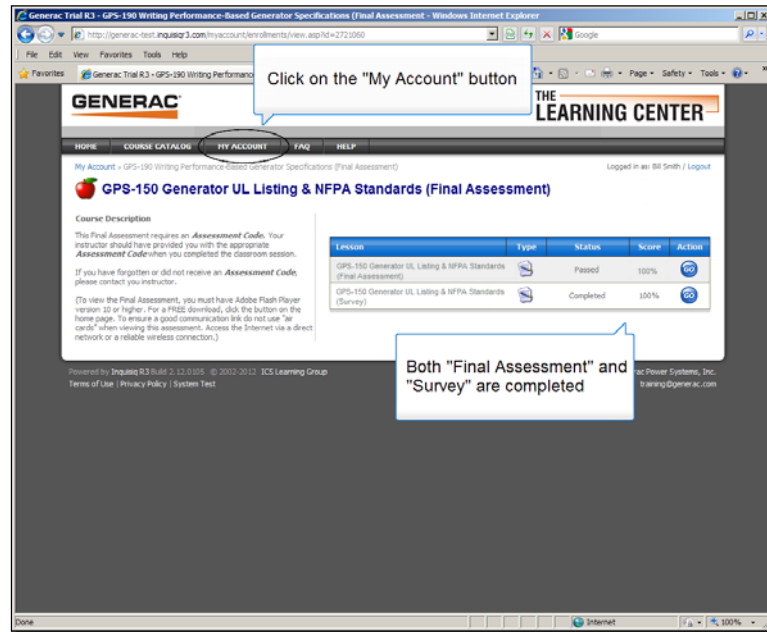


Upon launching the Survey, this screen will be displayed. Select the Generac dealer who conducted the seminar you attended.

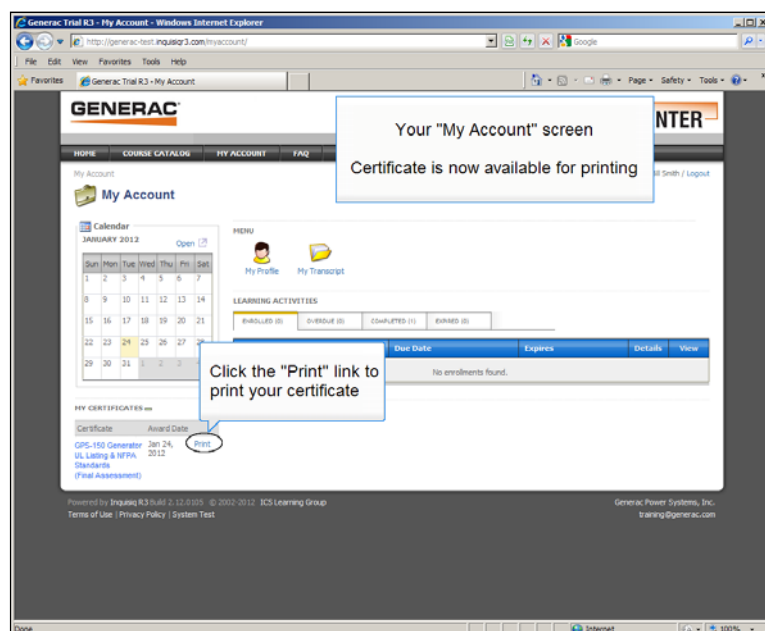


ONLINE FINAL ASSESSMENT AND CERTIFICATE REGISTRATION AND LOGIN PROCEDURE

After completing the survey you will be prompted to return to the assessment menu. Your response data will be saved as before, and you will see the screen below. Click the "My Account" button to continue.



Your "My Account" screen will look similar to the one shown here. Click the "Print" link to print your certificate.



NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

NOTES

This image shows a full page of blank, lined paper. It features approximately 28 horizontal black lines spaced evenly across the page, typical of standard notebook paper. The lines are thin and extend from the left edge to the right edge. There are no margins, text, or other markings on the page.

NOTES

This image shows a full page of blank, lined paper. It features approximately 20 evenly spaced horizontal black lines running across the width of the page, typical of notebook or legal stationery. The background is a solid off-white color. There are no margins, text, or other markings present.

