

# NATURAL GAS VEHICLE MAINTENANCE FACILITIES

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ALLIANT ENERGY CENTER  
MADISON, WISCONSIN

## NGV MAINTENANCE FACILITIES

*Code Related Modifications For NGVs In Existing Maintenance  
Facilities*



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# TODAYS AGENDA



- Overview NG properties and applicable codes
- Requirements and compliance strategies
- Case Studies
- Costs
- Q&A

# ET ENVIRONMENTAL

- First CNG project completed in 2004
- 90 fueling projects completed
- Team dedicated to turn-key CNG projects
  - *Design staff – 17*
  - *Construction staff – 37*
  - *40+ projects in progress*
- 12 offices



# SEO Guidelines Document

## ■ Background

- *State outreach programs identified a barrier to growth of the NGV market*



## ■ Purpose

- *Provide industry guidance on maintenance shop code and safety requirements*
- *Encourage consistent code interpretation*

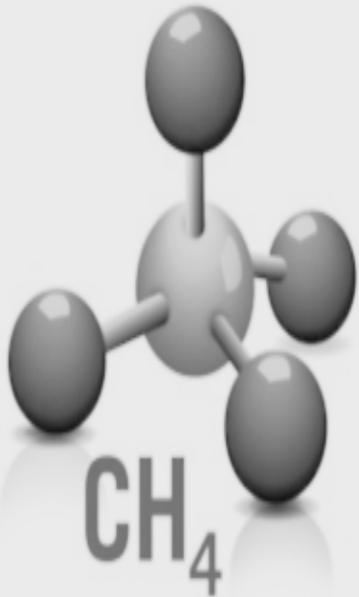
## ■ Document Development

- *In coordination with SEO, DSPPS, Fire Officials, and Fleet Owners*

# NATURAL GAS PROPERTIES

- Natural Gas differs from gasoline and diesel

- 1) *Natural gas is 90-99% Methane*
- 2) *Methane is nontoxic, colorless, odorless, and tasteless*
- 3) *Natural gas is lighter-than-air*
- 4) *The mixture of natural gas in air that will support combustion - between 5% and 15% by volume*
- 5) *NG has a high ignition temperature of around 900 to 1,200 degrees Fahrenheit (°F)*
- 6) *Natural Gas is odorized (CNG). LNG is not odorized.*



# NATURAL GAS PROPERTIES

- LNG
  - $-260\text{ }^{\circ}\text{F}$
  - *Gaseous vapors are heavier than air below  $-170\text{ }^{\circ}\text{F}$*
- Hazards of Natural Gas
  - *Flammability*
  - *Asphyxiant Gas*
  - *High Pressure (CNG)*
  - *Cryogenic (LNG)*



# Applicable Codes



**National Fire Protection Association**  
The authority on fire, electrical, and building safety



Partial list of codes and standards:

- National Fire Protection Association (NFPA)
  - *NFPA 30A Code for Motor Fuel Dispensing Facilities and Repair Garages*
  - *NFPA 70 National Electric Code (NEC)*
  - *NFPA 52 Vehicular Gaseous Fuel Systems Code*
- I-Codes – IBC, IMC, IFC, IEBC
- Municipal / Local requirements and amendments

# MAINTENANCE FACILITIES GARAGE RETROFITS FOR NGVs



- Every shop is unique
- Consult a professional
- Code compliance is only one component
  - *Operations*
  - *Training*

# WHO APPLIES & ENFORCES THE CODE?



- Qualified Design Professional prepares permit documents
- Authority Having Jurisdiction (AHJ)
  - *State Review*
  - *Local Building Dept and Fire official*

# NGV MAINTENANCE FACILITY EVALUATION

- 1) Ventilation
  - 2) Gas Detection
  - 3) Heating Systems
  - 4) Electrical Systems and Components
- Existing Conditions and Code Triggers
  - Other items that may be applicable
- (for now, assume “Major Repair Garage”)

# NGV MAINTENANCE FACILITY VENTILATION

## TWO DISTINCT VENTING CRITERIA

### 1) PURGE VENTING

- *Only required for NGV's, not Diesel or Gasoline Vehicles*



### 2) AIR QUALITY FOR OCCUPIED SPACES

- *Same for Natural Gas, Diesel, and Gasoline*



# NGV MAINTENANCE FACILITY VENTILATION



IMC 502.16 - Purge Venting

*“Repair garages for the repair of vehicles which use CNG, LNG or other lighter-than-air motor fuels shall be provided with an approved mechanical ventilation system.”*

# NGV MAINTENANCE FACILITY VENTILATION

Approved system includes:

- *5 air changes per hour (ACH)*
- *Continuous operation or interlocked to gas detection*
- *CNG garages are also compliant with ventilation interlocked to lights*
- *Uniform airflow – outlets at high point, inlets at floor*

Exception:

- *Natural ventilation **when approved***

# NGV MAINTENANCE FACILITY VENTILATION

## Compliance Strategies:

- *Continuous ventilation by fans at high point of roof with intake louvers in sidewalls near floor*  
*-or-*
- *Interlock to detection system so emergency ventilation will operate only when gas is detected. This will reduce heating load and ongoing heating costs.*

# NGV MAINTENANCE FACILITY DETECTION



- *Where repairing NGVs fueled by non-odorized gas, such as LNG, a gas detection system is required*
- *Detection is required in pits for LNG*
- *Detection can be used to control purge ventilation*

Reference: NFPA 30A Section 7.4.7 & IBC 406.6.6

# NGV MAINTENANCE FACILITY DETECTION

## Compliance Strategy

- *Install detection system where CNG vehicles are present to reduce heating load or as an enhanced safety measure.*
- *How many detectors*
- *Activate at 25% LEL*
- *Control Systems and monitoring*
- *Maintenance and calibration*
- *Detectors are required to trigger audio/visual signal, deactivate heating, and activate mechanical venting if interlocked*



# NGV MAINTENANCE FACILITY HEATERS

*“Where major repairs are conducted on NGVs, open flame heaters or heating equipment with surface temperatures in excess of 750° F shall not be permitted in areas subject to ignitable concentrations of gas.”*



# NGV MAINTENANCE FACILITY HEATERS

## Compliance Strategies:

- *Removal of appliances with pilot or open flame*
- *Replace with compliant heaters*
  - *Typically radiant heaters rated for hazardous location*
  - *Steam, hot water, forced air if designed properly*

# NGV MAINTENANCE FACILITY HEATERS



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# NGV MAINTENANCE FACILITY ELECTRICAL



## Classified Zone

*“In major repair garages where NGVs are repaired or stored, the area with 18” of the ceiling shall be designated a Class 1, Division 2 hazardous location*

# NGV MAINTENANCE FACILITY ELECTRICAL

## Classified zones con't

- *18" at the floor is also Class 1 Div. 2 for Gasoline Vehicles*
- *Maintenance pits are classified areas but with the same criteria as Diesel and Gasoline Shops*



# NGV MAINTENANCE FACILITY ELECTRICAL

Ventilation Exception:

*NEC allows ventilation to mitigate the ceiling classified area*

*But ....*

*In Wisconsin, all ceilings areas of major repair garages are considered classified even if ventilation is provided.*

*Reference*

*SPS 316.511*



# NGV MAINTENANCE FACILITY ELECTRICAL

## Compliance Strategies

- Relocate electrical outside classified zone
- Use equipment and wiring permitted in classified zone
- Proposed Wisconsin amendment will eliminate ceiling classified area with IMC ventilation



# NGV MAINTENANCE FACILITY

## ADJACENT OCCUPANCIES



*“Enclosed rooms for [NGVs] ... should prohibit the transmission of gases to other areas of the building.”*

### Compliance Strategies:

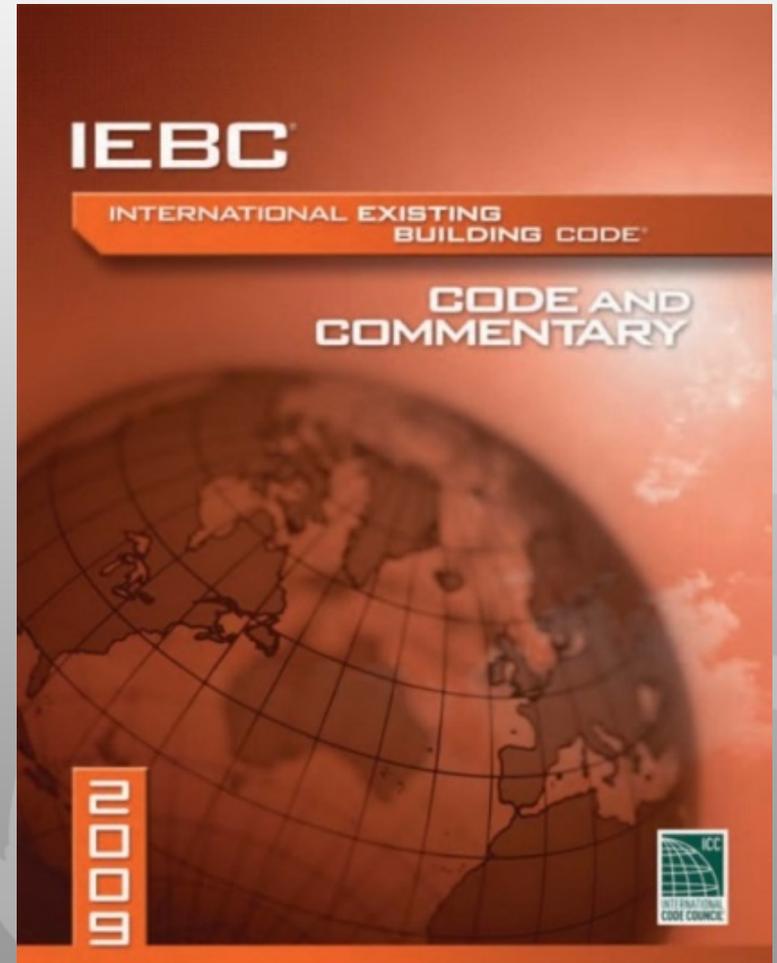
- *Positive pressure in adjacent occupancy*
- *Separation wall sealed to prevent transmission of gas*

# ADDITIONAL ITEMS TO CONSIDER

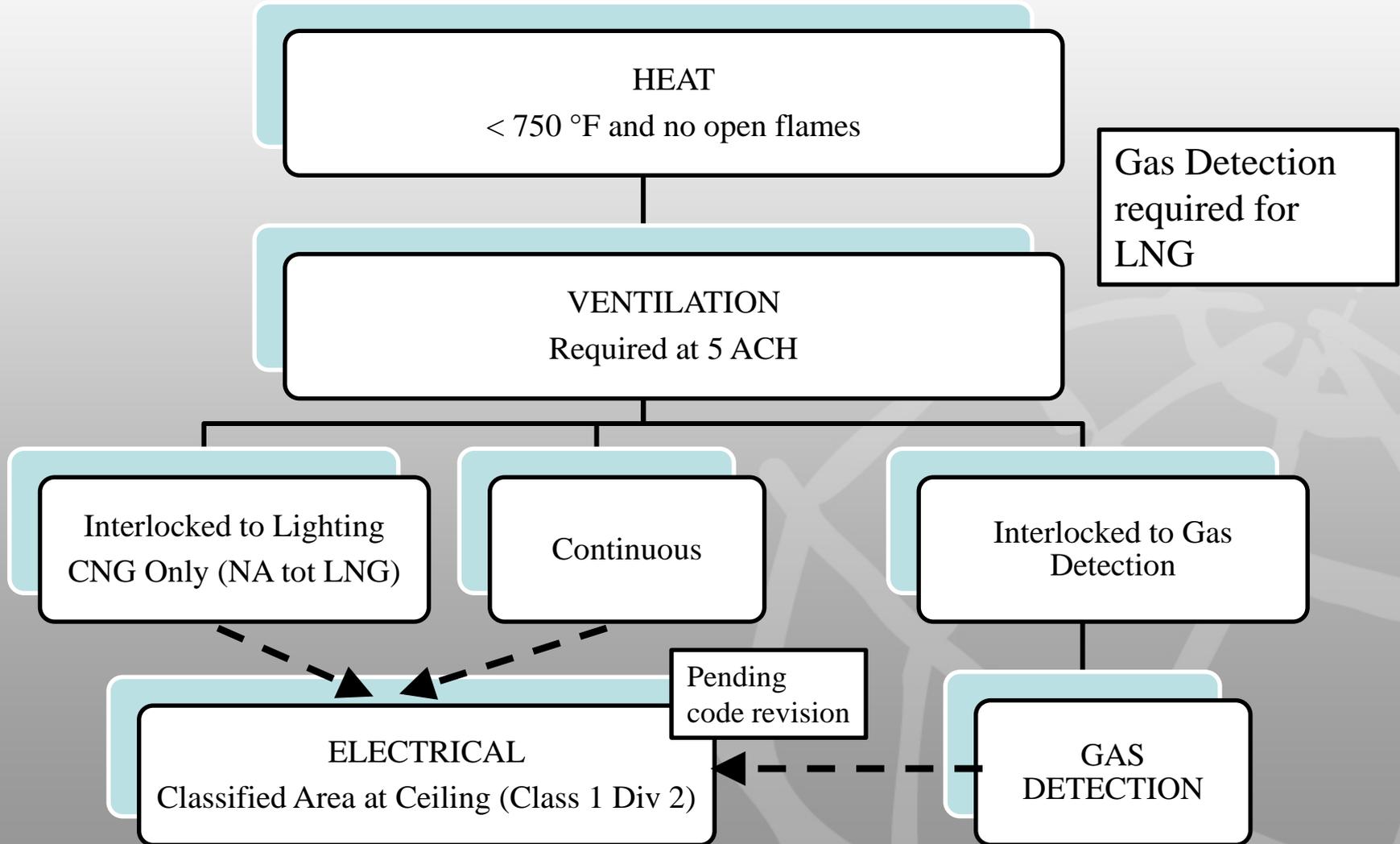
- Floor drains
  - *Provisions must be made to prohibit LNG from entering drain conveyance system*
- Overhead cranes – may be an ignition source, confirm motors and contactors are not within classified space

# Existing Building & Conditions

- WI has adopted the 2009 IEBC
- Identify “triggers” for current code compliance
- Alteration Level and Change in Occupancy



# NGV MAINTENANCE FACILITY



# MINOR REPAIR GARAGES

MINOR REPAIR GARAGE = lubrication, inspection, tune-ups, replacement of parts, fluid changes, brakes, tires, and similar routine maintenance

- NGV Minor Repair Garages are exempt from many but not all of the code provisions.

# MINOR REPAIR GARAGES

- Electrical – Ceiling Classified Areas
  - *Exempt, ceiling is “unclassified”*
- Heating and Sources of Ignition
  - *Exempt from 750 ° F and open flame requirement*
- Ventilation
  - *5 ACH required by International Mechanical Code*
  - *“Petition for Variance” may be a method of compliance*
- Gas Detection
  - *Required for LNG*
  - *May be used for ventilation controls (CNG)*

# MINOR REPAIR GARAGES

Electrical - Ceiling Unclassified

Heat

No 750 °F and open flame requirements

Gas Detection  
required for  
LNG

Ventilation

Required at 5 ACH

Interlocked to lighting  
CNG Only (NA to LNG)

Continuous

Interlocked to Gas  
Detection

# CASE STUDIES

- Reviewed 4 examples in the state of WI
  - All 4 used different means of compliance
- 

## Frito Lay

- 3 bay Minor NGV Repair
- Continuous ventilation while occupied
- Sealed separation walls
- Adjacent indoor fueling bay



# CASE STUDIES

## Waste and Recycling Vehicle Garage

- 7 bay Major repair garage
- Gas detection
- Purge venting
- Infrared Heating



- Electrical rated for Classified area at ceiling
- Sealed Separation walls at office and wash bay

# CASE STUDIES

## Kwik Trip

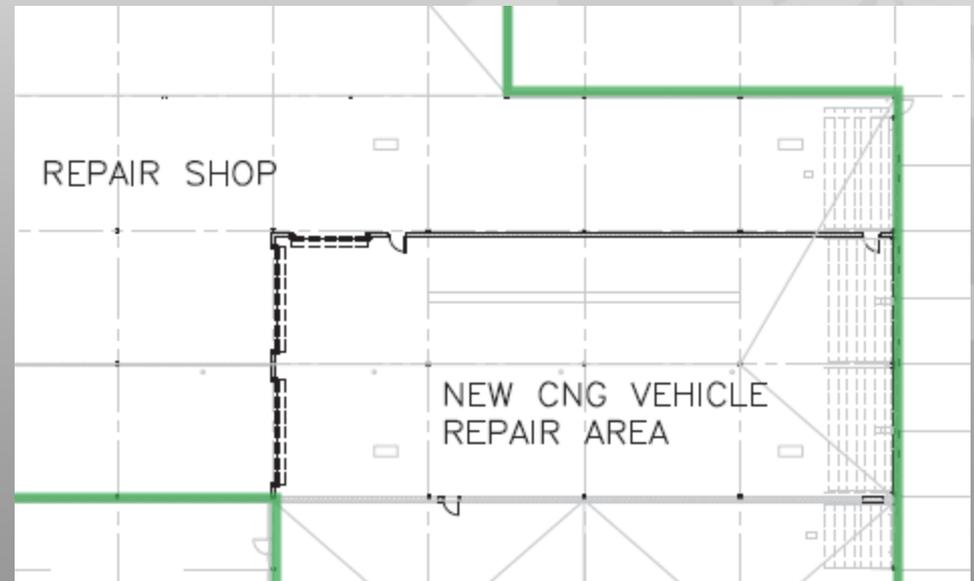
- Separated 1 Bay Major NGV Repair & LNG,
- Gas detection
- Purge venting
- Compliant Heating
- Electrical removed ceiling
- Plugged floor drain
- Additional lighting



# CASE STUDIES

## City of Milwaukee

- Separated 6 Bays Major Repair for NGVs
  - Partition Walls
  - Gas detection
  - Purge venting
  - Air handler heating
  - Lighting rated for classified area
- classified area



# COSTS

- Cost information is presented in the guidelines document.
- Costs are generic and qualified but should be useful in getting a rough idea.
- Based on a 4 to 10 truck bay garage.
- Start with an initial assessment and method of compliance.
- Determine # of bays to be retrofitted for NGVs.
- Not intended to replace qualified estimates.
- More cost information is in the guidelines document

# COSTS Cont.

Some examples of cost information .....

<b>Assessment and Design</b>		\$	
<b>Professional Services</b>	Lump Sum	\$25,000 - \$40,000	Assessment, Design, Permitting, & Construction Support
<b>Ventilation</b>		\$	
<b>Exhaust fans</b>	EA	\$8,200 - \$9,200	Ventilation required for 5 ACH. Includes Mechanical, Electrical, Roof Framing & Roofing Work.
<b>Ducting</b>	LF	\$45-\$60	Exposed non-insulated interior duct & fittings

# COSTS Cont.

<b>Gas Detection</b>		\$	
<b>Detectors and Controller</b>	1	\$30,000-\$45,000	Equipment, installation, and electrical.
<b>LNG – Pit Detectors</b>	EA	\$3,500-\$5,000	Dependent on floor slab and underground scope of work.

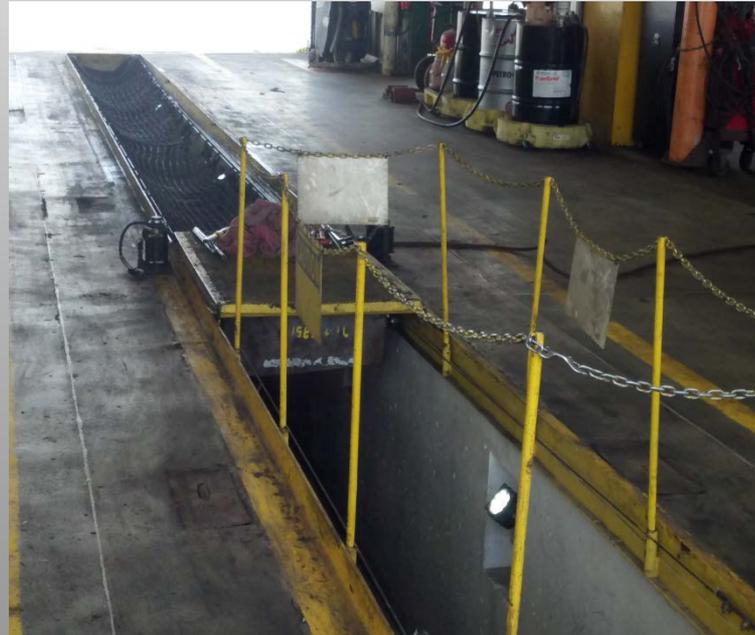
<b>Heating</b>		\$	
<b>Air handling unit (AHU)</b>	\$/SF	\$3.00 - \$7.50	Includes pad mounted direct fired unit, installation, and electrical. Heat exchangers or cooling systems are not included.
<b>Infrared Tube heaters</b>	\$/SF	\$12-\$17	Includes electrical

# COSTS Cont.

<b>Electrical</b>		\$	
<b>Retrofit electrical conduit in the ceiling</b>	\$/SF	\$1.50 - \$2.50	Garage Doors, lights, Misc.
<b>Power Feeders, Data &amp; Low Voltage in Ceiling</b>		Varies	Dependent on quantity and complexity
<b>Shunt Trip 30A Breakers</b>	EA	\$525- \$650	Assumes space is available in the panel
<b>Other</b>		\$	
<b>Separation Wall</b>	SF	\$18 - \$25	Metal Stud with metal panels
<b>Design Management</b>		5% to 10%	Schematic, design mgmt, permitting, permit fees
<b>Construction Management</b>		20% to 50%	Bidding, contingency, supervision, overhead, fee

# COSTS Cont.

- Other cost items are addressed in more detail in the guidelines document.
  - *Misc Demolition*
  - *Lighting*
  - *LNG Floor Drains*
  - *Roof Access Ladder*



# Cost Saving Strategies

- Use a sealed partition wall to separate NGV repair areas
- Hire experienced design professionals and contractors
- Select HVAC system considering operational costs
- Seek out financial incentives (WI Focus on Energy program, grants, etc.)
- + more ideas in the guidelines document

# QUESTIONS?



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