Review of the Compressed Natural Gas Vehicle Maintenance Facility Modification Handbook

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CNG Facility Mods Handbook

- Funded under DOE Clean Cities Tiger Teams effort, managed by NREL
- Designed specifically as a resource for fleet managers who will be converting their maintenance facilities to accept CNG
  - Consolidated resource of existing guidelines
  - Allow them to "speak the language" of design engineers, but not become one!
- *To be published shortly by NREL*

Handbook Background

- Increase in use of CNG vehicles
- Need to convert conventional fuel garages
- Specific hazards associated with CNG in garages
- Many lack full understanding of requirements
- *Conflicting information in competing regulations and ordinances*
- Provides guidance to fleet and garage managers who are considering modifications

Implementation

- Handbook is intended to provide guidance to fleet managers when dealing with assessors and engineers, not for them to actually conduct implementation
- Handbook provides a questionnaire which will provide step-by-step actions for managers to evaluate requirements
- Handbook contains useful decision tree matrix for garage modification requirements
- Engage permitting authorities (AHJ) up front
- Select experienced facility assessor
  - Prepare preliminary design and equipment list
  - Develop RFP for construction
- Select experienced design-build contractor

Implementation

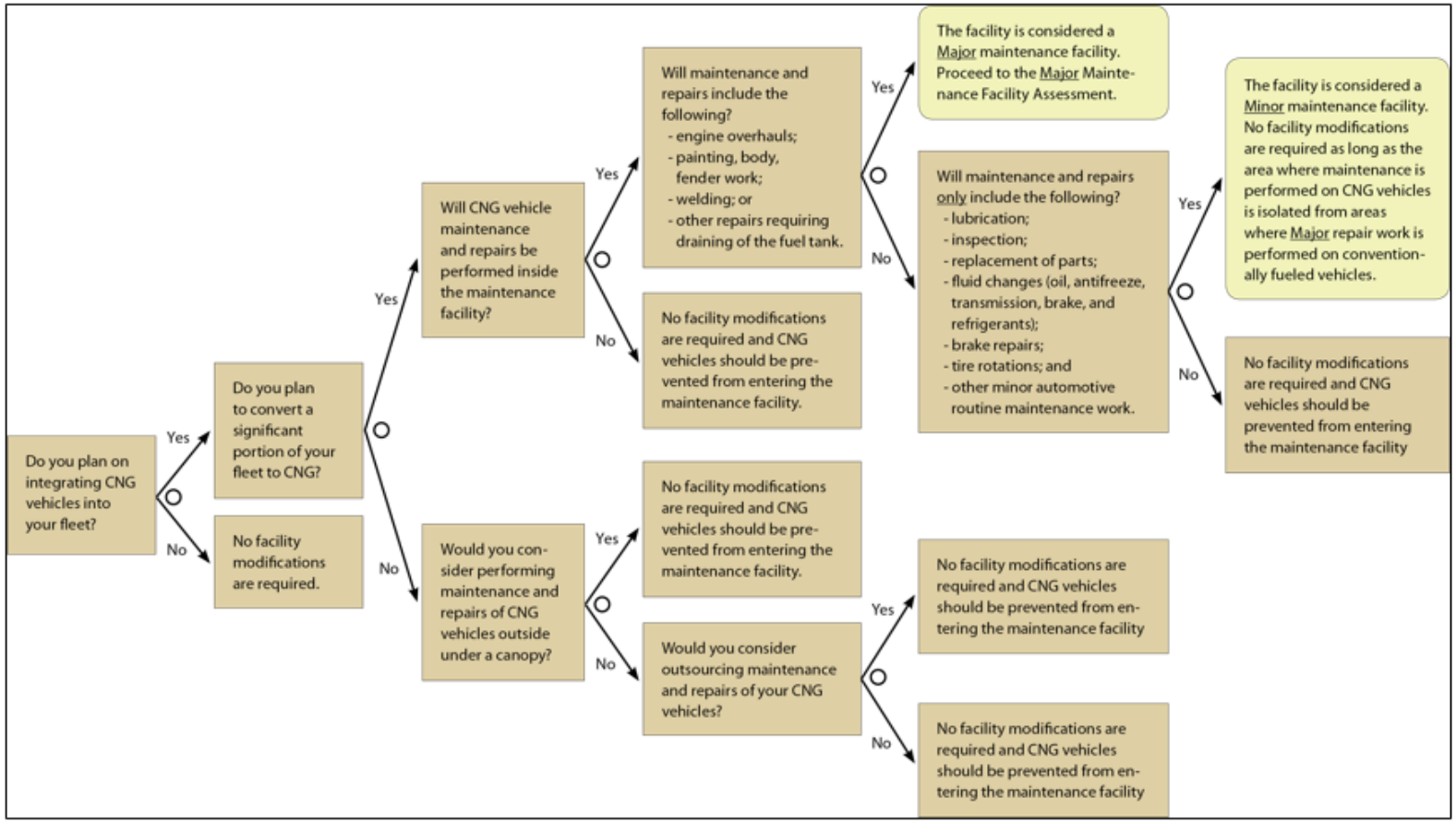


Figure B1. Critical decision path of a CNG vehicle maintenance facility modification

Sources of Natural Gas Releases

- Slow leaks from vehicles
- Release during maintenance such as opening fuel system components under pressure
- Massive release from failure of tank, valves, or fittings

Causes of Natural Gas Ignition

- Spark (electrical or mechanical)
- Hot surfaces
- Open flames

Regulations

- Primarily NFPA 30A
- NFPA 52
- International (State) Electrical Codes
- International (State) Mechanical Codes
- International (State) Building Codes
- International (State) Fire Codes
- Must confirm which regulations and which versions are to be used

Role of Authority Having Jurisdiction (AHJ)

- Responsible for approving modification designs
- The AHJ can be determined by consulting local building/fire department
- Usually the fire marshal's office
- Very early involvement essential
- Often inexperienced with CNG and requirements for both fueling and maintenance
- Will provide guidance on regulations in effect

Garage Classification by Use
Definition from NFPA 30A

Major Repair Garage

Activities including engine overhauls, painting, body and fender work, and repairs that require the emptying of the motor vehicle fuel tank. This includes maintenance work on the vehicle fuel system during which gas could be discharged into the area.

Minor Repair Garage

Activities including lubrication, inspection, and minor automotive maintenance work, such as engine tune-ups, replacement of parts, fluid changes (e.g., oil, antifreeze, transmission fluid, brake fluid, air conditioning refrigerants, etc.), brake system repairs, tire rotation, and similar routine maintenance work. Maintenance, repair, or service to the vehicle fuel system is not permitted in a minor maintenance and repair garage.

Distinction of Classification

- Fleet and garage managers must determine the nature of the maintenance to be performed
- The entire facility will be classified by the nature of the work performed therein. If ANY work classified as major is to be performed, the facility MUST be classified as a major repair garage, regardless of how infrequent or how small the activity
- Distinctions are critical because they define the types of protection needed within the facility and the nature of the maintenance work that may be performed
- The protection needed for a minor repair garage is generally less extensive and less costly than that required for a major repair garage

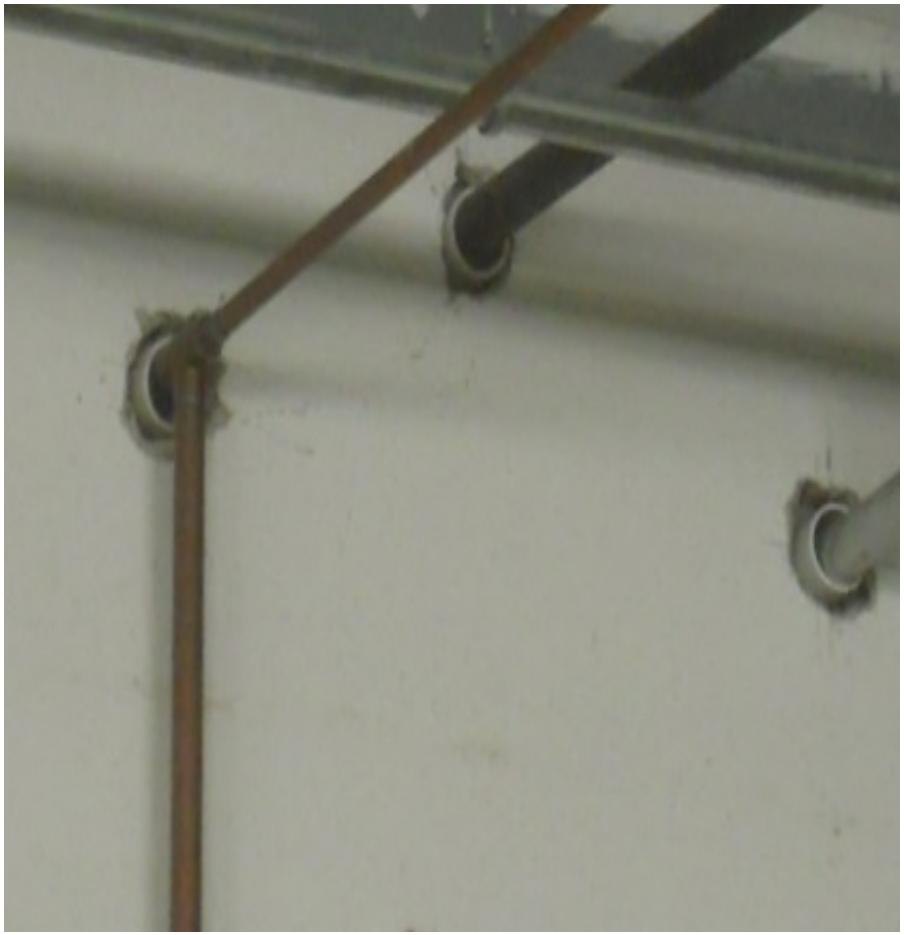
Alternatives to Full Modification

- Outsource work to off-site maintenance facility
- Perform maintenance work out of doors
- Modify only certain bays according to the work to be performed

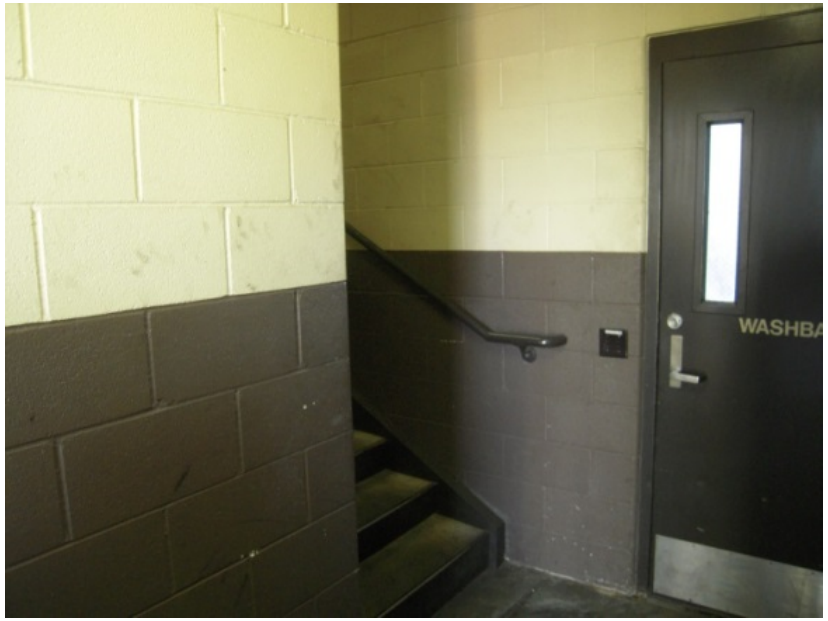
Facility Assessment – Five Areas for Consideration

- Paths of migration
- Ventilation
- Space heating
- Electrical wiring and equipment
- Methane detection, control systems, and alarms

Potential Paths of Migration – Structural Elements



Potential Paths of Migration – Facility Design



Ventilation

- Mandated by regulations
- Primary strategy preventing explosive concentrations
- Dilutes gas release concentrations
- Directs gas to evacuation points

Conflict in Regulations Regarding Ventilation Rates and Controls

- International Fire Code states 5 air changes per hour based on building volume
  - Continuous ventilation
  - Controlled by occupancy
  - Controlled by gas detection and alarm systems
- NFPA 30A states 4 air changes per hour based on floor area
  - Based on electrical classification of ceiling area
  - Operational parameters not specifically addressed
- Involve AHJ early in the process to determine which of the regulations (or hybrid) is applicable for the specific location

Ventilation Strategies

- Select exhaust fan locations
- Determine makeup air volumes and sources
- Choose direct evacuation or ducting
- Continuous vs. intermittent operation
- Receive early approval from the AHJ

Ventilation – Direct Exhaust or Ductwork?

Ceiling Profiles and Protection

- Not necessary to ventilate all ceiling pockets if no ignition source

Ventilation Control Strategies

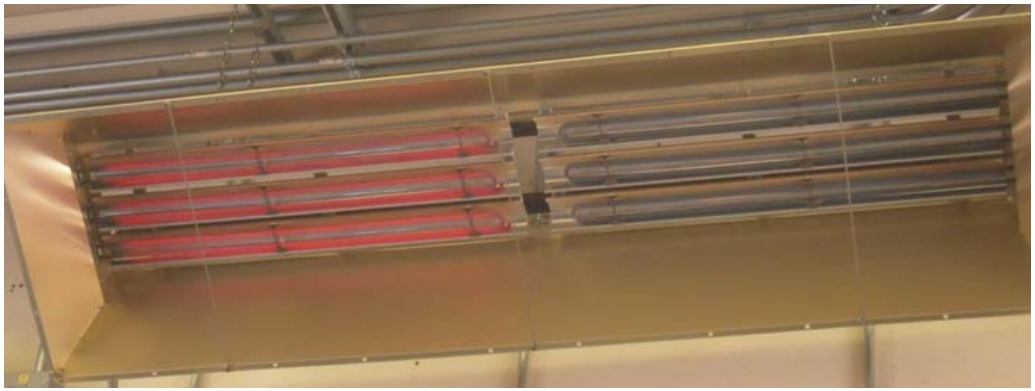
- Continuous operation?
  - Consider cost of tempering air, electrical and maintenance costs
- Based on input from gas detection and control system
- Based on building occupancy through lighting system
- Make-up air source and control
- AHJ approval essential

Makeup Air Sources

Space Heating

- Essential for worker comfort
- Types available include:
  - Gas-fired infrared
  - Electric infrared
  - Gas-fired fan
  - Propane floor mounted
- Strict regulations regarding the type employed
  - No open flames
  - Surfaces less than 750^{O} F
  - Combustion and exhaust air must be contained

Space Heaters



Electrical Wiring and Equipment

- Provides potential ignition sources
- Class I, Division 2 designation may be required
  - Not for minor repair garages
  - Not for major repair garages if ventilation is 4 air changes per hour
- Potential problem areas include
  - Conduits and wiring
  - Lights
  - Motors
  - Low voltage applications
- AHJ will have the final say

Potential Problem Areas

Gas Detection and Control Systems

- Requirements provided in NFPA 30A
- Regulations do not categorically require that a gas detection system be employed but -
  - May be difficult to get approval from AHJ
  - Insurance underwriters may object
  - For cost involved, offers sound protection for personnel and property
- Provides early warning to occupants that a methane gas release has occurred
- Initiates actions to eliminate potential ignition sources
- Initiates actions that provide conditions to promote quick dilution of the concentrated gas to levels below the LFL

Types of Detectors

- Catalytic bead
- Infrared
  - Point type
  - Open path
- Recommend point type infrared – made by many manufacturers
- Periodic calibration required
- Hand-held portable detectors

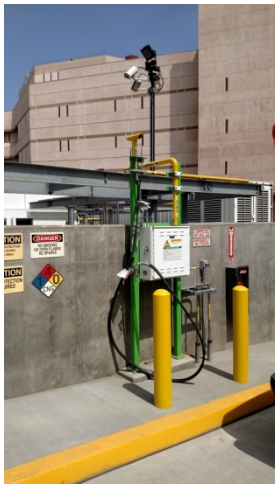
Concentration Levels for Action Specified

- 25% LFL suggested by NFPA 30A
- Consider two levels – 20% and 40%
  - Offers protection against nuisance alarms and call-outs
  - Provides two levels for action
  - Requires AHJ approval – but widely accepted

Actions Upon Detection

- Initiate audible and visual alarms
- Activate ventilation system
- Deactivate heating systems
- Shunt-trip selected circuits
- Call out selected personnel

Other Considerations



Project Cost Elements

- Number of bays to be modified
- Age of the overall facility
- Associated attached or nearby structures
- Sophistication of the modification and the extent to which new systems are required
- Inclusion of “non-modification” upgrades
- Typically between $40,000 and $80,000 per bay
- Ensure management is aware and has budgets in place
- Can control budget with operational protocols
- Need not modify entire garage

Project Schedules

CNG Vehicle Maintenance Facility Modification Schedule																							
Activity	**Weeks**																						
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Initial Assessment																								
Preliminary Design / AHJ Approval																								
RFP Preparation																								
Contractor Selection																								
Detailed Facility Design																								
Final Permitting																								
Equipment Procurement																								
Modification Work																								
Construction																								
Startup / Acceptance Testing																								
Training																								

Conclusions

- New handbook will be available to help fleet managers in modifying their CNG maintenance garages
- Handbook contains useful decision tree matrix for garage modification requirements
- Handbook provides a questionnaire which will provide step-by-step actions for managers to evaluate requirements
- Handbook will be available free of charge from the National Renewable Energy Laboratory at www.nrel.gov/publications