

CNG Conversions at Waste Management Hauling Facilities

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Why WM is moving toward CNG

- Environmental benefits
- Potential for fuel and labor savings
- Reduced operational issues over current diesel technology
- Payload improvement

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Why WM is moving toward CNG

- Environmental benefits
 - Natural gas fueled vehicles can produce significantly lower amounts of harmful air emissions such as nitrogen dioxides, particulate matter, and toxic and carcinogenic pollutants as well as the greenhouse gas carbon dioxide.
 - EPA is continuing to set tougher and tougher restrictions on air pollutant emissions from heavy and light vehicles. Switching fuels to Natural Gas is one way to meet and exceed current requirements.
 - Emission reductions from switching from diesel to natural gas for a heavy duty (hauling) vehicle -
 - Carbon monoxide emissions are reduced by up to 80%
 - Greenhouse Gas emissions are reduced by up to 25%
 - Nitrogen oxide emissions are reduced by up to 32%
 - Hydrocarbon emissions are reduced by up to 64%
 - Particulate matter emissions are reduced by up to 86%
 - WM sustainability 2007 goal to reduce our vehicle emissions 15% by 2020
 - Noise reductions

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Why WM is moving toward CNG

- **Example Fleet – WM of Seattle**
 - 106 CNG trucks implemented in early 2009
 - Displacing 1.2 million gallons of diesel annually with CNG
 - Reducing NOx by 97%
 - Reducing PM by 94%
 - Reducing GHGs by 20%
 - Over 3,000 MT of GHGs reduced annually



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Why WM is moving toward CNG

- Potential for fuel and labor savings

- Projected natural gas fuel price stability

- Drilling technology improvements have dramatically improved North American Natural Gas supply



- Potential labor savings in time fill fueling

- Traditional Diesel Methods – 10 to 15 minutes per day per truck versus CNG Time fill at 1 to 2 minutes per day per truck
 - Third Party Wet Hose applications – \$.10 to \$.15 premium per gallon



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Why WM is moving toward CNG

- Reduced operational issues over current diesel technology

- 2007 - Advanced emission control devices (Diesel particulate filters)

- Operational Issues with regeneration

- 2010 – Catalytic Converters and Diesel Exhaust Fluid (DEF)

- Payload improvement

- 2000 lb payload improvement with CNG vs Diesel

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2010 Diesel Emission standards... (reduction of ~2,000 lbs of payload)



2010 Catalytic converter and DEF tank
(ammonia based urea...a.k.a., diesel emission fluid)

Diesel Particulate Filter



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Current Natural Gas Infrastructure

Current WM Fleet

- Natural Gas Fleet of 1,150 trucks CNG, LNG (5% of Total Fleet)
- 70/30 split CNG to LNG
- CNG to be predominant platform for future truck replacements

WM Current Natural Gas Fueling Infrastructure

- 1 Landfill Gas to LNG production facility
- 16 facilities providing natural gas fueling
- 8 LNG, 5 LCNG, 7 CNG

WM Future Natural Gas Fueling Infrastructure

- 7 CNG facilities permitted or under construction
- 9 Facilities CNG, LCNG designed, currently in permitting
- 20 Facilities in planning or design

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Types of Fueling Infrastructure

- CNG / LNG / LCNG
- CNG
 - Equipment Compound
 - 3 Phase 480-V 800–1000 amp Service
 - Gas MSA 15-psi min
 - Gas Dryer 1100 scfm capacity
 - Compressor(s) Twin 500 scfm
 - Priority Panel & PLC Control Panel
 - Ground Storage 10,000 to 36,000 scf
 - Fast-Fill - Can fill at rates of 10 gallons per minute (DGE)
 - Time-Fill - Fills entire fleet overnight, plug-in fuel hose, low labor



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K-rail Style Dispensers



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Light Pole Style Dispensers



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Types of Fueling Infrastructure



- LNG
 - Utility Pipeline Gas Availability
 - Transport LNG
 - Biomethane (GHG Reduction)
- LNG Equipment
 - 3 Phase 480-V 400 service
 - LNG transfer pump
 - Dispenser(s)

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Types of Fueling Infrastructure

- LCNG
 - Utility Pipeline Gas Availability
 - Transport LNG to create CNG
 - Biomethane (GHG Reduction)
- LCNG Equipment
 - 3 Phase 480-V 400-600-amp service
 - LNG transfer pump
 - LNG tank(s)
 - LCNG pumps
 - Anti-venting compressor
 - Vaporizer(s)
 - CNG Ground Storage
 - High flow Dispensers



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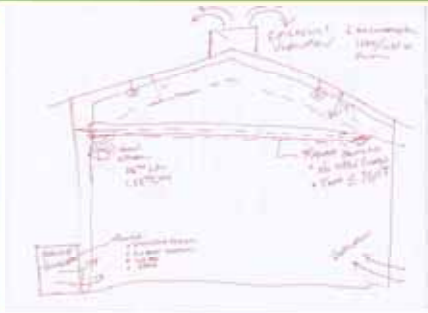
Maintenance Shop Upgrades

- Ventilation (Continuous or Emergency)
- No electrical in classified areas (18" zone at ceiling)
- Combustible gas detection
- HVAC Systems
 - No open flames or surface temps above 750 deg F
 - Positive pressure in office spaces from shop
 - Backup power for detection & ventilation
 - Interlock welding circuits to gas detection system

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Maintenance Shop Upgrades



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Maintenance Shop Upgrades



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CNG Trucks and Fuel Systems



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CNG Cylinders



CNG Cylinders

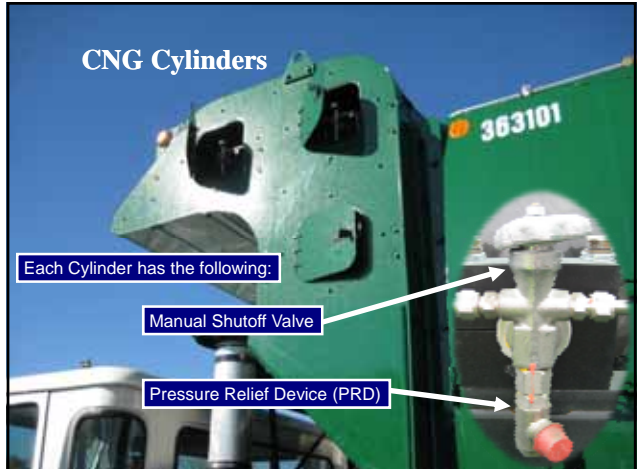


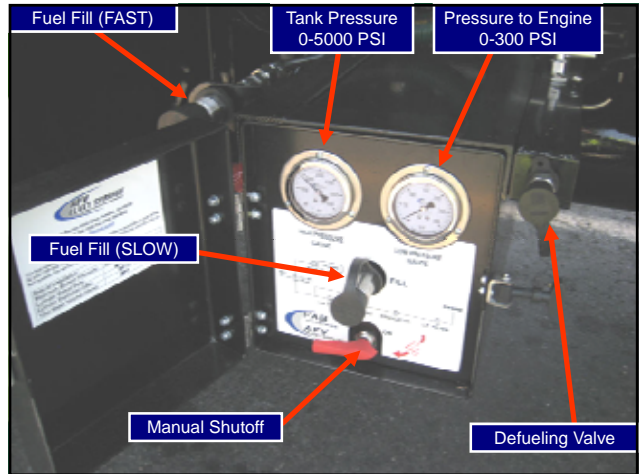
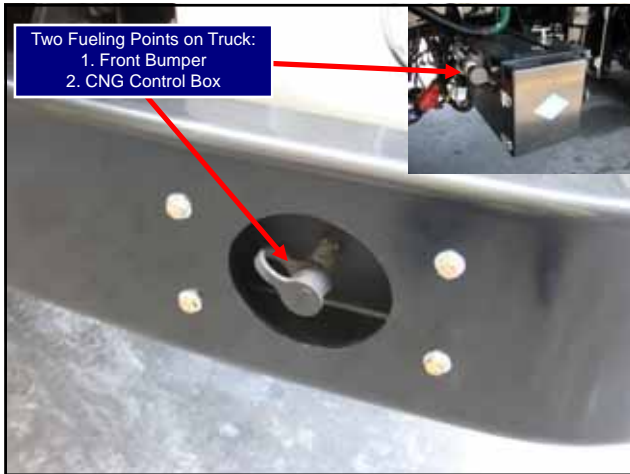
CNG Cylinders

Each Cylinder has the following:

Manual Shutoff Valve

Pressure Relief Device (PRD)





CNG Fuel System

- Melts at 212°F (100°C)
- Bursts at 5000 psi

Other high pressure components include

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Regulatory Codes For CNG

IFC
 INTERNATIONAL FIRE CODE

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Thank You !



QUESTIONS



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