

*Massachusetts Department of Fire Services
Massachusetts Firefighting Academy*

Liquefied Natural Gas (LNG) Awareness



Massachusetts Firefighting
Academy



Liquified
Natural Gas
(LNG)

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Objectives

- Discuss LNG and it's properties
- Discuss combustible gas indicators and how they function
- Discuss considerations for using combustible gas indicators

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Objectives

- Discuss over-the-road transportation of LNG
- Considerations for handling a transportation emergency
- Future uses for LNG

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Liquified Natural Gas



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Briefly explain the U.N. system for placarding. Also give a brief overview of the Emergency Response Guidebook, and how it is used.

Properties of LNG

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Composition

- 97% Methane
- 3% Ethane
- Trace quantities of Propane and Butane

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Source

- Natural Gas is formed by the decay of organic matter
- Found naturally in large pockets under ground
- Often found when drilling for oil
- Liquefied Natural Gas is produced by a cooling process of Natural Gas

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New technologies for extracting “shale gas” have provided a supply of natural gas expected to last for at least 100 years. Because of these finds, the United States may soon become an energy exporting nation.

Characteristics

- Color –
Both NG & LNG are colorless
- Odor –
Both NG & LNG are Odorless

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Odor

- An odorant is added to Natural Gas (Mercaptan)
- However no odorant is effective when added to LNG due to the very nature of the product

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Toxicity

- LNG is non-toxic
- However it is an asphyxiant
- An asphyxiant will displace the oxygen that we breathe

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Specific Gravity

- 0.421
- Water is assigned a value of 1.0
- Any material with a specific gravity less than 1 will FLOAT on water
- Any material with a specific gravity greater than 1 will SINK in water

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Specific gravity refers to a material's density in comparison with water. Water is always given a value of 1. Anything with a specific gravity less than 1 will FLOAT on water, while anything with a specific gravity greater than 1 will SINK in water. Examples: Hydrocarbons will float and corrosives will sink.

Weight

- LNG weighs 3.5 pounds per gallon
- Water weighs 8.3 pounds per gallon

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Solubility

- LNG is NOT soluble in water

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Vapor Density

- .506
- Air is assigned a value of 1
- Any gas less than 1 is lighter than air and will rise
- Any gas more than 1 is heavier than air and will collect in low spots such as ground level or basements, etc.

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Vapor Density

- Heavier than air at -260° F
- Lighter than air at -170° F

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Expansion Rate

- 600 to 1
- Every cubic foot of liquid will create 600 cubic feet of vapor

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This is why Natural Gas is liquefied. For every truck load of liquid you would need 600 truckloads of vapor.

Temperatures

- Storage Temperature
-260 degrees F
- Boiling Temperature
-260 degrees F

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LNG is kept a liquid by keeping it cold, unlike LPG (Propane) which is kept a liquid by keeping it under pressure.

Fire Characteristics

- Flammable Range
5% to 15%
- Ignition Temperature
1,000 to 1,200 degrees F
- Flame Spread
300 to 400 feet per minute



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Burn back rate is the time it takes for the flame to spread from ignition source back to product. Compared to the flame spread of LPG at 900ft per minute, LNG is much slower, and more easily affected by weather conditions.

Storage Pressures

- Large capacity vertical tanks



Usually .5 to 1.0 psi

- Horizontal tanks



Usually 20 to 270 psi

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Relief valves for large capacity vertical tanks are usually set for $\frac{3}{4}$ of a pound. Large capacity vertical tanks hold millions of gallons of product. Horizontal tanks hold thousands of gallons.

Pressure in Transportation

- Normal over the road pressure is 8 to 10 psi

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Specific Dangers

- Flammable – range 5 to 15%
- Explosive – in confined spaces
- Asphyxiant – will replace oxygen
- Cryogenic - Frostbite

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Extreme frostbite. Instant crystallization of living tissues.

Extinguishment

- Extinguishing Agent
Dry Chemical
- Extinguishing Method
Stop the flow of gas

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After flow of gas is stopped, beware of puddles or areas of pooled LNG.

Combustible Gas Indicators



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What do you have for meters? What the meters are calibrated to? Who calibrates the meter and when is it done?

Combustible Gas Indicators

CGIs, also referred to as “explosive meters” or “explosimeters,” are used to test atmospheres that may contain a sufficient concentration of combustible vapors to cause an explosion or support combustion

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Combustible Gas Indicators

There are three different scales used on various CGI models:

- Percentage of lower explosive limit (LEL)
- Percentage of gas in air
- Parts Per Million (PPM)

The most common is the percentage of LEL meter

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CGI Response

- A properly set low level alarm on a CGI meter is 10% of the LEL for the calibration gas
- The reason this percentage is fairly low is that it serves as a safety factor

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CGI's and Oxygen

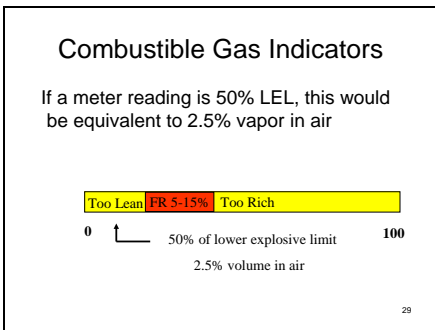
- Oxygen concentrations will effect meter readings

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Oxygen is required for proper functioning of any CGI since oxygen is necessary for the combustion of the gas or vapor. Most instruments will not give an accurate reading at less than 10% oxygen. Oxygen-enriched atmospheres will enhance the catalytic combustion process and may result in false high readings.



Combustible gases enter the instrument, diffuse through a coarse metal filter, and come in contact with two hot filaments inside the sensor. Both filaments are heated to the same temperature and, therefore, have the same resistance. One filament is coated with a catalyst. Combustible gases burn on this catalytic filament; no combustion occurs on the uncoated filament. Combustion causes the filament with the catalyst to increase in temperature, causing an increase in resistance. This change in resistance causes an imbalance in the resistor circuit. The change in resistance across the circuit is translated into a CGI meter reading.



- Carbon Monoxide (CO) and Hydrogen Sulfide (H₂S) Meters
- These instruments utilize a detector that operates by chemical reaction with the gas
 - Like the oxygen meter, these meters are subject to interference from other gases or vapors
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Note that both these materials are measured in **Parts Per Million**. Remember that CO also has a wide flammable range.

Oxygen Meters

- Oxygen meters are used to detect the percentage of oxygen in atmosphere
- Most oxygen-sensing devices are calibrated to indicate concentrations between 0% and 25%

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Note that when oxygen levels become too high, OR too low, that readings may not be accurate.

CGI

All CGI readings are relative to a calibration gas. When measuring another gas or vapor, the instrument still responds to the increased temperature of the filament



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In order to know what the exact levels are you must know what your meter is calibrated to, and what the conversion factors are.

Conversion Factors

Combustible Gas/ Vapor	Correction factor when Instrument is calibrated on Propane	Correction factor when Instrument is Calibrated on Methane
Hydrogen	0.61	1.11
Methane	0.55	1.0
Propane	1.0	1.82
N-Butane	1.0	1.82
N-Pentane	1.22	2.22
Methanol	0.65	1.18
Ethanol	0.85	1.54
Ammonia	0.46	0.83
Toluene	1.57	2.86
Gasoline	0.85	1.54

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This is an example of a partial conversion chart for a **PhD Ultra** combustible gas sensor. Many gas sensors are calibrated to Pentane. In order to get an accurate reading you must know what you are metering for. It is very important that students know what their gas meters are calibrated for, and where the conversion chart is located. A suggestion might be to make a smaller chart of the materials found in the student's response areas, and tape it to the meter itself.

Metering Considerations

- Confirm meter is reading properly in a non contaminated atmosphere
- Approach with full PPE
- When possible approach from uphill/upwind side

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Metering Considerations

- Take readings both high AND low
- Consider the need for metering both inside and outside
- Establish operating zones based meter readings
- Do not rely on a single meter

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Road Transportation



The reasons we going to spend time on LNG in transportation are: At this time, Much of the LNG transported by road is done in the Northeast section of the country. One of the largest transporters of LNG in the country is TransGas located in Lowell, MA. With approximately 55 dedicated LNG tankers. There are approximately 25 different sites in Massachusetts alone that deal with LNG. The chances of responding to an LNG incident are not as remote as you would think.

The basic design of an LNG transporter is of a double-shelled insulated container. They are Approximately 12'6" high and 40 to 45 feet long. Capacities run from approximately 10,000 to 13,800 gallons which makes the weight of the payload anywhere from 38,000 to 43,000 pounds. The payload is the amount of product, whether

measured by weight (pounds), or volume (gallons)



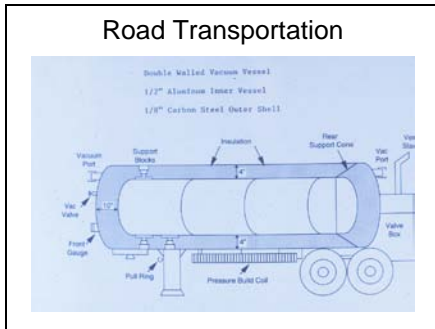
There are 3 distinct features of the LNG transporter. The size of the tank, the “bucket box” at the rear, and the pressure building coils under the belly of the tank. They are placarded 1972 and stenciled “Methane refrigerated liquid.” This means that they are “dedicated” transporters and will only carry LNG.

One of the few tanker trailers designed to rest on the landing gear while fully loaded.



Close up of pressure building coils. These coils are used to facilitate unloading of the trailer. The cold LNG (-260F) is sent through the coils. As the liquid moves through it contacts the ambient temperature via the fins in the coils. This causes the liquid to vaporize. It then re-enters the top of the tank creating a head pressure which is then used to force the liquid out of the trailer. Example: When a transporter arrives to deliver a load of LNG at the MFA, the pressure in the trailer is 8 to 10 psi. Our storage tank is anywhere from 20 to 60 psi. To be able to off load the trailer it is necessary to “blow down” the pressure in the storage tank by venting it to the outside air, while the pressure in the transporter is being increased via the pressure building coils. At our facility, as at most facilities, LNG is unloaded strictly by pressure differential. LNG is not normally “pumped” unlike LPG which is normally pumped

due to its pressure. Once the pressure in the transporter is greater than the pressure in the storage tank it can be off loaded.



Tank construction: Double shelled container. The outer shell is made of 1" carbon steel. The inner shell is made of 1/2" thick high-strength aluminum. There is an annular space between the two shells. This space contains an insulating medium, and is placed under a vacuum.

The insulating material is one of 3 types. Older trailers had an annular space filled with a white, fluffy material called perlite. Some of these trailers were retrofitted with what is known as fiberglass insulation. The newer transporters are now "super wrapped" during construction. During construction, the aluminum inner vessel is placed on a trundle and slowly turned. While it is turning it is wrapped with a foil backed paper insulation to a thickness of about 1/2". Again the annular space is placed under vacuum which makes the transporter act like a thermos bottle. These 3 types of insulation can be found on trailers at the present time. As a rule of thumb, Trans Gas trailers numbered 90 and above are "super wrapped" trailers.

Road Transportation



This shows a piece of the 1/2" aluminum used to make the inner vessel.

Road Transportation



Rear of the transporter. Placarded 1972 and stenciled "Methane refrigerated liquid." Relief stacks are located on the left. The vacuum plate with the number 96 is at the top center.

One of the first items checked before the trailer is loaded is the vacuum plate. Because it is held on by the vacuum in the annular space, if it has shifted, it is an indication that the trailer has lost its vacuum, and will not be loaded. The vacuum and the insulation work hand in hand to keep the liquid cold. One without the other would allow the liquid to heat up, thereby causing the pressure to build in the tank to possibly dangerous levels. (the first relief valve operates at 70psi)

Emergency Shutdowns

- LNG transporters have emergency shutdowns that can either be cable operated or pneumatically operated.



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Emergency Shutdowns

- One emergency shutdown will be on the drivers side of the trailer in the vicinity of the cab or landing gear.



Emergency Shutdowns



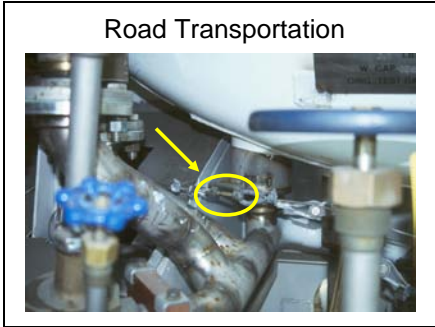
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Pneumatic system

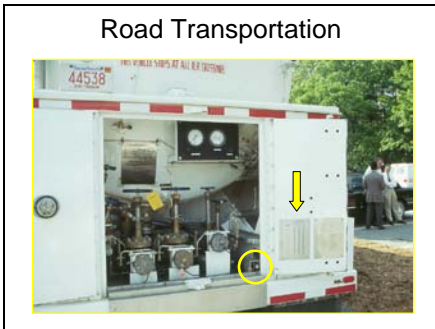
Road Transportation



The bucket box: The red colored spring-loaded handles are part of the emergency shut down system. When the emergency shut down rings are pulled, these springs activate, instantly closing the valves. In the center of the slide you can see three tri-cock valves. These give a true indication as to the amount of liquid in the tank. The green indicates (empty), The yellow indicates (87%), and the red indicates (90%) The piping from these tri-cocks enters the tank at different levels. When opened and liquid flows out, that is a true measure of the liquid level in the tank.

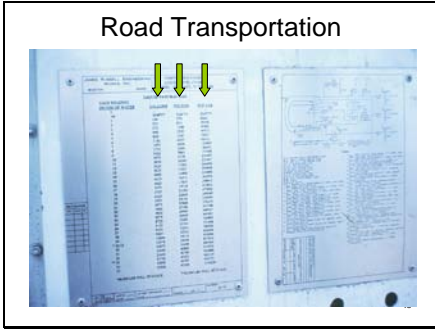


Another component of the emergency shut down system are fusible links or frangible bulbs holding the springs in position. Melting or breakage of either causes the springs to activate, closing the valves.



Bucket box piping, valves and gauges:
 There are three main valves located in the bucket box. On Trans-Gas trailers, the main liquid line is the furthest to the left, when looking at the box from the rear. The vapor return line is in the middle, and the trailer cool down valve is on the right. The two gauges at the top are the inches of water column gauge on the left which measures the amount of product in the tank, and the pressure gauge on the right.

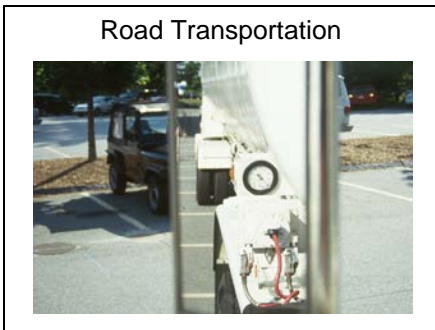
Remember....over the road pressure is 8 to 10 psi. Unless loading or unloading anything above 10 psi indicates a possible problem with the trailer, such as a loss of vacuum which might allow the pressure to rise. There are 2 pressure gauges on the trailer, 1 located in the bucket box, and 1 located on the driver's side front of the trailer (The next two slides show the remote gauge.) The inches of water column gauge measures volume. This gauge is only accurate if the trailer is in the normal upright position. Once on it's side, the gauge is no longer accurate. In the lower right hand corner of the bucket box is a small air valve (circled) that locks the trailer brakes when activated. Opening the right bucket box door activates this valve. It is designed to prevent "pull away" accidents during loading procedures.



On the right bucket box door is the conversion chart used to determine three things. 1) Pounds of product 2) Gallons 3) cubic feet of gas.



Remote pressure gauge mounted so that it can be seen in driver's rear view mirror.



View from drivers seat.
Remember: over the road pressure is 8 to 10 psi.

Road Transportation



Dents in outer shell:

These dents do not necessarily indicate damage due to an accident. They may have been caused by bottom filling a “hot” trailer.

The third valve in the bucket box furthest to the right is the trailer cool down valve. This is the fill valve that needs to be used when filling a “hot” trailer. A “hot” trailer is one that for whatever reason hasn’t hauled a load recently. Because of this the internal temperature has been able to approach ambient temperature. Injecting -260 degree LNG into the normal liquid fill line would cause the inner vessel to instantly contract. This contraction could possibly pull the outer wall in against the stiffening rings between the two shells. This could also cause hairline fractures to form in the outer shell which could cause the trailer to lose it’s vacuum. This may also cause dents to appear in the outer shell. To avoid this, trailers that are considered “hot” are tagged, and filled through the cool down valve to start. The cool down valve leads to a pipe that runs across the top of the inner shell. This pipe has numerous holes in it (similar to a deluge sprinkler pipe.) As the liquid flows through these openings, it flows down the sides of the tank, gradually cooling the metal as it fills preventing any contraction of the inner shell.

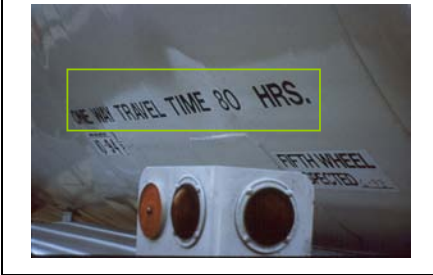
Road Transportation



All LNG tankers have information stenciled on the right side towards the front of the tank. This will say “ONE WAY TRAVEL TIME.”

One way travel time 192 hours.

Road Transportation



This one marked 80 hours

Road Transportation



This one marked 206 hours.

What is meant by “ONE WAY TRAVEL TIME”?

Theoretically, at the end of its one way travel time(206 hours) the pressure in the tank will have risen enough to activate the first safety relief valve at 70 psi, well over its normal over the road pressure of 8-10psi.

Road Transportation



Relief Stacks:

There are different configurations of relief stacks. Some can be like this, all on the left. Some may be all on the right. Still others might be split on both sides.

This is a newer trailer, both safety relief devices are spring-loaded. The first is set for 70 psi, and the other for 105 psi. Spring-loaded means that when the pressure drops below the set point, the valve SHOULD reset. (close)

Road Transportation



Burst Disc:

Older trailers also have two safety relief devices. One is a spring loaded relief valve set at 70 psi. The second is a burst disc (relief vent) set at 105 psi. Every trailer equipped with a burst disc is required to carry a spare. The theory is that if the burst disc ruptures, the extreme cold temperature will cause the load to “self refrigerate” after a short time. This would cause the pressure to drop below the operating pressure, and allow the driver to unbolt the device and replace the disc. The significant difference between a burst disc, and a relief valve is that a burst disc WILL NOT reset itself.

Product Filling



Loading facility at Distri-Gas.

Distrigas has the ability to load four transports at one time. Again, the transporters are sitting on scales. In the back is one of the large capacity vertical storage tanks.

Distrigas has two large capacity tanks, one holding 25.2 million gallons and the other holding 16.8 million gallons for a total on site capacity of 42 million gallons(1 million barrels). These tanks are filled by ships which come mainly from Trinidad and Tobago.

Product Filling



Loading Operations:

Loading and unloading is done by pump off. Here, two trailers are being loaded. The main liquid line and the vapor return line are hooked up. Both trailers are sitting on scales.

As we know, LNG is loaded mostly by weight. In MA, and RI they can be loaded to carry a payload of 43,000 pounds, which is approximately 90%. In fact, at Distri-Gas they open the 90% tricock when loading. When the valve starts spitting product, they stop filling even if the weight is less than 43,000 pounds. The ability to carry up to 43,000 pounds in MA, and RI is due to the fact that these states issue overweight permits. Other states do not issue overweight permits. Therefore they are only loaded to 80,000 pounds GVW, which equals approximately 38,000 pound of product.

Road Transportation

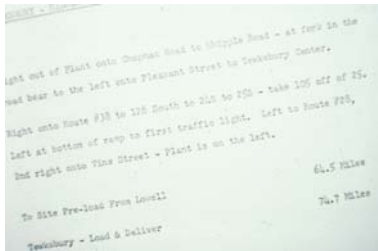


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Grounding and Bonding:

All LNG trailers are grounded and/or bonded during loading and unloading. This is to prevent a static electrical charge from developing. Any time that liquid is flowing a static electrical charge can develop. There have been numerous incidents in the past where this static electrical charge has been the cause of fires, when the grounding/bonding step was not completed.

Road Transportation



Routes of travel:

LNG is strictly controlled in transport. There are certain routes and highways that allow LNG and others that do not. There are also school bus and Haz – Mat exclusion restrictions in many areas that limit the actual time of day that the product can be on the road. Once a load of LNG has started moving, it is not supposed to come to a stop. There are numerous restrictions for specific routes such as tunnel travel, and the Massachusetts Turnpike (RTE 90.) For example, on the mass pike, two transporters traveling in the same direction cannot be within a quarter of a mile of each other. If the speed limit is reduced to 45 mph, the transports must exit the highway. At no time are LNG transporters supposed to stop on the Mass. Pike

Industry Resources



Driver



Dispatcher

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Resources:

Both the driver and the company dispatcher are excellent sources of information, and technical advice. Do not hesitate to get their input.

Show the LNG response plan book.

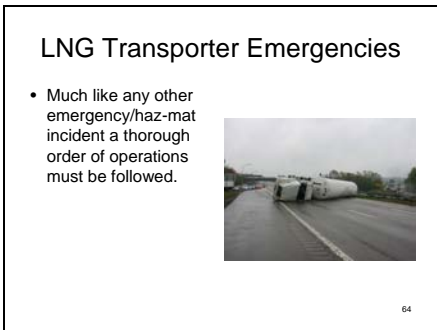
Driver	Dispatcher
<ul style="list-style-type: none"> • Notify his company • Investigate leak, spill • Serve as technical resource 	<ul style="list-style-type: none"> • Notify emergency forces • Report accident location • Serve as technical resource • Activate emergency response plan

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Shipping Papers:


If the driver is unavailable, the shipping papers will be found in a pocket in the drivers door. This of course may change should the unit be involved in a roll over. Note the Emergency response guide book as well.



LNG transporter accident is no different from any other haz-mat incident. Follow the logical order of operations and base the tactical decisions on sound facts. The sound facts are based upon knowledge of the commodity and the transporter.

LNG Transporter Emergencies

- Begin by identifying the commodity and its physical properties
- Detect if any leaks are present
- Ascertain the amount of product on site
- Determine the extent of the damage to the trailer and if it had lost its vacuum.




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Use this slide as a “Post-test” of LNG in transportation. Ask students how they would achieve each of the above objectives.

LNG Transporter Emergencies

- Establish control zones
- Monitor the situation visually and with the use of a CGI and appropriate PPE.




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Limit access to all zones to only those needed. Keep all unnecessary personnel out of the hot zone. Entry shall only be performed with appropriate PPE and for a reason.

LNG Transporter Emergencies

- Establish water supply and deploy hand lines as needed for current or possible future vapor control issues.




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Be prepared

LNG Transporter Emergencies

In most tank incidents the fire service attempts to apply water to reduce pressure build up within the tank.


DO NOT APPLY WATER TO AN LNG TRANSPORTER UNLESS THERE IS FIRE IMPINGEMENT OR DIRECTED TO BY AN LNG SPECIALIST/TECHNICAL ADVISOR.



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Applying water from a fire stream on an LNG tank will actually be heating it up and increasing internal pressure.

LNG Transporter Emergencies



The goal of vapor control is to direct the vapors into an area YOU want them to go.


Another goal of vapor control/suppression is to dilute the gas concentration below the flammable range.

If a fire is present the intention is to keep the fire burning unless there is a confirmed life hazard and there is certainty the leak can be shut down.

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LNG Transporter Emergencies

- All agencies must work together under the unified command concept for the successful completion of the incident.



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LNG Transporter Emergencies

- Each agency comes to the table with their own expertise.
- Safety is the #1 criteria in the mission to mitigate the incident.



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LNG TRUCKING PLAN



- The NGA trucking plan is a classic example of resource management.
- An emergency response trucking plan is a program developed by the Northeast Gas Association.
- The plan creates zones of coverage for response to LNG truck incidents by trained professionals.

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This is a perfect example of a working plan that has been utilized at actual incidents, but is regularly reviewed, updated and tested.

Where will we be
finding it next?

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Portable Vaporizers



Portable vaporizers:

Portable vaporizers have become an integral part of LNG transport in this area. TransGas can now supplement gas supply to customers while plants are off line for maintenance etc.

These vaporizers would be used in connection with LNG transporters. They would be taken to a gate station where a connection to the main is located, and set up. The LNG would be off loaded from the transporter to the vaporizer where it is then converted back to Natural gas. The gas is then odorized prior to being injected into the gas main.

Industrial Supply



The northeast is now beginning to see the use of LNG as an alternative to Propane. LNG storage tanks are connected to portable/fixed vaporizers and odorant stations. This system in NH is being used to replace a 30,000 gallon LP tank. (Shown back left at base of smokestack)

Modified Transporter



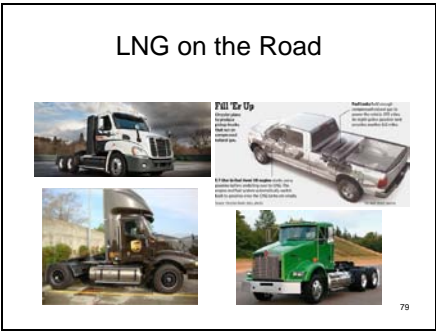
Storage tank has integrated UV, IR and CGI sensors with automatic shut-offs and alarms.



Dual vaporizers alternate on a 12 hour cycle due to icing. Methane vapors are odorized with Mercaptan and the gas is heated to 40 degrees Fahrenheit before entering the facility.



A Large Gypsum producer in central Vermont is currently in the process of installing eight 15,000 gallon fixed LNG storage tanks to replace their use of #2 Fuel oil.



There are already several large fleets that have converted to LNG. It is now starting to work its way into the Northeast. As the support infrastructure increases, the use by both commercial and private drivers will increase as well.

On the Rails



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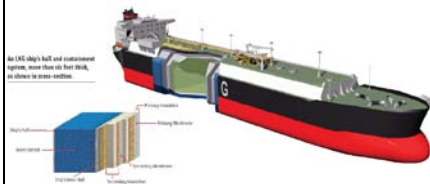
On the Seas



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LNG Membrane Ship

One style of ship design. Tank is integral to ship



January 30, 2013

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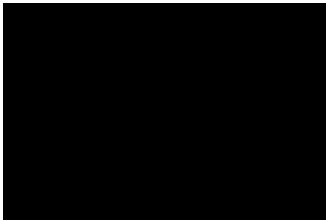
In the Air



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“Boeing’s SUGAR Freeze plane concept runs on cryogenically frozen liquid natural gas” Currently in development in conjunction with NASA

LNG Video



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Hats of Command



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Summary

- Much of the LNG transported by road is done in the Northeast section of the country
- One of the largest transporters of LNG in the country is TransGas located in Lowell, MA. With approximately 55 dedicated LNG tankers, but new players are joining the game.

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Summary

- There are approximately 25 different sites in Massachusetts alone that deal with LNG
- New technologies and supplies are increasing the uses for LNG
- The chances of responding to an LNG incident are not as remote as you would think

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Questions ??



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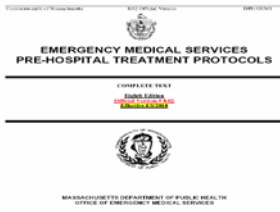
EMS Patient Care



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Always perform EMS care according to appropriate standards



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Always follow prescribed protocols

Respiratory Hazards



• Asphyxiation

- Vapors mix readily with CO₂ in the lungs, signaling the body to stop breathing
- Extremely cold vapors may cause respiratory tract damage

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Respiratory Treatment

- Remove from hazard to minimize exposure
- Place on high flow O₂
- Check lung sounds for signs of pulmonary edema

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Respiratory Treatment cont.

- If possible check SPO₂ level
- Be prepared to support respirations if necessary
- Arrange for transportation to medical facility



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Frostbite

- LNG boils at minus 260 degrees F
- LPG boils at minus 44 degrees F
- Direct contact with skin will cause immediate loss of tissue

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Frostbite Treatment

- Remove to safe area
- If possible elevate affected area to help minimize swelling
- Remove any clothing or jewelry in affected area



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Frostbite Treatment cont.

- Cover area with dry gauze and use cotton to separate toes or fingers if affected
- DO NOT rub area in an attempt to rewarm
- Arrange for immediate transport to closest appropriate medical facility



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Burns

- There are several ways thermal burn injuries can occur when dealing with LNG, NG and LPG fires

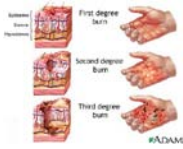
Direct flame contact
Radiant heat
Steam burns

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Steam burns often caused by perspiration trapped under firefighting PPE

Burn Classifications



- **First Degree**

Is superficial and causes local inflammation of the skin. Sunburns often are categorized as first degree burns. Characterized by pain, redness, and a mild amount of swelling. The skin may be very tender to touch

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98

Burn Classifications



- **Second Degree**

Deeper into the tissue and includes blistering of the skin in addition to the pain, redness and inflammation

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Burn Classifications

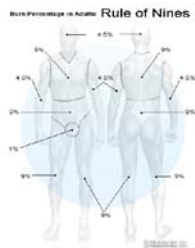


- **Third Degree**

The deepest burn involving all layers of the skin, in effect killing that area of skin. Because the nerves and blood vessels are damaged, third degree burns appear white and leathery and tend to be relatively painless

100
100

Determining Extent of Injury



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Burn Treatment

First or second degree burns involving a small area of the body

- Always ensure airway has not been compromised
- Gently clean the wound with lukewarm water
- Rings, bracelets, and other potentially constricting articles should be removed (edema, or swelling from inflammation may occur and the item may cut into the skin)

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Burn Treatment cont.

First or second degree burns involving a small area of the body

- The burn may be dressed with a topical antibiotic ointment
- Area may be covered with dry gauze.
- If there is concern that the burn is deeper and may be second or third degree in nature appropriate medical care should be sought, emergency transport if necessary

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Burn Treatment cont.

Serious burns (second and third degree)

- Remove the victim from the burning area, remembering not to put the rescuer in danger.
- Remove any burning material from the patient.
- Always ensure airway has not been compromised.

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Burn Treatment cont.

Serious burns (second and third degree)

- Call 911 or activate the emergency response system in your area if needed.
- Once the victim is in a safe place, keep them warm and still. Try to wrap the injured areas in a clean sheet if available. DO NOT use cold water on the victim; this may drop the body temperature and cause [hypothermia](#)

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Burn Treatment cont.

Burns of the face, hands, and feet should always be considered a significant injury (although this may exclude sunburn)

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Blast Injuries



A BLEVE involving an LPG storage container may result in both blunt force trauma and penetrating injuries

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Blast Injuries

- **Primary**

Injury from over-pressurization impacting the body surface

(blast wave)

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Injuries could include Tympanic Membrane rupture, pulmonary damage and air embolization as well as hollow viscus injury

Blast Injuries

- **Secondary**

Injuries caused by projectiles (shrapnel) which could include container segments and other flying debris

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Injuries may include penetrating trauma, fragmentation injuries and blunt trauma.

Blast Injuries

- **Tertiary**

Injuries caused when the victim is displaced by the blast wind

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Injuries can include blunt/penetrating trauma, fractures and traumatic amputations.

Blast Injuries

- **Quaternary**

All other injuries

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May include crush injuries, burns, asphyxia, toxic exposures and exacerbations of chronic illnesses.

Summary

- There are many ways flammable gases can cause injury
- Scene safety is the primary concern for emergency responders
- Proper body substance isolation (BSI) practices **MUST** be followed
- It is very likely that it will turn into a mass casualty incident (MCI)

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Summary cont.

- Not all injuries will be readily apparent
- Rapid triage, treatment and transportation is critical
- EMS responders may be working side by side with other rescuers
- Post incident issues may need to be addressed

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Source – Warner Brothers

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