LNG Awareness
For Crews of LNG Fueled Vessels
Marine Firefighting Inc. and LNG

MFI has been training mariners and Firefighters in all aspects of LNG safety and Firefighting for over 17-years.

MFI delivered awareness level training for the First Responders and Mariners involved in bunkering the world's first LNG fueled container (ConRo) ships.
What is LNG?
LNG Properties

- Liquefied Natural Gas
  - -260 degrees F
- LNG Properties
  - Lighter than water (62.4 lb./cu.ft)
- LNG Transportation
  - NO PRESSURE
- Refrigeration reduces the size of natural gas by 600 times…

600 times smaller!
Common Sense and Knowledge

- Natural Gas presents an asphyxiation hazard
- LNG → Natural Gas
  - Without the odor
- LNG is a cryogenic liquid – physical contact or spillage constitute a personnel and equipment hazard.
Natural Gas Properties

- Natural gas is lighter than air
- Natural gas density: 0.47 (Air - 1.0)
- Natural gas rises under normal atmospheric conditions.
- Gas from LNG will rise after re-gasification and warming.
- Until it warms, it will be heavier than air...
Common Sense and Knowledge About LNG

- Natural gas needs to be in vapor form and mixed with air to burn
- Natural gas is only combustible in the range of **5% to 15%** volume concentrations in air
- Combustible mixtures in confined space can burn explosively
  - **LNG does not explode in the open**
Why LNG Now?
The Case for LNG as Fuel?

- Recent discoveries of large deposits of Natural Gas and new recovery methods of shale gas in the USA have made natural gas more plentiful and therefore more cost effective.
Strict ECA Regime Now in Force

- ECA (Emissions Control Area) is defined as 200 nautical miles out to the edge of the exclusive economic zone
- Ports within the ECA zones expect LNG to be 24% of the total bunkering volume by 2025
Sulfur Cap to Drop in 2020

By MarEx 2016-10-27

• The IMO’s Marine Environment Protection Committee has agreed to reduce the global sulfur emissions limit to 0.5 percent in 2020. The agreement not to delay the new limit until 2025 was reached at a session on Thursday.

• "Refiners will not invest to de-sulfurize fuel oil, and there is not enough low-sulfur fuel oil to meet demand from the shipping sector," said Robert Campbell, head of oil products research with consultancy Energy Aspects.

• Scrubbers.. But what about CO2 emissions?????
• Shipping emits around 1 billion tones of carbon dioxide (CO2), accounting for about 2.5 percent of global greenhouse gas emissions, but this can be **cut by about 75 percent** if ships take measures like **switching to** the cleaner burning fuel **LNG**, a study by the International Maritime Organisation (IMO) shows.

• International Shipping News 29/10/2016
The sector is likely to be forced to make changes once the European Commission implements a monitoring, reporting and verification (MRV) system for CO2 emissions for ships from 2018, Angus Campbell, Bernhard Schulte's corporate director of energy projects, told Reuters in an interview.

"If you are a shipowner, and you are burning liquid hydrocarbon fuels (diesel, fuel oil), you don't have any options.

- Neither distillates nor scrubbers can reduce your CO2 footprint," Campbell said, adding shipowners would have to pay the carbon tax or switch to cleaner fuels like LNG or methanol.
What’s New About LNG?
LNG fueled vessels

There are 86 LNG fueled ships currently in operation and 93 ships on order as of October 2016, according to DNV GL.

Alongside this, there are 68 LNG ready ships in operation or on order.

The classification society believes that by 2020 there could be between **400 and 600 vessels operating on LNG worldwide.**

13 of 73 Cruise Ships on Order are LNG-Powered  --  November 07, 2016
## 2015 LNG Bunkering ‘Snapshot’ (bunkering facilities)

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Type</th>
<th>State/Region</th>
<th>LNG Fuel Supply</th>
<th>Startup Year</th>
</tr>
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<tbody>
<tr>
<td>Port Fuchon/Shell</td>
<td>Bunkering</td>
<td>LA</td>
<td>Under Construction</td>
<td>2016</td>
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<tr>
<td>Jacksonville – Tote</td>
<td>Bunkering</td>
<td>FLA</td>
<td>In Operation now</td>
<td>In Operation now</td>
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<tr>
<td>WSF/PSE</td>
<td>Liquefaction</td>
<td>LA</td>
<td>Proposed</td>
<td>????</td>
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<td>WA</td>
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<td>Bunkering</td>
<td>BC</td>
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<td>SEASPAN/FORTIS</td>
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<td>Bunkering</td>
<td>WA</td>
<td>Proposed</td>
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</tr>
</tbody>
</table>
Size Does Matter!

What about smaller work boats and LNG?
Smaller Tow Boats
The Wärtsilä system specified is ...a smaller version of the system installed on the Harvey Gulf .... the z-drive towboat designs have been operating successfully since 2008.
LNG Bunkering Methods

Photo from ABS - LNG Bunkering: Technical and Operational Advisory
Ship to Ship
Shore to Ship

Harvey Gulf Facility in Port Fuchon, LA
Regulations

- **International**
  - International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code).

- **USCG**
  - 33 CFR 105 Facility Security Plan
  - 33 cfr 127 lng facility requirements
  - HQ (CG-5-ENG) Design basis standard modifying MSC.285(86).
  - Policy Letter No. 01-15 and 02-15 into planning and development of facility

- **NFPA codes and standards**
  - 59A, 52, 70, 72, 10, 11, 12, 12A, 13, 14, 15, 16, 17, 20, 33, 24, 25 into planning and development of facility

- **Company required manuals**
  - LNG Operations Manual
  - LNG Operating Procedures Manual
  - LNG Facility Emergency Manual
LNG Fuel Applications

- There are two basic IMO approved design concepts for machinery spaces on natural gas-fueled ships:
  - The inherently gas safe machinery space
  - The emergency shutdown (ESD) protected machinery space.
Gas safe machinery spaces are considered gas-safe under all conditions. This requires natural gas fuel piping within engine room boundaries to be fitted in a gas-tight enclosure. This is accomplished using double-walled pipe, or single-walled piping within a gas-tight duct. The space between the inner and outer pipe/duct must be either pressurized with inert gas or ventilated.

**Figure 16**  Typical layout of a gas-safe machinery space. Source: ABS.
LNG Fuel Applications

- The ESD machinery spaces are considered gas-safe under normal conditions, but may become gas-dangerous spaces under certain conditions.
- This application allows for single-walled piping inside the engine room without an external gas-tight enclosure.
- It requires air changes of 30 changes per hour to prevent the accumulation of flammable vapors within the space.
- If gas is detected within the space, all electrical equipment not certified safe for hazardous locations is automatically shut down…
LNG Fuel Applications

Figure 17  Typical layout of an ESD protected engine room. Source: ABS.
Wärtsilä LNGPac
Staff Training
Training Requirements
Vessels Using Gases or Low Flashpoint Fuels

• 2.1 Prior to being assigned duties on board a vessel using gases or other low flashpoint fuels, all mariners should receive appropriate training in accordance with this section.
Training Requirements
Vessels Using Gases or Low Flashpoint Fuels

- 2.2 Mariners responsible for designated safety duties associated with the care, use or in emergency response to the fuel on board these vessels should receive basic training or instruction in accordance with paragraph 3.1 and should meet the standard of competence specified therein.
Training Requirements
Vessels Using Gases or Low Flashpoint Fuels

• 2.3 Masters, engineer officers and all personnel with immediate responsibility for the care and use of fuel and fuel systems on board these vessels should receive **advanced training** in accordance with paragraph 3.2 and should meet the standard of competence specified therein.
Training Requirements
Vessels using gases or low flashpoint fuels

• **Person in Charge (PIC)** for anyone in charge of supplying LNG bunker fuel either from land or another vessel.
LNG Bunkering
Why Is This New Training Needed
General Considerations for LNG Bunkering

- Loading LNG into fuel tanks is a **different process** from loading HFO due to some unique differences in the fuel’s characteristics.
- One difference is that LNG is carried as a **boiling liquid**, which means temperature and pressure influence the behavior of the liquid.
- A second difference is that LNG is a **cryogenic liquid** at temperatures of about -162°C (-259°F), and consequently, it is hazardous to personnel and any conventional steel structures or piping with which it comes into contact.
- A third difference is that the **vapor** from typical petroleum bunkering is not considered to create a **hazardous zone** because the flash point is above 60°C (140°F).
  - In contrast, LNG vapor can form explosive clouds **in confined spaces** and is considered hazardous.
  - This requires special handling of the vapor when bunkering.
Measures that mitigate embrittlement of steel structures as a result of leakage of LNG during transfer operations.

Vessel platings are not to be exposed to low temperatures below the allowable design temperature of the material.

Drip trays are to be fitted below liquid gas bunkering connections and where LNG release may occur. Made of stainless steel, drainage arrangements may be temporarily fitted for bunkering operations.

If damage to the hull structure from accidental release of LNG during bunkering operations cannot be precluded, additional measures such as a low-pressure water curtain, are to be fitted under the bunkering station to provide for additional protection of the hull steel and the ship's side structure.
Carbon steel will become brittle and crack when in contact with LNG. **So will you and your equipment!**
LNG Safety: Vessel Crew

• Understanding and controlling what you have in your piping, tanks and surrounding atmosphere at every phase of the operation is critical to safe handling of LNG
• Training your crew to thoroughly understand the properties and characteristics of LNG is essential

• Understanding how to control the flammability of the mixture within your system is crucial to safe operation
• **Insuring that oxygen and gas never mix within the flammable range is the simplest way to insure maximum safety**
Mobile barge explosions happened after vapors entered nearby tugboat's engine.
LNG Firefighting
Most times it is better to let the fuel burn off!

• Water **WILL NOT** extinguish an LNG fire. However---
• It may be used in a **coordinated** effort to
  – Cool exposures
  – Disperse LNG vapors.
  – Protect decks from brittle fracture*
  – Increase LNG vaporization
LNG Firefighting

• We said that water will not extinguish an LNG fire.

• Dry Chemical is main extinguishing agent.
  – Coordinated attack (Coordinated training)
  – Re-ignition possible if:
    • Area not completely covered
    • Sources of ignition remain
What is the transportation safety record of LNG ships?

- During more than **135,000** voyages completed since the inception of LNG maritime transportation in 1959, there have been only eight significant incidents involving LNG ships.
- None of which resulted in spills from cargo tank ruptures.
- This involved relatively few times that the LNG was actually transferred.
- **What will happen now that vessels will be re-fueling with LNG regularly?**
Common Tasks

• “When something becomes more common, people may start taking chances”

• “Our challenge is to transfer the knowledge and experience from a small group of specialists to a large group of generalists”

• *USMRC president Brian Holden Workboat March 2015*
LNG Bunkering Leak ‘A Wake-Up Call’ for Sector

Authorities say Skangass spillage during Fjord Line ferry refuelling could have become ‘major accident’

Photo by Anders Minge
LNG leak in Risavika while bunkering 09 May 2014

- The incident was caused by a test of the ship’s stability system taking place at the same time as bunkering the MS “Bergensfjord” that resulted in a large exterior strain to the hose connection to the bunker station on board the ship.
- The leakage is estimated to 130 kilograms (approx. 300 lbs) of LNG.
• With proper training and technology, LNG as a fuel will not be good for the environment but also for the marine industry.
Thank you for your attention
Are there any questions?

Visit us on the web at MarineFirefighting.com
Email us at MarineFires@aol.com