International Workboat Show
Ernest N Morial Convention Center
New Orleans, Louisiana
02 December 2015

Training and Competence for LNG Fueled Vessel Crews

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Managing Partner
Mystic River Partners LLC
Overview:

• Why do we need training? Lessons learned, mitigation measures, do’s and don’ts from current operational experience

• The latest regulations and requirements for crew training

• Overview for developing crew-focused practical LNG training

• Assuring knowledge, understanding and proficiency is delivered for LNG fueled vessel crews

• Developing, assessing and demonstrating true LNG Fuel crew competence
Skangass speaks on spill

LNG provider Skangass has explained why LNG was spilt during a cruise ferry bunkering operation last month.

Skangass said a leak of an estimated 130 kilograms of LNG, which occurred during the truck-to-ship bunkering of Fjord Line’s 1500-passenger ferry newbuilding Bergensfjord at Risavika near Stavanger on 9 May, was due to a test of the ship’s stability system taking place at the same time as bunkering.

Root Causes:
- Improper / Failure to follow procedure & regs
- Improper equipment / use of equipment
- Inadequate personnel on location
- Inadequate training / documentation
- Simops- passenger loading / stability system
- Poor Communications

May 2014

LNG bunkering leak 'a wake-up call' for sector

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

Norway’s civil defence authorities are conducting an investigation into a serious leak of LNG that occurred during truck-to-ship bunkering operations involving a cruise ferry last month.

Torill Tandberg, department director for industry, products and hazardous substances at the Norwegian Directorate for Civil Protection (DSB), says 100 kilograms of LNG leaked from the hose connection in the bunkering room onboard Fjord Line’s 1,500-passengership newbuilding Bergensfjord on 9 May at Risavika.

Tandberg says the hose disconnect appears to have occurred because the ship’s stabilising systems were not engaged.

“This was a very serious incident that had the potential to become a major accident,” Tandberg said.

“The people working onshore were in danger. It is very important that we learn from this.”

She says there have been other LNG marine bunkering incidents in Norway — one just recently involving a ferry — although nothing as serious as this.
Lessons Learned and Mitigation Measures Implemented

• Extension of safety zone
• No passenger / car loading during bunkering
• Extra personnel from supplier on dock
• Implementation of risk assessment and management of change procedures
• Documentation and certification of training for bunkering personnel
• Improved communication / prompt reporting to Fire Dept and Emergency Responders
• Regularly scheduled drill and incident response program with participation from local authorities
• Water spray capability for protection of terminal building
US Lessons Learned

Memo from USCG NCOE Port Arthur, Sept 2015:

“USCG has witnessed several bunkering operations… and seen common errors/failures…. some that have resulted in release of LNG…

Recommendations:
• USCG Reviewed procedures
• Crew familiarity with specific equipment / system
• Proper work/rest schedule
• Record of fueling alarms and valve closing times
• Approved plans/drawings
• Attendance of USCG at training courses
• Involve NCOE in pre-planning
LNG Bunkering Training – Where are we now?

The IMO Maritime Safety Committee (MSC) 95th session in June 2015 adopted:

- Draft IGF Code to come into effect on Jan 1, 2017
- Draft Amendments to SOLAS to incorporate and reference the new IGF Code
- Draft Amendments to STCW describing training, competence, knowledge, understanding and proficiency standards for gas fueled vessel crews
- Interim Training Guidelines until the entry into force of the above (Jan 2017)
Annex 5 HTW 1/21 Report to the Maritime Safety Committee Mar 2014 adds standards of competence for ships operating on low flash point fuels

- Adopts comprehensive knowledge, proficiency and understanding (KUPs) requirements in Table A-V/3-1 and A-V/3-2
- Include methods to demonstrate and evaluate competence

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<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
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<tr>
<td>Competence</td>
<td>Knowledge, understanding and proficiency</td>
<td>Methods for demonstrating competence</td>
<td>Criteria for evaluating competence</td>
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<tr>
<td>Contribute to the safe operation of a ship subject to the IGF Code</td>
<td>Design and operational characteristics of ships subject to the IGF Code</td>
<td>Examination and assessment of evidence obtained from one or more of the following:</td>
<td>Operations within the area of responsibility are clear and effective</td>
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<td>Basic knowledge of ships subject to the IGF Code, their fuel systems and fuel storage systems.</td>
<td>.1 approved in-service experience</td>
<td>Operations related to ships subject to the IGF Code are carried out in accordance with accepted principles and procedures to ensure safety of operations</td>
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<td>. fuels addressed by the IGF Code</td>
<td>.2 approved training ship experience</td>
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<td>.2 types of fuel systems subject to the IGF Code</td>
<td>.3 approved simulator training</td>
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<td>.3 atmospheric, cryogenic or compressed storage of fuels on board ships subject to the IGF Code</td>
<td>.4 approved training programme</td>
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</tr>
<tr>
<td>Familiarity with physical and chemical properties of fuels aboard ships subject to the IGF Code</td>
<td>Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to the safe bunkering and use fuels used on board ships subject to the IGF Code, including:</td>
<td>Examination and assessment of evidence obtained from one or more of the following:</td>
<td>Effective use is made of information resources for identification of properties and characteristics of fuels addressed by the IGF Code and their impact on safety, environmental protection and ship operation</td>
</tr>
<tr>
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<td>.1 the chemical structure of different fuels used on board ships subject to the IGF Code.</td>
<td>.1 approved in-service experience</td>
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IGF and STCW Training Requirements:

“Ensure that seafarers...are adequately qualified, trained and experienced.”

“Companies shall ensure that seafarers...have completed training...appropriate to the duties and responsibilities...given in the STCW Code as amended...”

Basic Training for mariners responsible for designated safety duties

Advanced Training for Masters, Engineer Officers and all personnel with immediate responsibility
What does USCG Say about Crew Training?

Issued 2 long-anticipated policy letters addressing training in February 2015:

1. USCG Policy Letter 01-15, GUIDELINES FOR LIQUEFIED NATURAL GAS FUEL TRANSFER OPERATIONS AND TRAINING OF PERSONNEL ON VESSELS USING NATURAL GAS AS FUEL

   - Enclosure (3) Adopts and references IMO STCW.7/Circ.23 -IMO Interim Guidance on Training for Seafarers on board ships using gases or other low flash point fuels
   - Adds additional requirements related to documentation, treatment of uninspected vessels and training course review for conformance
   - No endorsement or certification for mariners to be issued by USCG – yet...

2. 02 - 15 GUIDANCE RELATED TO VESSELS AND WATERFRONT FACILITIES CONDUCTING LIQUEFIED NATURAL GAS (LNG) MARINE FUEL TRANSFER (BUNKERING) OPERATIONS

   - Shoreside transfer personnel must meet training requirements for PIC of waterfront facilities
   - References 49 CFR Part 172, Subpart H (172.700-172.704) – Training for truck and rail car operations
Existing and Applicable Guidelines & Regulations
Training Objective- 3 Simple Rules:

Rule #1: Don’t let LNG out of its containment!

Rule #2: Don’t let LNG come in contact with Air!

Rule #3: If you fail to observe Rules #1 and #2, don’t introduce a source of ignition!
Day 1 Classroom Instruction Basic Training
Covers the Basic competencies and associated KUPs:

1. contribute to safe operation of an LNG fueled vessel
2. prevent hazards
3. health and safety precautions
4. carry out firefighting operations
5. respond to emergencies; and
6. prevent pollution
LNG Firefighting

Day 2, Basic and Advanced

STCW Competence:
(Basic) Carryout Firefighting operations
  • Organization
  • Action to be taken
  • Special Hazards
  • FF extinguishing agents and methods

(Advanced) Have knowledge of prevention, control, firefighting and extinguishing systems
  • Fire fighting methods and appliances
  • Detection
  • Control
  • Extinguishment
Advanced Training

Day 3 Advanced training for mariners with immediate responsibility

Advanced Competencies and associated KUPs:

1. physical and chemical properties (of LNG)
2. operate controls...related to propulsion plant
3. perform and monitor all operations
4. safe bunkering, stowage and securing
5. prevent pollution
6. control compliance with legislative requirements
7. prevent hazards;
8. health and safety precautions
9. prevention, control and firefighting and extinguishing systems

Includes ship specific propulsion system design, construction and operation
Simulator Training

Day 4 Simulation Training - covers specific system operation and contingency response

Draft STCW Regulation V/3:
Two of the three bunkering operations may be replaced by approved simulator training on bunkering operations as part of the training in paragraph 1 above.

- Proficiency in the operation of bunkering systems on board ships subject to the IGF Code
- Proficiency to perform fuel-system measurements and calculations
- Knowledge of safe procedures and checklists for taking fuel tanks in and out of service
- Ability to use all data available on board related to bunkering, storage and securing
- Establish clear and concise communications and between the ship and the terminal, truck or supply vessel

LNG Fuel system operator practical assessment meeting draft STCW Requirements
What’s wrong with this picture?
Thank You!

Answers?

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http://usmrc.org/
Tel: +1 (401) 849-0222
LNG Awareness
For Crews of LNG Fueled Vessels
Why LNG Now?
LNG fueling driven by economic and regulatory forces

A combination of cost reduction and environmental regulations have made LNG a most appealing alternative to current vessel fuels.
The Case for LNG as Fuel?

• The potential fuel savings from LNG use could be between 30% and 35% compared to diesel in the energy industry alone.
• Once oil and diesel prices recover, LNG as a fuel in the transportation sector will be even more attractive.
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.
- Add to that the fact that LNG already meets current and future environmental regulations and the answer is clear.
LNG fueled engines burn cleaner and do not require after-treatment or specialized NOx abatement measures to meet EPA Tier 4. This in conjunction with its significantly lower fuel cost makes LNG an attractive option for compliance.

“EPA Tier 4 Emission Regulations”
Marinelink.com Nov 14, 2013
## LNG Technology is Proven

### Safe
- >135,000 LNG voyages without incident
- 1 in 5 new transit buses are gas-powered
- Non-toxic

### Reliable
- First LNG design in 1915
- Existing technology in service (Over 60 vessels)
- 100+ years of domestic supply

### Growing
- Over 100 vessels on order
- 2500 vessels projected by 2020
- Coast Guard, DOE approvals for new projects

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**LNG Fueling Europe**

**LNG Fueling US**

Note: Canadian LNG facilities shown in inset box. All suppliers are transported to the state border inset.

Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System, December 2006.
What’s New About LNG?
LNG fueled vessels

Carnival orders four 6,600 guest LNG fueled cruise ships.

Construction Begins on Crowley’s Second LNG-Powered ConRo Ship
# 2015 LNG Bunkering ‘Snapshot’
(bunkering facilities )

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Type</th>
<th>State/Region</th>
<th>LNG Fuel Supply Status</th>
<th>Startup Year</th>
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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>Proposed</td>
<td>2015</td>
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<td>LA</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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</table>
What is LNG?
LNG Properties

- **Liquefied Natural gas**: A cryogenic liquid
  - -260 degrees F
- **LNG Density**
  - 26.5 LB./Cu. Ft.
  - Lighter than water (62.4 lb./cu.ft)
- **LNG is not transported under pressure**.

**NOW!**
- 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
• LNG is a cryogenic liquid – physical contact or spillage constitute a personnel and equipment hazard.
Because LNG is almost pure methane it will burn with little or no smoke!
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 regasification and warming.
- Until it warms, it will be heavier than air.
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.
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**
LNG Bunkering
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.
LNG Bunkering Methods

Photo from ABS - LNG Bunkering: Technical and Operational Advisory
• 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.
LNG Safety - Metal Fracture

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.
• Strict adherence to procedure for every evolution.
LNG Safety: Vessel Crew

All personnel involved directly with LNG handling operations should wear personal protective equipment (PPE) including:
- gloves
- face protection
- other suitable clothing to protect against LNG drips, spray, spills, and leaks.

PPE is also required to protect against skin damage caused by contact with the cold pipes, hoses, or equipment.
WESPAAC Midstream
LNG Bunkering Barge
For Totem Ocean Trailer Express

• America’s first!
• Initial deployment in Tacoma, WA followed by Jacksonville, FL
• Plans for the new barge include GTT’s innovative REACH4 bunker mast ‘to ensure a simple and safe transfer of LNG fuel to the client vessel’
Sources of Ignition

Do not enter an LNG Cloud
Mobile barge explosions happened after vapors entered nearby tugboat's engine.
Water on LNG Fires

• 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.

• In fact, it may be best **not to extinguish** an LNG fire!

• Dry Chemical is main extinguishing agent.
  – Coordinated attack (Coordinated training)
  – Shadow areas
  – Re-ignition possible if---
    • Area not completely covered
    • Sources of ignition remain
Thank you for your attention.

Questions?

Visit us on the web at MarineFirefighting.com

Email us at MarineFires@aol.com