



# LNG FUELED VESSEL Crew Training and Competence

SUNY MARITIME COLLEGE  
LNG CENTER OF EXCELLENCE  
20 February 2020

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# Company Overview

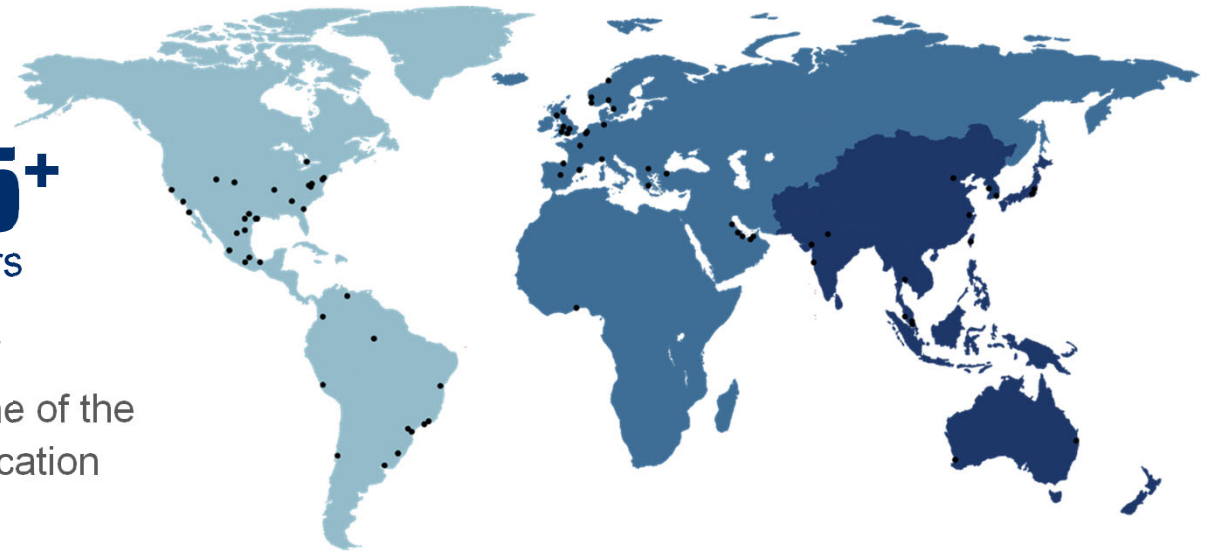
ABS Group provides data-driven risk and reliability solutions and technical services that help clients confirm the safety, integrity, quality and environmental efficiency of critical assets and operations. We are focused on adding value to the industries we serve and strategically capturing synergies with ABS.

**1000+**  
Employees

**20+**  
Countries

**45+**  
Years

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ENERGY AND TRANSPORTATION (LNG AND  
ALTERNATIVE MARINE FUELS) CONFERENCE

# LNG Marine Fuel Development 2020

- 170 LNG fueled vessels in service, 184 on order as of Dec 2019 (SGMF)



## Ongoing Challenges?

- Equipment and Installation Cost
- Supply and Distribution Infrastructure
- Technical, Risk and Operations Issues



### Slide 3

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- RK3** [https://cdn2.webdamdb.com/220th\\_sm\\_0Wfu44LC6Esn.jpg?1497355282](https://cdn2.webdamdb.com/220th_sm_0Wfu44LC6Esn.jpg?1497355282)  
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- RK4** [https://cdn2.webdamdb.com/220th\\_sm\\_60WZf00Oc4hg.jpg?1476968357](https://cdn2.webdamdb.com/220th_sm_60WZf00Oc4hg.jpg?1476968357)  
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# Perspective: 55+ years of LNG Marine fuel

- LNG Carriers were the first LNG fueled vessels
- Since the mid 1960's, LNG carriers have been designed to use their cargo as fuel:
  - 1960s- Steam Turbine era, 60s – present
  - 2005- Dual fuel Diesel Electric (DFDE)
  - 2007- Tri fuel diesel electric (TFDE)
  - 2010- ME-GI, 2S HP Fuel Injection Direct Drive
  - Gas turbine (proposed)
- About 28% of the current conventional trading LNGC fleet are dual fuel diesel
- About 67% of LNGCs on order are dual fuel diesel
- Technical development over 50 years of operational experience is adopted for use in gas fueled ships (non-LNGC) today



## Slide 4

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# IGF Code & STCW Basic Training

As of 01 January 2017:

## IGF Code Chapter 19:

- “Companies shall ensure that seafarers have training appropriate to duties and responsibilities...”

## STCW Regulation A-V/3

- **Mandatory** minimum requirements for the training and qualifications of **masters, officers, ratings and other personnel** on ships subject to the IGF Code :
- Seafarers responsible for **designated safety duties**
- ...with the **care, use or in emergency response** to the fuel...
- Shall complete **basic training** in accordance with Section A-V/3-1



**Table A-V/3-1**  
Specification of minimum standard of competence in basic training for ships subject to the IGF Code

Column 1	Column 2	Column 3	Column 4
Competence	Knowledge, understanding and proficiency	Methods for demonstrating competence	Criteria for evaluating competence
Contribute to the safe operation of a ship subject to the IGF Code	<p>Design and operational characteristics of ships subject to the IGF Code</p> <p>Basic knowledge of ships subject to the IGF Code, their fuel systems and fuel storage systems:</p> <ol style="list-style-type: none"> <li>.1 fuels addressed by the IGF Code</li> <li>.2 types of fuel systems subject to the IGF Code</li> <li>.3 atmospheric, cryogenic or compressed storage of fuels on board ships subject to the IGF Code</li> <li>.4 general arrangement of fuel storage systems on board ships subject to the IGF Code</li> <li>.5 hazard zones and areas</li> <li>.6 typical fire safety plan</li> <li>.7 monitoring, control and safety systems aboard ships subject to the IGF Code</li> </ol> <p>Basic knowledge of fuels and fuel storage systems' operations on board ships subject to the IGF Code:</p> <ol style="list-style-type: none"> <li>.1 piping systems and valves</li> <li>.2 atmospheric, compressed or cryogenic storage</li> <li>.3 relief systems and protection screens</li> <li>.4 basic bunkering operations and bunkering systems</li> <li>.5 protection against cryogenic accidents</li> <li>.6 fuel leak monitoring and detection</li> </ol> <p>Basic knowledge of the physical properties of fuels on board ships subject to the IGF Code, including:</p> <ol style="list-style-type: none"> <li>.1 properties and characteristics</li> <li>.2 pressure and temperature, including vapour pressure/temperature relationship</li> </ol> <p>Knowledge and understanding of safety requirements and safety management on board ships subject to the IGF Code</p>	<p>Examination and assessment of evidence obtained from one or more of the following:</p> <ol style="list-style-type: none"> <li>.1 approved in-service experience</li> <li>.2 approved training ship experience</li> <li>.3 approved simulator training</li> <li>.4 approved training programme</li> </ol>	<p>Communications within the area of responsibility are clear and effective</p> <p>Operations related to ships subject to the IGF Code are carried out in accordance with accepted principles and procedures to ensure safety of operations</p>

# STCW Advanced Training Requirements

- Applies specifically to “Masters, engineer officers and all personnel with **immediate responsibility** for the care and use of fuels and fuel systems...
- for a **certificate in advanced training** for service on ships subject to the IGF Code shall:
  - have successfully completed the approved advanced training **per table A-V/3-2**; and
  - Completed at least **one month of seagoing service** with three bunkering operations (2 may be simulated)
- May meet the requirements with “**appropriate training and certification** according to the requirements for **service on liquefied gas tankers**

**Table A-V/3-2**  
Specification of minimum standard of competence of advanced training for ships subject to the IGF Code

Column 1	Column 2	Column 3	Column 4
Competence	Knowledge, understanding and proficiency	Methods for demonstrating competence	Criteria for evaluating competence
Familiarity with physical and chemical properties of fuels aboard ships subject to the IGF Code	Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to safe bunkering and use of fuels used on board ships subject to the IGF Code, including: <ol style="list-style-type: none"> <li>.1 the chemical structure of different fuels used on board ships subject to the IGF Code</li> <li>.2 the properties and characteristics of fuels used on board ships subject to the IGF Code, including:                             <ol style="list-style-type: none"> <li>.2.1 simple physical laws</li> <li>.2.2 states of matter</li> <li>.2.3 liquid and vapour densities</li> <li>.2.4 boil-off and weathering of cryogenic fuels</li> <li>.2.5 compression and expansion of gases</li> <li>.2.6 critical pressure and temperature of gases</li> <li>.2.7 flashpoint, upper and lower flammable limits, auto-ignition temperature</li> <li>.2.8 saturated vapour pressure/ reference temperature</li> <li>.2.9 dewpoint and bubble point</li> <li>.2.10 hydrate formation</li> <li>.2.11 combustion properties: heating values</li> <li>.2.12 methane number/ knocking</li> <li>.2.13 pollutant characteristics of fuels addressed by the IGF Code</li> </ol> </li> <li>.3 the properties of single liquids</li> <li>.4 the nature and properties of solutions</li> </ol>	Examination and assessment of evidence obtained from one or more of the following: <ol style="list-style-type: none"> <li>.1 approved in-service experience</li> <li>.2 approved training ship experience</li> <li>.3 approved simulator training</li> <li>.4 approved training programme</li> </ol>	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



# Summary Crew Training Requirements

## Basic

- **Designated safety duties**
- Care, use, or emergency response
- STCW Table A-V/3-1

## Advanced

- Masters, Engineer Officers & Personnel with **immediate responsibility**
- STCW Table A-V/3-2
- At least 1-month sea time,
- Participation in 3 bunkering operations

## Ship Specific Familiarization

- ALL Seafarers on gas fueled ships
- Prior to assignment of shipboard duties
- Ship and Equipment specific familiarization

### Basic Competencies:

1. Safe Operation
2. Prevent hazards
3. Health & Safety
4. Firefighting
5. Emergency Response
6. Prevent Pollution

### Advanced Competencies:

1. Properties of LPPF
2. Operate Propulsion
3. Operate / Monitor
4. Safe Bunkering
5. Prevent Pollution
6. Regulatory Compliance
7. Prevent Hazards
8. Health & Safety
9. Prevent / Control Fire

# LNG Bunkering Training – US Regulation



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

### Training Requirements:

- All mariners must complete **ship specific familiarization** and basic training before assuming duties and responsibilities (46 CFR 15.405)
- **Basic Training** for Mariners responsible for **designated safety duties**
- Advanced training for Masters, Engineer Officers, and all persons with **Immediate Responsibility** for care and use of fuel
- Current holders of **Tankerman PIC LG and Tankerman Assistant LG** meet the qualification requirements ( with 3 months service in last 5 years plus company and vessel specific training)

USCG LNG Bunkering Training Guidance

# STCW Equivalence for LNGC Service

To meet gas fueled ship **Basic** per STCW Regulation A-V/3-6 :

- Meet STCW Chapter A-V, Reg 2 and 5 (Tankerman assistant LG (Basic))
- 3 months seagoing service on LNGC –OR--
- Approved basic training
- Qualified and certified

-- OR --

- Meet STCW Chapter A-V Reg 4 and 5 ( Tankerman LG (Advanced))
- Meet LNGC basic training requirements
- 3 months LNGC seagoing service or approved 1-month onboard training
- Qualified and certified

• To meet IGF Code **Advanced** per STCW Regulation A-V/3-8:

- Be “qualified and certified” for Tankerman LG Basic (meet Reg 2) --Plus---
  - Gas fueled ship specific familiarization
  - One month approved gas fueled ship seagoing service with minimum 3 bunkering operations\* OR-
  - 3 Cargo transfers AND 3 months seagoing service in the previous 5 years

# Onboard Training Programs

- STCW Section B-V/3 Guidance for seagoing service:
  - Experience appropriate to their duties...
  - Practical “hands on experience” related to seafarer employment
  - Under the supervision **of qualified and experienced personnel**
  - On board a ship for which the certification is required
  - Specialized equipment for safe transfer and handling is **brought into operation**
- General onboard training principles for all ship types
  - Trainee should have no other duties
  - Managed and coordinated by the ship manager
  - Identify a “shipboard training officer” and “company training officer”
  - Training record book for documentation of completed tasks and exercises
  - Program should replicate / demonstrate all aspects related to the trainees expected duties and responsibilities

# ABS Group Crew Training Experience

- **Crews / Vessel Type**

- Harvey Gulf International Marine (HGIM): 10 OSV series, U.S. Gulf of Mexico
- BC Ferries: 3 newbuild 2 conversion car/ passenger ferries, BC Canada
- Seaspan Ferries: 2 newbuild trailer ferries, BC Canada
- TOTE 2 new build 2800 TEU Container ships, U.S. Jacksonville to Puerto Rico
- Transport Desgagnes, 2 newbuild handy size asphalt / chemical tankers, QC, Canada
- Crowley, 2 ConRos, U.S. Jacksonville to Puerto Rico
- Various LNG stakeholders, including USCG, Transport Canada, Suppliers, Shipyards and Class surveyors

- **Services**

- Collaborative partnership with U.S. Maritime Resource Center (USMRC)
- LNG Technical and Operations seminars for marine operations staff– safety, risk management, operations and emergency procedures, vetting, quality assurance, system design and functional requirements
- Training material development according to IMO STCW
- Experienced instructors with actual LNG experience
- Coordination and liaison with Regulators for flag state acceptance

# Representative Course Outline: Basic Day 1

Topic	Time	Start
<b>Welcome and Introduction to the Training Program</b>	60 min	08:00
<b>Safe Operation</b>		
<b>01 LNG Physical &amp; Chemical Properties</b>	60 min	09:00
<b>02 Why LNG?</b>	15 min	10:00
<b>Coffee (15 mins)</b>		
<b>03 Gas Fueled Ships Design &amp; Operational Characteristics</b>	60 min	10:30
<b>04 Safety Management</b>	30 min	11:30
<b>Lunch (30 mins)</b>		
<b>05 Fuels and Fuel Storage Systems' Operations</b>	90 min	12:30
<b>Coffee (15 mins)</b>		
<b>Prevent Hazards</b>		
<b>06 LNG Fuel Hazards &amp; Controls</b>	90 min	2:15
<b>Day 1 Wrap up</b>	15 mins	3:45



# Course Agenda: Basic Day 2

Topic	Time	Start
<b>Welcome to Day 2</b>	30 min	08:00
<b>Health and Safety Precautions</b>		
<b>07 Gas Measuring Instruments</b>	15 min	08:30
<b>08 Safety Equipment And Protective Devices</b>	30 min	08:45
<b>09 Safe Working Practices and Personal Shipboard Safety</b>	45 min	09:15
<b>Coffee (15 mins)</b>		
<b>Firefighting and Emergencies</b>		
<b>10 Fire Fighting Operations</b>	45 min	10:15
<b>11 Emergency Response</b>	60 min	11:00
<b>Lunch (30 mins)</b>		
<b>Prevent Pollution</b>		
<b>12 Pollution Prevention</b>	15 min	12:30
<b>Day 2 Wrap up</b>		
<b>Review</b>	30 min	12:45
<b>Coffee (15 mins)</b>		
<b>Competency Assessment</b>	60 min	1:30

# Firefighting and Emergency Response Training



- TABLE A-V/3-1 Competence:
  - Carry out firefighting operations on a ship subject to the IGF Code
- Knowledge, Understanding and Proficiency:
  - Fire organization and actions to be taken on LNG fueled vessels
  - Special hazards associated with LNG fuel systems and handling
  - Firefighting agents and method to detect, control and extinguish fires involving low flash point fuels
  - Firefighting system operations
- One-day firefighting field exercise meeting STCW training requirement under “***approved and truly realistic training conditions***”

## Slide 14

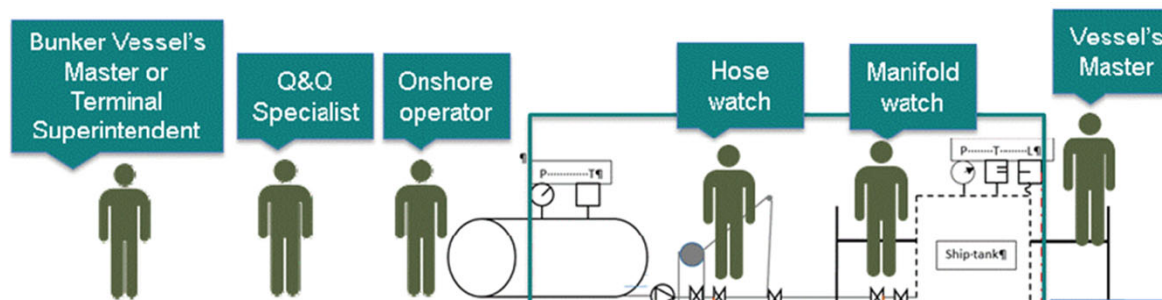
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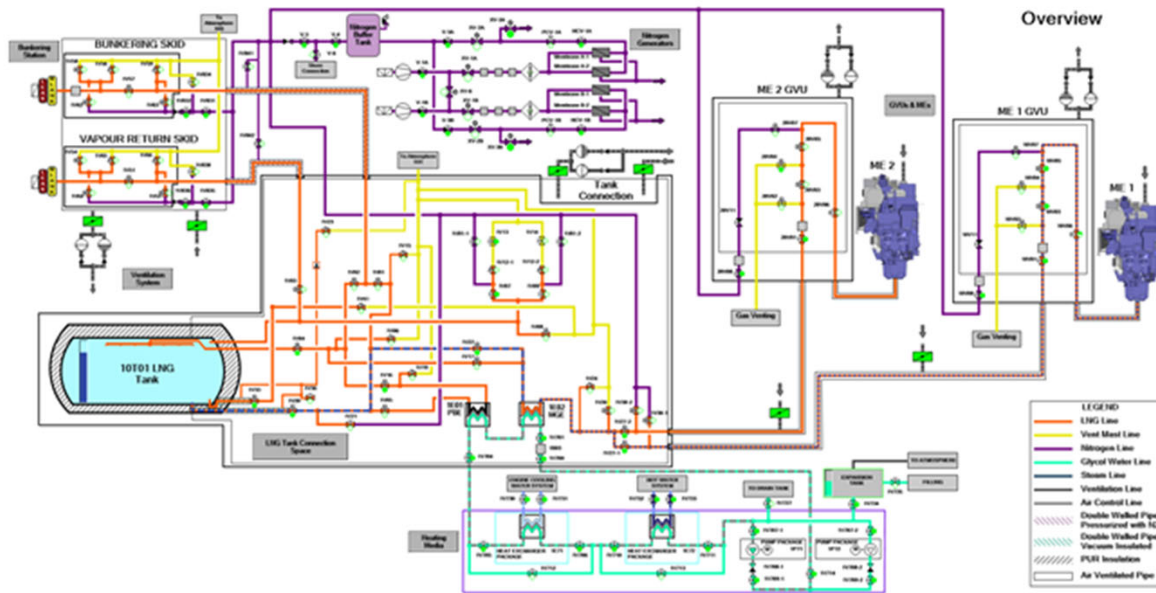
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# Tabletop Bunkering / Simulation Exercise

- Interactive classroom exercise to examine each phase of the LNG bunkering process for each available transfer mode
- Guided role-playing exercise of the LNG fueling procedure including all activities from Pre-planning, pre-bunkering, during transfer through post-bunkering
- Includes completion of bunker safety checklists and can be ship specific procedure



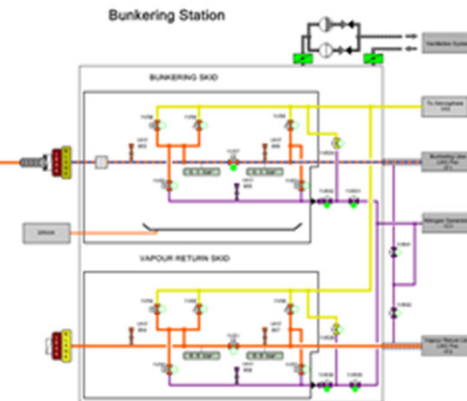
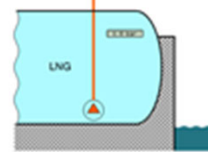
# Simulator Training



Overview

Source: Wartsila

- May substitute for 2 of the STCW required 3 bunkering



# Training Development Approach

- **Develop Material**
  - Compliant with STCW – all basic and advanced competence and KUPs addressed
  - Follow IMO model course training format (not currently developed for IGF Code)
  - Incorporate ship specific design and operational procedures
  - Incorporate LNG fire fighting and emergency response field training
- **Regulator Review**
  - Communication, coordination and liaison with flag state / RO
  - ABS guidance and explanation of compliance requirements
  - Encourage regulator attendance at training sessions
  - Acceptance or approval depending on implementation of SOLAS and STCW amendments
- **Conduct Training** - usually owner arranges schedule and venue:
  1. 2 days basic classroom instruction (for crewmembers with "designated safety duties")
  2. 1 day firefighting field training for all participants
  3. 2 days advanced classroom instruction (for crewmembers with "immediate responsibility")
  - Minimum requirements to demonstrate competence:
    - Passing grade on exam, quizzes and class exercises
    - Satisfactory completion of fire fighting field training
    - Seagoing service and 3 bunkering operations (2 simulated)
    - Issuance of certification from USMRC (flag state approved training provider)



# Conclusion, Knowledge Check, Q&A

- Where can the mandatory minimum requirements for LNG fueled ship crew training and competence be found?
  - Flag state regulations
  - IGF Code
  - STCW Table A-V/3-1 and A-V/3-2 ←
  - ABS Class Rules
- Which crew members are required to meet the requirements for Advanced Training:
  - All crew with designated safety duties on board
  - All officers
  - Masters, engineer officers and those with immediate responsibility ←
  - None of the above
- True or false? Crew members of LNG Carriers are exempt from the STCW training and competence requirements for low flashpoint fueled ships.
  - True
  - False ←
- Are Administrations required to issue endorsements for seafarers meeting the qualification and certification requirements of the STCW?
  - Yes
  - No ←



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