SYLLABUS

LNG AS A FUEL AND BUNKERING AGENDA

MODULE 1

SESSION 01 – INTRODUCTION FOR THE USE OF LNG AS FUEL

Understand where natural gas comes from & transportation

- Natural gas constituents
- Processing natural gas
- Composition and energy content relationship
- Transporting natural gas by pipe or by ship
- Main exporting and importing countries, NG reserves

Why use LNG as a fuel?

- MARPOL Annex VI why is it needed?
- Background to MARPOL Annex VI
- Overview of Annex VI
- Regulation 13 NOx
- Regulation 14 SOx
- Compliance Options

LNG Fuelled Vessels Facts & Figures

- Vessels Fuelled by LNG
- Small-scale LNG infrastructure development
- Environmental emissions comparison

SESSION 02 – LNG PROPERTIES AND GAS LAW REVISION

Composition of natural gas

- Differences in load port compositions
- Effect of different compositions
- Physical properties of the components

Relationship between pressure and temperature

- Saturated vapour pressure
- Relationship of SVP with temperature
- Boiling
- Change of boiling point with temperature

How LNG is kept cold

- Evaporation and boiling in a tank
- Dropping pressure to cool liquid

Natural gas vapour

- Vapour density
- The visible white cloud
- Difference between a vapour and a gas

Flammable range of natural gas

- Flammable mixtures in air
- Flammable range diagram

Managing tank atmospheres

- Inerting to avoid a flammable atmosphere
- Gas freeing to avoid a flammable atmosphere

Other properties of Methane

- Flash point
- Auto-ignition temperature

SESSION 03 – HAZARDS OF LNG

Health

- Asphyxiation
- TLV

Low Temperature

- Cold burns and frostbite
- Liquid and vapour effect of ship structures
- Brittle fracture

Pressure

- In tanks
- In pipelines

Flammability

- Flammable range in a vapour cloud
- Ignition of a vapour cloud
- Ignition of a cloud from a vent mast
- Burn back of ignited clouds
- Vapour cloud explosions, detonation and deflagration
- BLEVE

Sloshing in membrane tanks

- In large LNGCs
- In small fuel tanks and bunker vessels

Rollover

- Stratification of layers
- How it may occur

MODULE 2

SESSION 04 – REGULATIONS

Current regulations status

- SOLAS statement on low flashpoint fuels

Rules for bunker vessels

- The IGC code

Rules for vessels using LNG as a marine fuel

- The IGF code
- Evolution of the IGF code
- IMO interim guidelines for LNG as a fuel
- Crew training requirements
- Proposed amendments to STCW
- National regulations for inland waterways
- Additional guidance – SGMF

SESSION 05 – LNG CONTAINMENT SYSTEMS

Tank types approved by the IGC code

Independent tanks, A,B,C and Membrane tanks

Type A tanks

- Description of tank type
- Main characteristics

Type B tanks

- Description of tank type
- Main characteristics

Type C tanks

- Description of tank type
- Main characteristics

Membrane tanks

- Membranes generally
- NO96 description
- MkIII description
- MkV description

Options for bunker vessels

- Examples of small scale LNGCs with type C & membrane
- Comparison of size and weight differences

Tank location requirements

- Requirement for greater volume
- Draft IGF code requirements
- Examples of membrane and type C tank usage
- Inland barge Eiger example use of type C

SESSION 06 – BUNKER DELIVERY METHODS

Methods of bunker delivery

- Pipe, truck or barge to ship
- Container swap out

Bunker station and hose requirements

SYLLABUS

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- Draft IGF requirements
- Dry disconnect couplings
- Emergency release system
- Emergency shutdown

Management of pressure during the bunker transfer

- Factors to consider
- Pressure and temperature relationship
- Typical tank pressure settings
- Membrane to membrane transfer
- Type C to membrane transfer
- Membrane to type C transfer
- Type C to type C transfer
- Keeping cargo cold in a bunker vessel

MODULE 3

SESSION 07 – BUNKERING SAFETY CONSIDERATIONS

Organisation

- Master
- Person in charge

Communications

- Receiving vessel and bunker supplier
- Verbal & non-verbal communications

Hazardous areas

- Definition of the hazardous area
- Electrical equipment in hazardous areas

Safety and security zones

- Definition of safety and security zone

Cryogenic protection

Controlling sources of ignition

- Potential sources of ignition
- Static electricity
- Galvanic currents

PPE

- Protective clothing
- Resuscitators and BA

SESSION 08 – THE BUNKERING OPERATION – PROCESS

Before bunkering

- Compatibility
- Safety
- Checklists
- Weather
- Lighting
- Authorisations/Notifications
- Maximum filling level

Hose connection

- Connection
- Purging
- Leak testing

During bunkering

- Supervision
- Starting
- Bulk transfer
- Topping off
- Filling limits
- Vapour management

After bunkering

- Post-transfer checklist
- Draining and purging of hoses
- Disconnection of hoses

SESSION 09 – TYPES OF GAS-FUELLED ENGINES

Propulsion systems using gas-fuelled engines

- Electrical and mechanical systems
- Fuel gas delivery pressures

Basic principles of gas fuelled engines

- Pure gas engines
- 4-stroke dual fuel engines
- 2-stroke dual fuel engine HP and LP gas injection

Knocking and methane number

- Cause of knocking
- Problems caused by knocking
- Methane number and relationship to knocking

SYLLABUS

LNG AS A FUEL AND BUNKERING AGENDA

MODULE 4

SESSION 10 – MANAGEMENT OF LNG FUEL TANKS

Gas fuel management and delivery systems

- Requirements of stored fuel systems
- Main components in delivery system
- Example of Wartsila LNGPac for LP delivery
- Example of HP gas delivery system

High fuel demand

- Delivery of BOG gas to engines
- Generation of additional gas

Low fuel demand

- Delivery of BOG gas to engines
- Dealing with excess BOG

Bringing a tank into service

- Inerting
- Gassing up
- Cooling down

Taking a tank out of service

- Removal of liquid
- Warming up
- Inerting
- Aerating

SESSION 11 – QUANTITY AND QUALITY MEASUREMENT

Understand the requirement to measure quantity and quality

- Recognise that LNG traded on energy content which varies with evaporation
- Discuss the variability of LNG composition around the world
- Understand the need to pay for what is received and the taxes due
- State the requirement to know the methane number for engine performance

Quantity measurement

- List the measurement options
- Describe a Coriolis Mass Flowmeter
- Describe an Ultrasonic Flowmeter
- Describe the way in which density is determined

Quality measurement

- Recognise the issues associated with taking a sample of LNG liquid
- Describe the way in which samples may be taken
- Discuss the use of gas chromatography in determining composition of samples

Legal metrology

- Explain the meaning of legal metrology
- State the difference between OIML and MID
- Have an understanding of the requirements under MID

SESSION 12 – EMERGENCY RESPONSE

Leaks

- Detection
- Response
- Protection from low temperatures
- Use of water spray to deflect gas clouds

Venting

- Location of vent mast
- Vapour cloud dispersion
- Lightning strike

Fighting Gas Fires

- Fire-fighting equipment
- Techniques for fighting gas fires
- Use of dry powder