BRITANNIA LOSS PREVENTION

B!NSIGHT

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ALTERNATIVE FUELS - LNG

THE MARITIME INDUSTRY ENCOUNTERS UNPRECEDENTED CHALLENGES AS IT STRIVES FOR DECARBONISATION AND THE ATTAINMENT OF NET-ZERO EMISSIONS.

Decarbonising shipping is not only an environmental imperative but also an emerging area of innovation, reflecting the industry's shift towards alternative fuels.

WAVES GROUP

OUR PARTNER FOR THIS ISSUE

Waves Group is a leading, independent maritime and offshore consultancy with a global presence. We provide essential advice, analysis, and data to support clients in the shipping and offshore energy sectors, enhancing operational confidence and certainty in outcomes.

Our 24/7 worldwide response team assists clients in both planned projects and unforeseen circumstances. With a solid track record built on years of operational experience, we offer practical advice backed by detailed technical analysis and data, reducing uncertainty and solving problems effectively.

Our team of experts, including Master Mariners, Marine Engineers, Naval Architects, and Maritime Civil Engineers, offers specialised expertise in areas such as fires, marine salvage, offshore energy, cranes, alternative fuels and maritime data acquisition and analysis. From project inception to completion and beyond, we support clients in marine casualties, disputes, port operations, offshore energy infrastructure construction and decommissioning.

With offices located in London, Southampton, Singapore, Houston, and Rotterdam, we ensure swift and efficient support for projects worldwide.

LIQUEFIED NATURAL GAS (LNG) IS CURRENTLY TAKING THE LEAD AS A TRANSITIONAL FUEL; HOWEVER, SEVERAL POTENTIAL ZERO-EMISSION FUELS SUCH AS METHANOL AND HYDROGEN ARE ALSO ON THE RISE. IT IS UNCERTAIN WHICH FUEL WILL BE THE PREFERRED CHOICE OF THE FUTURE, AND IT IS LIKELY THAT A VARIETY OF ALTERNATIVE FUELS WILL BE REQUIRED TO MEET FUTURE DEMAND.

As part of their decision making, shipowners need to perform due diligence which includes a thorough risk identification and assessment when choosing an alternative fuel. As part of this assessment, several stakeholders will need to be consulted, for example the engine maker, fuel supplier, classification society, hull & machinery insurers and the ship's flag state.

CONSIDERATIONS THAT SHOULD BE TAKEN INTO ACCOUNT INCLUDE:

1. SUITABILITY AND IMPACT ON THE ON BOARD ENGINES

The engine maker should be consulted to determine whether the on board engines are suitable for consuming the selected alternative fuel or whether the engine will require any retrofitting.

2. FUEL MANAGEMENT

Handling alternative fuel on board is likely to present different operational hazards compared to other fuels. Therefore, it is essential to train the crew properly in handling these new fuels.

3. HEALTH, SAFETY AND ENVIRONMENT (HSE)

While the alternative fuels may have their obvious environmental benefits, they may come with some increased safety risks. Therefore, any alternative fuel should be accompanied by a thorough assessment of its HSE risks, and this should form the basis of the on board safety measures for handling the fuel.

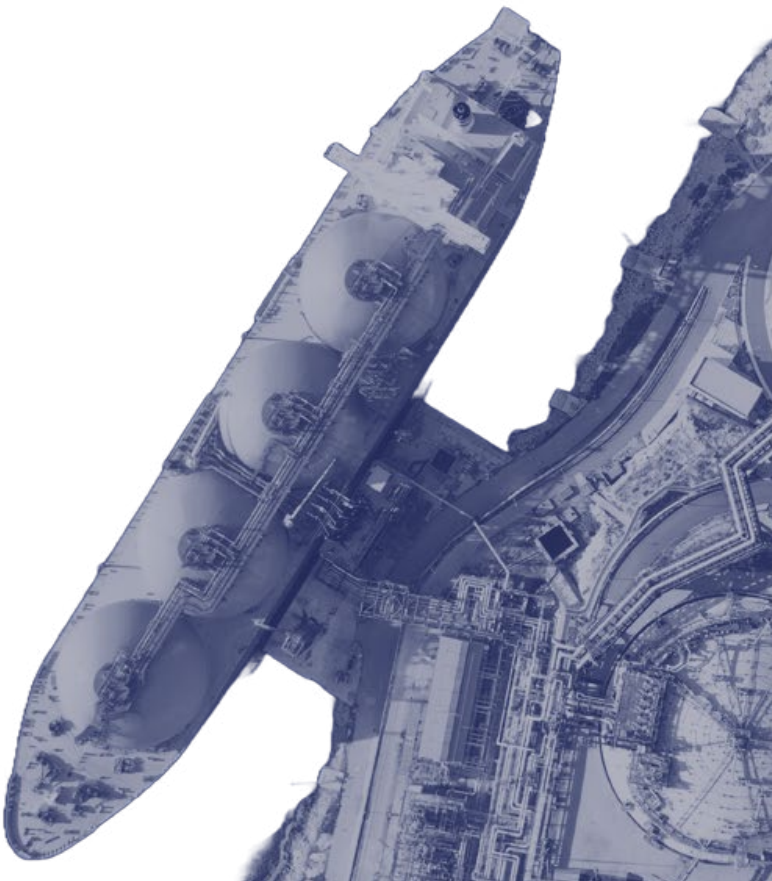
4. QUALITY

With the current lack of international standardisation, a clear and detailed bunker specification needs to be developed by the shipowner to ensure suitable fuel is delivered.

Britannia's loss prevention department has collaborated with Waves Group to provide practical advice on the widely discussed alternative fuels: Biofuels, Liquefied Natural Gas, Methanol, Ammonia, and Hydrogen. The examination for each of these alternative fuel types will focus on good practices in storage, handling, bunkering, safety and emergency response.

In this guidance, we will focus on **Liquefied Natural Gas (LNG)**. LNG has for many years been carried as cargo and used as fuel on board LNG carriers, however in this article we focus on ships using LNG as a fuel only. Due to its environmental benefits, increased availability and proven technology as a reliable ship fuel, it has also become a very popular alternative to conventional fossil fuel on various ship types. As LNG is a fossil fuel it may not meet future requirements and expectations for emission free fuels. Therefore, LNG is often regarded as merely an interim solution until other emission free alternative fuels are available on a wider scale.

Regarding legal framework, LNG as a fuel will fall under the guidance of the International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF) code, specifically addressing bunkering, storage, and on board handling.



STORAGE

FOR LNG AS A FUEL THERE ARE PRINCIPALLY TWO DIFFERENT STORAGE TANK TYPES IN USE: **TYPE 'C' PRESSURISED TANKS** THAT ALLOW THE LNG TO BE STORED UNDER PRESSURE, USUALLY FITTED ON DECK, AND TAKING UP CONSIDERABLE SPACE. OR **MEMBRANE TANKS**, THAT WILL GENERALLY BE CONTAINED WITHIN THE SHIP'S HULL. MEMBRANE TANKS RELY SOLELY ON INSULATION TO KEEP THE LNG BELOW BOILING POINT.

Due to the difficulty of storing LNG in a tank at cryogenic conditions there will ultimately be some form of inleak of heat causing the LNG to boil. This heat inleak could be from movement of the ship agitating the cargo or transfer of heat from the tanks environment, the result of which is for the liquid fuel to evolve to a vapour and cause a build up a pressure within the tank. If the tank pressure is not maintained correctly it can result in an unintended release of the fuel through the pressure relief valves. Not only is this wasteful of the fuel and damaging to the environment but there is a risk that the relief valve may not reseal once the excess pressure has vented, potentially allowing the entire tank to vent. To avoid this situation arising a prudent operator will:

1. Look to prevent heat inleak to the tank by ensuring that the insulation of the tank and cryogenic pipework is well maintained, using heat cameras to identify cold spots and repairing any damaged insulation when the tank/pipework is in a warm condition.

2. Monitor the tank pressures, the higher the tank pressure the warmer the LNG will become, by consuming LNG regularly the pressure will remain lower, and the temperature can be maintained. However, this can cause issues on dual fuel vessels with the charterers, should the charterer be looking to optimise the fuel prices at times when liquid fuel is cheaper than LNG. By burning the less expensive liquid fuel and not consuming any LNG it will result in an increase of pressure (and temperature) in the LNG tank. If the charterer requests to burn the liquid fuel they should be made aware of the vessels need to consume LNG to maintain tank temperatures and pressures.

BUNKERING

THE INHERENT PROPERTIES OF LNG AND ITS CRYOGENIC NATURE DIFFERS SIGNIFICANTLY FROM CONVENTIONAL FUELS AND THE TRANSFER OF LNG DURING BUNKERING PRESENTS SAFETY HAZARDS AND CREATES RISKS WHICH NEED TO BE MITIGATED.

To manage these new risks and hazards there will be a need for careful planning and compatibility studies. Specific LNG procedures will need to be developed for each bunkering supply scenario whether ship to ship, shore to ship or truck to ship, and to further ensure a smooth operation, a compatibility assessment will be required. The use of these robust studies and procedures will ensure that in the event of a potential leak or a breakout situation that the bunker transfer system is returned to a safe condition and that the flow of LNG is halted. To achieve this, it will be necessary that:

1. The Vessels Bunker Scenario has been identified during vessel design phase and as such the limitations on how much and how quickly it can load its bunkers is identified and that the transfer system is correct for this operation.
2. The maximum flow rate of bunkers that the vessel can receive is limited to 12 m/s.
3. Consideration is given to pressure surge in the event of an emergency shut down (ESD) operating.
4. Leak Detection provides adequate coverage and rapid identification of leakage.
5. Bunker transfer equipment is rated to a Safety integrity level (SIL) to guarantee that the equipment will not 'fail on demand'.
6. Safety procedures and training on board the vessel ensures that hazardous zones are identified and that no ignition risk is presented within the bunkering area.
7. Use of water spray curtains in the vicinity ensures any minimal spillage of LNG is vaporised and that any tank structure is 'insulated' from the cryogenic fluid.
8. Moorings are continuously monitored and tended as required when completing ship to ship bunkering, to reduce the risk of a breakout. This would usually form a part of the compatibility assessment, but care and attention will be required by the operators to ensure a break situation and potential ESD is avoided.

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9. Testing of ESD systems prior to operation is carried out.
10. A decision is made on whether simultaneous operations (SIMOPS) will be allowed during the bunkering operation.

HANDLING

Due to the low temperature of LNG and its behaviour under atmospheric conditions it needs to be kept in its containment system and leakages should be prevented and monitored using gas detection systems linked to the ESD system. If the containment system or any LNG pipework needs to be broken for bunkering, maintenance, or repairs then it is imperative that the system is purged with an inert gas that will not liquify or freeze when it placed under cryogenic conditions. Therefore, Nitrogen is the preferred gas for this. Similarly, it is necessary that when a system has been opened for maintenance, then it will require drying, purging and inerting prior to admitting LNG into it.

SAFETY

Due to the cryogenic nature of LNG, it will start to vaporise on contact with air, ground or water. As a result, if it leaks, it will have fewer long-term environmental impacts. It will however form a gas cloud which will disperse as it warms up, this gas cloud may initially be cold gas depending on the vaporisation rate. As the cold gas will be denser than air, the effect will be for the cold gas to stay close to deck level increasing the likelihood of injuries to personnel or of reaching an ignition source.
As LNG is cryogenic, it can cause cold burns to personnel. All personnel working with LNG must be briefed on this danger, and companies are suggested to prepare first aid procedures should personnel be exposed to LNG.

EMERGENCY RESPONSE

Although there are many barriers in place to prevent accidents and incidents, an emergency can occur at any time and in any situation. Should an emergency occur, effective action is only possible if preplanned and practical procedures are in place and the personnel involved are well versed in the procedures through training and regular practice.

When applying emergency response, the following objectives of the plan should cover

- **RESCUE AND TREATMENT OF CASUALTIES**
- **SAFEGUARDING OTHERS**
- **MINIMISING DAMAGE TO PROPERTY AND THE ENVIRONMENT**
- **BRINGING THE INCIDENT UNDER CONTROL**

For the specific use of LNG, the procedures and the training will have to prepare for differing scenarios including:

- **COLLISIONS AND IMPACTS FROM PASSING VESSELS (ALLISIONS)**
- **LNG RELEASE**
- **VENTING**
- **FIRES**
- **LEAKAGE DURING TRANSFER**

The main firefighting mediums used for tackling LNG fires are water, dry chemical powders, foam and inert gas systems. Extinguishing a gas fire, can create additional hazards if the gas leak is not also stopped. Stopping the source of leakage is important to prevent further build-up of gas with the potential to create an explosive atmosphere.

WATER

Being abundantly available, water is an excellent cooling agent for surfaces exposed to radiation or direct fire impingement. Also, it may be used in spray form as a radiation screen to protect fire-fighters. It should never be applied to a burning liquefied gas pool as this will give cause for a more rapid vaporisation of the liquid and increase the rate of burning. Water is best suited to:

- **Extinguish a jet of burning gas but this is not always desirable**
- **Disperse vapour clouds using water monitors prior to an ignition**
- **Protect decks from cryogenic leaks using water prior to ignition**
- **Protect steel-work and pipelines adjacent to the seat of the fire post ignition, using water monitors**
- **Assist with the extinguishing of secondary fires. (This would need to be well co-ordinated as high through-put water monitors could endanger the ship's crew if miss-directed).**

DRY CHEMICAL POWDERS

Dry chemicals attack the flame by the absorption of free radicals in the combustion process but have a negligible cooling effect meaning that the gas could reignite on contact with adjacent hot surfaces. This risk should be guarded against by cooling any hot areas with water before extinguishing the flame with dry powder. Dry powder should never be used in combination with sprayed water.

Dry powder is best suited when:

EXTINGUISHING JET FIRES

EXTINGUISHING FIRES AT VENT MASTS

EXTINGUISHING FIRES ON DECK

FOAM

The use of high expansion foam can suppress radiation and reduce the vaporisation rate when being applied to pool fires (fires where LNG has pooled). However, it requires a depth of a least one or two metres to be effective and for this reason would only be suitable in a contained or bunded area. Used best when:

- **Applied up to two metres on a bunded LNG pool fire**
- **Applied on an LNG Pool to increase vaporisation rate disperse vapour cloud.**

INERT GAS SYSTEMS

The use of nitrogen or CO2 on board a vessel is useful for fighting fires in enclosed spaces, by dispersing oxygen to a level where a fire cannot be supported. It is best used when applied to:

- **Enclosed spaces, provided there is a high enough flow rate of the inert gas to rapidly inert the space**
- **Fires on vent masts and risers**

When releasing into an enclosed space boundary, cooling is required as a measure to be taken to ensure that on re introduction of oxygen to that space the fire does not reignite.

For further considerations on risks associated with alternative fuels please see our guidance on decarbonisation.

FURTHER INFORMATION

For further information, please do not hesitate to contact the loss prevention department.