GUIDE FOR PLANNING GAS TRIALS FOR LNG VESSELS

CONTENTS

- INTRODUCTION
- PURPOSE OF GAS TRIALS
- DELIVERY CONDITION OF THE VESSEL
- ONBOARD TESTING OF CARGO HANDLING EQUIPMENT
- COLD TESTING WITH LN_2
- PRE-GAS TRIALS PREPARATION
- GAS TRIALS
- GLOSSARY

SIGTTO
London Liaison Office, 17 St Helen's Place, London, EC3A 6DG
Tel: +44 (0) 207 628 1124 E-mail: secretariat@sigtto.org Fax: +44 (0) 207 628 3163

For details of SIGTTO publications:
Seamanship
Web: www.witherbyseamanship.com

GUIDE FOR PLANNING GAS TRIALS FOR LNG VESSELS

Introduction

The term 'Gas Trials' is used to encompass those tests that are undertaken during a period when a quantity of LNG is taken onboard for testing shipboard facilities at, or near to, the design temperature. Gas Trials are usually carried out prior to the vessel entering service in order to confirm the correct function, integrity and capacity of the complete cargo system, including containment, insulation, cargo handling equipment, pipelines and valves and the equipment to handle boil-off gas (BOG).

This document is intended to provide members of SIGTTO some guidance on the requirements for testing the systems for handling the LNG cargo, and its consequential BOG, using LNG loaded onto a vessel specifically for that purpose. The scope is considered applicable for established membrane, spherical tank and SPB designs. However, it does not extend to novel or prototype designs, which may require specific additional testing. This document is not intended to be used as an operational procedure, but merely as an aide to preparing a specification for gas trials.

The guidance aims to cover those items tested prior to the handover of a vessel and also the testing carried out post delivery, when a first full cargo has been loaded.

Any figures provided in the text are only indicative and reference should be made to the shipbuilder and manufacturer's information for figures applicable to a specific vessel.

The underlying assumption in this document is that the Gas Trials are conducted by the shipbuilder prior to delivery of the vessel. This is the common practice for LNG ships, but by no means exclusive (Note, the normal practice in the LPG industry appears to be for the trials to be conducted at the first load port after delivery).

'Gas Trials Guide for LNG Vessels', SNAME 1977 is an informative reference often cited in LNG Shipbuilding Contracts.

Purpose of Gas Trials

Gas Trials are performed primarily for confirmation of the correct operation of the LNG and gas handling systems, which cannot otherwise be factory tested, and for verification of the correct operation of the equipment and systems that will be used for containment and custody transfer measurement of the LNG cargo.

Function testing should usually include the gas management system, the monitoring control and alarm systems for the LNG tanks and liquid pumps, valve operation, the gas compressors, heat exchangers, gas combustion units (GCU) and reliquefaction plant, if provided. Where applicable, dual or tri fuel engines should usually also be included in the test programme in their respective gas burning modes.

BOG generated during gas trials may be used either as fuel burnt in boilers or multi-fuel engines, sent to the GCU, or reliquefied and returned to the cargo tanks, as applicable. The vapour may also be returned ashore while the vessel is alongside the LNG terminal if this facility is available.

Disposal of excess BOG may be dealt with through steam dumping or thermal oxidising in a GCU. Venting of natural gas to atmosphere, other than to test the vent system operation, should not be included as part of Gas Trials procedure and it is suggested that it should only take place if unavoidable through equipment failure or emergency condition.

SIGTTO
London Liaison Office, 17 St Helen's Place, London, EC3A 6DG
Tel: +44 (0) 207 628 1124 E-mail: secretariat@sigtto.org Fax: +44 (0) 207 628 3163

Correct function of the entire system should be confirmed as being in compliance with the requirements of the Classification Society, the Flag Administration, the particular ship-building specification for the vessel and any other criteria that may apply.

It is usual that the performance testing of cargo pumps and compressors is carried out at the manufacturer's facility prior to delivery to the shipyard, to ensure that the equipment meets the specification requirements and to facilitate accuracy of the recording of calibrated measurements. The operational testing of this equipment at full capacity during Gas Trials is therefore not usually intended to prove that the performance meets the contractual requirements.

Similarly the calibration and testing of cargo temperature, level sensor and pressure measuring devices used for custody transfer purposes, is usually carried out at the equipment manufacturer's facility in the presence of a third party surveyor, prior to their installation on the vessel.

Delivery Condition of the Vessel

A major consideration in the planning of the Gas Trials may be the condition in which the vessel is to be delivered to the owner after completion of Gas Trials.

If contractual arrangements require the vessel to be delivered in a gas-free condition then any liquid remaining onboard on completion of Gas Trials will need to be discharged ashore, necessitating a second visit to the selected LNG terminal. Thereafter, cargo tank warm-up, inerting and aeration will have to be undertaken.

If contractual and commercial arrangements allow for delivery of the vessel with the cargo tanks in 'gassed up' condition and/or with residual LNG remaining on board, then a second visit to the terminal for discharge of residual liquid may not be required. However the 'gassed-up' condition will usually preclude the return of the vessel to the shipyard for any remaining works to be undertaken and certain post trial options, such as the internal inspection of the cargo tanks, will not be possible.

Should an owner require the cargo tanks to be subjected to a complete thermal cycle, for example cooling the tanks until the secondary membrane is reduced to -100°C in all regions, this will usually result in an extended period alongside the LNG terminal and a significant increase in the quantity of LNG required for the Gas Trials. It is recommended that, in these cases, the requirements are discussed with the shipyard at an early stage and details included in the contractual arrangements for vessel delivery.

Prior to Gas Trials

Before Gas Trials can be carried out, it is to be expected that the shipyard's confirmation that the cargo containment and cargo handling systems are completed is required.

To include:

- Completion of the cargo containment system
- onboard testing of cargo equipment
- cold testing (with LN_2)

Completion of the Cargo Containment System

Irrespective of the type of containment system selected, the inspection and testing of the cargo tank components will usually be undertaken in fabrication shops and onboard the vessel throughout its construction.

Cargo tanks, on completion of construction, will usually have been strength and leak tested, at ambient temperature, in accordance with Classification Society and Flag Administration requ irements.

Tightness tests are usually carried out on membrane tanks after the repair of any leakage found during the

appropriate ambient temperature testing programme for the particular tank design. A tightness test of the secondary barrier of the membrane tank systems is usually carried out after completion of the construction of the containment system. A pressure differential between the primary and secondary insulation spaces is usually established by use of vacuum pumps to create a vacuum in the secondary space. The variation of pressure difference against time is recorded and a 'vacuum decay curve' plotted to summarise the results. The data obtained during this test provides a reference for comparison with periodic testing at intervals during the service life of the vessel.

Internal cleaning and final inspection of cargo tanks, to ensure removal of all equipment and debris, is then carried out; after which the tank lids are immediately secured to prevent unauthorised entry and possible contamination.

As far as practical, it is suggested that an internal inspection of the cargo lines is carried out to ensure that there is no debris left inside.

For those systems with glued secondary barriers, ie GTT Mark III and CS-1, there is presently an additional requirement under IMO Resolution A.997(25) to conduct further secondary barrier tightness tests after the initial cool down in accordance with the approved procedures of the system manufacturer.

Onboard Testing of Cargo Handling Equipment

Prior to testing any items of equipment it is suggested that all relevant alarms and safety devices should be confirmed as operational.

It is also recommended that, as a minimum, the following items are included in the onboard testing programme:

- Confirmation of cargo pump and spray pump installation, including checks to ensure correct pump rotation on start up. Where an emergency pump is provided, the checks made should include confirmation of column foot valve operation when the pump is deployed. A dummy pump may be used for this purpose.
- Commissioning and installation checks of the vapour compressors, including confirmation of correct rotation and a functional test on the surge control systems with the unit running on air.
- Cargo valve operation, including timing of emergency shut down valves and emergency shut down systems. Checks should include all means of Emergency Shut Down (ESD) activation.
- Demonstration of the fitting of all the cargo pipeline portable bends and spools pieces, without requiring undue force.
- Cargo tank relief valves, insulation space relief valves, hold space relief valves and pipeline relief valves should have been tested and pressure settings confirmed in the manufacturers' facilities prior to installation on a vessel. It is recommended that cargo tank relief valves, that were tested and sealed at the manufacturers' factory, are checked after installation on a vessel to confirm their correct opening/closing pressures and operation[1].

Cold Testing (with LN_2)

Prior to any cold testing taking place the dew point in cargo piping system, cargo tanks and insulation spaces should be reduced to a level below that at

[1] 'An Introduction to the Design and Maintenance of Cargo System Pressure Relief Valves on Board Gas Carriers' SIGTTO 1998

which condensation is likely to occur. To achieve this, where provided, both a vessel's N_2 plants and inert gas/dry air plants are required to be operational.

An N_2 purge of cargo tank insulation spaces is carried out to reduce both the O_2 content and dew point in those spaces. The duration and details of this operation are dependent on the type of cargo containment system, but typically the O_2 content in the N_2 purged spaces will be reduced to 3% by volume and the dew point will be reduced to at least minus 40°C.

Dry air, produced by the inert gas plant, is used to blow through the cargo piping system and to purge the cargo tanks of humid air, reducing the dew point to minus 20°C or below. Where applicable, hold spaces are also purged with dry air.

Prior to liquid N_2 being taken onboard a vessel, the LNG spray line, from the liquid manifold to the cargo machinery room is further dried and purged by the use of N_2 generated onboard.

Should cool down of cargo tank(s) be required during the cold testing, then N_2 taken onboard may be vaporised in the ship's LNG vaporiser and used to inert selected cargo tank(s). Cooling of the selected tank(s) may be carried out using N_2 supplied from shore, received on the vessel at the liquid manifold, and directed to the selected cargo tank via the spray header. Liquid cargo, vapour and spray lines are cooled down by introduction of cold N_2 gas to achieve the target temperature, typically minus 100°C, and thereafter they are pressurised to confirm their integrity. Freedom of movement of the pipelines in the way of the sliding supports should be confirmed and pipeline deflections measured to check that the design criteria are met.

Where applicable the correct operation of cofferdam heating systems should be confirmed.

If cargo tank(s) have been previously cooled down these tanks are usually warmed by recirculation using the high duty compressor and the gas heater.

Throughout these operations displaced humid air, dry air or N_2 gas is usually vented to atmosphere from the forward-most vent mast.

Pre-Gas Trials Preparation

It is suggested that Gas Trials are not commenced until all functional testing of gas and associated equipment has been satisfactorily completed both at ambient temperature and at LN_2 or LNG temperature. The gas equipment system should have been tested and be fully operational prior to the start of gas trials.

All fire-fighting and safety equipment, as required by applicable regulatory authority rules, must be onboard, appropriately located, proven by testing to work correctly and ready for use. Due attention should be paid to both the number of persons on the vessel during trials over and above the normal complement, and also to any statutory requirement for safety drills.

The cargo system instrumentation and controls should be confirmed as being fully operational and ready for use.

Drip pans and trays should be appropriately positioned.

Gas Trials

The following activities are intended to cover the main stages of the Gas Trials

Prior to Arrival at LNG Terminal

Insulation Space N_2 filling (for membrane ships). Prior to putting the cargo tanks into service it is necessary to replace ambient air in the barrier

spaces with dry N_2. This operation can often be carried out concurrently with cargo tank drying and inerting.

Equator Ring N_2 Purge (for spherical tank vessels)

Prior to putting the cargo tanks into service, the equator ring purging system must be commissioned.

Cargo Tank Drying

Cargo tanks and pipelines are purged with dry air produced by the inert gas generator and the dew point reduced in these spaces to lower than minus 20°C.

Cargo Tank Inerting

Before the introduction of cargo vapour into the system, the cargo tanks and pipelines are inerted to further reduce the dew point and reducing the O_2 content to a level that is insufficient to support combustion. A typical target O_2 content is a level that is below 2% by volume.

In order to mimic normal operation, the tank inerting is carried out using shipboard equipment. However, dependent upon the requirements of the selected LNG terminal, it may be necessary to use N_2 gas for the inerting of cargo tanks that are to be 'gassed up' alongside.

Arrival at LNG Terminal

Testing of Emergency Shut Down Systems

The extent of testing that can be carried out during Gas Trials will usually depend upon the system installed at the LNG terminal. Where primary and back up ship/shore communication systems are installed at the terminal, then testing of the corresponding vessel's systems is recommended. Once the vessel is securely moored at the LNG berth, details of the pending gas trials are discussed at the pre-loading meeting.

The ship–shore link functions should be tested. These will include the voice communication channels and the data transfer channels, including mooring tension monitoring, in addition to the ESD alarm and function channels.

Cargo Tank 'Gassing-Up'

LNG is usually supplied by the terminal to the shipboard LNG vaporiser through the spray line and the generated vapour is directed to the cargo tanks. The inert gas displaced from the cargo tanks may be directed ashore, according to the terminal's requirements. Typically the target for gassing up is a 98% hydrocarbon content in each applicable tank. Gassing-up may only be carried out in those tanks that are scheduled for cooling and loading while the vessel is at the LNG terminal.

Cargo Tank Cool-Down

LNG supplied to the spray header is directed to the spray nozzles of the cargo tanks to be cooled. BOG, generated from tank cooling, is usually discharged to the terminal through the vapour header via the vessel's gas compressors. Tanks are cooled to reduce the temperature of the tank wall and its internal structure at a controlled rate to ensure that the volume of BOG is kept within the required limits. For IMO Type 'B' tanks (spherical tanks and IHI-SPB), control of the cooling rate is critical in order to minimise thermal stresses in the tank structure. Tank temperatures are monitored to ensure cooling is carried out in accordance with the design requirements.

LNG Loading

When the cargo tanks have attained the required temperature, the amount of LNG required for the entire Gas Trials process can be loaded into the cooled tanks. Displaced BOG is discharged to the terminal through the vapour header and manifold, via the vessel's gas compressors, as necessary.

Depart LNG Terminal, at Sea

Once LNG loading is complete and the post loading custody transfer formalities have been completed the vessel can usually depart from the terminal. After the vessel has departed the LNG terminal the BOG from the loaded cargo tanks is either used as fuel gas, handled by the reliquefaction plant (if installed on the vessel) or thermally oxidised in a gas combustion unit (GCU), depending upon the readiness of equipment to handle the BOG.

Cargo Tank Gassing-Up

Using the spray pump in one of the tanks containing LNG, liquid is supplied to the LNG vaporiser. The gas generated by the vaporiser is directed to those remaining cargo tanks that were not gassed up, cooled or loaded at the LNG terminal. Displaced inert gas from these remaining tanks is usually vented through the forward-most vent mast until a hydrocarbon content is detected in the inert gas stream.

Cargo Tank Cool-Down

The remaining tanks are now cooled by spraying LNG into them. The BOG generated is either used as fuel gas, reliquefied or disposed of in the GCU. *Only in case of an equipment failure that prevents handling of the gas or, in an emergency, should venting through the forward-most vent mast be performed.* Tank temperatures should be monitored to ensure the cool-down is carried out in accordance with design requirements. In the final stages of the tank cooling, the liquid lines should be cooled in preparation for the following cargo pump testing sequence.

Cargo Pump Testing (Including main cargo pumps, spray and fuel gas and emergency cargo pumps where provided).

It is recommended that each pump in every tank is tested sequentially, the LNG necessary for these tests being transferred from tank to tank. Where an emergency cargo pump is provided, the gas trials testing programme should incorporate a test of this pump. Where emergency tank to tank transfer is designed to be performed by pressurising of the cargo tank, this cargo transfer is not normally performed during the gas trials, except in the case of testing a prototype tank.

If it is a requirement of the shipbuilding specification that any cargo pump can be run using the vessel's emergency generator as the electric source, it is recommended that this capability be demonstrated during the Gas Trials.

Boil-Off Gas Management System

Testing of dual fuel burning or reliquefaction plant operation and GCU operation is recommended, if applicable. The testing should be for a duration sufficient to demonstrate successful control of cargo tank pressures over a range of operations.

The interfaces between the cargo machinery plant and the BOG management system should be demonstrated as compliant with the shipbuilding specification.

Dual Fuel Burning

It is recommended that dual fuel burning tests should ordinarily include the following as applicable:

- Gas burning either in boilers with the steam dump, or in main engines or in a GCU, to handle excess boil-off.
- Gas burning in the main propulsion system, including the operation of the plant at the equivalent of 100% gas burning at MCR, with the fuel gas requirements being met by forced vaporisation. Should the gas management system be designed to allow for solely gas burning at all ranges of load requirements, this should also be tested.

SIGTTO
London Liaison Office, 17 St Helen's Place, London, EC3A 6DG
Tel: +44 (0) 207 628 1124 E-mail: secretariat@sigtto.org Fax: +44 (0) 207 628 3163

- Gas burning operation tests can include:
  - N_2 purge sequence confirmation
  - Burner fuel mode changeover sequence
  - Burner fuel increase/decrease sequence
  - Maximum turn down ratio (where defined)
  - Fuel oil back up sequence confirmation
  - Dual fuel change over sequence confirmation

Reliquefaction Plant

Where a reliquefaction plant is installed on the vessel, sufficient LNG should be loaded to test the entire system in normal operation, the gas usually being generated by spraying LNG into the cargo tanks.

When duplicated equipment, such as BOG compressors, N_2 companders, N_2 booster compressors and LNG transfer pumps are provided, the trials should be programmed to ensure both sets of equipment are tested.

It is recommended that the following should usually also be tested:

- Operation of the plant in the stand-by mode
- Operation of the plant in the free flow or idle mode
- Operation of the vent gas heater (if installed)
- Validation of warm start and cold start sequences
- Operation of the GCU for a period of sufficient duration at a suitable throughput capacity to demonstrate successful operation of the tank pressure control system with or without reliquefaction equipment operating.

Blackout Test

The purpose of such a test is to demonstrate the capability of the system to be restarted safely; considering BOG treatment recovery by burning and/or reliquefying.

Unmanned Engine Room Operation

It is recommended that an Unmanned Engine Room (UMS) operation test, at full sea speed under normal operating condition (ie burning boil-off gas) be performed if possible for a period of at least 4 hours to satisfy the requirements for UMS or ACCU notation.

Crew Familiarisation

It is considered essential that a period be allocated, under the supervision of the shipbuilder, sufficient to allow the vessel's crew to become fully familiarised with the safe operation of all cargo handling equipment and systems.

Cold Spot Inspection of Cargo Lines and Tank Boundaries.

During tank-to-tank liquid transfer a cold spot inspection of the cargo line insulation is recommended; while the cargo tanks are in the cold condition, a hold space inspection of independent type cargo tank insulation surfaces should be performed. (Note: A full cold spot inspection of independent and membrane tank boundaries should be carried out after the first loading, when the cargo tanks are fully loaded)

Return to LNG Terminal

(This and the following item may be considered optional depending upon the contractual arrangements for the condition of the vessel at delivery to owners)

Unloading remaining LNG

Following return to the LNG terminal and berthing and testing of the ESD systems, the remaining pumpable LNG should be discharged ashore to the terminal. It is recommended

that, if possible, and subject to the terminal's acceptance, the automatic unloading sequence be tested.

Depart LNG Terminal and at Sea

Cargo Tank Warm-Up

The remaining un-pumpable LNG is usually disposed of by vaporisation, ensured by the recirculation of heated vapour using the high duty compressor and the warm-up heater(s). Excess vapour is usually either used as fuel or handled by the GCU. Following the removal of any un-pumpable liquid the cargo tank warm-up process can be continued until the tank temperatures reach the required level (typically around minus 20°C on the equator profile of spherical tanks and +5°C on the secondary barrier of membrane tanks). Tank temperatures should be monitored to ensure warm-up is carried out in accordance with the design requirements.

Cargo Tank Inerting

After the tanks have been warmed to near ambient temperatures the LNG vapour should be displaced by the introduction of inert gas into the cargo tanks and pipelines. Inerting should usually then be continued until the hydrocarbon content is reduced to below 2% by volume. The displaced cargo vapour is usually either used as fuel or disposed of in a gas combustion unit for as long as safely combustible. Thereafter, the displaced mixture can be vented through the forward-most vent mast.

Cargo Tank Aeration

Dry air, produced by the inert gas plant, is introduced into the top of the cargo tanks. Displaced inert gas is discharged from the tank bottom, through the filling line and liquid header to the forward-most vent mast. Normally, tank aeration should then continue until, in the vapour discharge stream from the vent-mast and in the cargo tanks, the O_2 content approaches 21% by volume, the hydrocarbon content is below 0.2% by volume, the CO_2 content is below 0.5% by volume and the CO content is below 25 ppm.

Throughout the gas trials the following should be monitored.

- The insulation space pressures and temperatures
- The cargo tank pressures, temperatures and levels
- N_2 flow rates to insulation spaces
- The gas concentrations in the insulation spaces
- The cofferdam and inner hull temperatures, with cofferdam heating system ready for service.

Note: Depending on the containment system design, the details of actual items to be measured may vary.

During each of the testing phases of the trials, data relevant to the equipment in operation should be recorded at regular intervals. Where equipment operation is designed for automatic control, this mode should be tested and operating data recorded.

Quantity of LNG to be taken onboard

In order to test the pumping arrangements in all cargo tanks, the minimum quantity of LNG to be taken onboard should be based on the amount required to allow for pump start-up and transfer of liquid, sequentially from tank to tank, until all pumps have been soaked and operated.

The calculation of quantity to load will depend upon a significant number of factors and, for this reason, example quantities are not included in this guidance document.

Among the factors requiring consideration are:

- The number, shape and dimensions of cargo tanks on vessel.
- The number of tanks to be 'gassed-up' and cooled down at the LNG terminal.
- The requirements for 'gassing-up' and cool-down of the remaining tanks at sea.
- The amount of un-pumpable liquid remaining in each tank after transfer by the main cargo pumps and the spray/stripping pumps. Dependent upon the containment system design, trim and list may have an effect on this figure.
- The amount of liquid that will boil off during all the requisite trials.
- If gas burning tests are to run concurrently with pumping trials, the liquid amount will have to be increased accordingly to ensure sufficient liquid remains for the final stages of the transfer operation.
- For multi-fuel diesel engines the quality of the fuel gas during gas burning tests should be maintained within the limits provided by the engine manufacturer. As, during the course of gas trials, the BOG methane number drops, it is important to factor this in to the trials programme. For example, it may be decided to perform the gas burning tests prior to the pumping trials.
- If tanks are to be emptied and gas freed after gas trials then sufficient quantity must remain onboard at the time of return to LNG terminal to allow for start-up of the cargo pump.

It is not normally considered necessary to fully load any cargo tank for the purpose of confirming stress levels or the testing of overfill alarms and shut downs, as such alarms and shut downs should be fully tested to the satisfaction of the Classification Society surveyor, during the loading of the first cargo, by slowly filling the tanks until the alarms and trips are activated.

Post Gas Trials Inspection

After completion of Gas Trials a visual inspection of a number of items is recommended, including but not limited to: filters, cargo compressors, the inert gas generator and the N_2 generators.

Testing at First Loading

Whilst loading the first cargo, all high and high-high level alarms, overfill alarms and automatic shut-downs should be fully tested to the satisfaction of the vessel's Classification Society surveyor. The most rigorous method of testing will usually involve the careful transfer of LNG from tank to tank in order to test the systems at overfill levels. However, alternative methods may be agreed with Class.

A full cold spot inspection of the cargo tank insulation/inner hull should usually be carried out after temperatures have stabilised in the insulation system. The compartments to be entered and the nature of inspection will usually depend upon the containment system design.

Boil-Off Rate Measurement and Reliquefaction Plant Testing at Design Condition

During the early stages of the vessel's service life a number of BOG measurement voyages are usually completed to confirm that the cargo boil-off rate meets the contractual requirements and the containment system design specifications.

Reliquefaction plant capacity for operation at design conditions will usually require monitoring over a number of loaded voyages to collect sufficient data in order to confirm that the equipment sizing and control successfully handles normal BOG volume, without the necessity of operating the GCU. A possible method for measuring BOG volume might be to use one cargo tank as a buffer tank for receiving all reliquefied LNG. Boil-off rate measurements could then be performed on the remaining cargo tanks. Following a number

of readings, another cargo tank is designated as the buffer tank. In so doing, the boil-off from each cargo tank could be determined.

Testing at or After Refit

During routine refits Classification Society requirements should include the inspection and testing of a number of cargo containment system items.

The items for survey should include tank mounted cargo valves and relief valves for the cargo tank, insulation space and liquid pipelines.

Verification of the operation of the high level and overfill alarms and shutdowns, following the loading of first post-refit cargo, should be carried out to the satisfaction of the Classification Society surveyor.

It is presently an IGC Code requirement that the secondary barrier should be capable of being periodically checked for its effectiveness by means of a vacuum decay test or another suitable method. The test procedure for the cargo containment system will be dependent upon the actual system design. Such testing should usually be carried out at periods not exceeding five years, following licensors' procedures.

Timing of Gas Trials with respect to Delivery of the Vessel

As noted in the introduction, the common practice is to complete Gas Trials prior to the delivery of an LNG vessel. However, conducting Gas Trials post delivery, as for LPG ships, should not necessarily be rejected out of hand. This option may have to be considered if, for instance, the shipyard is unable to arrange, with a suitable terminal, for the provision of Gas Trial services in a timely manner. Such circumstances might perhaps arise in a period of high gas demand where the berth is simply not available for the time needed and could be presented as a *force-majeure* delay to delivery of the vessel.

In such a situation, it is suggested that the Owner should be fully conversant with the contractual warranty provisions and these should be fully acceptable. In particular, the responsibilities and course of action to be taken in the event that a major defect should come to light, which necessitates the vessel going for repair before entry into service, must be clarified.

It is suggested that the procedures adopted should follow, as closely as practicable, those set out in this document, while noting that a full warm-up, inert and gas free operation is unlikely to be conducted.

The timing of the Gas Trials should not be an issue for the Classification Society, but should remain a contractual issue between the Owner and Shipyard. Nevertheless, the Flag Administration and Classification Society are likely to need to be satisfied that the systems are tested and proven before they can issue the Certificate of Fitness and Class Certificate respectively. Such requirements will usually include, where appropriate, the need for secondary barrier testing on membrane ships post gas trials.

Whilst the decision to use this option has to be evaluated on a case by case basis, it is suggested that it is probably not appropriate for a first-in-series vessel, particularly if there are new design concepts to prove. The concept however is not without advantages for the Owner, particularly since his staff would, effectively, run the trials, rather then merely acting as observers of a shipyard team conducting the trials.

GLOSSARY

Aeration: The introduction of fresh air into a tank with the object of removing the inert gases and increasing oxygen content to ~ 21% by volume.

Boil-Off Gas (BOG): The vapour produced above the surface of a boiling liquid cargo. The boiling is caused by heat ingress into the cargo tank or a drop in pressure in the tank.

Classification Society: An organisation that sets technical rules, confirm that designs and calculations meet these rules, survey ships and structures during the process of construction and commissioning, and periodically survey vessels to ensure that they continue to meet the rules (e.g. Lloyd's Register of Shipping, American Bureau of Shipping, Det Norske Veritas)

Compander: A rotary machine incorporating, in one drive system, compressor stages and turbo-expander stages.

Cold Spot: An area indicated by frosting on the outer surface of pipeline insulation or cargo tank insulation, thereby showing the reduced thermal insulation properties in that particular area.

Cool-Down: The operation to reduce the temperature of a cargo tank to a temperature at which it is safe to commence the loading of LNG into the tank.

Emergency Shut Down System: A system specifically designed to safely shut down cargo transfer operations.

Flag Administration: The government of the State whose flag the ship is entitled to fly.

Gassing-Up: Replacing an inert atmosphere in a cargo tank with natural gas vapour derived from LNG.

Gaztransport & Technigaz (GTT): Licensors of a number of membrane cargo containment systems which are designed for installation in LNG vessels.

IGC Code: The International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk.

Inerting: Either of the following two processes:

(i) The introduction of inert gas into an aerated cargo tank with the object of attaining an inert condition suited to commencement of a safe gassing-up operation.

(ii) The introduction of inert gas into cargo tank to displace the cargo vapour, with the object of attaining an inert atmosphere suited to commencement of a safe aeration operation.

Liquefied Natural Gas (LNG): A colourless fluid in the liquid state composed predominately of methane and containing small quantities of C_2, C_3, N_2 or other components normally found in natural gas. See BS EN 1160

LN_2 : Liquefied Nitrogen

N_2 : Nitrogen gas

Un-pumpable Liquid: The liquid remaining in cargo tanks after completion of stripping.

Warm-Up: The operation to increase the temperature of a cargo tank to a temperature at which inerting and aeration can be safely commenced without the risk of condensation forming inside the tank.

SIGTTO
London Liaison Office, 17 St Helen's Place, London, EC3A 6DG
Tel: +44 (0) 207 628 1124 E-mail: secretariat@sigtto.org Fax: +44 (0) 207 628 3163