LNG as a marine fuel

Safety and Operational Guidelines – Bunkering

training & competence

environmental

technical

safety

contractual

Safety

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the society for gas as a marine fuel

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The Society for Gas as a Marine Fuel

The Society for Gas as a Marine Fuel (SGMF) is a non-governmental organisation (NGO) established to promote safety and good practice in the use of natural gas as a marine fuel. The society supports the wider use of gas as marine fuel by developing technical guidelines that encourage safe and responsible operations. More information on the society is available at: https://sgmf.info

Disclaimer

The advice given in these guidelines is based upon good, if not the best, current industry practice and relevant information. It is intended solely for guidance and use at the owner's/operator's own risk. No responsibility is accepted by SGMF – nor by any person, company or organisation related to SGMF – for any consequences resulting directly or indirectly from compliance with, or adoption of, any of the recommendations or guidance.

Notes:

1. This document provides only recommendations. They are not intended to constitute a detailed technical specification or operational procedure and apply only to the bunkering of liquefied natural gas (LNG) to a gas-fuelled vessel. It is the responsibility of the owner/operator:
   a. to develop appropriate operational guidance for a specific gas-fuelled vessel, bunkering facility and their equipment and systems, based on the builder's and manufacturer's instructions and these recommendations

b. to ensure that any design specification meets the actual operational conditions to which the whole bunkering operation will be subjected over the asset lifetime

2. The recommendations and considerations in the ***Lessons Learned*** sections represent the collective experience of SGMF's membership on common issues and challenges that may arise during LNG bunkering operations:
   a. they are not intended to constitute a technical specification or to provide specific safety recommendations
   b. their application is left to the skilled design team and operator, who should evaluate which are applicable or not to their asset and bunkering supply scenario and, if so, under which circumstances

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Foreword

LNG has established itself as the "marine fuel of the future, available today" – supporting the transition to a cleaner, less carbon-intensive shipping industry.

LNG provides significant benefits in reducing harmful local air emissions to negligible levels and cutting carbon dioxide (CO_2) emissions by a fifth. CO_2 reductions can be improved substantially if bio-LNG or, in future, synthetic LNG is used.

As a result of these benefits, the LNG-fuelled fleet has grown dramatically. With the entry into service of larger ships, as well as the growth in the number of ships in service and on order, LNG bunkering operations are growing – and will continue to do so.

As the quantity of LNG being supplied and the number of bunkering operations increases, safety remains paramount. Identifying risk and maintaining our focus on safety in gas bunkering operations will be vital.

An ambition to translate the successful safety record of seaborne LNG trades into success in LNG bunkering has been realised; to date, the safety record of LNG bunkering operations has been exceptional.

Much of that success is attributable to the guidelines, work and influence of the Society for Gas as a Marine Fuel (SGMF) – building on experience gained in the carriage of LNG. Adherence to such guidance, as well as mandatory port and ship regulatory requirements, combined with growing awareness, will underpin future success.

As we look further ahead, this "safety first" approach, built on accumulated experience and the continued application of expertise, will need to be embraced with further innovation and the development of new fuels – such as ammonia and hydrogen – for use as marine bunkers.

Accordingly, I strongly encourage and advocate our continued focus on safe bunkering and our support for the important work and leadership of the SGMF.

Martial Claudepierre
Bureau Veritas
General Manager Sustainable Shipping and Working Group Chairman

Abbreviations

The following abbreviations are used throughout this document:

BF – Bunkering Facility

BOG – Boil-Off Gas

LNGBMP – LNG Bunker Management Plan

BSL – Bunkering Safety Link

DD/CC – Dry-Disconnect/Connect Coupling

EMSA – European Maritime Safety Agency

ERC – Emergency Release Coupler

ERS – Emergency Release System

ESD – Emergency shutdown

GFV – Gas-Fuelled Vessel

HAZOP – HAZard and OPerability study

HAZID – HAZard Identification

IACS – International Association of Classification Societies

IAPH – International Association of Ports and Harbours

IGF – International Code of Safety for Ships using Gases or other Low-flashpoint Fuels

IGC – International Code of the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk

JBP – Joint Bunkering Plan

LFL – Lower Flammable Limit

LNG – Liquefied Natural Gas

LBV – LNG Bunker Vessel

PIC – Person-In-Charge

POAC – Person-in-Overall-Advisory-Control

PPE – Personal Protective Equipment

P&ID – Piping and Instrumentation Diagram

PRV – Pressure-Relief Valve

QCA – Quantitative Consequence Assessment

QualRA – Qualitative Risk Assessment

QRA – Quantitative Risk Assessment

QC/DC – Quick Connect/ Disconnect Coupler

SMS – Safety Management System

SIGTTO – Society of International Gas Tanker and Terminal Operators

STCW – International Convention on Standards of Training, Certification and Watchkeeping

TGN – Technical Guidance Note

Definitions

ALARP/ALARA
As Low As Reasonably Practicable/ As Low As Reasonably Achievable, without incurring excessive cost.

Boil-off Gas (BOG)
The vapour created when liquefied gas evaporates.

Bunker Management Plan (LNGBMP)
A collection of documents relevant to LNG bunkering activities, including safety procedures. Used to communicate information between the supplier and receiver. It may also be shared with other stakeholders such as port authorities and terminal operators.

Bunker station
The location(s) on board a vessel from which fuels are loaded and discharged to a bunkering facility.

Bunkering facility
Any technology or system designed to be used to transfer/bunker liquefied gas as fuel to a gas-fuelled vessel. It usually consists of a bunker vessel, road tanker or terminal.

Bunkering Safety Link (BSL)
Connects the supplier's and receiver's emergency shutdown (ESD) systems. It may be pneumatic, electric, fibre-optic or wireless. Also referred to as the "ESD link" or "Ship-to-Shore Link" (SSL).

Competent Authority
In this document, the general term "competent authority" describes an organisation with jurisdiction over the location, operation and/ or assets involved. The competent authority can have a legal, operational and location-specific interest over the operation and related activities, and can have a statutory function and enforce requirements, rules and standards. Different organisations, or more than one organisation, may act as a competent authority, depending on the activity being undertaken.

Connection flange
The part of the bunkering transfer system that connects to the gas-fuelled vessel's manifold. It can be a flange or a dry-disconnect/ connect coupling nozzle.

Coupling nozzle
The half part of the dry-disconnect/ connect coupling, bolted to the bunkering transfer system, which permits quick connection and disconnection to the receptacle installed on the gas-fuelled vessel's manifold. It includes an internal valve to seal the nozzle/transfer system when disconnected.

Coupling receptacle
The half part of the dry-disconnect/ connect coupling bolted to the gas-fuelled vessel's manifold to

Definitions

which the nozzle installed on the bunkering transfer system will be connected. It includes an internal valve to seal the receptacle/ manifold when disconnected.

Dry-Disconnect/Connect Coupling (DD/CC)
A manually-operated mechanical device enabling quick and safe connection and disconnection of the hose bunkering system to the manifold of the receiving vessel without employing bolts. The coupling consists of a nozzle and a receptacle. These couplings are also known as "Dry-Disconnect Couplings" or "Dry-Break Couplings". All DD/CCs are a type of Quick Connect Disconnect Coupler (QC/DC). Not all QC/DCs are DD/CCs but all DD/CCs are QC/DCs.

Emergency Release Coupler (ERC)
A coupling installed on liquid and vapour lines, as a component of the Emergency Release System (ERS), enabling quick physical disconnection of the transfer system from the unit to which it is connected. It is designed to prevent leakage and damage to loading/ unloading equipment if the transfer system's operational envelope and/or parameters are exceeded. An active controlled ERC is an emergency release coupler whose activation can be manually or automatically triggered by a control system and associated control switch/ signal.
A passive ERC is an emergency release coupler, triggered only by a set "breakaway" load to the ERC itself. Typically, a mechanical tension applied at the ERC collar when the gas-fuelled vessel and bunkering facility drift away from each other.

Emergency Release System (ERS)
A system that provides safe bunkering shutdown, transfer system isolation and quick release of hoses or transfer arms between the supplier and receiver to minimise product release at disconnection time.

Emergency Shutdown (ESD) (Bunkering)
The bunkering emergency shutdown is the event, signal or process initiated in an emergency to shut down the bunkering operation.
The process is divided into two consecutive stages: ESD 1 and ESD-2.
The first stage, ESD-1, is intended to stop the flow in a controlled manner. The initiation of an ESD-1 process does not imply that an ESD-2 process will be initiated soon after. The second stage ESD-2 process is primarily intended to protect the bunkering transfer system,

equipment and ship's manifold should the vessel drift out of a predetermined operating envelope. The ESD-2 release is usually initiated by the bunkering facility either automatically or manually.

ESD-1
The first stage of the bunkering emergency shutdown process (see Emergency shutdown).

ESD-2
The second stage of the bunkering emergency shutdown process (see Emergency shutdown).

ESD manifold valve
A remotely operated shutdown valve near the presentation flange closed in bunkering emergency shutdown by the bunkering ESD system.

ESD system (bunkering)
An ESD system safely and effectively ends the bunkering operation/process by stopping the transfer of LNG and vapour between the supplier and receiver. A bunkering ESD system should be found on board the gas-fuelled vessel and at the bunkering facility.

Flash gas
This refers to vapour spontaneously produced when liquefied gas is subjected to boiling from heating or depressurisation.

Fuel
In the context of the recommendations in this document, "fuel" means natural gas in its liquid or gaseous state.

Gas-Fuelled Vessel (GFV)
An IGF-compliant vessel using gas as marine fuel.

HAZard and OPerability study (HAZOP)
A HAZard and OPerability study is a qualitative technique based on guide-words which provides a detailed, systematic, examination – by a group of multidisciplinary specialists – of components within a system to determine what would happen if a particular component were to fail or operate outside its normal design mode.

HAZard IDentification (HAZID)
A HAZard Identification study is the process of identifying hazards – performed by a group of specialists in a systematic way – to plan for, avoid, or mitigate their impacts. Many specific methods are available.

Hazardous area/zone
The three-dimensional space in which a combustible or explosive atmosphere can be expected to be present frequently enough to require special precautions for the control of potential ignition sources.

Definitions

Defined by national regulations and both the IGF and IGC Codes.

Hose Bunker System
A hose bunker system allows the transfer of liquefied gas between a bunkering facility and a gas-fuelled vessel primarily using a flexible hose to transfer liquid and/or vapour.

Linked ESD System (bunkering)
The combined and connected arrangement of the bunkering facility's ESD system, the gas-fuelled vessel's ESD system, and the Bunkering Safety Link (BSL).

Liquid
In this document, liquid is fuel (natural gas) in the liquid phase.

LNG bunkering
The process of re-fuelling an LNG powered vessel from a bunkering facility.

LNG Bunkering Organisation
The organisation that staffs and operates a bunkering facility

Manifold flange
The flange permanently located on the gas-fuelled vessel's manifold, to which the reducer or spool piece should be connected.

Mobile-to-ship/truck-to-ship
An LNG bunkering operation to a gas-fuelled vessel from a mobile bunkering facility. Mobile bunkering facilities can consist of a truck, rail car or other mobile device (including portable tanks) used to bunker LNG.

Person-In-Charge (PIC)
The individual responsible for managing the bunkering operation on behalf of either the bunkering facility or the gas-fuelled vessel. One PIC might act as the Person-in-Overall-Advisory-Control (POAC).

Person-in-Overall-Advisory-Control (POAC)
An individual who manages the overall bunkering operation and coordinates the work of the supplier and receiver PICs. It may be performed by one of the PICs or a separate individual.

Presentation Flange
The part of the gas-fuelled vessel's manifold to which the transfer system is connected. Typically a spool-piece flange or a dry-disconnect/connect coupling receptacle.

Quick Connect Disconnect Coupler (QC/DC)
A Quick Connect/Disconnect Coupler (QC/DC) is a generic description of couplers. It uses a manual or hydraulic mechanical device to connect the transfer

system (such as a loading arm) to the bunkering manifold presentation flange without employing bolts.

Receiver
In this document, receiver is a general term used to refer to one or more organisations with ownership, operational and/or legal interests in a gas-fuelled vessel. The receiver may be the vessel owner(s), the charterer or the operator.

Receiving ship operator
The organisation staffing and operating a gas-fuelled vessel.

Reducer/spool piece
A short section of pipe bolted outboard of the manifold flange.

Ship-to-ship
A bunkering operation to a gas-fuelled vessel from a floating storage or bunker vessel.

Shore-to-ship
A bunkering operation to a gas-fuelled vessel from a fixed bunkering facility or terminal.

SIMultaneous Operations (SIMOPs)
Defined in this document as "bunkering plus one or more other independent operations conducted together within the control of the PIC(s), where the operations may impact, or increase impacts, on personnel safety, ship integrity and/or the environment".

Supplier
Supplier relates to the fuel owner or organisations mandated by them in the operation or development of a bunkering activity.

Transfer system/bunkering transfer system
A loading arm made of articulated piping or a transfer hose solution, or a combination of articulated piping and hose, that enables the transfer of liquefied gas from a bunkering facility to a gas-fuelled vessel.

Truck-to-ship
(See mobile-to-ship)

Vapour
The gaseous phase of liquefied gas.

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Lessons Learned

1. Purpose and Scope

1.1 Aims and Objectives

Safety and Operational Guidelines – Bunkering provides guidance to all the stakeholders involved in the bunkering of ships with liquefied natural gas (LNG):

- shipowners and operators
- suppliers of LNG as a marine fuel
- maritime administrations
- port authorities and terminal operators
- local and national authorities

A range of potential hazards are associated with bunkering liquefied natural gas (LNG). Experience of LNG bunkering to date, and of the wider LNG marine transport industry, shows that when good practice is applied and followed, risks can be effectively mitigated.

The overall aim of these guidelines is therefore to ensure that gas-fuelled ships are bunkered safely, reliably, efficiently and in an environmentally responsible way, with any fugitive emissions of natural gas effectively controlled.

It is assumed that receiving ships and LNG supply facilities comply with applicable codes, regulations and guidelines.

1.2 Applicability

These guidelines and recommendations apply to:

- LNG bunkering supply scenarios, as described in Section 3.1.1
- any gas-fuelled vessel compliant with the International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels (the IGF Code)
- any bunkering facility – for instance, a bunker vessel, a terminal, or a mobile truck, rail car or other mobile device (including portable tanks) – used to bunker LNG

Gas-fuelled vessels that are not formally required to comply with the IGF Code – for example, inland waterway and IGC vessels – may also benefit from the guidance in this publication, as this will ensure a common and consistent approach across the industry.

Currently, this publication addresses the specific requirements for Liquefied Natural Gas (LNG) used as a marine fuel as well as synthetic and bio-LNG. Its content may also, with appropriate limitations, be used as a reference for other low-flashpoint fuels and systems not specifically addressed in these guidelines.

1.3 New to the Latest Edition

New additions in v3.0 of the SGMF bunkering guidelines include the sharing of ***Lessons Learned***. These are based on the collective experience of SGMF's members and hundreds of successfully conducted bunkering operations. The aim is to provide the reader with an insight into how common challenges have been overcome by the industry, providing invaluable guidance to newcomers.

1.4 Structure

While this is an extensive publication, for the benefit of readers it is broken down into different sections to support the planning, development and implementation of the bunkering operation, starting from the essential knowledge in Chapter 3 to the various risk assessment techniques for identifying hazards and mitigations in Chapter 9.

To facilitate a common approach across the industry, the bunkering operation has been divided into four main stages (see Section 3.4): Design, Planning, Preparation and Operations (covered in detail in Chapters 4 to 7).

At each stage, key considerations are defined, and guidance is provided, including an examination of the roles and responsibilities of each key stakeholder. Additional special considerations and operations for bunkering operations are provided in Chapter 8.

Chapter 10 provides a list of relevant publications.

1.5 What is not Covered

These guidelines do not consider:

- commercial or contractual aspects of the bunker transfer between the two parties
- bunker delivery notes (BDNs), or
- the measurement of quantity or quality of LNG

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