gas as a marine fuel

Bunkering of ships with Liquefied Natural Gas (LNG) competency and assessment guidelines

technical
safety
contractual
training & competence
environmental

Training & Competence

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Disclaimer

While the advice given in this "Bunkering of ships with Liquefied Natural Gas (LNG) – competency and assessment guidelines" has been developed using the best currently available information, it is intended solely as guidance to be used at the owner's own risk.

Acknowledgements

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Foreword

Within risk management, it is generally acknowledged that by providing operatives with the information and skills that they need to undertake a task safely and efficiently, the lower the perceived risk will be. LNG has been carried at sea for over 50 years with an enviable safety record, thanks to the design of the vessels used, the use of common standards and protocols, along with skilled personnel engaged in all stages of the process.

The use of LNG as a fuel on marine vessels is a new and growing sector which is introducing some different and challenging factors which need consideration. The LNG in this context will be used as the fuel of the vessel, not the cargo. Consequently the transfer of LNG in bunkering operations may receive less focus than has traditionally been expected with LNG as cargo. In addition the transfer operations may take place in a variety of locations, using various methods, from different types of suppliers, again a very different environment to what has been used in the LNG shipping industry to date.

However, as many are aware, LNG when not handled correctly can be hazardous due to its very low temperature and its flammability properties. Consequently to reduce the risk to acceptable levels all personnel engaged in its handling need to be educated and trained accordingly so that they have the competence required. The training required for the actual facilities (i.e. terminals, trucks, supply vessels, receiving vessels) is defined by the responsible industry and authorities. However, as in any situation where an interface is required between two systems to allow an operation to take place there is an increased risk. For the use of LNG as a fuel, not only because of the interface but all the differing factors that will have to be considered, it is generally acknowledged that the bunkering process is the area that is going to pose the greatest risk.

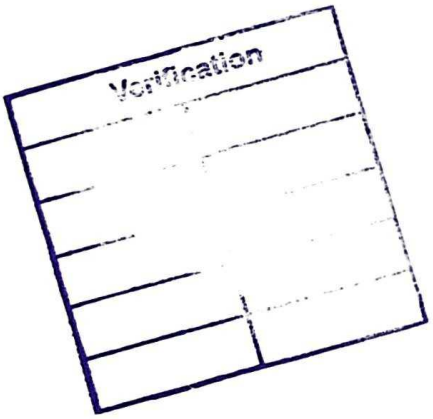
In compiling this document and methodology we have attempted to define a simple but common approach that focuses on the tasks that have to be performed to ensure the successful completion of a transfer of LNG from a supplier to a receiver. The aim is that the suggested guidelines can be used by any individual, organisation or authority, on either side of the transfer process to identify what tasks will be conducted

by themselves, their personnel, or within their scope and hence be able to identify the knowledge, understanding and competencies that they require. In so doing we have also tried to ensure the guidelines are simple to understand and interpret. Trying to develop a simple scheme that can be applicable to all the various parties that may be involved has not been an easy task, but I believe this document goes a long way to meeting that goal and for that I have to thank the hard work undertaken by the contributors to the working group and those that have provided comments separately.

The overall goal is to ensure that any transfer of LNG will be completed safely and effectively, no matter where, when or how.

The use of LNG as a fuel is a new industry that will develop and hence new knowledge, understanding and competence requirements will no doubt be identified. It is therefore the intention that this document will be reviewed and be updated accordingly and on a regular basis and to this end SGMF and the Training & Competence working group in particular would welcome any comments and suggestions for its improvement.

Ray Gillett
General Manager,
GTT Training Ltd



Introduction

This publication aims to provide guidance to all parties who may be directly or indirectly involved in the bunkering of ships with Liquefied Natural Gas (LNG), regarding the standards of competency which should be expected of those persons involved to ensure that bunkering is completed safely, effectively and in an environmentally responsible fashion.

These guidelines recognise that the bunkering process involves different organisations, both ashore and afloat, whose training and competency cultures may be significantly different. The competency framework developed aims to ensure that all persons have the same knowledge and understanding no matter the method by which the training may be delivered and thereby ensure a common standard across all interested parties, who may include (whilst not necessarily being limited to):

- ship owners, managers and personnel working for them on the LNG fuelled/receiving vessel
- drivers and operators of LNG road tankers or containerised LNG tanks
- LNG bunkering terminal staff supplying LNG direct to gas fuelled vessels
- bunker vessel owners, managers and personnel working for them on the LNG supply vessel
- port managers and staff including shore based personnel of ship owners working within ports in close proximity to LNG bunkering operations
- local and national authorities that need to approve and/or regulate bunkering infrastructure
- local emergency services personnel who need familiarity to allow them to design/manage emergency response plans
- third parties visiting or delivering to/from LNG fuelled vessels in port areas
- academics developing and delivering training courses for all the parties involved

The competency framework has been developed on several levels to ensure that staff with different roles, responsibilities and levels of exposure to LNG can each achieve the appropriate levels of knowledge about this relatively new area of activity.

The purpose of this document is to define the competence requirements in the undertaking of each task. How persons obtain the relevant competencies and hence the format of the training that will be provided will vary depending in which sector of the industry they are working. However the use of a modular approach is suggested, allowing individuals to progress through the competency framework as their knowledge and job role requires, and their experience develops. These guidelines have drawn from a wide range of initiatives and competency requirements covering the practices required within bulk LNG operations on LNG carriers, via a LNG import terminal and road tanker procedures, to the filling of LNG fuelled trucks, and the principles published by IMO and other authorities that will support the operation of gas/LNG fuelled ships. SGMF has drawn on the wealth of experience and expertise of its members, both in the handling of LNG and the various training programs that have previously been implemented, to produce a comprehensive set of guidelines to which the industry can refer.

The initial sections of this document cover the nature and philosophy behind the training and competency framework. The main body of this document lists competence areas within which individual elements are identified. The underpinning knowledge intended to support the training is also described, although in less detail. This combination is intended to ensure that personnel understand the appropriate actions to be taken, the reasons why they are appropriate and the implications of the actions. The final sections of this document present the competency modules in an alternative form centred on each functional role to make it easier to identify which modules are appropriate to the individuals concerned.

Contents

Definitions and Abbreviations

A&E – Accident and Emergency; a hospital or other urgent casualty care department. Sometimes referred to as a casualty department

ADN – European agreement concerning the international carriage of dangerous goods by inland waterways (Accord Européen Relatif au Transport International des Marchandises Dangereuses par Voies de Navigation Intérieures)

ADR – European agreement concerning the international carriage of dangerous goods by road (Accord Européen Relatif au Transport International des Marchandises Dangereuses par Route)

Agreement to bunker – is the process of following a formalised procedure agreed by all parties, ideally supported by a check list to ensure that LNG transfer takes place safely and in an environmentally acceptable manner

Apply – in this document means apply concepts, general rules and their knowledge to different but limited situations in their work place

ATEX – European Directive concerning protection of workers from the dangers of explosive atmospheres (Appareils destinés à être utilisés en ATmosphères EXplosibles)

BOG – Boil Off Gas, the vapour created by the evaporation of part of the LNG

BLEVE – Boiling Liquid Expanding Vapour Explosion, an explosion resulting from over pressurising a liquid gas storage tank usually as the result of a fire beneath the tank

CCNR – Central Commission for Navigation of the Rhine, the body that controls regulations on the major international inland waterways of Europe

CCTV – Close Circuit TeleVision, a means of monitoring an area remotely using cameras and TV screens

CH_4 – Methane, a hydrocarbon that is the main constituent of natural gas

Closed Questions – a question with a limited number of answers to choose from, for example a multiple choice test

CNG – Compressed Natural Gas is natural gas that is stored at high pressure (up to 300 bar)

CO_2 – carbon dioxide, a combustion product. A major greenhouse gas

Competence – indicates being capable of undertaking a task and completing it successfully with confidence and understanding

Cryogenic – temperatures less than -100°C (typically)

Custody transfer – in this document, refers to the formal agreements and associated legal and other documents related to the transfer of LNG from supplier to receiver

Custody transfer measurement – is defined by the American Petroleum Institute (API) as providing *'Quantity and Quality (Q&Q) information used for the physical and fiscal documentation of a change in ownership and/or a change in responsibility for commodities'*

Duty of care – requires employers/owners to take all steps which are reasonably possible while performing any acts that could foreseeably harm the health, safety and wellbeing of personnel, property or the environment

Emergency Shut-Down (ESD) – Emergency Shut Down, a control system and its components that when activated stops operations in a controlled manner and returns the system to a safe state

An ESD system may have several sequential stages, operation of each stage dependant on the potential consequences of the situation. During bunkering these stages are commonly designated ESD-1 and ESD-2.

ESD1 – where transfer of LNG to the bunkering vessel is stopped

ESD2 – where the transfer system is disconnected from the bunkering ship

In some ship types there may be additional definitions to the ESD system but these are outside the scope of this document.

Facilities – in this document refers to the land or ship based components of the bunkering system which could include the LNG road tanker or container, an onshore terminal, the receiving vessel or a bunker vessel

GIIGNL – an industry group made up of the main LNG importers worldwide (Groupe International des Importateurs de Gaz Naturel Liquéfié)

HSSE – common acronym for Health Safety Security and Environment

IGC Code – the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk. IMO publication regulating ships used for carrying all liquefied gases in bulk as cargo

IGF Code – The International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels

IMO – The International Maritime Organization, the United Nation's maritime regulatory body

Interpret – in this document means critically examining information to make judgements, interpret novel situations, plan procedures and troubleshoot events

ISM – the International Safety Management Code published by IMO

ISO – International Organization for Standardisation an international standard-setting body composed of representatives from various national standards organizations

Know – in this document means recall learned information, particularly underpinning knowledge, on request

Knowledge – indicates possession of information relating to an event or operation that gives the individual the capability to safely take part in that operation. (See also Understanding)

LEL/LFL – Lower Explosive/ flammable limits, the lowest concentration of a flammable hydrocarbon in air that can be ignited and burnt. Similarly UEL/ UFL are the upper limits of the flammable range

LNG – Liquefied Natural Gas. Natural gas that has been cooled to the point where it is liquid at the current pressure. GNL in French, Spanish and Italian (French Gaz Naturel Liquefié)

LNGC – LNG Carrier, a specialist ship carrying LNG as a cargo in bulk

LPG – Liquid Petroleum Gas, a

mixture of propane and butane used as fuel and chemical feedstock

MARPOL – the International Convention for the Prevention of Pollution from Ships published by IMO

Mechanical handling – is the method and/or equipment used to manoeuvre the LNG transfer system into place and may consist of a crane or simpler devices such as block and tackle, chain hoists, etc

MSDS – Material Safety Data Sheet which provides workers and emergency personnel with procedures for handling or working with that substance in a safe manner, and includes information such as physical data, toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures

Natural gas – a mixture of hydrocarbon gases, mostly methane, used as a fuel. May refer to natural gas in liquid or gaseous phase. A greenhouse gas

NPSH – Net Positive Suction Head, the absolute pressure at the suction port of the pump

OCIMF – Oil Companies International Marine Forum, an association representing operators of oil tankers and terminals dealing with safety and environmental issues and specifically associated with mooring and berthing guidelines

Open Questions – a question with no defined answers requiring candidates to consider and compare/contrast, for example an essay

P&ID – Process & Instrumentation Diagram, a drawing that shows all the main pipework, valves and instruments and how they are connected to each other

PIC – Person In Charge, sometimes also called the Person in Overall Advisory Control (POAC)

PPE – is a common abbreviation for Personal Protective Equipment

Q & Q – an abbreviation for Quality and Quantity, used to refer to specialist measurements taken as part of the transfer process

RPT – Rapid Phase Transition, the very rapid vaporisation of LNG into vapour through contact with a heat source, typically water

SGMF – Society for Gas as a

Marine Fuel, London based association for companies involved in the use of LNG as a marine fuel

SIGTTO – the Society of International Gas Tanker and Terminal Operators; an association representing operators of gas tankers and import and export terminals dealing with all liquefied gases in bulk

SIMOPS – Abbreviation referring to SIMultaneous OPerations; typically operations carried out on or close to a vessel at the same time as LNG bunkering

STCW – Standards of Training Certification and Watchkeeping. IMO publication detailing the standards and training for mariners on different ship types

Training – indicates teaching a particular skill or way of doing something

UEL/UFL – Upper Explosive/ flammable limits, the highest concentration of a flammable hydrocarbon in air that can be ignited and burnt. Similarly LEL/ LFL are the lower limits of the flammable range

Underpinning knowledge – is the minimum level of technical or other appropriate knowledge and understanding required to be able to carry out a task safely and efficiently without undue risk or delay.

Understand – in this document means understand the meaning and interpretation of instructions and problems based on the knowledge learnt

Understanding – indicates possession of sufficient breadth and depth of knowledge and experience to be able to make appropriate decisions about the preparation for, and conduct of an operation without compromising the safety or efficiency of that operation. (see also Knowledge)

VCM – Vinyl Chloride Monomer, highly volatile liquefied gas used to create PVC (polyvinyl chloride) for moulded plastic products

1. Purpose and Scope

This guide provides a summary of the recommended competence guidelines for the supply and bunkering of LNG for marine vessels, and the environment (for example the port), in which these LNG transfers take place, together with knowledge that underpins them. In identifying the competencies due account has been taken of the existing industry best practices and expertise.

There are many tasks involved in the use of gas as a marine fuel, often involving personnel both ashore and afloat. This document is therefore designed to be applicable to all the personnel who may be involved in carrying out the required tasks regardless of their background or location.

Note, these guidelines only cover the bunkering/transfer operation and are aimed to dovetail with and augment, rather than replace, other industry training schemes such as:

- STCW training for mariners on LNG fuelled ships
- STCW training for mariners serving on board IGC compliant vessels
- local or national training schemes for LNG road tanker drivers, for example ADR in Europe
- various systems for LNG bunkering terminal staff.
- guidelines issued by the respective bodies who may be engaged in the industry

This guide has been produced by the Society for Gas as a Marine Fuel's working group on Training & Competence.

The Society for Gas as a Marine Fuel *(www.sgmf.info)* has been established as a framework organisation covering the emerging gas as a marine fuel sector by working with other industry bodies, governmental and intergovernmental agencies, including IMO, within which both best practice and creative solutions can be reviewed and developed.

2. Introduction

In many industries that routinely handle potentially hazardous cargoes or fuels, for example, the bulk LNG transport business, their main strength (or weakness) is the quality and experience of the staff involved and how these individuals perform not just through routine operations but also how they react to unexpected or unusual events. Increasingly industries are turning to automation to take the "fallible" human out of the control system, but all these control techniques are only as good as the human who programmed them and whether the scenarios they envisaged are representative of real events.

Training is therefore essential to improving the knowledge, understanding and flexibility of the people involved throughout the LNG industry, with the bunkering of LNG for use as a fuel being no exception. In fact, because of the nature of the task and the environment in which it may be conducted additional focused training may be required to ensure the operations are conducted safely and efficiently.

This publication therefore aims to provide guidance to all parties who may be directly or indirectly involved in the bunkering of ships with LNG, as to the standards of competency that should be expected to ensure that bunkering is completed safely and in an environmentally responsible fashion. These same competencies also ensure that operations may also be efficient and take into account any commercial considerations.

It is not the intention of this document to define the format or content of any training that a person may undertake to obtain the respective competencies. The competencies may be obtained in different ways depending upon the role, industry and how the respective training programs are compiled. However, whenever and wherever the training is delivered the intention should be to ensure that the respective persons have shown they are competent as per the guidelines, before undertaking the particular role that they have to conduct.

2.1. Why Train?

LNG and natural gas, like most fuels, have certain safety and environmental aspects associated with them. Flammability is a requirement of all fuels and this combustion is harnessed to provide benefit. However, flammability also

presents a potential danger to the surroundings if the combustion process is uncontrolled. In addition, LNG is cryogenic, which creates other hazards that need to be addressed accordingly. Training of operatives is therefore required to ensure participants:

- are fully aware of all the potential hazards and how they may be mitigated
- understand the working practices that will minimise the occurrence of any incident and ensure that LNG can be transferred safely and in an environmentally acceptable manner
- understand the procedures to be implemented to ensure the fuel transferred can be accurately accounted for

2.2. What is Training and Competence?

2.2.1. What is training?

Training is an activity that involves the teaching of a particular skill or way of doing something. Generally, it does not require the trainee to have a particularly high level of understanding of the activity.

2.2.2. What is competency?

Competency (i.e. the possession of competence) is often defined as being capable of undertaking a task and completing it successfully with confidence and understanding.

Competency generally consists of the integration of one or more of:

- training
- physical skills
- underpinning knowledge

What is training?
"Helping people to learn

- how to do something,
- what they should or should not do or
- by simply giving them information

Training isn't just about formal "classroom" courses" UK Health & Safety Executive

What is competency?
The Engineering Council (UK) defines competence as: "the integration of knowledge, understanding, skills and values".

"I hear and I forget. I see and I remember. I do and I understand."

Confucius

- risk awareness
- experience
- understanding

of the

- the task at hand
- surrounding environment
- range of human factors

Having training and / or qualifications alone will not necessarily mean that a person is competent.

2.3. Who Needs Training?

The supply of gas as a marine fuel to a vessel could involve a number of persons, both on the side of the receiver and also the LNG supplier. All the personnel involved in planning and undertaking the transfer require a level of competence (i.e. possessing knowledge and understanding and being able to apply that knowledge in an appropriate way in given circumstances) so that the transfer will be undertaken in the required manner. Depending on how the transfer is being conducted, the persons concerned may include members of the ship's crew, shore personnel, road tanker drivers, and emergency services, all of whom will need a level of competence in their particular area of responsibility. The competence required will be gained by a combination of training and experience.

Individuals directly involved in the transfer process would typically include, but not be limited to:

- crew (including those ashore) of the gas/LNG fuelled (receiving) vessel
- personnel involved in the supply of the LNG (normally operators at a LNG terminal or small LNG liquefaction plant)
- personnel involved in the delivery of the LNG such as road tanker drivers or the crew of a LNG bunker vessel or the tug propelling a LNG bunker barge

Most bunkering operations will take place in, or close to, a port environment. These activities will need to be authorised under port rules and potentially under wider local governmental regulations. It may therefore be appropriate that personnel from the port and wider onshore area also require some level of training so that they have sufficient knowledge and understanding about the activities which may be conducted under their jurisdiction.

Individuals covered in this area may include:

- port staff, both managerial and dockside, for example stevedores, tug crews and crane operators; who are regularly in the gas fuelling area or may be affected by any spills or releases from that area
- local and national authorities, for example custom officials, who work a significant portion of time within the gas fuelling area

There are also personnel indirectly involved in the bunkering process that may require a basic understanding of the fuel and the bunkering process. This might include:

- shipping company procurement officers with responsibility for ordering fuel
- technical and operations superintendents with responsibility for ship equipment, maintenance and scheduling
- charterers

Finally there are a range of individuals and organisations that temporarily find themselves either on a gas fuelled ship or in a port area where LNG or gas bunkering takes place. Some basic training about the risks and emergency plans may be appropriate.

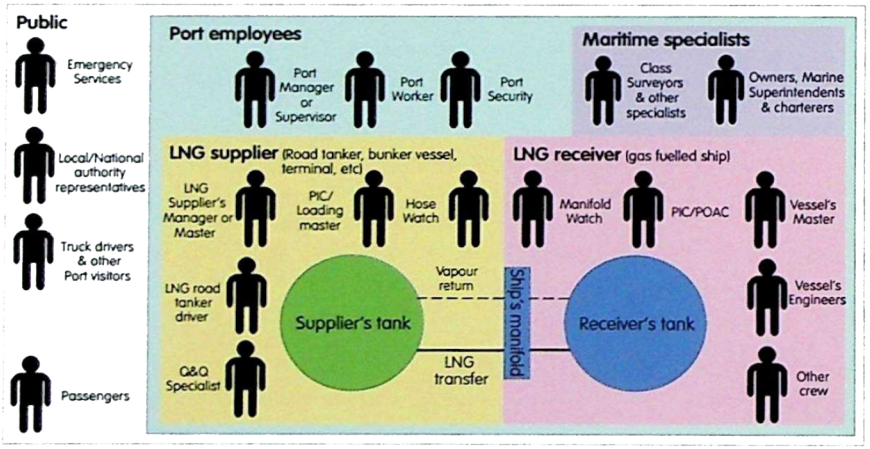
Individuals covered in this area may include

- port staff including shore based personnel of the ship owner or operating company who occasionally enter the gas fuelling area, including ship's agent

- visitors, including haulage company staff and contractors, who deliver to and collect cargoes from the port area but only spend short periods of time in the affected area
- emergency services personnel who need to plan responses to potential hazard scenarios
- local and national authorities who occasionally visit the facility for regulatory compliance purposes

Some of the roles that require appropriate levels of competence, and hence who may require training, are summarised in the figure below:

Figure 2.1: Roles that should require training



In defining training, this document should be read in conjunction with the appropriate international, regional and national standards applying to specific bunkering configurations.

3. SGMF Training and Competence Framework

3.1. Training and Competence Requirements

The level of competence required for each task will be different dependent on the individuals' particular roles and responsibilities. Competence will be gained by a combination of training and experience and hence the training that needs to be provided may differ from person to person. The level of competence and hence training required for any particular individual will depend on:

- their specific role
- their experience with LNG or gaseous fuels
- whether they will be directly involved in the management of the transfer or the handling of the LNG/gas.

SGMF suggest four levels of competence:

MANAGE – individuals that are responsible for the personnel who will be engaged in the operation or the area where this operation takes place, along with the administration, planning, and implementation of the supply of the fuel (LNG), on behalf of the receivers, suppliers or port authority/ regulatory bodies.

DO – individuals who will be engaged directly in the LNG/gas transfer and who may supervise other individuals engaged in the activity.

ASSIST – individuals that support the activities required in the transfer of LNG/gas but are under the direct supervision and direction of the **DO** level.

RESPOND – individuals who need to be familiar with, and understand the hazards associated with LNG and the actions that need to be implemented in an emergency situation.

In addition, two further levels can be envisaged:

SPECIALIST – training required to cover very specific skills required of a few individuals, such as medical staff who will only need knowledge

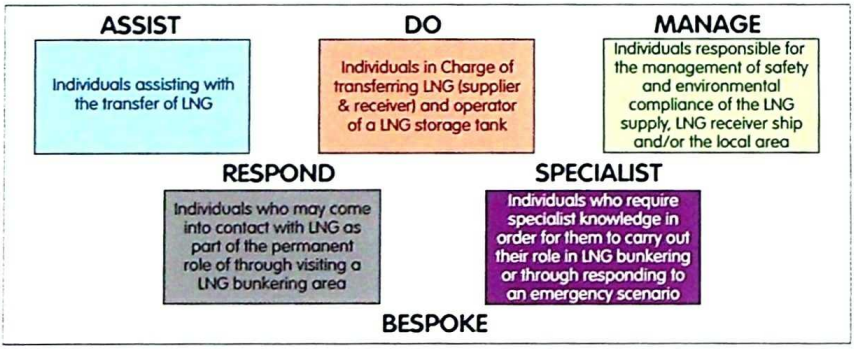
regarding the causes and treatments of injuries caused by cryogenic materials.

BESPOKE – training required for staff supporting the bunkering operation who do not immediately fall into the four competence levels described above

The four levels of competence and their relationship are summarised in Figure 3.1 below. The aim is to make the associated training task based and modularised so that individuals can progress through the required knowledge and skills in a logical manner taking into account any previous experience and understanding that they may have.

It would be reasonable to expect that candidates for training at the **ASSIST, DO,** and **MANAGE** competency levels possess a good understanding of the competencies at the subordinate levels.

Figure 3.1: Summary of training concept



3.2. General Approach

A modular approach to obtaining the knowledge and skills necessary for the undertaking of fuel transfer operations is suggested. Personnel can add modules to their training portfolio as required until they have sufficient to reach the desired overall level of competence for their intended role.

The modules are grouped into areas which follow a chronological route through the bunkering process and within each module the required competence elements are identified.

1. Operating and regulatory framework
   - activities that cover the operating and regulatory framework under which bunkering occurs and which are not specific to any given bunkering operation
   - modules that primarily cover organisational and management events
   - importance of safety and operating/bunkering procedures

2. Ensuring a safe environment
   - definition of the roles and responsibilities of individuals and the wider team. Good co-ordination and communication between all parties being an important aspect in maintaining a safe environment
   - activities that must be performed prior to a LNG transfer taking place but with the fuel supplier (bunker supplier) and receiving vessel present
   - risk assessment of the transfer environment, including factors such as the weather, time of day, security arrangements and the training/ competence of the personnel available

3. Checking equipment as fit for purpose
   - initial approaches to bunkering including the examination of the equipment to be used to identify damage and wear, to ensure the safety of the subsequent transfer
   - the management perspective and the duty of care to operating staff, both fuel supplier and receiver, by maintaining the equipment to be fit for purpose and within certification
   - the provision of appropriate safety related and personal protective equipment and how it should be used

4. Connection and testing
   - the function and correct assembly of the LNG transfer system
   - checks and testing undertaken prior to LNG transfer

5. Transferring LNG
   - ensuring the safe transfer of LNG, including the control and monitoring of the transfer and storage tank conditions and dealing with abnormal events
   - management oversight or governance of the process

6. Draining, disconnection and storage
   - the processes that need to occur after completion of the LNG transfer to ensure that equipment is safe to disconnect and store and also that its integrity is managed for future transfers

7. Responding to Emergencies
   - the tasks that are required to reduce the probability of an emergency and improve the effectiveness of the emergency response by making the facility safe and co-ordinating with the local emergency services

8. Quantity & Quality
   - accurate measurement of the quantity of LNG transferred and the techniques required to determine its quality/composition

9. Port & Ship Specific
   - Many processes will need to be specific to the ship, port or individual equipment selections. The competence requirements and subsequent training cannot be quantified so is excluded from the SGMF training guidelines. However, a "generic" module is included for reference.

The SGMF modular approach is shown in Figure 3.3

3.3. Assessing Training and Competence Requirements

The aim of this framework is to ensure competence based on the function of a specific role which will be different between various ship owner's/

managers, ports, LNG facilities and ship's crew. It is therefore not the intention of this document to be prescriptive in assigning competence and training requirements to specific ranks or positions. A mapping of competencies against job roles has deliberately been omitted from this document.

Some competency levels map fairly obviously to certain job roles. For example, the gas fuelled ship's master or the LNG terminal or port manager will require the **MANAGE** competency. Alternatively LNG road tanker drivers and the ship's engineering officer undertaking the transfer will require the **DO** competency.

If deemed applicable, the use of the **BESPOKE** and **SPECIALIST** levels will allow customisation of the modules for any specific role.

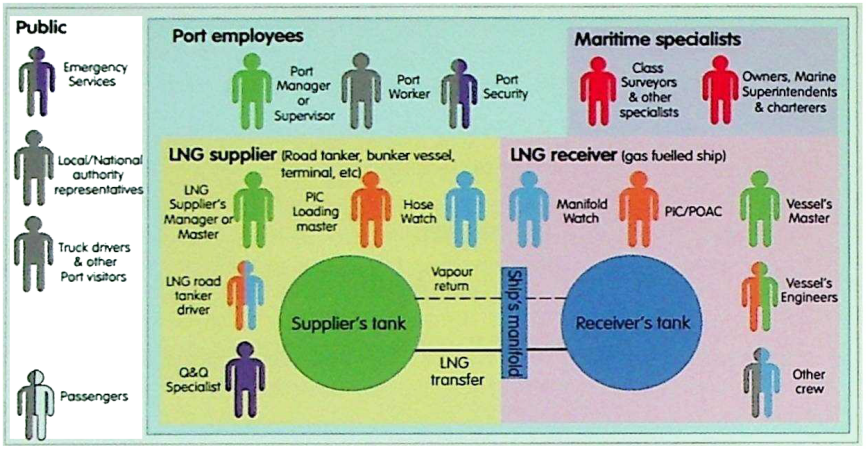
3.4. Progression Through the Competency Guidelines

The aim of the competency framework is that individuals can demonstrate their understanding of the training and their responsibilities in individual areas. These individual skills can be built up into a portfolio of capabilities (which may include training gained through other training or mandatory requirements). As their careers develop, individuals may take different or larger roles within an organisation which will require additional training and competency assessment. The strength of the module approach is that previously learnt and demonstrated behaviours, from a candidate's portfolio, are "portable" and can be recognised and therefore not repeated in future training programmes. Demonstration of the retention of the competence will, however, still be required.

The competency guidelines and modules can therefore be used in a multiplicity of ways to progress through a career path.

Figure 3.2 shows one possible interpretation of which roles, as a minimum, require which levels of training. Some roles have two suggestions for the training level required which reflects the possible options in interpretation which result from the variation worldwide of various training authorities and of ship owner practices.

Figure 3.2: Suggested roles and competence levels



Key: **ASSIST** = blue **DO** = orange **MANAGE** = green
RESPOND = grey **BESPOKE** = red **SPECIALIST** = purple
No specific training = white.

Figure 3.3: SGMF bunkering competence elements

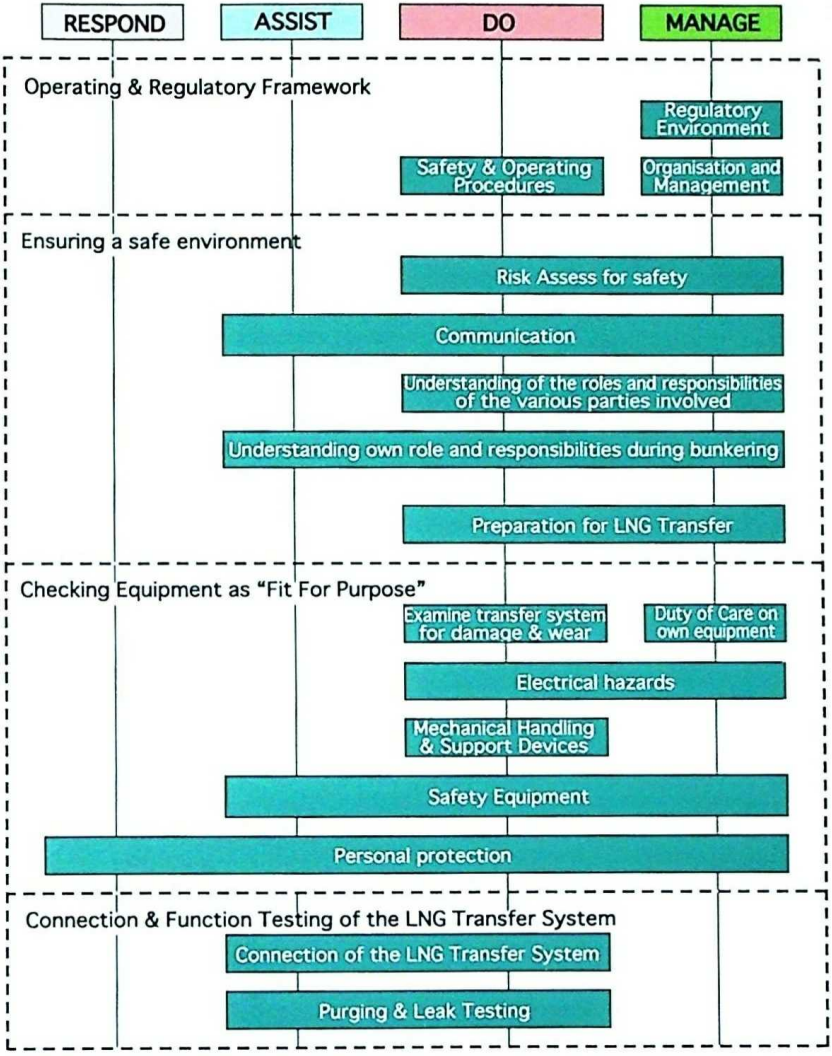
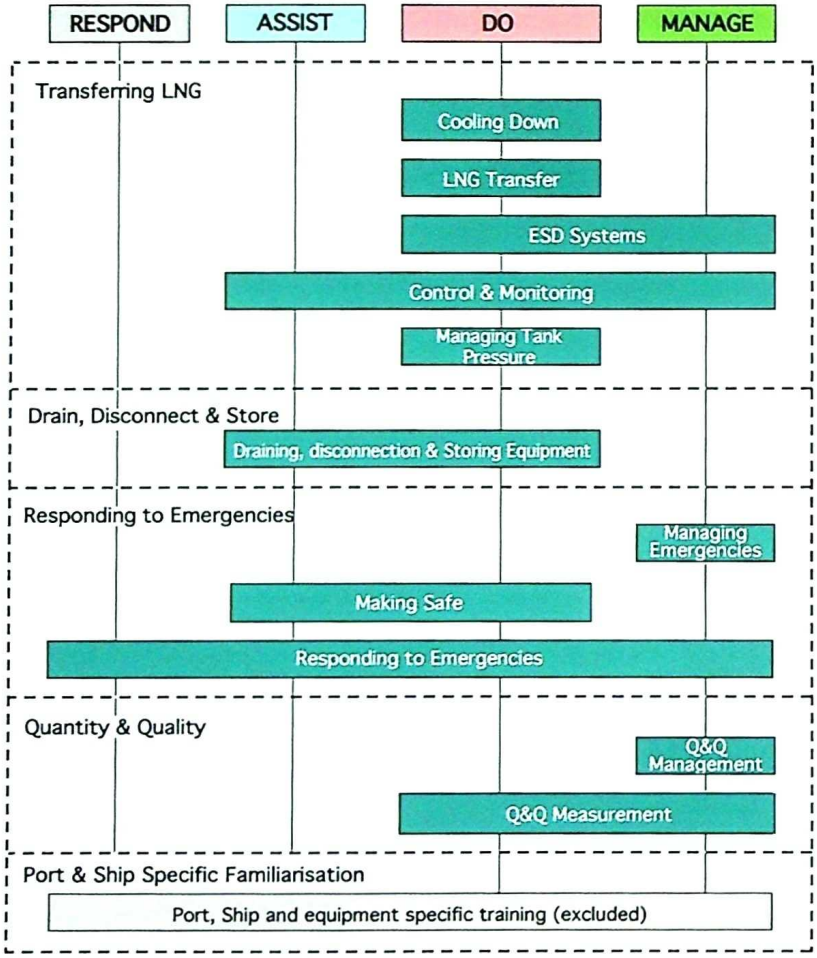
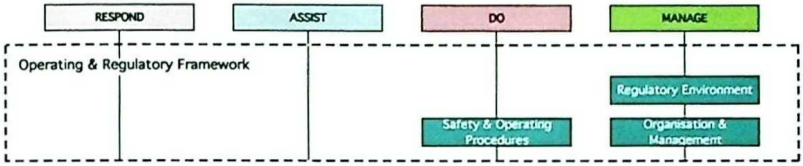


Figure 3.3: SGMF bunkering competence elements (continued)



4. SGMF Training and Competence Modules

4.1. Operating and Regulatory Framework



4.1.1. Regulatory Environment

Categories Applicable to: **MANAGE**

Module summary:

On satisfactory completion of this module the trainee will be able to implement and manage procedures and physical practices on the ship or in the port area that have an impact on compliance with international and local regulations. This will ensure that bunkering is conducted in a safe and environmentally responsible manner.

Competence required:

- Understand the international legal context of the bunkering process (local arrangements would be covered under Port and Ship Specific Familiarisation)
- Understand the role of the safety, environmental and operating manuals in complying with legal requirements and be able to compare manuals with rules and regulations and identify gaps in compliance
- Understand why equipment/systems on ships and/or facilities must not be modified from their original, compliant, design without appropriate risk assessment to demonstrate continued compliance
- Understand the requirement to ensure all regulatory requirements are fulfilled
- Understand why operating and maintenance procedures on ships

and/or facilities must not be modified from their compliant principles without appropriate risk assessment to demonstrate continued compliance

- Understand what steps must be completed before an "agreement to bunker" decision can be made and how this should be recorded

Underpinning knowledge:

- Know the International rules and regulations covering bunkering (section 5.2.1)
- Know about safety management systems (section 5.2.4)
- Know about pre bunkering activities (section 5.5.1)

4.1.2. Organisation and Management

Categories Applicable to: **MANAGE**

Module summary:
On satisfactory completion of this module the trainee will be capable of effective organisation and management of the ship/port/bunkering-supply system.

Competence required:

- Understand the training and competency required by those staff responsible for bunkering.
- Determine and Apply the required manning levels for transfer operations, including requirements for support personnel
- Understand the roles of the LNG buyer/receiver (ship), LNG seller and LNG deliverer (bunkerer)
- Understand the roles of specialists employed to support the bunker transfer process
- Understand the need for, and the main elements of, a communications plan between LNG receiver and LNG supplier
- Understand the need for mooring and bunkering equipment compatibility checks and how this should be implemented

Underpinning knowledge:

- Know about safety management system (section 5.2.4)
- Know about communication and team working (section 5.3.1)
- Know about roles and responsibilities (section 5.3.2)
- Know about pre bunkering activities (section 5.5.1)

4.1.3. Safety and operating procedures

Categories Applicable to: **DO**

Module summary:
On satisfactory completion of this module the trainee will be able to identify the appropriate safety and operating procedures (including manuals) and know how to implement them effectively.

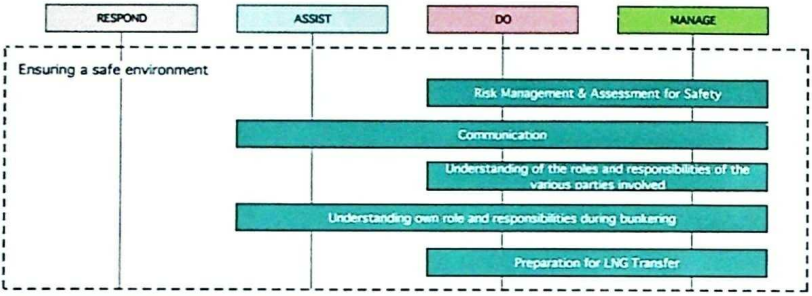
Competence required:

- Apply the appropriate safety and operating procedures to a LNG Bunkering operation.
- Understand the role and scope of the operating and safety procedures with respect to bunkering
- Understand where the safety and operating procedures are detailed and how to use them
- Apply the necessary modifications/improvements to procedures using risk assessment

Underpinning knowledge:

- Know about safety management systems (section 5.2.4)
- Know about operations procedures (section 5.2.5)

4.2. Ensuring a Safe Environment



4.2.1. Risk management and assessment for safety

Categories Applicable to: **MANAGE**

Module summary:

On satisfactory completion of this module the trainee will be able to understand risk assessment methodologies and how they should be applied to the LNG bunkering operation to manage risks.

Competence required:

- Understand the properties and characteristics of LNG and gases
- Interpret specific situations relating to a LNG bunkering operation, including SIMOPS, to determine whether a risk assessment should be undertaken
- Apply risk assessment techniques and implement the findings
- Apply learning to plan and monitor work carried out under a risk assessment to ensure its effectiveness and that all risks are managed
- Understand the necessity to regularly review risk assessments relating to commonly performed operations

Underpinning knowledge:

- Know the physics and chemistry of LNG (section 5.1.1)
- Know the hazards of LNG (section 5 1.3)
- Know the impact of LNG on equipment and construction materials (section 5.1.5)
- Know about risk assessment methodologies (section 5.2.2)
- Know about safety management systems (section 5.2.4)
- Know about communication and team working (section 5.3.1)

Categories Applicable to: **DO**

Module summary:
On satisfactory completion of this module the trainee will be able to understand the principles of risk assessment and the importance of following a risk assessed procedure.

Competence required:

- Understand the properties and characteristics of LNG and gases
- Interpret specific situations relating to a LNG bunkering operation, including SIMOPS, to determine whether a risk assessment should be undertaken
- Understand the principles of risk assessment
- Understand the importance of following a risk assessed procedure

Underpinning knowledge:

- Know the physics and chemistry of LNG (section 5.1.1)
- Know the hazards of LNG (section 5.1.3)
- Know the impact of LNG on equipment and construction materials (section 5.1.5)
- Know about risk assessment methodologies (section 5.2.2)

- Know about safety management systems (section 5.2.4)
- Know about communication and team working (section 5.3.1)

4.2.2. Communication

Categories Applicable to: **ASSIST, DO, MANAGE**

Module summary:
On satisfactory completion of this module the trainee will be able to implement effective communications to allow the transfer to take place safely and efficiently.

Competence required:

- Understand what information should be exchanged, when and with whom
- Apply effective communication methods
- Apply accurate recording of appropriate information for governance processes

Underpinning knowledge:

- Know about safety management systems (section 5.2.4)
- Know about communication and team work (section 5.3.1)
- Know about roles and responsibilities during bunkering (section 5.3.2)
- Know about pre bunkering activities (section 5.5.1)

4.2.3. Understanding the roles and responsibilities of the other parties involved

Categories Applicable to: **DO, MANAGE**

Module summary:
On satisfactory completion of this module the trainee will be able to understand the operational and safety roles of all the other parties (including the lines of responsibility and reporting) that may be involved in the process promoting alignment of behaviours.

Competence required:

- Understand the roles and responsibilities of the various persons and organisations who may be involved in a LNG Transfer operation

Underpinning knowledge

- Know about communication and team working (section 5.3.1)
- Know about roles and responsibilities during bunkering (section 5.3.2)

4.2.4. Understanding own role and responsibilities

Categories Applicable to: **ASSIST, DO, MANAGE**

Module summary:
On satisfactory completion of this module the trainee will understand their operational and safety roles throughout all stages of a bunkering operation.

Competence required

- Understand their own job role throughout the bunkering process
- Understand their own role in ensuring the safe and environmentally responsible transfer of LNG
- Understand the need to report and record safety/environmental incidents

Underpinning knowledge

- Know the impact of LNG liquid and vapour on the environment (section 5.1.2)
- Know about the hazards of LNG (section 5.1.3)

4.2.5. Preparation for LNG Transfer

Categories Applicable to: **DO, MANAGE**

Module summary:
On satisfactory completion of this module the trainee will be able to ensure that the conditions are safe prior to the commencement of LNG transfer and understand hazard and safety zones and how they should be implemented.

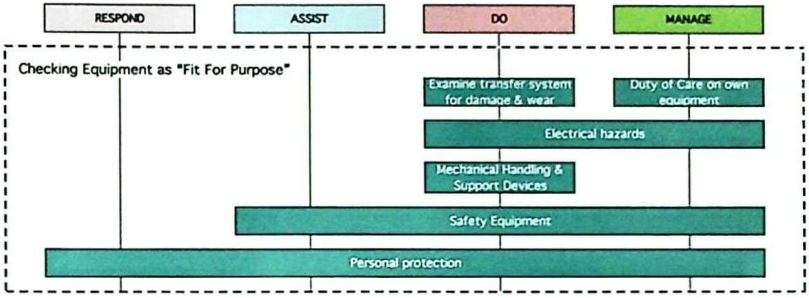
Competence required

- Apply – demonstrate how to prepare the area where the transfer will take place
- Understand the purpose and requirements of pre-transfer checks
- Apply the pre-transfer checks
- Understand the safety equipment that is required
- Understand the effect of environmental conditions and how they may impact the bunkering process and/or staff performance

Underpinning knowledge

- Know about physics and chemistry of LNG (section 5.1.1)
- Know about hazards of LNG (section 5.1.3)
- Know about leak behaviour (section 5.1.4)
- Know the impact of LNG on equipment and construction materials (section 5.1.5)
- Know how static and electrical equipment can cause sparks and ignition (section 5.1.6)
- Know about the risk assessment process (section 5.2.2)
- Know about the operation, calibration and maintenance of safety management (leak/spill) equipment required (section 5.4.8)
- Know about pre bunkering activities (section 5.5.1)

4.3. Checking equipment



4.3.1. Transfer System Equipment / Duty of Care

Categories Applicable to: **MANAGE**

Module summary:
On satisfactory completion of this module the trainee will be able to ensure that any transfer and safety equipment and their associated systems, whether owned or rented, are fit for purpose.

Competence required:

- Understand which items of equipment need to be certificated and confirm that certification is up to date
- Understand what maintenance and calibration records are required for owned and rented equipment
- Understand the Duty of Care concept, how this protects both persons and assets and how to decide which precautions/actions are necessary

Underpinning knowledge:

- Know about responsibilities surrounding owned and rented equipment (section 5.2.3)

4.3.2. Examine transfer system for Damage and Wear

Categories Applicable to: **DO**

Module summary:

On satisfactory completion of this module the trainee will be able to ensure that there is no damage or wear which may lead to a dangerous situation.

Competence required:

- Understand which items of equipment need to be certificated and confirm that they are within certification
- Apply - examine all the components of the LNG transfer system for physical damage and wear

Underpinning knowledge:

- Know about the impact of LNG on equipment and construction materials (section 5.1.5)
- Know about the operation, calibration and maintenance of LNG transfer system (section 5.4.2)
- Know the importance of the equipment manufacturers' operating manuals and how to use them (section 5.4.10)

4.3.3. Electrical hazards

Categories Applicable to: **DO, MANAGE**

Module summary:

On satisfactory completion of this module the trainee will be able to manage the electrical hazards that provide potential ignition sources during the transfer of LNG or its vapour.

Competence required:

- Understand the hazards associated with both current electricity and static electricity when transferring LNG liquid and/or vapour

- Understand the purpose of an insulating flange
- Understand the reason for maintaining electrical continuity of bunkering lines
- Understand the requirements for the use of electrical equipment in hazardous areas
- Apply – examine the physical condition of electrical equipment in hazardous zones for safe function prior to use

Underpinning knowledge:

- Know how static and electrical equipment can cause sparks and ignition (section 5.1.6)
- Know about the operation, calibration and maintenance of electrical equipment intended for use in hazardous areas (section 5.4.7)

4.3.4. Mechanical handling and support devices

Categories Applicable to: **DO**

Module summary

On satisfactory completion of this module the trainee will be able to understand the need for and appropriate use of mechanical handling equipment.

Competence required:

- Understand how to handle a transfer hose and loading arm correctly
- Understand why the LNG transfer system must be supported to avoid excessive stresses and bending in the hose, breakaway coupling, connector and manifolds
- Understand why and which mechanical handling equipment items are covered by certification systems and how to confirm that they are within certification
- Understand how to examine the mechanical handling system for safe function prior to use

- Understand which mechanical handling systems must remain in place during LNG transfer

Underpinning knowledge:

- Know about the operation, calibration and maintenance of mechanical handling equipment (section 5.4.1)
- Know about the operation, calibration and maintenance of LNG transfer system (section 5.4.2)
- Know the importance of the equipment manufacturers' operating manuals and how to use them (section 5.4.10)

4.3.5. Safety Equipment

Categories Applicable to: **DO, MANAGE**

Module summary:
On satisfactory completion of this module the trainee will know what items of safety equipment are required to support the LNG transfer operation including their purpose, operating procedures and maintenance.

Competence required:

- Apply – demonstrate the operation of equipment used for hazard detection (gas and fire detectors) and how environmental conditions may affect their performance
- Apply – adequately maintain hazard detection equipment
- Understand the purpose of drip trays and water curtain and how they are used to protect the vessel(s)/bunkering transfer area
- Understand where safety equipment is installed or needs to be placed

Underpinning knowledge:

- Know about the impact of LNG on equipment and construction materials (section 5.1.5)

- Know about the operation of safety management (leak/spill) equipment required (section 5.4.8)
- Know the importance of the equipment manufacturers' operating manuals and how to use them (section 5.4.10)
- Know about fire and gas detection systems (section 5.6.1)
- Know about fire-fighting techniques and equipment that may be used with LNG (section 5.7.2)

Categories Applicable to: **ASSIST**

Module summary:
On satisfactory completion of this module the trainee will know what items of safety equipment are required to support the LNG transfer operation including their purpose and operating procedures.

Competence required:

- Understand the operation of equipment used for hazard detection (gas and fire detectors)
- Understand the purpose of drip trays and water curtain and how they are used to protect the vessel(s)/bunkering transfer area
- Understand where safety equipment is installed or needs to be placed

Underpinning knowledge:

- Know about the impact of LNG on equipment and construction materials (section 5.1.5)
- Know about the operation of safety management (leak/spill) equipment required (section 5.4.8)
- Know about the fire-fighting techniques and equipment that may be used with LNG (section 5.7.2)

4.3.6. Personal Protection

Categories Applicable to: **RESPOND, ASSIST, DO, MANAGE**

Module summary:

On satisfactory completion of this module the trainee will know which types of Personnel Protection Equipment (PPE) are used when working with LNG, how to use it correctly, and how to check that the equipment is fit for purpose

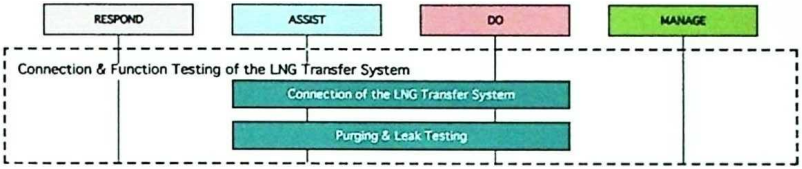
Competence required:

- Understand which items of PPE should be used when working with LNG

Underpinning knowledge:

- Know about the hazards of LNG (section 5.1.3)
- Know about Personal Protective Equipment (Section 5.4.9)

4.4. Connection and Testing



4.4.1. Connection of the LNG Transfer System

Categories Applicable to: **DO**

Module summary:
On satisfactory completion of this module the trainee will be able to assemble the LNG transfer system correctly.

Competence required:

- Understand the various connection methods that may be used
- Apply – assemble the LNG transfer system in the correct order
- Apply the checks to ensure that electrical continuity and insulation devices are correctly maintained and installed
- Apply the checks to verify the system is free from leaks across the operating temperature range
- Understand the various types of LNG storage systems that may be used by a supplier and the resulting implications that may need to be considered relating to the transfer of LNG

Underpinning knowledge:

- Know about the physics and chemistry of LNG (section 5.1.1)
- Know about the impact of LNG on equipment and construction materials (section 5.1.5)
- Know about mechanical handling principles (section 5.4.1)
- Know about the operation, calibration and maintenance of the LNG transfer systems (section 5.4.2)

- Know about the operation and maintenance of near atmospheric and pressurised LNG storage tanks (section 5.4.3)
- Know the importance of the equipment manufacturers' operating manuals and how to use them (section 5.4.10)

Categories Applicable to: **ASSIST**

Module summary:
On satisfactory completion of this module the trainee will be able to assist in the correct assembly of the LNG transfer system.

Competence required:

- Understand the various connection methods that may be used
- Apply – Assist in the assembly of the LNG transfer system
- Apply checks that verify the system is free from leaks across the operating temperature range

Underpinning knowledge:

- Know about the physics and chemistry of LNG (section 5.1.1)
- Know about the impact of LNG on equipment and construction materials (section 5.1.5)
- Know about mechanical handling principles (section 5.4.1)

4.4.2. Purging and leak testing

Categories Applicable to: **DO**

Module summary:
On satisfactory completion of this module the trainee will be able to understand the need to ensure the transfer system is clear of air and moisture and free from leaks prior to commencing transfer operations.

Competence required:

- Understand the risks that may result if oxygen and moisture are not removed from the LNG transfer system prior to the introduction of LNG vapour or liquid.
- Understand the methods that may be used to purge the LNG transfer system prior to use and the indications for satisfactory completion
- Understand the possible physical and environmental damage that may be caused by a leak of LNG
- Apply – test for leaks on the LNG transfer system
- Apply the appropriate corrective measures on identification of a leak of liquid or vapour

Underpinning knowledge:

- Know about the hazards of LNG (section 5.1.3)
- Know about leak behaviour (section 5.1.4)
- Know about the impact of LNG on equipment and construction materials (section 5.1.5)
- Know about the properties of inert gases (section 5.1.7)
- Know about leak/spill containment/management (section 5.4.8)
- Know about operations management (purging) (section 5.5.2)
- Know about pressurisation and depressurisation (section 5.5.3)

Categories Applicable to: **ASSIST**

Module summary:
On satisfactory completion of this module the trainee will be able to understand the reasons for the procedures to be followed to ensure the transfer system is clear of air and moisture and free from leaks prior to commencing transfer operations.

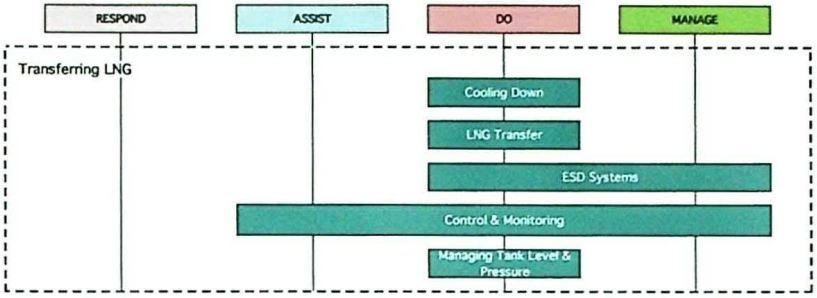
Competence required:

- Understand the possible physical and environmental damage that may be caused by a leak of LNG
- Apply the appropriate corrective measures on identification of a leak of liquid or vapour

Underpinning knowledge:

- Know about the hazards of LNG (section 5.1.3)
- Know about leak behaviour (section 5.1.4)
- Know about the impact of LNG on equipment and construction materials (section 5.1.5)
- Know about the properties of inert gases (section 5.1.7)
- Know about leak/spill containment/management (section 5.4.8)

4.5. Transferring LNG



4.5.1. Cooling down

Categories Applicable to: **DO**

Module summary:

On satisfactory completion of this module the trainee will be able to explain why and how to cool down the LNG transfer system.

Competence required:

- Understand why cooling down of LNG systems is required and the potential for leaks
- Apply the methods that can be used to cool down a LNG transfer system and how they should be monitored
- Understand the procedures for vapour return, disposal or pressure management related to different LNG storage systems

Underpinning knowledge:

- Know about the physics and chemistry of LNG (section 5.1.1)
- Know about leak behaviour (section 5.1.4)
- Know about the impact of LNG on equipment and construction materials (section 5.1.5)
- Know about the operation, calibration and maintenance of LNG storage tanks (section 5.4.3)

- Know about the operation, calibration and maintenance of LNG transfer systems (section 5.4.2)
- Know about pressure protection devices (section 5.4.6)
- Know about leak/spill containment/management (section 5.4.8)
- Know the importance of the equipment manufacturers' operating manuals and how to use them (section 5.4.10)
- Know about operations management (purging) (section 5.5.2)
- Know about storage tank operations (vapour control) (section 5.5.4)

4.5.2. LNG transfer

Categories Applicable to: **DO**

Module summary:
On satisfactory completion of this module the trainee will be able to undertake the transfer of LNG in a safe and efficient manner.

Competence required:

- Understand the importance of having an agreed transfer plan
- Apply – control and monitor LNG flows throughout all stages of the LNG transfer process
- Understand the data to be monitored and the appropriate parameters that indicate safe operation
- Apply – control and monitor the temperature and pressure within the LNG storage tank(s) and associated systems
- Understand the procedures for completion of the transfer
- Apply – take and record LNG transfer records throughout the transfer process

Underpinning knowledge:

- Know about the operation, calibration and maintenance of LNG pumps (section 5.4.4)

- Know about communication and team working (section 5.3.1)
- Know about the operation, calibration and maintenance of LNG storage tanks (section 5.4.3)
- Know about the operation, calibration and maintenance of LNG transfer systems (section 5.4.2)
- Know about the operation and maintenance of valves (section 5.4.5)
- Know about storage tank operations (section 5.5.4)
- Know about the operation, calibration and maintenance of instrumentation / monitoring devices (section 5.6.4)

4.5.3. ESD Systems

Categories Applicable to: **DO, MANAGE**

Module summary:
On satisfactory completion of this module the trainee will be able to understand the purpose and function of the Emergency Shut Down (ESD) system.

Competence required:

- Understand the philosophy of how ESD systems work and the different means and levels of activation including the impact of actuating the ESD system
- Interpret equipment status, instrumentation, alarms and other variables to find and correct the underlying cause of the occurrence of an ESD
- Understand why and how to link/connect and test an ESD system from LNG supplier to LNG receiver
- Understand the additional procedures and checks required should a linked ESD system not be available

Underpinning knowledge:

- Know about fire and gas detection systems (section 5.6.1)
- Know about the Emergency Shut Down System (section 5.6.2)

4.5.4. Control and monitoring

Categories Applicable to: **DO, MANAGE**

Module summary:
On satisfactory completion of this module the trainee will be able to describe the systems used to monitor and control the bunker system, and demonstrate the correct and effective use of these systems.

Competence required:

- Understand the key alarms and their likely causes and (potential) effects
- Understand the functions of the fire and gas monitoring systems
- Interpret equipment status, instrumentation, alarms and other variables to find and correct the underlying cause of the occurrence

Underpinning knowledge:

- Know about the operation and maintenance of valves (section 5.4.5)
- Know about the fire and gas detection systems (section 5.6.1)
- Know how control systems work (section 5.6.3)
- Know about the operation of instrumentation / monitoring devices (section 5.6.4)

Categories Applicable to: **ASSIST, DO, MANAGE**

Competence required:

- Understand the functions of the bunkering control system
- Understand how the LNG transfer process can be monitored, who does it and the equipment needed
- Understand the philosophy of how the ESD system works and its different means and levels of activation
- Understand how to accurately read temperature instruments

- Understand how to accurately read pressure gauges
- Understand how to accurately read level instruments

Underpinning knowledge

- Know how control systems work (section 5.6.3)

4.5.5. Managing tank level and pressure

Categories Applicable to: **DO**

Module summary:
On satisfactory completion of this module the trainee will be able to manage tank level and pressure to ensure it does not exceed a safe operating limit.

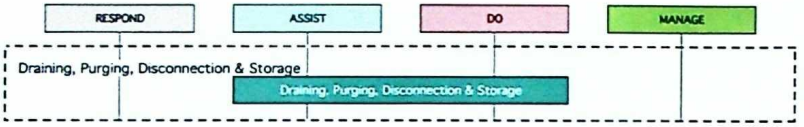
Competence required:

- Apply – manage level and pressure in a LNG tank during LNG transfer
- Understand pressure and vacuum protection systems on the LNG tank
- Understand the safe tank filling limit and how to calculate it
- Understand the types of level gauges installed, their accuracy limits, and how to accurately read them
- Understand the types of pressure gauges installed, their accuracy limits, and how to accurately read them

Underpinning knowledge:

- Know about the operation, calibration and maintenance of LNG storage tanks (section 5.4.3)
- Know about pressure protection devices (section 5.4.6)
- Know about storage tank operations (section 5.5.4)
- Know about the operation and maintenance of instrumentation / monitoring devices (section 5.6.4)

4.6. Draining, Purging, Disconnection and Storage



4.6.1. Draining, purging, disconnection and storage

Categories Applicable to: **DO**

Module summary:

On satisfactory completion of this module the trainee will be able to safely drain, purge and disconnect the LNG transfer system after transfer has been completed.

Competence required:

- Apply – isolate the LNG tank(s)
- Apply – safely and effectively drain and purge transfer lines without allowing LNG or vapour to leak into the environment
- Apply – ensure LNG is not trapped within sections of the transfer system.
- Apply – ensure/test line is gas free before disconnection
- Understand how to isolate and safely disconnect the LNG transfer equipment
- Understand how to correctly store/park LNG transfer equipment

Underpinning knowledge:

- Know about the properties of inert gases (section 5.1.7)
- Know about mechanical handling systems (section 5.4.1)
- Know about the operation, calibration and maintenance of equipment associated with the LNG transfer system (section 5.4.2)
- Know about the operation and maintenance of valves (section 5.4.5)

- Know about personal protective equipment (section 5.4.9)
- Know the importance of the equipment manufacturers' operating manuals and how to use them (section 5.4.10)
- Know about operations management – purging (section 5.5.2)
- Know about pressurisation and depressurisation (section 5.5.3)
- Know about operations management – draining (section 5.5.5)
- Know about the principles of valves and physical isolation (section 5.5.6)

Categories Applicable to: **ASSIST**

Module summary:
On satisfactory completion of this module the trainee will be able to assist in safely draining, purging and disconnecting the LNG transfer system after transfer has been completed.

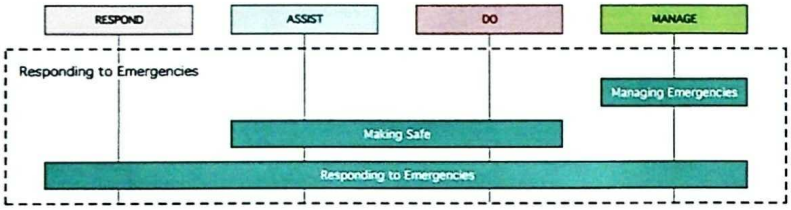
Competence required:

- Understand the different methods of safely and effectively draining and purging transfer lines without allowing LNG or its vapour to leak into the environment
- Understand how to correctly store/park LNG transfer equipment

Underpinning knowledge:

- Know about mechanical handling systems (section 5.4.1)
- Know about the operation of equipment associated with the LNG transfer system (section 5.4.2)
- Know about personal protective equipment (section 5.4.9)
- Know the importance of the equipment manufacturers' operating manuals and how to use them (section 5.4.10)
- Know about operations management – purging (section 5.5.2)
- Know about pressurisation and depressurisation (section 5.5.3)
- Know about operations management – draining (section 5.5.5)

4.7. Responding to Emergencies



4.7.1. Managing emergencies

Categories Applicable to: **MANAGE**

Module summary:

On satisfactory completion of this module the trainee will be able to show a detailed understanding of the potential hazards that may result from a bunkering process involving LNG and how such hazards should be dealt with.

Competence required:

- Interpret potentially hazardous events that may occur during bunkering operations and respond effectively
- Understand the principles of escalation where one hazardous event may lead to others
- Understand the principles of emergency evacuation, and where appropriate the role of temporary refuges, and how plans may need to be modified for different weather and damage scenarios and by the bunkering process
- Understand when to evacuate to a muster point (or temporary refuge)
- Understand how to co-ordinate with, and when to handover to, the local immediate responders and emergency services
- Apply – prepare, implement and review contingency plans
- Understand the need for, and benefits of, recording and completing any near miss/hazardous event paperwork

Underpinning knowledge:

- Know about the physics and chemistry of LNG (section 5.1.1)
- Know about the hazards of LNG (section 5.1.3)
- Know about the impact of LNG on equipment and construction materials (section 5.1.5)
- Know about safety management systems (section 5.2.4)
- Know about emergency procedures (section 5.7.1)
- Know about contingency planning (section 5.7.3)

4.7.2. Responding to emergencies

Categories Applicable to: **RESPOND, ASSIST, DO, MANAGE**

Module summary:
On satisfactory completion of this module the trainee will be able to identify hazardous scenarios and how to respond to these circumstances.

Competence required:

- Understand how LNG liquid or vapour could be released into the atmosphere during the bunkering process and its consequences
- Understand how to activate the ESD system and when to activate it
- Understand the emergency procedures

Underpinning knowledge:

- Know about the hazards of LNG (section 5.1.3)
- Know about leak behaviour (section 5.1.4)
- Know about emergency procedures (section 5.7.1)

4.7.3. Making Safe

Categories Applicable to: **ASSIST, DO**

Module summary:
On satisfactory completion of this module the trainee will be able to identify hazardous scenarios and how to respond to these circumstances.

Competence required:

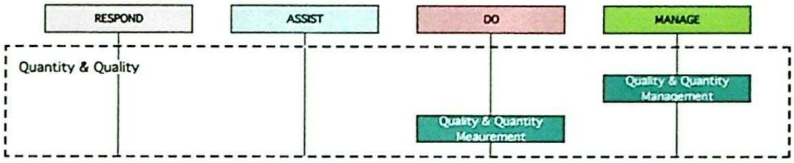
- Understand how the ESD system works and how and when to activate it
- Understand the purpose and operation of the gas venting and LNG discharge systems
- Understand the potential hazards resulting from trapped volumes of LNG and where they could occur
- Apply – safely isolate the bunkering system to prevent any release escalating
- Understand how to safely isolate potential ignition sources
- Understand how and when to initiate fixed and portable firefighting equipment
- Understand how and when to fight a LNG fire
- Understand the emergency procedures

Underpinning knowledge:

- Know about the physics and chemistry relating to gas and LNG (section 5.1.1)
- Know about the hazards of LNG (section 5.1.3)
- Know about leak behaviour (section 5.1.4)
- Know about pressure protection devices (section 5.4.6)
- Know about safety management (leak/spill) equipment (section 5.4.8)
- Know about operations management – Isolation (section 5.5.6)
- Know about Emergency Shut Down System (section 5.6.2)
- Know about emergency procedures (section 5.7.1)
- Know about the fire-fighting techniques and equipment that may be used with LNG (section 5.7.2)

- Know about the First Aid action to be taken in the event of personnel contact with LNG (section 5.7.4)

4.8. Quality and Quantity



4.8.1. Quality and quantity management

Categories Applicable to: **MANAGE**

Module summary:

On satisfactory completion of this module the trainee will be able to assess the amount of LNG transferred for commercial and governance reasons.

Competence required:

- Understand the LNG quality certification provided prior to LNG transfer including the composition and energy quality terms and be able to determine whether the LNG is outside of specification and the implications of this
- Understand the units of measurement, calculations and the accuracies required to confirm the amount and quality of the LNG transferred

Underpinning knowledge:

- Know about the operation and maintenance of instrumentation / monitoring devices (section 5.6.4)
- Know about the transfer measurement process (section 5.8.1)
- Know about fuel quality management (section 5.8.2)

4.8.2. Quality and quantity measurement

Categories Applicable to. **DO**

Module summary:
On satisfactory completion of this module the trainee will be able to assess the amount of LNG transferred and complete supporting records.

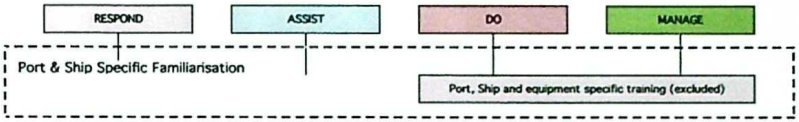
Competence required:

- Understand the principles of the transfer measurement process.
- Understand the information required to be recorded for Quality & Quantity purposes
- Understand the principle of operation and operating procedures of the various types of flow, level and weight measuring equipment that may be encountered
- Understand the types of temperature instruments installed, potential sources of inaccuracy, and how to accurately read them
- Understand the types of pressure gauges installed, potential sources of inaccuracy, and how to accurately read them
- Understand the types of level instruments installed, potential sources of inaccuracy, and how to accurately read them

Underpinning knowledge:

- Know about the operation and maintenance of instrumentation / monitoring devices (section 5.6.4)
- Know about the transfer measurement process (section 5.8.1)

4.9. Port and/or Ship Specific Operations



SGMF would expect that "localised" and "equipment specific" competence modules (based on the appropriate underpinning knowledge) would be developed to be equivalent to the generic modules previously described:

Categories Applicable to: **MANAGE**

Module Summary:
Familiarisation with specific items of port/ship rules and regulations and where necessary manufacturer equipment through manuals and manufacturer training courses.

Competence required:

- Understand the impact of port/ship rules and regulations on their job role
- Understand the LNG bunkering operations allowed in the port and the risk assessments required to support these
- Understand, where required for their role and implemented in the local area, the concept and limitations of permit to work schemes (or similar) on how they perform their work tasks
- Understand the SIMOPs allowed in the port and the risk assessments required to support these
- Understand the ship/port(s) layout and their safety and security measures

Underpinning knowledge:

- Know about port rules/regulations
- Know how to recognise, and correctly respond to, an emergency situation

Categories Applicable to: **DO**

Module Summary:
Familiarisation with specific items of equipment and operating procedures through manufacturer equipment manuals and training courses.

Competence required:

- Apply – ensure safe and responsible operations of any equipment (for example, vehicle driving, crane operation, etc) that their role and the ship/port requires
- Understand equipment capability, layout and safety and security measures

Underpinning knowledge:

- Know about port rules/regulations
- Know how to recognise, and correctly respond to, an emergency situation
- Know the importance of appropriate equipment manufacturers' manuals and training course material

5. Underpinning Knowledge

This section covers the knowledge that is required by individuals to support the competencies previously identified. The subsections deal with general industry practices and are not specific to particular manufacturers or vessel, truck, rail car and/or port configurations. It identifies the subjects that need to be studied.

All this knowledge needs to be recalled so is assessed using the Know keyword. This underpinning knowledge forms the background for understanding but does not, in isolation, result in understanding.

5.1. Fundamental Knowledge

5.1.1. The physics and chemistry of gas and LNG

- The gas laws and how they are applicable to LNG operations
- The physics related to the change of state of liquids
  - Latent heat
  - Heat and energy transfer
  - Refrigeration and liquefaction of gases
  - Critical temperature
  - Diffusion and mixing of gases
  - The meaning of dew point
  - The causes of rollover and resulting effects

5.1.2. The impact of LNG liquid and vapour on the environment

- Performance of gas fuelled engines vs oil with regard to emissions
  - CO_2
  - NOx
  - SOx
  - Particulate Matter (PM)
- Greenhouse gas role of methane

5.1.3. *Hazards of LNG*

- Cryogenic nature
  - Hypothermia and frostbite
  - Cold burns
- Flammability
  - Explosive and Flammable limits (UEL, UFL, LEL and LFL)
  - Flash point
  - Auto ignition temperature
  - Jet fires
  - Pool fires
  - Flash fires
  - Vapour cloud explosions
  - BLEVE
- Oxygen deficiency
- Product data sheets

5.1.4. *Leak Behaviour*

- Behaviour of gas/LNG upon leakage
  - Liquid pools
  - Dense gas clouds, heavier than air (until warmed)
  - Wind direction
  - The cause and effect of 'Rapid Phase Transition'

5.1.5. *The impact of LNG on equipment and construction materials*

- Impact of cryogenic conditions on (construction) materials including selection and failure modes
- How materials contract when their temperature reduces
  - The term "Co-efficient of expansion"
- Location of materials used

- Repair methods, including the importance of using the correct replacement materials
- Effect on materials / equipment when cooled
- How LNG and water interact
- How water and moisture may block transfer systems internally by the creation of ice

5.1.6. How static and electrical equipment can cause sparks and ignition

- How electrical equipment causes sparks
- Causes of static
- Definition of hazardous zones

5.1.7. The properties of inert gases (including nitrogen)

- Definition of an inert gas
- Oxygen content
- Gaseous nature, (asphyxiation)
- Moisture content

5.2. Corporate Governance and Management Systems

5.2.1. International rules, regulations and guidance covering bunkering

- LNG as fuel for example, MARPOL Annex VI, the IGF Code and codes covering Inland waterways
- LNG Transfer via Port rules and the ISM Code
- LNG Supply from road tankers and containers, bunker vessels and bunkering at LNG terminals
- LNG reception rules and guidance provided by ship yards, Flag State, Class societies and equipment suppliers
- Guidance from industry bodies such as SGMF, ISO, OCIMF and SIGTTO

5.2.2. *Risk assessment*

- Elements of an assessment
- How to identify hazards
- How to determine risk
- How to establish likelihood and severity
- How to decide if risk is tolerable
- How to prepare a risk control action plan

5.2.3. *The responsibilities surrounding owned and leased equipment*

- Knowledge of the responsibilities resulting from the legal principle of Duty of Care regarding safeguarding of others from harm
- Knowledge of regulatory and procurement processes for owned/ rented equipment
- Knowledge of equipment manufacturers' operating manuals
- Knowledge of the principles of mechanical handling and the associated dangers of performing this without mechanical support
- Knowledge of how the LNG transfer system must be supported to avoid excessive stresses in the hose, breakaway coupling, connector and manifolds
- Knowledge of appropriate response/reaction if defects are noted in equipment or documentation
- Knowledge of how the various safety detection devices work and are calibrated

5.2.4. *Safety management system*

- Overview of corporate safety management systems and how corporate level policies are translated into ship/operating unit specific documentation
- Techniques and methodologies to ensure effective risk management
- Need to manage any change to ensure continued safety requirements are met and changes are implemented in a controlled manner
- Importance of recording information on safety incidents and near

misses to promote understanding, learning and improved future performance

- Safe manning levels for the task to be undertaken

5.2.5. Operations procedures

- The role of operations procedures and the legal framework that they represent
- The content of the various operations procedures and where they may be located
- The need to follow operational procedures
- The need to manage any change to the operations procedures in a controlled manner

5.3. Organisation and Management

5.3.1. Communication and team working

- Chain of command
- Importance of communication methodologies and practices and methods of obtaining feedback that communication has been understood
- Pre transfer meetings
  - o Purpose
  - o Content
- Checklists and how they should be used to be effective
  - o Ship shore safety checklist (or similar)

5.3.2. Roles and responsibilities during bunkering

- LNG supplier
- Bunker delivery company
- LNG receiver
- Port authority
- Independent surveyors

5.4. Familiarity with the Operation, Calibration and Maintenance of Equipment and Instrumentation

5.4.1. Mechanical handling

- Knowledge of the type of mechanical handling devices that might be used in LNG bunkering
- Knowledge of the principles of mechanical handling and the dangers associated with operating transfer equipment without adequate mechanical support

5.4.2. The LNG transfer system

- Knowledge of the Components and their principles of operation that make up a LNG transfer system:
  - Flexible hoses
  - Articulated hard arms
  - Fixed pipework on the vessel or ashore
  - Breakaway and emergency release couplings,
  - Transfer system/manifold connectors,
  - Manifold arrangements
- Understanding of failure modes that may lead to failure of equipment

5.4.3. LNG storage tanks

- Types of LNG storage tank used for bunkering:
  - Construction and installation for each type
- Classification of tanks
  - Details of Type A and examples
  - Details of Type B and examples
  - Details of Type C and examples
  - Details of Integral or Membrane tanks and examples
- Operating requirements for each type
- Operating restrictions for each type

5.4.4. *LNG pumps*

- Pump operation
  - o Head vs flow characteristics
  - o NPSH requirements
  - o Specific issues around pumping a boiling liquid such as LNG, eg cavitation, starting, re-starting, etc
- Types of LNG pumps used for bunkering:
  - o Construction and installation for each type
  - o Operating requirements for each type
  - o Operating restrictions for each type

5.4.5. *Valves*

- Types of valves used in LNG and gas systems for
  - o Isolation
  - o Control
- Design features
- Operating requirements
  - o Prevention of surge pressures
- Maintenance requirements
- Problems that can occur – leakage

5.4.6. *Pressure-protection devices*

- Pressure release valves and systems
  - o Types
  - o Design features
  - o Operating requirements
  - o Design and operation
  - o Limitations
  - o Problems that can occur

5.4.7. *Electrical equipment in hazardous areas*

- Hazardous area classification (zones and different gases)
  - The various categories of safe type electrical equipment
  - The role of standards in regulating the safe use of electrical equipment
  - How to identify that an electrical item is safe for use in a hazardous area

5.4.8. *Safety management (leak/spill) equipment*

- Water Curtains
- Drip trays
  - Recommended practice
  - Draining procedures
- CCTV / Monitoring equipment
- Overfill protection methods
- Firefighting equipment

5.4.9. *Personal protective equipment*

- Clothing
- Personal monitors

5.4.10. *Equipment manufacturers' operating manuals*

- Content of equipment manufacturers' operating and maintenance manuals for each item of equipment
  - Importance of referring to equipment specific rather than generic information

5.5. Bunkering Operations

5.5.1. Pre-bunkering activities

- Compatibility of the receiving vessel's manifold with the LNG transfer system
- Compatibility of the LNG supplier's equipment with the LNG transfer system
- Completion of appropriate pre-bunkering check lists
- Purpose of the pre-transfer meeting and the need for both the receiver and bunkerer to sign off each other's check lists

5.5.2. Operations management – purging

- Purpose and importance of the purging operation before and after LNG transfer
- Potential safety, operational and fiscal outcomes of incorrect or ineffective purging processes

5.5.3. Pressurisation and depressurisation

- Pressurisation processes
  - o Reasons for controlling pressurisation rate
  - o Pressurisation processes and related testing
  - o Pressure protection
- Depressurisation processes
  - o Joule-Thomson cooling effect and how equipment temperatures may reduce significantly
- Vacuum
- Fatigue cycles

5.5.4. Storage tank operations

- Operating requirements
  - o Tank temperature management

- Pressure management
  - Effect of mixing LNG of different compositions
  - Vapour return
  - Use of on board consumers
  - Spraying LNG within tank
- Level management
- Protection devices
- Alarm set points and actions

5.5.5. Operations management – draining

- Methods of draining lines prior to disconnection
  - Methods and precautions related to safe liquid freeing of lines and connections
  - Methods and precautions related to safe gas freeing of lines and connections prior to disconnection
  - Safety issues arising from ineffective draining or gas freeing processes

5.5.6. Operations management – isolation

- Methods of safely isolating lines and equipment with reference to:
  - Avoiding trapping of liquid
  - Ensuring safe disconnection
  - Ensuring safe condition on completion of transfer operation

5.6. Control and Monitoring

5.6.1. Fire and gas detection systems

- Operating principles
  - Suitability of different types of gas detectors for different environmental applications.

- Purpose, operating procedures, limitations and calibration requirements of each type
  - o O_2 analyser
  - o % LEL detector
  - o % gas volume detector
  - o Dew point meter
  - o CO_2 meter
  - o Chemical tubes
  - o Low temperature detectors
  - o Infra-red
  - o Ultra violet

5.6.2. Emergency Shut-Down (ESD) systems

- Purpose
- Operating principles
- Connection arrangements
- Operational considerations related to both linked and standalone systems
- Actions when triggered

5.6.3. How control systems work

- Overview of how control systems for bunkering work
- Overview of how different control systems interact
- Control functions
- Control elements
- Alarms and trips

5.6.4. Instrumentation/monitoring devices

- Temperature measurement
  - o Types

- Limitations
- Alarm set points

- Pressure measurement
  - Types
  - Limitations
  - Alarm set points and actions
- Level measurement
  - Principles of operation for each type
- Float
- Radar/Lidar
  - Operating requirements for each type
  - Limitations for each type
  - Maintenance requirements for each type
  - Alarm set points and actions

5.7. Non Standard and Emergency Operations

- Know where the muster point (or temporary refuge) is located and how to get there

5.7.1. Emergency procedures

- Effective use of contingency plans
- Importance of effective drills and post-drill discussion

5.7.2. The fire-fighting techniques and equipment that may be used with LNG

- Use of high-ex foam
- Use of dry powder
- Danger of re-ignition
- Heat intensity of LNG fires

- Potential dangers of extinguishing fire before stopping leak
- Process isolation and draining
- Water spray protection
- Use of water curtains to inhibit the drifting of cold gas clouds towards sensitive areas

5.7.3. Contingency planning

- Role of contingency planning in normal and non-standard and emergency operations

5.7.4. The First Aid action to be taken in the event of a person coming into contact with LNG

- Skin contact
- Inhalation
- Ingestion

5.8. Commercial Considerations

5.8.1. The fuel transfer process

- Fuel transfer procedures including accurate record keeping

5.8.2. Fuel quality and quantity management

- The importance of custody transfer systems and how they work
  - How to operate LNG quantity and quality measurement equipment
  - Achievable levels of accuracy of LNG quantity and quality measurement equipment and how to maintain these through calibration and testing
- The composition of LNG
- Impact of LNG composition on engine performance
- LNG quality certification and contractual documents and calculations

6. Assessment Guidelines

SGMF's assessment guidelines are based around educational principles (mostly Bloom's taxonomy and its variations – see Appendix A) which cover a range of requirements ranging from basic techniques through intermediary levels to more advanced behaviours. Most of these levels are based on cognitive principles although in some instances skills required for physical manipulation are also required.

The learning and therefore assessment levels are shown diagrammatically in Figure 6 1. Keywords are assigned to each taxonomy which are then used in each relevant competence in the competency framework in Section 4. For example "understand" represents the second lowest level of taxonomy (level 2) of comprehend and is used as follows;

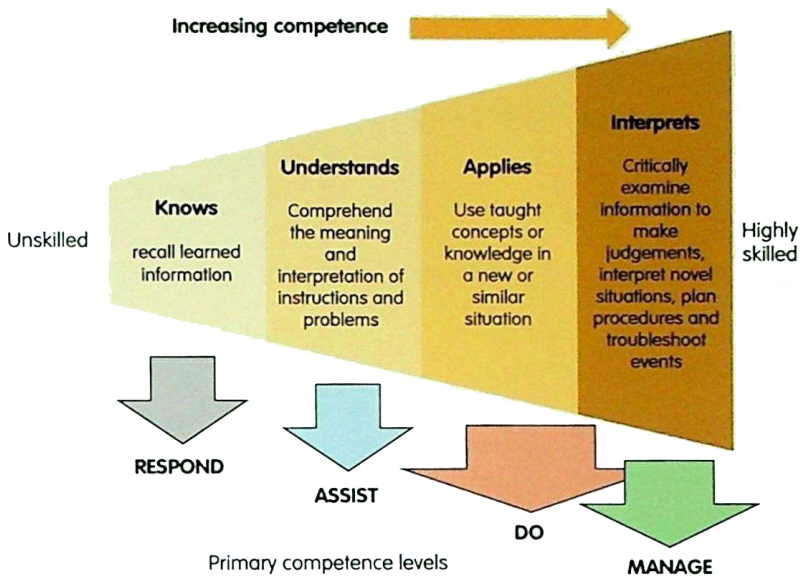
*"**Understand** their own role in ensuring the safe and environmentally responsible transfer of LNG" (section 4.2.4)*

The SGMF assessment guidelines are based on these keywords:

- **Know** – recall learned information, particularly underpinning knowledge, on request
- **Understand** – understand the meaning of instructions and problems based on the knowledge learnt
- **Apply** – use learned knowledge and understanding to complete tasks effectively
- **Interpret** – make judgements, interpret novel situations, plan procedures and troubleshoot events

Progression through the learning hierarchy requires that lower levels must be mastered before higher levels can be attempted. For example, if a candidate is trying to Understand they must already Know the (underpinning) knowledge on which their understanding will be based. Similarly anybody needing a skill at the Apply level will already have completed the Understand and Know stages.

Figure 6.1: Learning and Assessment Hierarchy



Training and competence can be assessed by combinations of many different means such as.

- written and/or verbal/oral assessments/examinations
- computer based assessment
- demonstration of practical skills
- acknowledgement of relevant experience
- review of multi-media (photographic/video) evidence

6.1. Know

Assessment needs to confirm that the candidate can recall learned information when required. Typical activities would be reciting or describing something or selecting from a range of options.

The information being assessed is normally underpinning knowledge and as such can be learnt by a candidate either in a classroom environment or by personal study such as reading books, watching DVDs/videos or completing web/internet based training.

Assessment is straightforward as it involves answering simple questions such as:

- who undertakes this activity?
- what is a ....?
- why is .... important?
- when does .... take place?
- where is the ..... located?
- which system is used for ....?
- Find .... on this diagram
- label/name the equipment items in this photograph
- list the components of ....
- match the list of components to the list of functions

6.2. Understand

Assessment needs to confirm that the candidate can comprehend the meaning and interpretation of instructions and problems based on the knowledge learnt (Know). Typical activities would be explaining and giving examples, interpreting what is happening given specific information or summarising those operation manual instructions relevant to a specific operation.

The majority of the competencies require an ability to understand. Some candidates may be able to gain this knowledge by personal study such as reading books, watching DVDs/videos or completing web/internet based training. However most will require a level of interaction with others either through classroom interaction, tutorials or web based techniques such as bulletin boards and discussion forums.

Assessment is relatively straightforward but more time consuming as it involves answering simple but open questions such as:

- explain how the vapour handling system works?
- compare and contrast pressurised and unpressurised LNG tanks
- what happens if .....?
- summarise the process for .....
- outline how you would react in ... situation?
- demonstrate the safe and effective use of .... system/equipment
- classify hazardous/safe areas or critical/non-critical equipment or operations

6.3. Apply

Assessment needs to confirm that the candidate can apply concepts (Understand), general rules and their knowledge (Know) to different scenarios in their work place. There is some need for interpretation. Typical activities would be inspecting, preparing, operating and maintaining equipment within defined limits and applying processes and procedures.

All candidates will need to have completed some form of simulation or have operational experience to gain the level of competence required.

Interaction with other students and supervisors is seen as key to gaining all the necessary learning points. This could take place through classroom discussions or web based techniques such as bulletin boards and discussion forums. However, small group or individual tutorials are perceived to provide the highest value.

Assessment is complex but might include questions like:

- develop/produce a risk assessment for a non-standard operation, for example depressurising a LNG tank
- solve common problems that occur during LNG transfer/modify LNG transfer variables
- choose how to ...

6.4. Interpret

Assessment needs to confirm that the candidate can analyse systems and procedures and identify gaps and weaknesses requiring judgements and decisions to be made. Additionally this requires the candidate to distinguish between facts and inferences and work in scenarios that do not have certain outcomes (Apply) and are therefore subject to interpretation. This combination of skills should allow candidates to troubleshoot and solve open ended problems and respond to local and regulatory needs.

Typical activities would be interpreting data to successfully control the LNG bunkering activity, discovering why something, for example an alarm in the control system has been triggered, risk assessment and responding to change (including regulatory, physical, staffing or procedural).

All candidates will need to have completed some form of modelling exercises/simulation or have operational/managerial experience to gain the level of competence required.
This may include:

- desk top exercises including objective analysis of the outcomes and formulation of proposals for improvement
- role playing including objective analysis of the outcomes and formulation of proposals for improvement
- emergency exercises and drills including objective analysis of the outcomes and formulation of proposals for improvement
- laboratory, workshop or ship based supervised practical exercises to encourage troubleshooting
- computer based simulation

Interaction with other students and supervisors is seen as key to gaining all the necessary learning points. This could take place through classroom discussions or web based techniques such as bulletin boards and discussion forums. However, small group or individual tutorials are perceived to provide the highest value.

Assessment is complex. Example questions to determine competence could include:

- identify/troubleshoot why a control loop is not performing correctly
- identify how to respond to … occurring during bunkering
- analyse a new bunkering scenario to identify risks/for compatibility
- interpret the diagrams and documents for ….
- debate the merits of/compare different bunkering options/tank types….
- interpret feedback from instruments and controls system
- identify bunkering options, compare their suitability given environmental conditions and port requirements and select a preference
- conduct a risk assessment and analyse the results and propose appropriate mitigation to reduce risk exposure
- devise a plan for …..
- organise a …..
- identify the weaknesses and … and revise
- plan a first visit to a port/qualify a ship
- how would you build a …..
- create a …..
- review ….. and …. and combine the results to provide an improved….

6.5. Valuing Experience

Actual experience of operating in a similar environment is very valuable as the candidate is more likely to appreciate more facets of what is happening and therefore be quicker at resolving any issues. There are however, two drawbacks

- firstly the development of bad habits/practice which solve most problems most of the time but which may stop an individual

performing suitably well in exceptional circumstance which are beyond or outside normal activities

- secondly individuals may become blasé or overconfident about how they operate and may therefore not notice warning signs that something unusual is taking place.

STCW when applied to the IGF code requires a probationary period before training is accepted as successful. This involves participation in 3 bunkering operations within a 12 month period. SGMF has a strong preference that these bunkering operations are on different days. Similarly many LNG road tanker drivers and terminal staff must operate under supervision for a period, usually because of the higher frequency of operations, for a few days or weeks until their level of competence is confirmed.

Until competence and experience at the **DO** level has been achieved the trainee should be considered to operate at the **ASSIST** competence level.

Experience should only be regarded as relevant if it covers a direct involvement in a LNG bunkering procedure. This means that multiple competencies of the appropriate level, for example **DO** are demonstrated by this involvement. For example, an individual with **DO** qualification if present during a bunkering in a minor role would only gain experience of the **ASSIST** role and therefore could not record this experience/bunkering against **DO** requalification. If the same individual was present on the ship but not involved at all in the bunker transfer, no experience is recorded.

Experience gained in other similar operations could be considered as relevant by training authorities but at a lower level of significance/ importance than LNG bunkering operations. Similar operations might include:

- bulk LNG transfer (highly relevant)
- transfer of other refrigerated liquefied gases (refrigerated LPG, ammonia, VCM, etc)
- transfer of hydrocarbons (pressurised LPG, oil, gas, hydrogen, etc)
- transfer of cryogens (liquid nitrogen, oxygen and argon, etc)

These alternative operations should not be solely used: they should support LNG bunkering experience and not vice versa. Candidates should be able to demonstrate a clear understanding of the differences between LNG bunkering operations and their prior experience as well as the transferable knowledge and skills.

6.6. Competence Re-assessment

If skills are not used on a regular basis their effectiveness becomes reduced. Less effective skills reduce individual performance and increase the probabilities of a LNG/gas release.

Individuals who have achieved the necessary competences for bunkering should be asked to demonstrate that they retain sufficient capability to perform their roles effectively by being periodically re-assessed. Best practice would encourage all staff to have their qualifications/competence checked by an independent reviewer.

SGMF suggests, that as a minimum, individuals should be re-assessed in accordance with the following timescale:

- when there has been no direct experience of LNG bunkering activity in a 24 month period
- every 5 years

The number of bunkering operations and the candidate's role in them should be recorded in a personal log book. The minimum information that should be recorded is suggested as:

Overall

- individual's name,
- personnel qualification (**DO, ASSIST, MANAGE**, etc)
- institution/certifying body, date and place of last assessment
- any other experience/training programmes since last assessment

For each bunkering

- time and date
- role in bunkering operation (primarily **DO/ASSIST** etc but other supporting information may be helpful)
- vessel bunkered (name and IMO number)
- bunkering type (truck to ship, ship to ship, etc)
- location of bunkering (port and country)
- amount of LNG transferred (mass or energy basis)
- details of competent person supervising/authorising activity (name, signature and qualifications)

If the candidate fails their reassessment several options are available prior to re-assessing. These include:

- additional training on the relevant competences
- operate under supervision (eg **ASSIST**) to resolve weaknesses

7. Modules and Responsibilities by Role

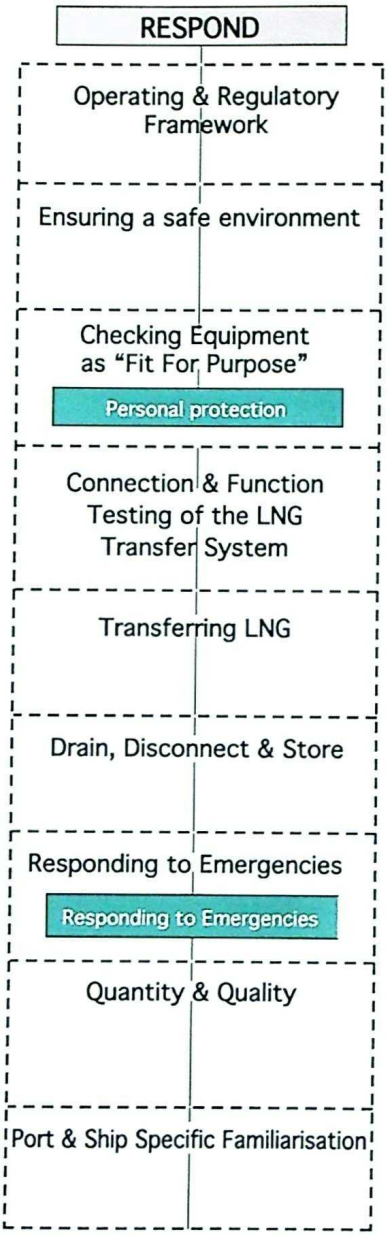
7.1. RESPOND Role

Individuals who occasionally come into contact with LNG whether as liquid or vapour need a degree of familiarisation with what to do and what not to do. The **RESPOND** training aims to fulfil these aims. **RESPOND** training would be expected to cover the following areas/concepts and behaviours

- know what LNG is
- understand the hazards of LNG
- understand evacuation procedures
- know basic LNG safety measures
- know how and when to contact the emergency services
- understand how to initiate an Emergency Shut Down (ESD)
- know the importance of reporting any incidents or near misses that they witness

Training would be short and may depend on the role of the individual and the frequency that the individual is involved with LNG. Parallels from other industries would include the safety briefing from airline crews for passengers; abandon ship instructions for cruise line passengers and informational safety videos that are produced by many major industrial facilities for visitors and temporary workers. The latter often exist in several forms to ensure that the training is appropriate to the role being undertaken, particularly if this involves working in hazardous areas. The difference in this scenario is that some form of test is required to ensure that the trainee has understood the information provided.

For example, several LNG import terminals use videos supported by multiple choice questions to assess understanding. The length and the depth of the video depends on the role that the individual is about to play. This training is usually supervised by security staff on first arrival at the site and then at specific time intervals.


RESPOND
Operating & Regulatory Framework
Ensuring a safe environment
Checking Equipment as "Fit For Purpose"
Personal protection
Connection & Function Testing of the LNG Transfer System
Transferring LNG
Drain, Disconnect & Store
Responding to Emergencies
Responding to Emergencies
Quantity & Quality
Port & Ship Specific Familiarisation

The assessment matrix for the **RESPOND** role is shown below

*Assessment Matrix for **RESPOND** Role*

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.3.6	Personnel Protection	Know the underpinning knowledge 5.1.3, 5.4.9	x			
		Understand which items of PPE should be used when working with LNG		x		
4.7.2	Responding to Emergencies	Know the underpinning knowledge 5.1.3, 5.1.4, 5.7.1	x			
		Understand how LNG liquid or vapour could be released into the atmosphere during the bunkering process and its consequences		x		
		Understand how to activate the ESD system and when to activate it		x		
		Understand the emergency procedures		x		

Example

Competence

- Understand the emergency procedures

Question:

What should you do when the emergency klaxon sounds?

Assessment

Closed multiple choice answer with the following options

a) safely stop what you are doing and head to a muster point

b) contact the control room by phone to say you are ok

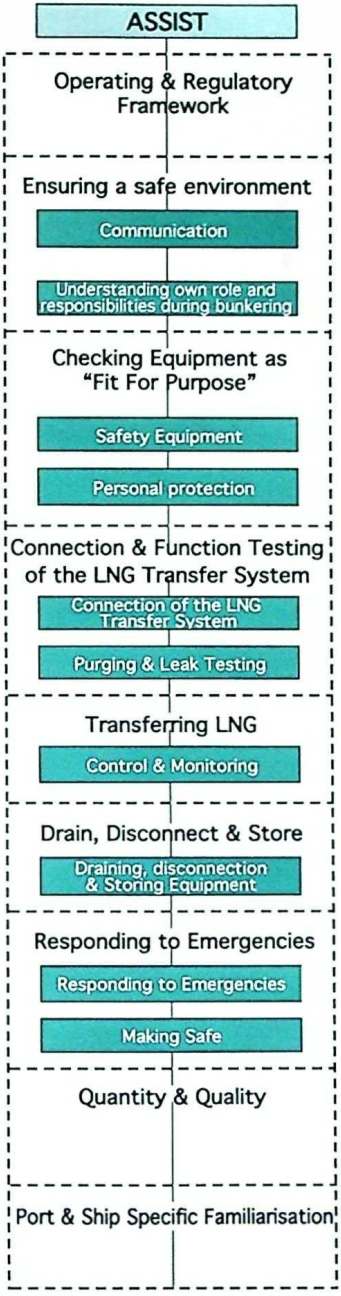
c) head to the nearest fence line and leave the site

7.2. ASSIST Role

This training is aimed at individuals who are involved with the transfer of LNG/gas but only under supervision of a more competent individual. One such role might be to perform a visual watch for leaks during the bunkering process or assist with the handling and/or connection of the LNG transfer equipment. **ASSIST** training would be expected to cover the following areas/concepts and behaviours

- understanding of their own role
- understand the behaviour of LNG/BOG
- understand mechanical handling principles
- understand how to connect and disconnect the transfer system to the manifold
- understand the need for and how to wear Personal Protective Equipment (PPE)
- understand the requirement for effective and timely communication

The assessment matrix for the **ASSIST** role is shown on the following pages.


ASSIST
Operating & Regulatory Framework
Ensuring a safe environment
Communication
Understanding own role and responsibilities during bunkering
Checking Equipment as "Fit For Purpose"
Safety Equipment
Personal protection
Connection & Function Testing of the LNG Transfer System
Connection of the LNG Transfer System
Purging & Leak Testing
Transferring LNG
Control & Monitoring
Drain, Disconnect & Store
Draining, disconnection & Storing Equipment
Responding to Emergencies
Responding to Emergencies
Making Safe
Quantity & Quality
Port & Ship Specific Familiarisation

*Assessment Matrix for **ASSIST** Role*

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.2.2	Communica-tion	Know the underpinning knowledge 5.2.4, 5.3.1, 5.3.2, 5.5.1	X			
		Understand what information should be exchanged, when and with whom		X		
		Apply effective communication methods			X	
		Apply accurate recording of appropriate information for governance processes			X	
4.2.4	Understanding own role and responsibilities	Know the underpinning knowledge 5.2.1, 5.1.3	X			
		Understand their own job role throughout the bunkering process		X		
		Understand their own role in ensuring the safe and environmentally responsible transfer of LNG		X		
		Understand the need to report and record safety/ environmental incidents		X		
4.3.5	Safety Equipment	Know the underpinning knowledge 5.1.5, 5.4.8, 5.7.2	X			
		Understand the operation of equipment used for hazard detection (gas and fire detectors)		X		
		Understand the purpose of drip trays and water curtain and how they are used to protect the vessel(s)/bunkering transfer area		X		
		Understand where safety equipment is installed or needs to be placed		X		
4.3.6	Personnel Protection	Know the underpinning knowledge 5.1.3,5.4.9	X			
		Understand which items of PPE should be used when working with LNG		X		

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.4.1	Connection of the Transfer System	Know the underpinning knowledge 5.1.1, 5.1.5, 5.4.1,	x			
		Understand the various connection methods that may be used		x		
		Apply – assist in the assembly of the LNG transfer system			x	
		Apply checks that verify the system is free from leaks across the operating temperature range			x	
4.4.2	Purging and Leak Testing	Know the underpinning knowledge 5.1.3, 5.1.4, 5.1.5, 5.1.7, 5.4.8,	x			
		Understand the possible physical and environmental damage that may be caused by a leak of LNG		x		
		Apply the appropriate corrective measures on identification of a leak of liquid or vapour			x	
4.5.4	Control and Monitoring	Know the underpinning knowledge 5.6.3	x			
		Understand the functions of the bunkering control system		x		
		Understand how the LNG transfer process can be monitored, by who and the equipment used		x		
		Understand the philosophy of how the ESD system works and its different means and levels of activation		x		
		Understand how to accurately read temperature instruments		x		
		Understand how to accurately read pressure gauges		x		
		Understand how to accurately read level instruments		x		

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.6.1	Draining, Purging, Disconnection and Storage	Know the underpinning knowledge 5.4.1, 5.4.2, 5.4.9, 5.4.10, 5.5.2, 5.5.3, 5.5.5	X			
		Understand the different methods of safely and effectively draining and purging transfer lines without allowing LNG or its vapour to leak into the environment		X		
		Understand how to correctly store/park LNG transfer equipment		X		
4.7.2	Responding to Emergencies	Know the underpinning knowledge 5.1.3, 5.1.4, 5.7.1	X			
		Understand how LNG liquid or vapour could be released into the atmosphere during the bunkering process and its consequences		X		
		Understand how to activate the ESD system and when to activate it		X		
		Understand the emergency procedures		X		
4.7.3	Making Safe	Know the underpinning knowledge 5.1.1, 5.1.3, 5.1.4, 5.4.6, 5.4.8, 5.5.6, 5.6.2, 5.7.2, 5.7.4	X			
		Understand how the ESD system works and how and when to activate it		X		
		Understand the purpose and operation of the gas venting and LNG discharge systems		X		
		Understand the potential hazards resulting from trapped volumes of LNG and where they could occur		X		
		Apply - safely isolate the bunkering system to prevent any release escalating			X	
		Understand how to safely isolate potential ignition sources		X		

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.7.3	Making Safe (Continued)	Understand how and when to initiate fixed and portable firefighting equipment		x		
		Understand how and when to fight a LNG fire		x		
		Understand the emergency procedures		x		

Example

Competence

- Connection of the Transfer System
- Understand the various connection methods that may be used

Question:

What connection methods may be used to connect a ship's manifold to a LNG supplier?

Assessment

Closed multiple choice answer with the following options

a) flexible hose with a dry disconnect coupler

b) loading arm with hydraulic coupler

c) flexible hose with a standard flange

d) all of the above

Example 2

Competence

- Connection of the Transfer System
- Apply learned skills to be able to undertake the checks that verify the system is free from leaks across the operating temperature range

Question:

Demonstrate the checks required for a flexible hose to be confirmed as leak tight

Assessment

Practical

- Review of the practical tasks by an instructor

OR

Open question

- Show where and when to leak test the connection system, what techniques to use and what to look out for by referring to a model or producing a diagram

7.3. DO Role

This training is aimed at individuals who perform the transfer of LNG/gas. The individual must be able to understand how LNG behaves, confirm that the transfer equipment is fit for purpose and how to connect the equipment to provide a safe and leak free fuel transfer. The individual must also understand the roles of others in the transfer process and be able to provide sufficient supervision and communication with these other participants.

DO training would be expected to cover the following areas/concepts and behaviours.

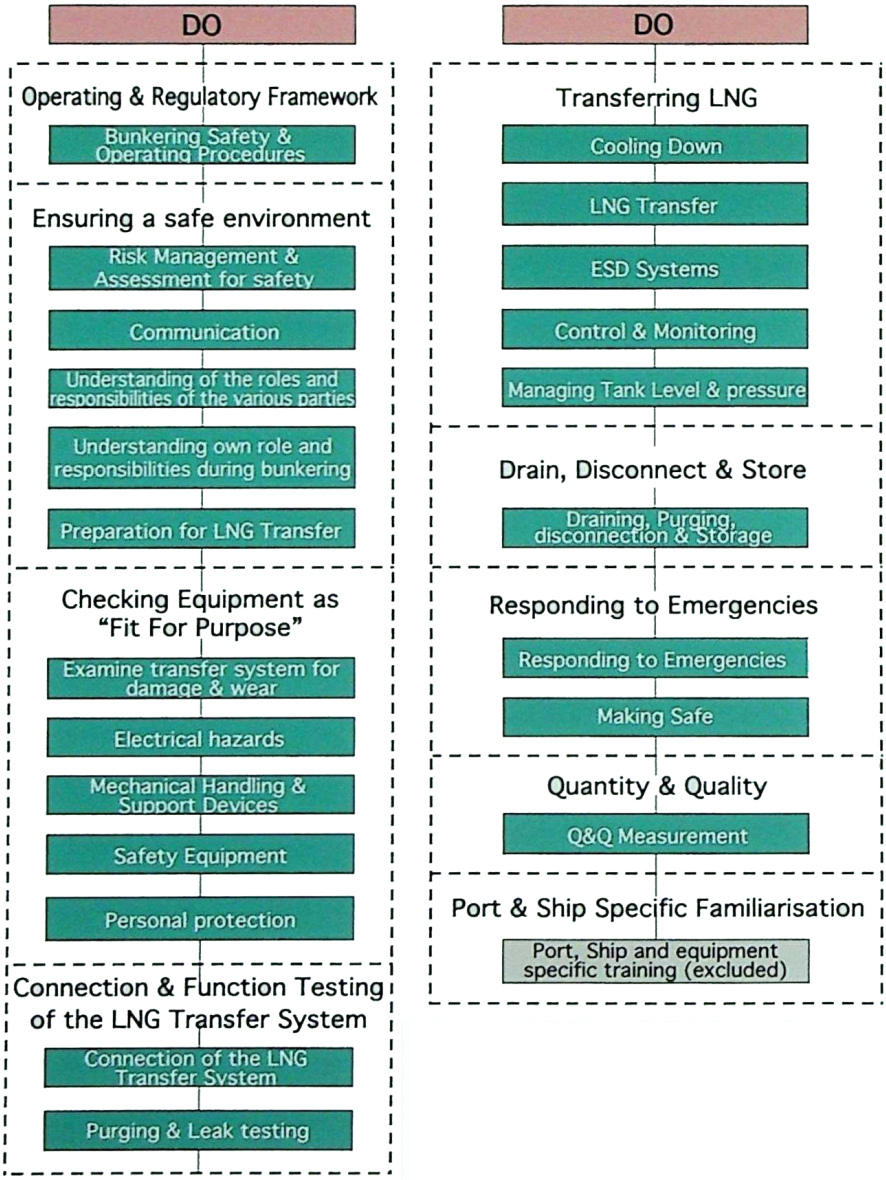
Supervisory Role

- understand and be able to follow the operating manual
- be able to perform a risk assessment for each bunkering
- understand the roles of others in bunkering and communicate effectively
- be able to ensure the safety of the LNG transfer process
- understand the LNG tank design and its limitations
- avoid venting of LNG vapour

Practical Tasks

- perform and record measurements
- confirm transfer system is fit for purpose - compatible and undamaged
- connect the transfer system correctly - no leaks
- ensure ESD system connected and works correctly
- initiate and stop LNG transfer
- effectively supervise **ASSIST** role

The assessment matrix for the **DO** role is shown on the following pages


DO
Operating & Regulatory Framework
Bunkering Safety & Operating Procedures
Ensuring a safe environment
Risk Management & Assessment for safety
Communication
Understanding of the roles and responsibilities of the various parties
Understanding own role and responsibilities during bunkering
Preparation for LNG Transfer
Checking Equipment as "Fit For Purpose"
Examine transfer system for damage & wear
Electrical hazards
Mechanical Handling & Support Devices
Safety Equipment
Personal protection
Connection & Function Testing of the LNG Transfer System
Connection of the LNG Transfer System
Purging & Leak testing
DO
Transferring LNG
Cooling Down
LNG Transfer
ESD Systems
Control & Monitoring
Managing Tank Level & pressure
Drain, Disconnect & Store
Draining, Purging, disconnection & Storage
Responding to Emergencies
Responding to Emergencies
Making Safe
Quantity & Quality
Q&Q Measurement
Port & Ship Specific Familiarisation
Port, Ship and equipment specific training (excluded)

*Assessment Matrix for **DO** Role*

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.1.3	Safety and Operating Procedures	Know the underpinning knowledge 5.2.4, 5.2.5	X			
		Apply the appropriate safety and operating procedures to a LNG Bunkering operation			X	
		Understand the role and scope of the operating and safety procedures with respect to bunkering		X		
		Understand where the safety and operating procedures are detailed and how to use them		X		
		Apply the necessary modifications/improvements to procedures			X	
4.2.1	Risk Management and Assessment for Safetys	Know the underpinning knowledge 5.11, 5.13, 5.15, 5.22, 5.24, 5.31	X			
		Understand the properties and characteristics of LNG and gases		X		
		Interpret specific situations relating to a LNG bunkering operation, including SIMOPS, to determine whether a risk assessment should be undertaken				X
		Understand the principles of risk assessment		X		
		Understand the importance of following a risk assessed procedure		X		
4.2.2	Communication	Know the underpinning knowledge 5.2.4, 5.3.1, 5.3.2, 5.5.1	X			
		Understand what information should be exchanged, when and with whom		X		
		Apply effective communication methods			X	
		Apply accurate recording of appropriate information for governance processes			X	

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.2.3	Understanding the roles and responsibilities of other parties involved	Know the underpinning knowledge 5.3.1, 5.3.2	x			
		Understand the roles and responsibilities of the various persons and organisations who may be involved in a LNG Transfer operation		x		
4.2.4	Understanding own role and responsibilities	Know the underpinning knowledge 5.2.1, 5.1.3	x			
		Understand their own job role throughout the bunkering process		x		
		Understand their own role in ensuring the safe and environmentally responsible transfer of LNG		x		
		Understand the need to report and record safety/ environmental incidents		x		
4.2.5	Preparation for LNG Transfer	Know the underpinning knowledge 5.1.1, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.2.2, 5.4.8, 5.5.1	x			
		Apply – demonstrate how to prepare the area where the transfer will take place			x	
		Understand the purpose and requirements of pre-transfer checks		x		
		Apply the pre-transfer checks			x	
		Understand the safety equipment that is required		x		
		Understand the effect of environmental conditions and how they may negatively impact the bunkering process and/or staff performance		x		

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.3.2	Examine Transfer System for Damage and Wear	Know the underpinning knowledge 5.1.5, 5.4.2, 5.4.10	x			
		Understand which items of equipment need to be certif-icated and confirm that they are within certification		x		
		Apply - examine all the components of the LNG transfer system for physical damage and wear			x	
4.3.3	Electrical Hazards	Know the underpinning knowledge 5.1.6, 5.4.7	x			
		Understand the hazards associated with both current electricity and static electricity when transferring LNG liquid and/or vapour		x		
		Understand the purpose of an insulating flange		x		
		Understand the reason for maintaining electrical continuity of bunkering lines		x		
		Understand the requirements for the use of electrical equip-ment in hazardous areas		x		
		Apply – examine the physical condition of electrical equip-ment in hazardous zones for safe function prior to use			x	
4.3.4	Mechanical Handling and Support Devices	Know the underpinning knowledge 5.4.1, 5.4.2, 5.4.10	x			
		Understand how to handle a transfer hose and loading arm correctly		x		
		Understand why the LNG transfer system must be supported to avoid excessive stresses and bending in the hose, breakaway coupling, connector and manifolds		x		

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.3.4	Mechanical Handling and Support Devices (continued)	Understand why and which mechanical handling equip-ment items are covered by certification systems and how to confirm that they are within certification		x		
		Understand how to examine the mechanical handling system for safe function prior to use		x		
		Understand which mechanical handling systems must remain in place during LNG transfer		x		
4.3.5	Safety Equipment	Know the underpinning knowledge 5.1.5, 5.4.8, 5.4.10, 5.6.1, 5.7.2	x			
		Apply - demonstrate the operation of equipment used for hazard detection (gas and fire detectors) and how en-vironmental conditions may affect their performance			x	
		Apply adequately maintain hazard detection equipment			x	
		Understand the purpose of drip trays and water curtain and how they are used to protect the vessel(s)/bunker-ing transfer area		x		
		Understand where safety equipment is installed or needs to be placed		x		
4.3.6	Personnel Protection	Know the underpinning knowledge 5.1.3, 5.4.9	x			
		Understand which items of PPE should be used when working with LNG		x		

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.4.1	Connection of the Transfer System	Know the underpinning knowledge 5.1.1, 5.1.5, 5.4.1, 5.4.2, 5.4.3, 5.4.10	X			
		Understand the various connection methods that may be used		X		
		Apply - assemble the LNG transfer system in the correct order			X	
		Apply the checks to ensure that electrical continuity and insulation devices are correctly maintained and installed			X	
		Apply the checks to verify the system is free from leaks across the operating temper-ature range			X	
		Understand the various types of LNG storage systems that may be used by a supplier and the resulting implications that may need to be considered relating to the transfer of LNG		X		
4.4.2	Purging and Leak Testing	Know the underpinning knowledge 5.1.4, 5.1.7, 5.1.3, 5.1.5, 5.4.8, 5.5.2, 5.5.3	X			
		Understand the risks that may result if oxygen and moisture are not removed from the LNG transfer system prior to the intro-duction of LNG vapour or liquid.		X		
		Understand the methods that may be used to purge the LNG transfer system prior to use and the indications for satisfactory completion		X		
		Understand the possible physical and environmental damage that may be caused by a leak of LNG		X		
		Apply - test for leaks on the LNG transfer system			X	
		Apply the appropriate corrective measures on identification of a leak of liquid or vapour			X	

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.5.1	Cooling Down	Know the underpinning knowledge 5.1.1, 5.1.4, 5.1.5, 5.4.2, 5.4.3, 5.4.6, 5.4.8, 5.4.10, 5.5.2, 5.5.4	X			
		Understand why cooling down of LNG systems is required and the potential for leaks		X		
		Apply the methods that can be used to cool down a LNG transfer system and how it should be monitored			X	
		Understand the procedures for vapour return, disposal or pressure management related to different LNG storage systems		X		
4.5.2	LNG Transfer	Know the underpinning knowledge 5.2.4, 5.3.1, 5.4.2, 5.4.3, 5.4.5, 5.5.4, 5.6.4	X			
		Understand the importance of having an agreed transfer plan		X		
		Apply - control and monitor LNG flows throughout all stages of the LNG transfer process			X	
		Understand the data to be monitored and the appropriate parameters that indicate safe operation		X		
		Apply - control and monitor the temperature and pressure within the LNG storage tank(s) and associated systems			X	
		Understand the procedures for completion of the transfer		X		
		Apply - take and record LNG transfer records throughout the transfer process			X	

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.5.3	ESD Systems	Know the underpinning knowledge 5.6.1, 5.6.2,	x			
		Understand the philosophy of how ESD systems work and the different means and levels of activation including the impact of actuating the ESD system		x		
		Interpret equipment status , instrumentation, alarms and other variables to find and correct the underlying cause of the occurrence of an ESD				x
		Understand why and how to link/connect and test an ESD system from LNG supplier to LNG receiver		x		
		Understand the additional procedures and checks required should a linked ESD system not be available		x		
4.5.4	Control and Monitoring	Know the underpinning knowledge 5 4.5, 5.6.1, 5.6.3, 5.6.4	x			
		Understand the key alarms and their likely causes and (potential) effects		x		
		Understand the functions of the fire and gas monitoring systems		x		
		Interpret equipment status , instrumentation, alarms and other variables to correctly re-spond to an alarm by finding and identifying its underlying cause				x
		Understand the functions of the bunkering control system		x		
		Understand how the LNG transfer process can be monitored, by who and the equipment used		x		

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.5.4	Control and Monitoring (continued)	Understand the philosophy of how the ESD system works and its different means and levels of activation		X		
		Understand how to accurately read temperature instruments		X		
		Understand how to accurately read pressure gauges		X		
		Understand how to accurately read level instruments		X		
4.5.5	Managing Tank Levels	Know the underpinning knowledge 5.4.3, 5.4.6, 5.5.4, 5.6.4	X			
		Apply – manage level and pressure in a LNG tank during LNG transfer			X	
		Understand pressure and vacuum protection systems on the LNG tank		X		
		Understand the safe tank filling limit and how to calculate it		X		
		Understand the types of level gauges installed, their accuracy limits, and how to accurately read them		X		
		Understand the types of pressure gauges installed, their accuracy limits, and how to accurately read them		X		
4.6.1	Draining, Purging, Disconnection and Storage	Know the underpinning knowledge 5.1.7, 5.4.1, 5.4.2, 5.4.5, 5.4.9, 5.4.10, 5.5.2, 5.5.3, 5.5.5, 5.5.6	X			
		Apply – isolate the LNG tank(s)			X	
		Apply – safely and effectively drain and purge transfer lines without allowing LNG or vapour to leak into the environment			X	

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.6.1	Draining, Purging, Disconnection and Storage (continued)	Apply - ensure LNG is not trapped within sections of the transfer system			X	
		Apply - ensure/test line is gas free before disconnection			X	
		Understand how to isolate and safely disconnect the LNG transfer equipment		X		
		Understand how to correctly store/park LNG transfer equipment		X		
4.7.2	Responding to Emergencies	Know the underpinning knowledge 5.1.3, 5.1.4, 5.7.1	X			
		Understand how LNG liquid or vapour could be released into the atmosphere during the bunkering process and its consequences		X		
		Understand how to activate the ESD system and when to activate it		X		
		Understand the emergency procedures		X		
4.7.3	Making Safe	Know the underpinning knowledge 5.1.1, 5.1.3, 5.1.4, 5.4.6, 5 4.8, 5.5.6, 5.6 2, 5.7.1, 5 7 2, 5.7.4	X			
		Understand how the ESD system works and how and when to activate it		X		
		Understand the purpose and operation of the gas venting and LNG discharge systems		X		
		Understand the potential hazards resulting from trapped volumes of LNG and where they could occur		X		
		Apply - safely isolate the bunkering system to prevent any release escalating			X	

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.7.3	Making Safe (continued)	Understand how to safely iso-late potential ignition sources		X		
		Understand how and when to initiate fixed and portable firefighting equipment		X		
		Understand how and when to fight a LNG fire		X		
		Understand the emergency procedures		X		
4.8.2	Quality and Quantity Measurement	Know the underpinning knowledge 5.6.4, 5 8.1	X			
		Understand the principles of the transfer measurement process.		X		
		Understand the information required to be recorded for Quality & Quantity purposes		X		
		Understand the principle of operation and operating procedures of the various types of flow, level and weight measuring equipment that may be encountered		X		
		Understand the types of temperature instruments installed, potential sources of inaccuracy, and how to accurately read them		X		
		Understand the types of pres-sure gauges installed, potential sources of inaccuracy, and how to accurately read them		X		
		Understand the types of level instruments installed, poten-tial sources of inaccuracy, and how to accurately read them		X		
4.9	Port and/or Ship Specific Operations	Apply – ensure safe and responsible operations of any equipment (for example, vehicle driving, crane oper-ation, etc.) that their role and the ship/port requires			X	
		Understand equipment capability, layout and safety and security measures		X		

Example 1

Competence

- Quality and Quantity Measurement
- Understand the information required to be recorded for Quality & Quantity purposes

Question:

Complete a custody transfer record using the data provided

Assessment

Open question

- select the appropriate data from a list and complete a custody transfer record sheet

Example 2

Competence

- Connection of the Transfer System
- Apply learning to demonstrate how to isolate the LNG at the tanks

Question:

Demonstrate how to isolate LNG at the LNG storage tank (on receiving vessel or delivery equipment)

Assessment

Practical

- Turn the appropriate valves in the correct order and make the appropriate instrumentation checks in front of the instructor

OR

Open question

- Using a P&ID (or similar) show which valves need to be turned and instruments checked and in which order.

Example 3

Competence

- Control and monitoring
- Interpret equipment status , instrumentation, alarms and other variables to correctly respond to an alarm by finding and identifying its underlying cause

Question:

Diagnose the cause of an alarm and correct the underlying issue to ensure it is reset and bunkering can continue/re-start

Assessment

Practical

- Using a simulator, interpret the data, diagnose the fault and correct it before restarting bunkering

7.4. MANAGE Role

This training is aimed at individuals who are legally responsible for the transfer of LNG/gas but do not necessarily take part in the practicalities of the transfer, for example connecting the hose or opening and closing valves (covered by **DO** training).

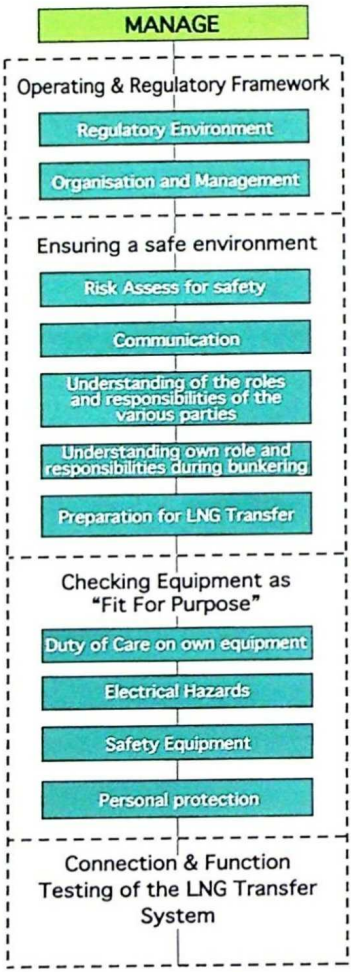
The individual must be able to understand the regulations at the LNG transfer location and ensure that the transfer process takes place within these restrictions. The main concepts here would be interpreting the regulations to ensure the operating manual is appropriate, risk assessing any changes and the impact of other simultaneous operations, ensuring the **DO**er and their **ASSIST**ant are competent and understand any special procedures for a transfer, ensuring that all parties agree when and how the LNG transfer takes place and ensure that all equipment under their control is designed, operated and maintained to suitable standards.

MANAGE training would be expected to cover the following areas/ concepts and behaviours:

- understand local rules and regulations and their impact on ship, LNG transfer and emergency operational plans and ensure that the law is complied with
- provide appropriate training for staff to ensure they comprehend and follow manuals, procedures and any special instructions
- ensure equipment is properly designed, modified, installed and maintained
- ensure that personnel at **DO** and **ASSIST** grades are appropriately trained and experienced
- risk assess any modifications to equipment or procedures/processes required for each location and any simultaneous operations proposed
- report, analyse and recommend changes resulting from incidents and near misses
- obtain permission to bunker and communicate effectively to all parties involved

- complete LNG transfer paperwork

The assessment matrix for the **MANAGE** role is shown on the following pages



Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.1.1	Regulatory Environment	Know the underpinning knowledge 5.2.1, 5.2.4, 5.5.1	X			
		Understand the international legal context of the bunkering process (local arrangements would be covered under Port and Ship Specific Familiarisation)		X		
		Understand the role of the safety, environmental and operating manuals in complying with legal requirements and be able to compare manuals with rules and regulations and identify gaps in compliance		X		
		Understand why ship's equipment/system and/or facilities must not be modified from their original, compliant, design without appropriate risk assessment to demonstrate continued compliance		X		
		Understand the requirement to ensure all regulatory requirements are fulfilled		X		
		Understand why operating and maintenance procedures on ships and/or facilities must not be modified from their compliant principles without appropriate risk assessment to demonstrate continued compliance		X		
		Understand what steps must be completed before an "agreement to bunker" decision can be made and how this should be recorded		X		
4.1.2	Organisation and Management	Know the underpinning knowledge 5.2.4, 5.3.1, 5.3.2, 5.5.1	X			
		Understand the training and competency required by those staff responsible for bunkering.		X		

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.1.2	Organisation and Management (continued)	Determine and Apply the required manning levels for transfer operations, including requirements for support personnel			X	
		Understand the roles of the LNG buyer/receiver (ship), LNG seller and LNG deliverer (bunkerer)		X		
		Understand the roles of specialists employed to support the bunker transfer process		X		
		Understand the need for, and the main elements of, a communications plan between LNG receiver and LNG supplier		X		
		Understand the need for mooring and bunkering equipment compatibility checks and how this should be implemented		X		
4.2.1	Risk Management and Assessment	Know the underpinning knowledge 5.1.1, 5.1.3, 5.1.5, 5.2.2, 5.2 4, 5.3 1	X			
		Understand the properties and characteristics of LNG and gases		X		
		Interpret specific situations relating to a LNG bunkering operation, including SIMOPS, to determine whether a risk assessment should be undertaken				X
		Apply risk assessment techniques and implement the findings			X	
		Apply - plan and monitor work carried out under a risk assessment to ensure its effectiveness and that all risks are managed			X	
		Understand the necessity to regularly review risk assessments relating to commonly performed operations		X		

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.2.2	Communica-tion	Know the underpinning knowledge 5.2.4, 5.3.1, 5.3.2, 5.5.1	X			
		Understand what information should be exchanged, when and with whom		X		
		Apply effective communication methods			X	
		Apply accurate recording of appropriate information for governance processes			X	
4.2.3	Understanding the roles and responsibilities of other parties involved	Know the underpinning knowledge 5.3.1, 5.3.2	X			
		Understand the roles and responsibilities of the various persons and organisations who may be involved in a LNG Transfer operation		X		
4.2.4	Understanding own role and responsibilities	Know the underpinning knowledge 5.2.1, 5.1.3	X			
		Understand their own job role throughout the bunkering process		X		
		Understand their own role in ensuring the safe and environmentally responsible transfer of LNG		X		
		Understand the need to report and record safety/environmental incidents		X		
4.2.5	Preparation for LNG Transfer	Know the underpinning knowledge 5.1.1, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.2.2, 5.4.8, 5.5.1	X			
		Apply - demonstrate how to prepare the area where the transfer will take place			X	
		Understand the purpose and requirements of pre-transfer checks		X		

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.2.5	Preparation for LNG Transfer (continued)	Apply the pre-transfer checks			X	
		Understand the safety equip-ment that is required		X		
		Understand the effect of environmental conditions and how they may impact the bunkering process and/or staff performance		X		
4.3.1	Transfer System Equipment / Duty of Care	Know the underpinning knowledge 5.2.3	X			
		Understand which items of equipment need to be certificated and confirm that certification is up to date		X		
		Understand what mainte-nance and calibration records are required for owned and rented equipment		X		
		Understand the Duty of Care concept, how this protects both persons and assets and how to decide which precau-tions/actions are necessary		X		
4.3.3	Electrical Hazards	Know the underpinning knowledge 5.1.6, 5.4.7	X			
		Understand the hazards associated with both current electricity and static electricity when transferring LNG liquid and/or vapour		X		
		Understand the purpose of an insulating flange		X		
		Understand the reason for maintaining electrical conti-nuity of bunkering lines		X		
		Understand the requirements for the use of electrical equip-ment in hazardous areas		X		

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.3.3	Electrical Hazards (continued)	Apply - examine the physical condition of electrical equip-ment in hazardous zones for safe function prior to use			X	
4.3.5	Safety Equipment	Know the underpinning knowledge 5.1.5, 5.4.8, 5.4.10, 5.6.1, 5.7.2	X			
		Apply - demonstrate the operation of equipment used for hazard detection (gas and fire detectors) and how en-vironmental conditions may affect their performance			X	
		Apply- adequately maintain hazard detection equipment			X	
		Understand the purpose of drip trays and water curtain and how they are used to protect the vessel(s)/bunker-ing transfer area		X		
		Understand where safety equipment is installed or needs to be placed		X		
4.3.6	Personnel Protection	Know the underpinning knowledge 5.1.3, 5.4.9	X			
		Understand which items of PPE should be used when working with LNG		X		
4.5.3	ESD Systems	Know the underpinning knowledge 5.6.1, 5.6.2,	X			
		Understand the philosophy of how ESD systems work and the different means and levels of activation including the impact of actuating the ESD system		X		
		Interpret equipment status, instrumentation, alarms and other variables to find and correct the underlying cause of the occurrence of an ESD				X

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.5.3	ESD Systems (continued)	Understand why and how to link/connect and test an ESD system from LNG supplier to LNG receiver		x		
		Understand the additional procedures and checks required should a linked ESD system not be available		x		
4.5.4	Control and Monitoring	Know the underpinning knowledge 5.4.5, 5.6.1, 5.6.3, 5.6.4	x			
		Understand the key alarms and their likely causes and (potential) effects		x		
		Understand the functions of the fire and gas monitoring systems		x		
		Interpret equipment status, instrumentation, alarms and other variables to correctly re-spond to an alarm by finding and identifying its underlying cause				x
		Understand the functions of the bunkering control system		x		
		Understand how the LNG transfer process can be monitored, by who and the equipment used		x		
		Understand the philosophy of how the ESD system works and its different means and levels of activation		x		
		Understand how to accurately read temperature instruments		x		
		Understand how to accurately read pressure gauges		x		
		Understand how to accurately read level instruments		x		

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.7.1	Managing Emergencies	Know the underpinning knowledge 5.1.1, 5.1.3, 5.1.5, 5.2.4, 5.7.1, 5.7.3	X			
		Interpret potentially hazard-ous events that may occur during bunkering operations and respond effectively				X
		Understand the principles of escalation where one hazardous event may lead to others		X		
		Understand the principles of emergency evacuation, and where appropriate the role of temporary refuges, and how plans may need to be modified for different weather and damage scenarios and by the bunkering process		X		
		Understand when to evac-uate to a muster point (or temporary refuge)		X		
		Understand how to co-ordi-nate with, and when to hand-over to, the local immediate responders and emergency services		X		
		Apply – prepare, implement and review contingency plans			X	
		Understand the need for, and benefits of, recording and completing any near miss/ hazardous event paperwork		X		
4.7.2	Responding to Emergencies	Know the underpinning knowledge 5.1.3, 5.1.4, 5.7.1	X			
		Understand how LNG liquid or vapour could be released into the atmosphere during the bunkering process and its consequences		X		

Ref	Module	Competence	Know (K)	Under-stand (U)	Apply (A)	Interpret (I)
4.7.2	Responding to Emergencies (continued)	Understand how to activate the ESD system and when to activate it		X		
		Understand the emergency procedures		X		
4 8.1	Quantity and Quality Management	Know the underpinning knowledge 5 6 4, 5.8.1, 5.8.2	X			
		Understand the LNG quality certification provided prior to LNG transfer including the composition and energy quality terms and be able to determine whether the LNG is outside of specification and the implications of this		X		
		Understand the units of measurement, calculations and the accuracies required to confirm the amount and quality of the LNG transferred		X		
4.9	Port and/or Ship Specific Operations	Understand the impact of port/ship rules and regula-tions on their job role		X		
		Understand the LNG bunker-ing operations allowed in the port and the risk assessments required to support these		X		
		Understand, where required for their role and imple-mented in the local area, the concept and limitations of permit to work schemes (or similar) on how they perform their work tasks		X		
		Understand the SIMOPS allowed in the port and the risk assessments required to support these		X		
		Understand the ship/port(s) layout and their safety and security measures		X		

Example 1

Competence

- Quality and Quantity Measurement
- Understand the units of measurement, calculations and the accuracies required to confirm the amount and quality of the LNG transferred

Question:

Calculate the amount of LNG transferred and its financial value using the data provided

Assessment

Open question

- select the appropriate data from a list and calculate the answers using the appropriate equations

Example 2

Competence

- Managing Emergencies
- Apply – demonstrate the planning and execution of emergency plans and how to incorporate lessons learned into contingency plans

Question:

Prepare an emergency plan for a given vessel and apply it to a specific hazard scenario

Assessment

Practical

- Examine a vessel layout and develop an emergency plan
- Subsequently test the plan against an incident proposed by the instructor

Example 3

Competence

- Risk Management and Acceptance
- Interpret specific situations relating to a LNG bunkering operation, including SIMOPS, which may require a risk assessment to be undertaken

Question:

For a given port and ship combination investigate what actions need to be performed simultaneously with bunkering and perform a risk assessment to determine any additional precautions/actions required.

Assessment

Practical

- Review a series of circumstances and perform one or more risk assessments

8. SPECIALIST Roles

This training is aimed at individuals who will provide specialist services to enable a bunker facility to operate safely and in an environmentally responsible manner in a particular location. A non-exhaustive list of suggested roles would include:

- medical staff ranging from emergency doctors in local or regional hospitals to local first aiders needing familiarity with the causes and treatments of injuries caused by cryogenic material
- land based fire fighters, salvors, lifeboat crews and tug captains required to assist with the management of any spills and/or fires involving LNG (fire training for mariners is covered by STCW)
- maintenance (and operating) staff working on specialist equipment needing extensive knowledge from the equipment manufacturer.
- jetty staff (including line handlers) who may be called on to assist during ship movements
- staff in ferry terminals or on board passenger vessels responsible for mustering and mass evacuation
- individuals sampling and analysing LNG for quality purposes
- ship repair and/or inspection personnel working on a ship that is gas-live where special precautions are required to work within active hazardous zones and gassed up or LNG containing systems.

9. BESPOKE Roles

BESPOKE roles within the LNG bunkering business that may benefit from combinations of the competence modules described in this report could, whilst not being limited to, include

- ship owners/operators marine superintendent
- classification society surveyor
- port and flag state personnel
- local authority permitting staff and auditors
- port authority staff and regulators

10. Relevant Training Courses/ Syllabuses

SGMF does not require specialist courses for LNG bunkering if the competence can be demonstrated by prior learning and demonstrated competence achieved through other organisations/training schemes.

A list of training providers who use these competence and assessment guidelines can be found on the SGMF website.

SIGTTO provide guidance on the selection of training providers for the IGC Code. Much of this is relevant to training providers under the IGF Code.

10.1. STCW

The IMO has prescribed certain training requirements for personnel involved with the operation of ships that conform to the **International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)** and the **International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels (IGF Code)**.

Many of the training requirements required by STCW and implemented by Flag States are also documented in SGMF's guidelines. Knowledge and skills developed under STCW training courses, if demonstrated to be correctly understood by the trainee, can be used as evidence of competency under the SGMF guidelines and should not need to be taught again.

Obvious examples of compatibility between SGMF and STCW are:

- underpinning knowledge on the behaviour of LNG/natural gas
- risk assessment
- fire training
- first aid

Other STCW courses such as the "Advanced Training for Oil Tankers" and "Advanced Training for Chemical Tankers" also provide training that will meet some of the competences required for IGF.

Obvious examples of compatibility between these courses and SGMF are:

- hazards of hydrocarbons
- electrical equipment in hazardous areas
- purging and inerting
- gas detection
- risk assessment
- emergency procedures
- fire training
- first aid

Many companies and academic institutions worldwide offer training to STCW requirements.

10.2. Other Maritime Training

Other organisations provide alternative competency based frame works for the IGF Code which may be equally applicable.

Some national regulatory bodies, for example in Singapore, are also developing training systems for mariners similar to those suggested by SGMF.

10.3. Road Tankers

All drivers of LNG road tankers are required to have some degree of training under various national and supra-national training schemes, for example, ADR (European agreement concerning the international carriage of dangerous goods by road in europe).

Knowledge and skills developed under these training courses, if demonstrated to be correctly understood by the trainee, can be used as evidence of competency under the SGMF guidelines and should not need to be taught again.

However, the variability between road tanker training courses is much wider than under maritime regulation so more care and attention needs to be considered to ensure that competencies are fully understood and transferable.

10.4. LNG Terminals

In most terminals and certainly in Europe (European Union's Seveso III directive) and in the USA (NFPA and CFR codes) and Canada under Federal rules all operators at LNG terminals must undergo extensive training to ensure their competence to operate a LNG terminal. These courses and often practical experience last several months and are anticipated to cover most of the competences required by SGMF.

Knowledge and skills developed under these training courses, if demonstrated to be correctly understood by the trainee, can be used as evidence of competency under the SGMF guidelines.

However, the variability between training courses is very large with each course being terminal specific.

10.5. Oil and Gas Facilities

Most oil and gas facilities from offshore drilling and production platforms to oil refineries via liquefied gas terminals such as LPG or ammonia and pipelines have similar safety cultures and therefore encourage many of the same practices as in this document. Some training schemes for these industries and products may well have competences, for example risk assessment, that are transferable and in accordance with these guidelines. However, the great variety of potential options available would need to be individually assessed to ensure compatibility.

11. References

11.1. Bibliography

IMO Sub-committee on Human Element Training and Watchkeeping, "Standards regarding special training for personnel on ships subject to the IGF Code", HTW 1/17,

DNVGL-ST-0026:2014-04, "Competence related to the on board use of LNG as fuel", DNV GL AS, April 2014

Krathwohl D.R., "A Revision of Bloom's Taxonomy: An Overview", Theory into Practice, Volume 41, Number 4, Autumn 2002

SIGTTO, "Suggested Quality Standards for LNG Training Providers", 2014

IMO Sub-committee on Human Element Training and Watchkeeping, "Model Course – Advanced Training for Liquefied Gas Tanker Cargo Operations", HTW 1/3/6, 22 November 2013

11.2. Supporting Material

Society for Gas as a Marine Fuel
(http://www.sgmf.info)

International Maritime Organization
(http://www.imo.org/en/OurWork/HumanElement/TrainingCertification/Pages/Default.aspx)

Alert! (Nautical Institute)
(http://www.he-alert.org/)

US Coast Guard National Maritime Centre
(http://www.uscg.mil/nmc/default.asp)

Seafarers International Research Centre
(http://www.sirc.cf.ac.uk/Education_and_Training.aspx)

Society of International Gas Tanker and Terminal Operators (SIGTTO)
(www.sigtto.org)

Oil & Gas Industry Academy
(http://www.opito.com/)

DNV GL
(http://rules.dnvgl.com/docs/pdf/DNVGL/ST/2014-04/DNVGL-ST-0026.pdf)

Appendix A: Taxonomy

A1. Assessment Guidelines

SGMF's assessment guidelines are based around educational principles (mostly Bloom's taxonomy and its variations) which cover a range of requirements ranging from basic techniques through intermediary levels to more advanced behaviours. Most of these levels are based on cognitive principles although in some instances skills required for physical manipulation are also required.

The learning and therefore assessment levels are shown diagrammatically in Figure A1 and in tabular form (Table A1). The titles are as follows:

- Description – what a successful candidate should be able to do
- Verb – the doing words associated with the description
- Keywords - assigned to each taxonomy which are then used in each relevant competence in the competency framework in Section 4. For example "understand" represents the second lowest level of taxonomy (level 2), or comprehend in Bloom's version and is used as follows;

  *"**Understand** their own role in ensuring the safe and environmentally responsible transfer of LNG"*

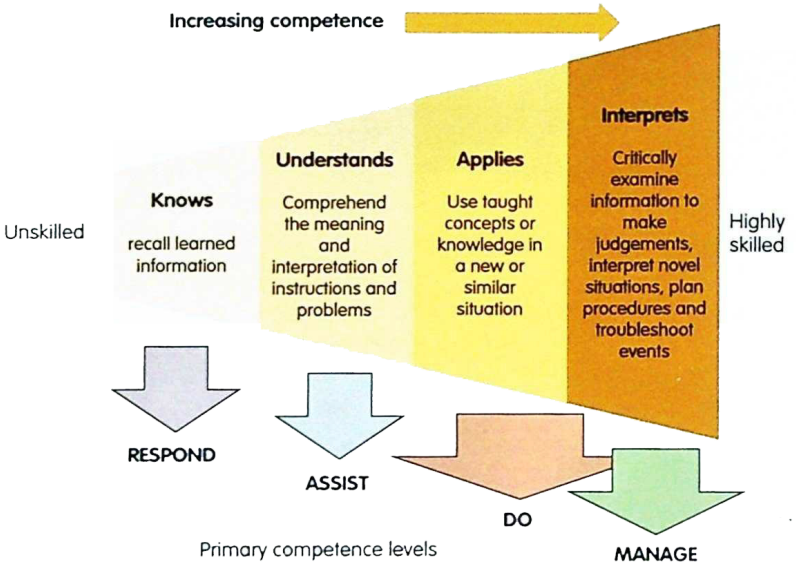
The SGMF assessment guidelines are based on these keywords:

- **Know** - recall learned information, particularly underpinning knowledge, on request
- **Understand** – understand the meaning and interpretation of instructions and problems based on the knowledge learnt
- **Apply** – use taught knowledge and general rules to different but similar situations
- **Interpret** – Critically examine information to make judgements, interpret novel situations, plan procedures and troubleshoot events

Progression through the learning hierarchy requires that lower levels must be mastered before higher levels can be attempted. For example,

if a candidate is trying to Understand they must already Know the (underpinning) knowledge on which their understanding will be based. Similarly anybody needing a skill at the Apply level will already have completed the Understand and Know stages.

Figure A1: Learning and Assessment Hierarchy



Level	Taxonomy	Description	Verbs	SGMF Keyword
1	Know	recall learned information	describes, knows,recalls, outlines, selects, recites	Know
2	Comprehend	Comprehend the meaning and interpretation of instructions and problems	comprehends, explains, gives examples, interprets, paraphrases, rewrites, summarises	Understand
3	Apply	Use a taught concepts or knowledge in new but similar situations	applies, changes, computes, demonstrates, discovers, manipulates, modifies, operates, prepares, produces, solves, uses	Apply
4	Analyse	Critically examine information to make judgements, interpret novel situations, plan procedures and troubleshoot events	analyses, breaks down, compares, contrasts, diagrams, deconstructs, differentiates, identifies, illustrates, infers, selects, troubleshoots, debates, combines, compiles, creates, devises, designs, explains, organizes, plans, rearranges, revises, builds	Interpret