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Guidelines for Safe STS LNG Transfer Operation



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CONTENTS

CHAPTER 1 INTRODUCTION	1
Section 1 General	1
Section 2 Terms and Definitions	2
CHAPTER 2 OVERVIEW OF STS LNG TRANSFER OPERATION	5
Section 1 General	5
CHAPTER 3 SAFETY REQUIREMENTS OF STS LNG TRANSFER OPERATION	6
Section 1 General	6
Section 2 Safety Requirements - Prior to STS LNG Transfer Operation	6
Section 3 Safety Requirements - Starting and Ending of the STS LNG Transfer Operation	12
ANNEX 1 CHECKLIST - PRIOR TO STS LNG TRANSFER OPERATION	15
ANNEX 2 CHECKLIST - STARTING AND ENDING OF THE STS LNG TRANSFER OPERATION	26

CHAPTER 1 INTRODUCTION

Section 1 General

101. Application

1. The guidelines apply to ship-to-ship (hereinafter referred to as STS) LNG transfer operation and STS LNG bunkering operation.
2. The LNG transfer operation described in the guidelines is applicable to various equipment and systems, including ships, and is not limited to specific technical and regulatory fields.
3. The rules for the transfer of LNG between ships described in the guidelines are applied in Pt 7, Ch 5 of Rules for the classification of steel ships.
4. The rules for ships using LNG fuel described in the guidelines are applied in the Rules for the classification of ships using low-flashpoint fuels.
5. All operations described in the guidelines are applied in the ISM code.
6. The guidelines mainly presents safety requirements for safe operation based on risk scenarios identified in risk assessment such as HAZID and HAZOP study related to LNG transfer operation and STS LNG bunkering operation conducted by the Korean Register for many years.

102. Overview

1. The application method of the Guidelines for safe STS LNG transfer operation is as follows.
 - (1) Prepare the Self-safety management plan.
 - (2) Conduct the Safety assessment based on (1) above. Safety evaluation here refers to Compatibility study, Risk assessment (HAZID, HAZOP, SIMOPS, etc.), Safety zone study, etc.
 - (3) Improve and supplement the safety requirements described in the Checklist for STS LNG transfer operation based on the results of Safety assessment conducted in (2) above.
 - (4) Complement the Self-safety management plan in (1) above by identifying the improvements and supplements conducted in (3) above.
 - (5) If improvements and supplements identified during actual STS LNG transfer operation are applied in the Checklist for STS LNG transfer operation, the Self-safety management plan, STS LNG transfer Operation can be carried out more safely.

103. Purpose

1. The purpose of Guidelines for safe STS LNG transfer operation is to help for securing the safety of operation by providing the guidelines so that the STS LNG transfer and bunkering operation can be safely carried out to minimize the risk of personnel, asset and environment.

104. Objects

1. Guidelines for safe STS LNG transfer operation are for:
 - (1) STS LNG transfer between ships at sea
 - (A) LNG supply vessel: LNG bunkering vessel, LNG barge, etc.
 - (B) LNG receiving vessel: LNG fuelled vessel, LNG carrier, etc.
 - (2) Gas trial for LNG bunkering vessel
 - (3) Gas trial of LNG fuelled vessel
 - (4) Gas trial of LNG carrier

105. Key documents

1. Self-safety management plan is a plan established in accordance with domestic laws and guidelines for the safe transfer operation of dangerous cargo ship at a place where a handling dangerous cargo, including LNG, equipped with facilities for loading and unloading. It includes the matters

concerning the safety and environmental protection policies of the chief executive officer, the operation and work of an organization dedicated to safety management of handling dangerous goods, the appointment and duties of a dangerous materials safety manager, the specifications such as names, specifications, quantities, etc. of dangerous cargo handling facilities (including ship fuel supply vessels), the safety education and training for hazardous materials handlers, the safety facilities, such as firefighting facilities, safety equipment and pollution control equipment, the work standards for handling hazardous materials and safety work tips, the safety inspection plans and implementation of safety inspections for docks and ships, the contents and implementation method of comprehensive emergency response drills, the chain of command and emergency action plan in the event of an emergency situation, the reporting system and handling method when unsafe elements are discovered.

2. Compatibility study should be conducted at the review stage before the LNG transfer operation, and confirmation from all stakeholders is required. In particular, if ship-to-ship mooring safety cannot be confirmed, measures to secure mooring safety, such as additional insecticides and mooring lines, must be applied, so it must be reviewed first in LNG bunkering operation. Specifically, the LNG bunkering compatibility study is aimed at identifying problems that may occur in relation to fuel transfer between an LNG supplying vessel and a receiving vessel, or preparing countermeasures for identified problems.
3. HAZID, which is an abbreviation to 'hazard identification', is one of the qualitative risk analysis methods based on expert judgement, and identifies potential hazards or hazardous events likely to cause loss or damage to human, environment, or asset during the operation of target system in a systematic manner, and then draws and proposes risk reduction measures to lower the risk levels of hazards or hazardous events identified below an allowable level.
4. HAZOP, which is an abbreviation to 'Hazard & Operability', is one of the qualitative risk analysis methods based on expert judgement, and identifies potential hazards or hazardous events likely to cause loss or damage to human, environment, or asset during the operation of target system in a systematic manner, and then draws and proposes risk reduction measures to lower the risk levels of hazards or hazardous events identified below an allowable level. HAZOP identifies potential deviations against design intent, investigates the possible causes, and evaluates the consequences of hazardous events.
5. Gas dispersion analysis can estimate the results of shape and size of the flammable gas cloud (e.g. LEL extent) developed by the dispersion of LNG discharged from the vent mast or other vent outlets in normal or abnormal scenarios in system operation. LNG dispersion scenario selected through a qualitative risk assessment technique such as HAZID can be utilized for definition. The result can be used to designate control zones such as hazardous zone, safety zone, marine zone, monitoring & security zone, and external zone by conducting safety zone study.
6. SIMOPS, which is an abbreviation to 'simultaneous operations', is to identify hazardous scenarios that can occur when LNG transfer (bunkering) operation and ship's original works, such as port loading/unloading, maintenance, ship inspection, and training, are conducted simultaneously. It is one of the qualitative risk analysis methods based on expert judgement, and identifies potential hazards or hazardous events likely to cause loss or damage to human, environment, or asset during the operation of target system in a systematic manner, and then draws and proposes risk reduction measures to lower the risk levels of hazards or hazardous events identified below an allowable level.

Section 2 Terms and Definitions

201. Application

1. Definitions of terms are in accordance with Rules for the classification of steel ships unless otherwise specified.

201. Terms and definitions

1. Accidents means unforeseen events that may entail the loss of human life, personal injuries, environmental damage or the loss of assets and financial interests.

2. Additional safety action or safety action is a risk reduction measure that is recommended to be additionally applied to the target system. It is an additional safety system that needs to be reviewed for implement to the target system, and may include design changes, safety equipment additions, operation procedure changes, and reinforcement of safety procedures, operation procedure, maintenance, system inspection, safety training, etc.
3. BOG (boil off gas) means the boil-off gas that evaporates and vaporizes naturally in a liquefied gas tank or container.
4. Bunkering is the transfer of liquid or gaseous fuel from land or floating installations to fixed or mobile tanks connected to the ship's fueling system.
5. Cause is a specific event or factor that has the potential to cause a hazard (or accident).
6. Consequence is the negative result (or impact) that can result from the occurrence and progress of a hazard (or accident). It is usually expressed as consequential loss or damage to life, the environment or asset.
7. Enclosed area is a space in which ventilation is limited and explosive atmospheres do not dissipate naturally, in the absence of artificial ventilation.
8. ESD is an abbreviation of "emergency shut-down", and is a function that can shut down the system to prevent further economic and social damage that may occur due to events such as leaks in abnormal situations.
9. Frequency means the number of occurrences per unit time (e.g., 10 occurrences per year).
10. Hazard is a potential factor that can have a negative impact on human life, the environment and asset. A hazard can be caused by various accident causes and can lead to various accident consequences.
11. Hazardous area (zone) is an area where an explosive gas atmosphere exists or is expected to exist, requiring special measures for the manufacture, installation and use of equipment.
12. Hazardous scenario means a sequence of accident from a specific cause to a specific consequence.
13. The International Association of Ports and Harbors (IAPH) refers to the International Association of Ports and Harbors as a non-governmental organization (NGO) headquartered in Tokyo, Japan in 1995.
14. The international code of the construction and equipment of ships carrying liquefied gases in bulk (IGC) code refers to IMO Res. Refers to the International Code for the Construction and Equipment of Liquefied Gas Carriers in Bulk as amended in accordance with MSC.370(93).
15. The international code of safety for ships using gases or other low-flashpoint fuels (IGF) code refers to the international code for the safety of low-flashpoint fuel ships according to IMO Res.MSC.391(95).
16. The International Maritime Organization (IMO) is a specialised agency of the United Nations responsible for regulating shipping.
17. The International Safety Management (ISM) code is to provide an international standard for the safe management and operation of ships and for pollution prevention.
18. LEL / UEL is an abbreviation of "Lower explosive limit / Upper explosive limit", indicating the lower explosive limit and upper explosive limit. LEL means that the concentration of a mixture is low in air and can not ignited below this specific concentration. Exceeding the UEL means that the concentration of the mixture in the air is too high to be ignited. These can also be called LFL / UFL, and is an abbreviation of "Lower flammable limit / Upper flammable limit".
19. Liquefied natural gas(LNG) is an abbreviation of "Liquefied natural gas" and refers to liquefied natural gas generated during the process of liquefying methane obtained by refining natural gas produced from a gas field.
20. LNG fueled vessels are the vessels powered by LNG fuel.
21. Mooring equipment guidelines (MEG) published by OCIMF presents the recommended minimum requirements that will help ship designers, terminal designers, ship operators and mooring line

manufacturers improve the design, performance and safety of mooring systems. The OCIMF (Oil Companies International Marine Forum), established in 1970, is an advisory body of IMO established by the union of the world's oil companies' shipping officials.

22. Personal protective equipment(PPE) is an abbreviation of "Personal protective equipment" and means protective equipment such as anti-static working clothes, helmet, gloves, masks, and goggles to protect personnel against unexpected hazardous incidents.
23. Risk is the degree combining the frequency of accident occurrence(or accident causes) that can cause loss to people, the environment, and assets and the consequence of accident.
23. Risk reduction measures are specific methods by which risk can be reduced. Primarily, the risk level can be reduced by reducing the frequency of accidents through prevention (or causes of accidents) or by reducing the severity through mitigation of the consequences of accidents. It has a similar meaning to risk control measures.
24. Risk analysis means the process of understanding undesirable failures that may occur in a target facility, the probability of occurrence of failures, and the severity of failure consequences.
25. Safeguard is a risk reduction method that is based on the target system. For example, safety arrangements, safety equipment, operation procedures, safety procedures and manuals, maintenance procedures, periodic inspections, and safety training may be included.
26. A semi-enclosed area is an area arranged so that the natural ventilation conditions, due to roofs, windbreaks and bulkheads, are significantly different from those of open decks, and the dispersion of gas is limited in this area.
27. Severity means the degree or level of loss or damage to life, environment or asset.
28. The society for gas as a marine fuel (SGMF) is a non-governmental organisation (NGO) established to promote safety and industry best practice in the use of gas as a marine fuel.
29. Ship-to-ship (STS) means the direct transfer of cargo and fuel between two ships.



CHAPTER 2 OVERVIEW OF STS LNG TRANSFER OPERATION

Section 1 General

101. Overview of STS LNG transfer operation

1. STS LNG transfer operation is largely classified into two processes, which can be divided into safety evaluation and STS LNG transfer work.
2. Safety evaluation is a task to evaluate and review the safety of STS LNG transfer operation by conducting compatibility study, risk analysis (HAZID, HAZOP, SIMOPS, etc.), safety zone study, etc. in advance of transfer operation.
3. STS LNG transfer operation can be divided into LNG supply (bunkering) vessel approach/departure, STS mooring connection/disconnection, STS LNG transfer hose connection/disconnection, and LNG transfer operation. The LNG transfer operation proceeds according to the scenario reviewed after the above safety evaluation.
4. The general checklists in STS LNG transfer operation to be referred in the IAPH bunker checklist.

102. Sequence of STS LNG transfer operation

1. The general sequence of operation from the mooring of the LNG bunkering vessel to the departure of the LNG bunkering vessel after the completion of STS LNG transfer operation is as follows. Only authorized operators are allowed to access the safety zone, and the relevant control areas must be continuously monitored.
 - (1) Hose/manifold connection
 - (A) Conduct the purging and leak test after connecting the N2 line
 - (2) ESD trip test (LNG supply vessel and receiving vessel)
 - (A) Conduct the ESD trip test before cool down of hose, piping and tank
 - (3) Cool down of hose, piping and tank
 - (A) Maintain the minimum flow rate
 - (B) Check the cooling flow rate
 - (C) Tank internal pressure control
 - (4) LNG transfer operation
 - (A) Patrolling the area of transfer operation
 - (B) Monitoring and control of transfer flow rate/temperature/pressure/tank level
 - (C) Record and report the temperature/pressure every 30 minutes
 - (D) Ordinary management/check of mooring tension
 - (E) Wearing the PPE
 - (F) Only permitted simultaneous operations are conducted during LNG transfer operations
 - (5) End of LNG transfer operation
 - (A) Stop the LNG transfer operation
 - (B) Drain and purging of LNG transport system piping and manifold, etc.
 - (C) Safe release



CHAPTER 3 SAFETY REQUIREMENTS OF STS LNG TRANSFER OPERATION

Section 1 General

101. Overview

1. This chapter presents safety requirements to lower the risk level to an acceptable level among the results of risk assessments conducted by Korean register for many years.
2. Safety requirements are to be considered prior to carrying out STS LNG transfer operation can be found in Section 2, and safety requirements to be considered for starting and ending of the STS LNG transfer operation (LNG supply (bunkering) vessel approach/departure, STS mooring connection/disconnection, STS LNG transfer hose connection/disconnection, and LNG transfer operation) can be found in Section 3.
3. Based on the safety requirements presented in this chapter, the checklists are prepared and presented in the appendix of guidelines, which can be referenced to safely carry out the actual LNG transfer operation.

Section 2 Safety Requirements - Prior to STS LNG Transfer Operation

201. Overview

1. Safety requirements suggested in this section are to be considered/evaluated prior to carrying out the STS LNG transfer operation.
2. Safety requirements for ship operational aspects are suggested first, followed by safety requirements for each in order of design aspects, operator aspects, and self-safety management plan.

202. Prior to STS LNG transfer operation

1. Safety requirements are to be considered in terms of ship operation prior to STS LNG transfer operation are as follows.
 - (1) It is necessary to check whether the LNG bunkering operation is permitted.
 - (2) It is necessary to review the adequacy of notification of bunkering operations in ports.
 - (3) Lights and shapes are to be used according to the international regulations for preventing collisions at sea (COLREG).
 - (4) Release of gas within the port to be discussed in advance with the relative authorities.
 - (5) Information on underwater rocks that may exist in the planned route to be investigated in advance.
 - (6) It should be confirmed that the site of LNG transfer operation is carried out in an area (separation distance) sufficiently secured from residential and industrial areas.
 - (7) The need for safety review related to night bunkering operation to be confirmed.
 - (8) The voyage speed of LNG bunkering vessels is to be limited considering the requirements for limiting vessel movement speed in the port.
 - (9) The operation of LNG bunkering vessels is to be restricted according to weather conditions such as bad weather and visibility.
 - (10) In case of LNG leakage, it is necessary to set a safety zone through gas dispersion analysis.
 - (11) When performing gas dispersion analysis, all possible scenarios for leaks in tanks and pipes to be considered.
 - (12) Hazardous zone, safety zone, and monitoring & security zone within the port are to be defined, controlled and monitored.
 - (13) It is necessary to designate a person in charge of control, and the person in charge to be exclusively responsible for control the STS LNG transfer operation.
 - (14) A preliminary review meeting is to be conducted between the LNG bunkering vessel and the LNG receiving vessel by referring to the contents of bunkering operations in the Rules for the

- classification of ships using low-flashpoint fuels.
- (15) It is necessary to discuss the contents of information (LNG transfer amount/speed, tank level, etc.) and communication means for transfer operation between the two ships.
 - (16) It is necessary to review the appropriate berthing plan.
 - (17) It is necessary to review the method of handling residual LNG between the flange and ESD valve in case of activation of ESD on LNG receiving vessel.
 - (18) It is necessary to review the means of operator access between ships.
 - (19) It is necessary to review the disposal method for BOG of cargo tanks.
 - (20) It is necessary to review the work through 3D model or down scale model testing in advance.
 - (21) Operation procedures to be prepared in consideration of the impact on bunkering operation in case of horizontal/longitudinal inclination between ships or collision between ships.
 - (22) It is necessary to review whether the workable range of the hose handling crane is appropriate considering the effect on bunkering work in case of horizontal/longitudinal inclination between ships or collision between ships.
 - (23) It is necessary to review whether the length of LNG transfer hose is appropriate considering the effect on bunkering work in case of horizontal/longitudinal inclination between ships or collision between ships.
 - (24) It is necessary to review whether the means of preventing the fall of LNG transfer hose is appropriate considering the effect on bunkering work in case of horizontal/longitudinal inclination between ships or collision between ships.
 - (25) It is necessary to review the fender installation in advance, taking into account changes in ship draft, mooring compatibility, and ship size.
 - (26) It is necessary to prepare the procedures for prior sharing and agreement on the fender information of size, number and location between the ships.
 - (27) It is necessary to review the suitability of ship to ship mooring between the LNG bunkering vessel and the receiving vessel.
 - (28) It is necessary to review the effect of time delay in case of converting the emergency power due to black-out.
 - (29) It is necessary to review the compatibility of bunkering devices and safety devices (e.g. emergency shut-off devices) between the two ships, such as tank types and tank connections.
2. Safety requirements are to be considered in terms of ship design prior to STS LNG transfer operation are as follows.
- (1) The length of the LNG transfer hose is to have sufficient safety margin, such as taking into account the movement and draft of the vessel.
 - (2) The LNG transfer hose is to follow the requirements of the Rules for the classification of ships using low-flashpoint fuels.
 - (3) The quick connect/disconnect coupling (QC/DC) is to follow the requirements of the Rules for the classification of ships using low-flashpoint fuels.
 - (4) It is necessary to review the drip tray capacity, such as determining the capacity based on an estimation of the maximum leakage in the containment section.
 - (5) The design of drip tray is to follow the requirements of the Rules for the classification of ships using low-flashpoint fuels.
 - (6) It is necessary to consider the fuel preparation room with weathertight or gastight access openings.
 - (7) The design of facilities related to fuel preparation rooms is to follow the requirements of the Rules for the classification of ships using low-flashpoint fuels.
 - (8) All major fittings and LNG piping of tanks are to be located under the passages. Where this is not possible, the application of suitable protective measures for the piping (e.g. FRP cover or double-walled piping) is required.
 - (9) It is necessary to have the means to visualize such as installing an indicating sign on the hull so that the vessel can be recognized as a vessel handling the LNG inside or outside of the port.
 - (10) In case of contact and attachment of the fender, the effect of frequent contact between the LNG bunkering vessel and the receiving vessel to be considered.
 - (11) In case of contact and attachment of the fender, the hull structure is to be verified through structural calculation.
 - (12) The emergency shutdown system is to be configured in accordance with the requirements of the Rules for the classification of ships using low-flashpoint fuels.
 - (13) The design of fixed fire-extinguishing system on bunkering system is to follow the requirements of the Rules for the classification of ships using low-flashpoint fuels.
 - (14) A semi-enclosed shelter structure and handrail are to be installed around the bunkering station

- in order to prevent damage to the bunkering manifold considering waves, mooring lines, impact of dropped object, etc.
- (15) The sufficient natural ventilation is to be provided, if the bunkering manifold area is located on the open deck.
 - (16) Safe working load of The bunkering manifold is to be designed to withstand the external loads during bunkering operation. Information about maximum safe working load of bunkering connection is to be detailed in the operation manuals and posted at the bunker station.
 - (17) Safe working load of the manifold is to meet the Manifold recommendations for liquefied gas carriers of OCIMF.
 - (18) Connections for vapor return from the LNG receiving vessel are to be provided and The capacity of vapor return systems is to be sufficient for handling excess vapor returned from the receiving vessel.
 - (19) Vapor return process piping is to be adequately separated from other cargo process piping to avoid over pressure of cargo system on the LNG bunkering vessel.
 - (20) Control and monitoring of the vapor return system is to be integrated into the control and monitoring system of bunkering systems and to be capable of varying LNG delivery rates in consideration of the monitored vapor return system parameters.
 - (21) Calculations for the maximum vapor return flow rate, pressure and corresponding tank pressure management details, are to be submitted and summary information is to be detailed in the operation manuals.
 - (22) Manifold connections not being used for bunker transfer operations are to be blanked with blind flanges suitable for the design pressure.
 - (23) All pipelines or components which may be isolated in a liquid full condition are to be protected with relief valves for thermal expansion and evaporation.
 - (24) Cargo tanks of the LNG bunkering vessel are to be assessed for all partial loading conditions considering abortion of bunkering operation at any stage in case of emergency such that there are no operational limits on partial loading.
 - (25) Inter-vessel electrical isolation between the LNG bunkering vessel and the LNG receiving vessel is to be maintained during transfer to reduce the possibility of ignition source being produced by the electrical potential difference between the hulls.
 - (26) Each transfer connection is to have insulation flange to maintain electrical isolation.
 - (27) The connections for LNG transfer and vapor return are to be fitted with manually operated stop valve and a remotely/automatically operated valve fitted in series.
 - (28) Means are to be provided to drain residual LNG in the bunkering systems to cargo tanks.
 - (29) Transfer arms are to be designed in consideration of the followings; acceleration forces acting on the transfer arm, permissible manifold loadings, arm working envelope, arm support arrangement in operation and storage condition, the effect of hull vibration on the arm, vertical and horizontal ship movement, allowable flow rate and pressure drop.
 - (30) Hoses are to be designed for a bursting pressure not less than five times the maximum working pressure.
 - (31) Material of hoses is to be compatible with the cargo and suitable for the cargo temperature.
 - (32) The overall hose length is to be sufficient to meet both storage and operation condition.
 - (33) Hoses for LNG transfer are to be protected from over pressure by relief valves fitted outboard manifold valve.
 - (34) In determining the size and length of the hoses to be used, the followings are to be considered; maximum allowable bend radius of the hose, horizontal distance between the ships, difference in fore and after alignment(manifold offset), distance between the manifold and the ship's side, vertical and horizontal ship movement, relative change in freeboard between the ships, allowable flow rate and pressure drop, hose supporting and handling equipment.
 - (35) The LNG bunkering vessel is to fitted with equipment supporting hoses during the transfer and handling hoses after activation of emergency release coupling.
 - (36) Hose saddles or hose bun are to be arranged in consideration of hose bend radius.
 - (37) When connecting spool pieces to connectors of various sizes and shapes, they must be installed and tested before bunkering. Through the leak test, the batch containing the spool piece must be completely deactivated and the seal of the gas must be verified before transport.
 - (38) Activation of emergency shutdown system is to initiates the shut-down of cargo transfer pump and vapor return compressor. And closure of emergency shutdown valve; The closing time of the valve is to be considered so that the surge pressure in the transfer piping is not to be greater than allowable pressure.
 - (39) A functional flow diagram of the emergency shutdown system and related systems is to be

- provided at the bunkering control station and cargo control station or bridge, as applicable.
- (40) Activation of the emergency shutdown system is to be controllable from both LNG bunkering vessel and LNG receiving vessel.
 - (41) Emergency shutdown systems of the LNG bunkering vessel and LNG receiving vessel are to be linked to ensure the co-ordinated operation on both ships, and this is to be fail-safe.
 - (42) The bunkering system is not to be resumed until the transfer system and associated safety systems are returned to normal operation condition.
 - (43) As a minimum, the emergency shutdown system is to be capable of manual operation in the followings; bunkering control station, cargo control station, navigation bridge, and LNG transfer area.
 - (44) Emergency release systems are to be capable of rapidly and automatically disconnecting the transfer system from the ship to protect the transfer system when exceeding design loads in any direction.
 - (45) Emergency release systems are to be composed with emergency release coupling and two self-closing shutoff valves and each valve is fitted at each side of the coupling to minimize cargo leakage when the coupling is activated.
 - (46) Emergency release systems are to be controllable from both LNG bunkering vessel and LNG receiving vessel.
 - (47) Emergency release systems is to be of powered type and the actuating power is to have reserve storage of energy sufficient for disconnection of all transfer lines in case the main source of actuating power becomes unavailable (e.g. in case of black-out)
 - (48) Emergency release systems is to be capable to be activated manually on local location and at least two remote locations including bunker control station.
 - (49) Where transfer hoses are used, the disconnected hoses are to be supported by cranes or other measures are to be taken to prevent hull and hose being damaged.
 - (50) Manual or automatic activation of the emergency release system is to be inhibited without prior operation of the emergency shutdown system.
3. Safety requirements that operators to check are to be considered prior to STS LNG transfer operation are as follows.
- (1) The responsible person for safe LNG transfer operation and his/her authorities and duties are to be confirmed.
 - (2) Access by outsiders who are not authorized is to be prohibited during STS LNG transfer operation, and the personnel who controls the access on the work place is to be assigned.
 - (3) It is necessary to consider the installation of warning signs, warning colors, and protective equipment to prevent the outsiders' access.
 - (4) It is necessary to check whether the weather conditions allow for the STS LNG transfer operation.
 - (5) Mooring ropes are to be arranged so as not to contact the bunkering station and LNG pipelines.
 - (6) Frequent patrols, inspections and maintenances are to be required for the safety of mooring ropes, and replacement of mooring ropes is to be implemented if required.
 - (7) The compatibility of all communication links between the LNG bunkering vessel and the LNG receiving vessel is to be checked.
 - (8) The language for communication between the ships is to be specified.
 - (9) Primary and secondary communication means are to be secured in preparation for emergency situations.
 - (10) Communication is to be continuously maintained throughout the whole STS LNG transfer operation.
 - (11) Portable fire extinguisher is to be provided at the bunkering station.
 - (12) The area around the bunkering station is to be kept clean and without the flammable materials.
 - (13) It is necessary to ensure that operators are aware that hot work on board during the STS LNG transfer operation is absolutely prohibited.
 - (14) It is necessary to secure sufficient space for safe work such as inspection and maintenance.
 - (15) Operators are to wear the personal protective equipment (PPE) such as equipment/tools and work clothes for safety.
 - (16) It is necessary to check whether the LNG transfer hose has been regularly maintained.
 - (17) The LNG transfer hose is to be managed by plugging or covering to prevent contamination due to yellow sand and dust, etc.
 - (18) It is necessary to check whether onboard cargo is fixed to prevent the damage to LNG piping and equipment, etc. due to unexpected movement of onboard cargo and failure in securing.
 - (19) It is necessary to confirm whether inspection and maintenance of valves related to LNG piping

and tanks were done.

- (20) It is necessary to monitor continuously the valves related to LNG piping/tanks.
 - (21) Inspection and maintenance of remote control valves are to be strictly carried out.
 - (22) The operation status of the emergency shutdown system is to be checked.
 - (23) It is necessary to check the remaining amount of nitrogen storage before the LNG transfer operation.
 - (24) It is necessary to check the operation of fixed fire fighting system before the LNG transfer operation.
 - (25) It is necessary to confirm the appropriateness of ventilation for the LNG fuel storage room.
 - (26) It is necessary to check whether the gas detector is normally operated.
 - (27) It is necessary to check whether the mooring winches are normally operated.
 - (28) It is necessary to check the measures such as warning signs, warning sounds, safety lines, etc. for the prohibition of access to the bunkering operation area.
 - (29) It is necessary to check whether the operators of the LNG bunkering vessel and the LNG receiving vessel are familiar with the procedures for safe operation.
 - (30) In preparation for black-out case, operators are to be familiar with the countermeasures such as ESD operation, emergency power recovery, etc.
 - (31) In preparation for the event of an accident such as collision and contact, operators are to be familiar with the reporting system (including port authority reporting procedures) and countermeasures.
 - (32) When the communication between the LNG bunkering vessel and LNG receiving vessel is unavailable, operators are to be familiar with the countermeasures such as emergency communication device, hand signal, etc.
 - (33) In preparation for the event of an accident related to mooring work such as cutting of mooring lines, operators are to be familiar with the countermeasures such as waiting for a tugboat to ensure safety, etc.
 - (34) In preparation for accidents caused by detachment and damage of fenders, operators are to be familiar with the countermeasures such as reporting and responding to accidents.
 - (35) In preparation for accidents related to operator's safety, operators are to be familiar with the countermeasures such as reporting and responding to accidents.
 - (36) In preparation for accidents related to leaks of hose connection, operators are to be familiar with the countermeasures such as reporting and responding to accidents.
 - (37) In preparation for accidents related to the saddle damage, operators are to be familiar with the countermeasures such as reporting and responding to accidents.
 - (38) In preparation for accidents related to the LNG leakage, operators are to be familiar with the countermeasures such as ESD activation and emergency escape & evacuation, etc.
 - (39) In preparation for accidents related to the major valve failure, operators are to be familiar with the manual operation procedures.
 - (40) In the event of an accident, operators are to know who is responsible for making decisions on whether to stop or continue bunkering operations.
 - (41) In preparation for accidents related to the personnel falling into water, operators are to be familiar with the rescue procedures, and periodic rescue training to be required.
 - (42) Operators are to be familiar with the procedure for emergency escape, evacuation and rescue.
 - (43) In the event of ERS activation, operators are to be familiar with the response procedure for each emergency situation.
 - (44) LNG bunkering vessel and LNG receiving vessel are to comply with mooring equipment guidelines (MEG).
 - (45) Operators are to wear the life jackets and safety belts during outboard operations such as saddle installation and hose connection work.
4. Safety requirements to be considered in the Self-safety management plan prior to STS LNG transfer operation are as follows.
- (1) The procedures of operation, inspection and maintenance for the safety of operators are to be prepared in accordance with the ISM code.
 - (2) Designation of responsible person for safe STS LNG transfer operation and authority and obligations of person in charge are to be prepared.
 - (3) The guidelines for bunkering operation including bunkering procedures for the safety of operators are to be prepared.
 - (4) The conditions (environmental conditions, conditions in the port, etc.) for allowing bunkering operation and for stopping bunkering operation to be prepared.
 - (5) Suspension of bunkering operation is to be considered in case of poor environmental conditions

- such as wind direction, speed and temperature based on the results of gas dispersion analysis.
- (6) In order to minimize property, human and environmental damage through safe and quick response in the event of an accident, periodic safety-related training for operators is to be prepared.
 - (7) In preparation for the event of an accident such as collision/contact, operators are to be familiar with the reporting system (including port authority reporting procedures) and countermeasures.
 - (8) The guideline for crane operation is to be prepared, because operators' communication that has not been clearly discussed in advance and carelessness can cause a heavy weight fall accident, which can damage LNG piping and equipment, resulting in a major accident.
 - (9) Warning signs and guidelines for communication are to be prepared.
 - (10) Prohibition of hot work on board during the STS LNG transfer operation is to be prepared.
 - (11) Emergency response procedures are to be prepared for emergency situations that may occur during STS LNG transfer operation.
 - (12) The necessity of inspection of working methods is to be prepared to conduct the deck work safely, such as removing saddles and handrails.
 - (13) The procedure for connecting LNG transfer hoses is to be prepared.
 - (14) The location of Manual push button for emergency shutdown of STS LNG transfer (open space separated from manifold, etc.) to be indicated.
 - (15) The need for periodic inspection of the temperature sensor on the drip tray is to be prepared.
 - (16) The need to establish a plan before bunkering operation and to share it between LNG bunkering vessel and LNG receiving vessel.
 - (17) Shipping company operating LNG bunkering vessels is to store the pre-inspection procedures and results of inspections.
 - (18) The information of LNG bunkering vessel and LNG receiving vessel is to be provided.
 - (19) The need for inspection of the main propulsion system of the LNG bunkering vessel is to be prepared in accordance with the requirements of the ISM code.
 - (20) The inspection of the propulsion system is to be conducted upon the arrival and departure of all ships through checklists/entry/departure checklists, etc., and must be stored.
 - (21) The appropriateness of the safety line for the fall prevention of LNG bunkering hose is to be reviewed.
 - (22) It is necessary to check whether the operators of the LNG bunkering vessel and the LNG receiving vessel are familiar with the procedures for safe operation.
 - (23) The suitability of the hose curvature limit is to be reviewed based on the maximum draft difference between the LNG bunkering vessel and LNG receiving vessel.
 - (24) The method and compatibility of ship-to-ship link (SSL) is to be discussed, and the results of SSL simulation test are to be reviewed.
 - (25) The suitability of bunkering hose is to be reviewed.
 - (26) The qualifications and training requirements of bunkering operation are to be reviewed.
 - (27) The water curtain system around the bunkering manifold is to be reviewed.
 - (28) The drip tray under the bunkering manifold is to be reviewed.
 - (29) The fire extinguishing system around the bunkering manifold is to be reviewed.
 - (30) Gas detection, low temperature detection around the bunkering manifold and related alarm functions are to be reviewed.
 - (31) The procedures for safe work on the LNG bunkering vessel and LNG receiving vessel is to be prepared.
 - (32) Emergency stop and follow-up procedures in case of abnormal operation are to be prepared.
 - (33) Manual operating procedures are to be prepared in case of major valve failure.
 - (34) The effects and response procedures are to be prepared in case of operation/malfunction of various alarms and safety devices.
 - (35) The response procedures for excessive hull movement during bunkering operations are to be prepared.
 - (36) The response procedures in case of SSL simulation test failure or malfunction are to be prepared.
 - (37) The means of exchanging information through wireless communication are to be secured.

Section 3 Safety Requirements – Starting and Ending of the STS LNG Transfer Operation

301. Overview

1. Safety requirements suggested in this section are to be considered for starting and ending of the STS LNG transfer operation.
2. Safety requirements for ship operational aspects are suggested first, followed by safety requirements for each in order of operator aspects, and self-safety management plan during STS LNG transfer operation sequentially, i.e., LNG supply (bunkering) vessel approach/departure, STS mooring connection/disconnection, STS LNG transfer hose connection/disconnection, and LNG transfer operation.

302. LNG supply (bunkering) vessel approach/departure

1. The LNG supply (bunkering) vessel approach/departure for starting and ending of the STS LNG transfer operation refers to the operation for the purpose of berthing the LNG bunkering vessel.
2. Safety requirements are to be considered in terms of ship operation during the LNG supply (bunkering) vessel approach/departure are as follows.
 - (1) The arrangement of tugboats to secure the safety of the sea area in the port is to be reviewed.
 - (2) The schedule of other operating vessels is to be reviewed.
 - (3) The LNG transfer operation is to be carried out after installing fenders on LNG bunkering vessel or LNG receiving vessel through prior discussion.
 - (4) The vessels are to be operated after checking the ship speed limit in port.
 - (5) Loading and unloading, maintenance work, etc. that cause changes in the draft of the ship are to be prohibited.
3. Safety requirements that operators to check are to be considered during the LNG supply (bunkering) vessel approach/departure are as follows.
 - (1) Operators are to be familiar with bunkering signals, shapes and lights according to the international regulations for preventing collisions at sea (COLREG) and the international code of signals (INTERCO).
 - (2) It is necessary to share and agree on the location of the fenders between the LNG bunkering vessel and LNG receiving vessel in advance.
 - (3) It is necessary to conduct a preliminary inspection using the checklists for major propulsion systems of supply vessels.
 - (4) Prior inspection of mooring winches is to be required.
4. Safety requirements to be considered in the Self-safety management plan during the LNG supply (bunkering) vessel approach/departure are as follows.
 - (1) The information of LNG bunkering vessel and LNG receiving vessel and the procedure for bunkering operations are to be prepared.
 - (2) It is necessary to check whether the LNG bunkering vessel operator qualifications and training requirements are acquired and whether the training complies with international standards such as TR-56 (Singapore) and STCW, etc.
 - (3) The need for continuous monitoring of weather conditions (deteriorating weather, visibility, etc.) for bunkering work is to be prepared.
 - (4) Information on the LNG receiving vessel (type of fuel, supply method, etc.) is to be provided in advance.
 - (5) The conditions (environmental conditions, conditions in the port, etc.) for allowing bunkering operation and for stopping bunkering operation to be prepared.
 - (6) Whether the installation of fenders are appropriate is to be reviewed considering the position of fenders between the LNG bunkering vessel and LNG receiving vessel and the situation of transverse/vertical inclination of ships.

303. STS mooring connection/disconnection

1. The STS mooring connection/disconnection for starting and ending of the STS LNG transfer operation refers to the operation of mooring connection/disconnection an LNG bunkering vessel by berthing an

LNG receiving vessel for the purpose of LNG transfer.

2. Safety requirements are to be considered in terms of ship operation during the STS mooring connection/disconnection are as follows.
 - (1) The arrangement of tugboats to secure the safety of the sea area in the port is to be reviewed.
 - (2) After completion of mooring, it is necessary to hold a onboard meeting between the operators of the LNG bunkering vessel and LNG receiving vessel, and discuss/confirm the process of bunkering operation.
 - (3) The conditions (environmental conditions, conditions in the port, etc.) for allowing bunkering operation and for stopping bunkering operation to be prepared.
3. Safety requirements that operators to check are to be considered during the STS mooring connection/disconnection are as follows.
 - (1) Prior to LNG transfer operation, it is necessary to prepare and share the operation plan in advance, and to check whether the operators are familiar with it.
 - (2) Prior to the LNG transfer operation, it is necessary to ensure that the vessel is safely moored according to the agreed/approved mooring plan.
 - (3) Weather (wind, current/sea current, wave/swell, drift ice, etc.) and vessel conditions (drifting, vessel motion, draft, trim, etc. due to operation of nearby vessels) are to be continuously monitored.
 - (4) The tension of mooring line is to be continuously monitored through periodic patrols, tension checklists, monitoring equipment, etc.
 - (5) It is to be checked whether sufficient mooring distance is secured between the LNG bunkering vessel and LNG receiving vessel. At this time, mooring distance can be secured with the size of the fender, and a baby fender can be used in case of an emergency.

304. STS LNG transfer hose connection/disconnection

1. The STS LNG transfer hose connection/disconnection for starting and ending of the STS LNG transfer operation means the connection/disconnection the LNG transfer hose for the purpose of LNG transfer with LNG bunkering vessel being moored to the LNG receiving vessel.
2. Safety requirements are to be considered in terms of ship operation during the STS LNG transfer hose connection/disconnection are as follows.
 - (1) The arrangement of tugboats to secure the safety of the sea area in the port is to be reviewed.
 - (2) It is necessary to install the means of safe transportation between LNG bunkering vessel and LNG receiving vessel for operators who will conduct the hose connection/disconnection for LNG transfer.
3. Safety requirements that operators to check are to be considered during the STS LNG transfer hose connection/disconnection are as follows.
 - (1) It is necessary to check whether there is an object that may fall to the top of the LNG transfer hose.
 - (2) It is necessary to check whether the test for LNG leakage and ESD function are conducted.
 - (3) It is necessary to check whether the LNG bunkering manifold flange is pre-inspected for airtightness.
 - (4) The overall condition of the hoses and manifolds used for LNG transfer is to be inspected.
 - (5) It is necessary to confirm the location of activation switch for the fire extinguishing system activation and check the condition of them.
 - (6) Airtightness inspection is to be performed using one or more methods, such as a bubble test, on the hose flange connection for LNG transfer.
 - (7) The inside of the hose for transporting LNG is to be inspected.
 - (8) Before the LNG transfer operation, the test history of vessel separated detection (VSD) system is to be checked.
 - (9) The operation of the water curtain system is to be checked.
 - (10) After disconnecting the hose for LNG transfer, the remaining LNG inside the pipe is to be removed through N₂ gas purging.
 - (11) Operators are to be familiar with the procedure for connecting the LNG transfer hose.
 - (12) It is necessary to check the gas leakage before and after connecting the LNG transfer hose.
 - (13) It is necessary to check whether the measures to prohibit access to the area of LNG transfer operation are in place such as warning signs, warning sounds, safety lines, etc.

- (14) Weather (wind, current/sea current, wave/swell, drift ice, etc.) and vessel conditions (drifting, vessel motion, draft, trim, etc. due to operation of nearby vessels) are to be continuously monitored.
- (15) Operators are to familiar with the N₂ gas capacity check and countermeasures in case of shortage.
- (16) It is necessary to check whether a remote control for emergency stop is installed on the LNG bunkering vessel.

305. LNG transfer operation

1. The LNG transfer operation for starting and ending of the STS LNG transfer operation refers to the operation of LNG transfer from LNG bunkering vessel to LNG receiving vessel.
2. Safety requirements are to be considered in terms of ship operation during the LNG transfer operation are as follows.
 - (1) The arrangement of tugboats to secure the safety of the sea area in the port during the LNG transfer operation is to be reviewed.
 - (2) During normal operation, LNG are not to be discharged into the atmosphere.
3. Safety requirements that operators to check are to be considered during the LNG transfer operation are as follows.
 - (1) Periodic inspection for the equipment (loading arm or hose) is to be required to prevent LNG leakage.
 - (2) Weather (wind, current/sea current, wave/swell, drift ice, etc.) and vessel conditions (drifting, vessel motion, draft, trim, etc. due to operation of nearby vessels) are to be continuously monitored.
 - (3) The operation of the water curtain system is to be checked.
 - (4) During the LNG transfer operation, the pump operation status is to be monitored.
 - (5) During the LNG transfer operation, the vicinity of the LNG transfer hose and manifold is to be constantly monitored with methods such as visual observation of workers in the safety area, CCTV monitoring, etc.
 - (6) During the LNG transfer operation, the internal condition of the hose (temperature, pressure, flow rate, etc.) is to be constantly monitored.
 - (7) The abnormalities in the saddle is to be checked.
 - (8) A safe distance is to be secured between the LNG bunkering station and the operators.
 - (9) Cleanliness around the tank and related piping is to be maintained.
 - (10) Pre-inspection of the alarm system related to LNG transfer operation is to be required.
 - (11) Pre-inspection is to be conducted for any major valve operation abnormalities.
 - (12) The operations of emergency release system (ERS) and the linkage of emergency shutdown (ESD) between LNG bunkering vessel and LNG receiving vessel are to be inspected in advance.



ANNEX 1 CHECKLIST - PRIOR TO STS LNG TRANSFER OPERATION

101. Ship operation

1. To check whether the LNG bunkering operation is permitted.
2. To review the adequacy of notification of bunkering operations in ports.
3. Lights and shapes are to be used according to the international regulations for preventing collisions at sea (COLREG).
4. Release of gas within the port to be discussed in advance with the relative authorities.
5. Information on underwater rocks that may exist in the planned route to be investigated in advance.
6. It should be confirmed that the site of LNG transfer operation is carried out in an area (separation distance) sufficiently secured from residential and industrial areas.
7. The need for safety review related to night bunkering operation to be confirmed.
8. The voyage speed of LNG bunkering vessels is to be limited considering the requirements for limiting vessel movement speed in the port.
9. The operation of LNG bunkering vessels is to be restricted according to weather conditions such as bad weather and visibility.
10. In case of LNG leakage, it is necessary to set a safety zone through gas dispersion analysis.
11. When performing gas dispersion analysis, all possible scenarios for leaks in tanks and pipes to be considered.
12. Hazardous zone, safety zone, and monitoring & security zone within the port are to be defined, controlled and monitored.
13. To designate a person in charge of control, and the person in charge to be exclusively responsible for control the STS LNG transfer operation.
14. A preliminary review meeting is to be conducted between the LNG bunkering vessel and the LNG receiving vessel by referring to the contents of bunkering operations in the Rules for the classification of ships using low-flashpoint fuels.
15. To discuss the contents of information (LNG transfer amount/speed, tank level, etc.) and communication means for transfer operation between the two ships.
16. To review the appropriate berthing plan.

17. To review the method of handling residual LNG between the flange and ESD valve in case of activation of ESD on LNG receiving vessel.
18. To review the means of transfer operator access between ships.
19. To review the disposal method for BOG of cargo tanks.
20. To review the work through 3D model or down scale model testing in advance.
21. Operation procedures to be prepared in consideration of the impact on bunkering operation in case of horizontal/longitudinal inclination between ships or collision between ships.
22. To review whether the workable range of the hose handling crane is appropriate considering the effect on bunkering work in case of horizontal/longitudinal inclination between ships or collision between ships.
23. To review whether the length of LNG transfer hose is appropriate considering the effect on bunkering work in case of horizontal/longitudinal inclination between ships or collision between ships.
24. To review whether the means of preventing the fall of LNG transfer hose is appropriate considering the effect on bunkering work in case of horizontal/longitudinal inclination between ships or collision between ships.
25. To prepare and review the fender installation in advance, taking into account changes in ship draft, mooring compatibility, and ship size.
26. To prepare the procedures for prior sharing and agreement on the fender information of size, number and location between the ships.
27. To review the suitability of ship to ship mooring between the LNG bunkering vessel and the receiving vessel.
28. To review the effect of time delay in case of converting the emergency power due to black-out.
29. To review the compatibility of bunkering devices and safety devices (e.g. emergency shut-off devices) between the two ships, such as tank types and tank connections.

102. Ship design

1. The length of the LNG transfer hose is to have sufficient safety margin, such as taking into account the movement and draft of the vessel.
2. The LNG transfer hose is to follow the requirements of the Rules for the classification of ships using low-flashpoint fuels.

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3. The quick connect/disconnect coupling (QC/DC) is to follow the requirements of the Rules for the classification of ships using low-flashpoint fuels.
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4. To review the drip tray capacity, such as determining the capacity based on an estimation of the maximum leakage in the containment section.
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5. The design of drip tray is to follow the requirements of the Rules for the classification of ships using low-flashpoint fuels.
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6. To consider the fuel preparation room with weathertight or gastight access openings.
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7. The design of facilities related to fuel preparation rooms is to follow the requirements of the Rules for the classification of ships using low-flashpoint fuels.
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8. All major fittings and LNG piping of tanks are to be located under the passages. Where this is not possible, the application of suitable protective measures for the piping (e.g. FRP cover or double-walled piping) is required.
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9. have the means to visualize such as installing an indicating sign on the hull so that the vessel can be recognized as a vessel handling the LNG inside or outside of the port.
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10. In case of contact and attachment of the fender, the effect of frequent contact between the LNG bunkering vessel and the LNG receiving vessel to be considered.
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11. In case of contact and attachment of the fender, the hull structure is to be verified through structural calculation.
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12. The emergency shutdown system is to be configured in accordance with the requirements of the Rules for the classification of ships using low-flashpoint fuels.
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13. The design of fixed fire-extinguishing system on bunkering system is to follow the requirements of the Rules for the classification of ships using low-flashpoint fuels.
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14. A semi-enclosed shelter structure and handrail are to be installed around the bunkering station in order to prevent damage to the bunkering manifold considering waves, mooring lines, impact of dropped object, etc.
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15. The sufficient natural ventilation is to be provided, if the bunkering manifold area is located on the open deck.
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16. Safe working load of The bunkering manifold is to be designed to withstand the external loads during bunkering operation. Information about maximum safe working load of bunkering connection is to be detailed in the operation manuals and posted at the bunker station.
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17. Safe working load of the manifold is to meet the Manifold recommendations for liquefied gas carriers of OCIMF.
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18. Connections for vapor return from the LNG receiving vessel are to be provided and The capacity of vapor return systems is to be sufficient for handling excess vapor returned from the receiving vessel.
19. Vapor return process piping is to be adequately separated from other cargo process piping to avoid over pressure of cargo system on the LNG bunkering vessel.
20. Control and monitoring of the vapor return system is to be integrated into the control and monitoring system of bunkering systems and to be capable of varying LNG delivery rates in consideration of the monitored vapor return system parameters.
21. Calculations for the maximum vapor return flow rate, pressure and corresponding tank pressure management details, are to be submitted and summary information is to be detailed in the operation manuals.
22. Manifold connections not being used for bunker transfer operations are to be blanked with blind flanges suitable for the design pressure.
23. All pipelines or components which may be isolated in a liquid full condition are to be protected with relief valves for thermal expansion and evaporation.
24. Cargo tanks of the LNG bunkering vessel are to be assessed for all partial loading conditions considering abortion of bunkering operation at any stage in case of emergency such that there are no operational limits on partial loading.
25. Inter-vessel electrical isolation between the LNG bunkering vessel and the LNG receiving vessel is to be maintained during transfer to reduce the possibility of ignition source being produced by the electrical potential difference between the hulls.
26. Each transfer connection is to have insulation flange to maintain electrical isolation.
27. The connections for LNG transfer and vapor return are to be fitted with manually operated stop valve and a remotely/automatically operated valve fitted in series.
28. Means are to be provided to drain residual LNG in the bunkering systems to cargo tanks.
29. Transfer arms are to be designed in consideration of the followings; acceleration forces acting on the transfer arm, permissible manifold loadings, arm working envelope, arm support arrangement in operation and storage condition, the effect of hull vibration on the arm, vertical and horizontal ship movement, allowable flow rate and pressure drop.
30. Hoses are to be designed for a bursting pressure not less than five times the maximum working pressure.
31. Material of hoses is to be compatible with the cargo and suitable for the cargo temperature.
32. The overall hose length is to be sufficient to meet both storage and operation condition.

33. Hoses for LNG transfer are to be protected from over pressure by relief valves fitted outboard manifold valve.
34. In determining the size and length of the hoses to be used, the followings are to be considered; maximum allowable bend radius of the hose, horizontal distance between the ships, difference in fore and after alignment(manifold offset), distance between the manifold and the ship's side, vertical and horizontal ship movement, relative change in freeboard between the ships, allowable flow rate and pressure drop, hose supporting and handling equipment.
35. The LNG bunkering vessel is to fitted with equipment supporting hoses during the transfer and handling hoses after activation of emergency release coupling.
36. Hose saddles or hose bun are to be arranged in consideration of hose bend radius.
37. When connecting spool pieces to connectors of various sizes and shapes, they must be installed and tested before bunkering. Through the leak test, the batch containing the spool piece must be completely deactivated and the seal of the gas must be verified before transport.
38. Activation of emergency shutdown system is to initiates the shut-down of cargo transfer pump and vapor return compressor. And closure of emergency shutdown valve; The closing time of the valve is to be considered so that the surge pressure in the transfer piping is not to be greater than allowable pressure.
39. A functional flow diagram of the emergency shutdown system and related systems is to be provided at the bunkering control station and cargo control station or bridge, as applicable.
40. Activation of the emergency shutdown system is to be controllable from both LNG bunkering vessel and LNG receiving vessel.
41. Emergency shutdown systems of the LNG bunkering vessel and LNG receiving vessel are to be linked to ensure the co-ordinated operation on both ships. This ESD link is to be fail-safe.
42. The bunkering system is not to be resumed until the transfer system and associated safety systems are returned to normal operation condition.
43. As a minimum, the emergency shutdown system is to be capable of manual operation in the followings; bunkering control station, cargo control station, navigation bridge, navigation bridge, and LNG transfer area.
44. Emergency release systems are to be capable of rapidly and automatically disconnecting the transfer system from the ship to protect the transfer system when exceeding design loads in any direction.

45. Emergency release systems are to be composed with emergency release coupling and two self-closing shutoff valves and each valve is fitted at each side of the coupling to minimize cargo leakage when the coupling is activated.
46. Emergency release systems are to be controllable from both LNG bunkering vessel and LNG receiving vessel.
47. Emergency release systems is to be of powered type and the actuating power is to have reserve storage of energy sufficient for disconnection of all transfer lines in case the main source of actuating power becomes unavailable (e.g. in case of black-out)
48. Emergency release systems is to be capable to be activated manually on local location and at least two remote locations including bunker control station.
49. Where transfer hoses are used, the disconnected hoses are to be supported by cranes or other measures are to be taken to prevent hull and hose being damaged.
50. Manual or automatic activation of the emergency release system is to be inhibited without prior operation of the emergency shutdown system.

103. Operators

1. The responsible person for safe LNG transfer operation and his/her authorities and duties are to be confirmed.
2. Access by outsiders who are not authorized is to be prohibited during STS LNG transfer operation, and the personnel who controls the access on the work place is to be assigned.
3. To consider the installation of warning signs, warning colors, and protective equipment to prevent the outsiders' access.
4. To check whether the weather conditions allow for the STS LNG transfer operation.
5. Mooring ropes are to be arranged so as not to contact the bunkering station and LNG pipelines.
6. Frequent patrols, inspections and maintenances are to be required for the safety of mooring ropes, and replacement of mooring ropes is to be implemented if required.
7. The compatibility of all communication links between the LNG bunkering vessel and the LNG receiving vessel is to be checked.
8. The language for communication between the ships is to be specified.
9. Primary and secondary communication means are to be secured in preparation for emergency situations.

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10. Communication is to be continuously maintained throughout the STS LNG transfer operation.
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11. Portable fire extinguisher is to be provided at the bunkering station.
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12. The area around the bunkering station is to be kept clean and without the flammable materials.
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13. To ensure that operators are aware that hot work on board during the STS LNG transfer operation is absolutely prohibited.
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14. To secure sufficient space for safe work such as inspection and maintenance.
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15. Operators are to wear the personal protective equipment (PPE) such as equipment/tools and work clothes for safety.
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16. To check whether the LNG transfer hose has been regularly maintained.
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17. The LNG transfer hose is to be managed by plugging or covering to prevent contamination due to yellow sand and dust, etc.
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18. To check whether onboard cargo is fixed to prevent the damage to LNG piping and equipment, etc. due to unexpected movement of onboard cargo and failure in securing.
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19. To confirm whether inspection and maintenance of valves related to LNG piping/tanks were done.
-
20. To monitor continuously the valves related to LNG piping/tanks.
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21. Inspection and maintenance of remote control valves are to be strictly carried out.
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22. The operation status of the emergency shutdown system is to be checked.
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23. To check the remaining amount of nitrogen storage before the LNG transfer operation.
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24. To check the operation of fixed fire fighting system before the LNG transfer operation.
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25. To confirm the appropriateness of ventilation for the LNG fuel storage room.
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26. To check whether the gas detector is normally operated.
-
27. To check whether the mooring winches are normally operated.
-
28. To check the measures such as warning signs, warning sounds, safety lines, etc. for the prohibition of access to the bunkering operation area.
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29. To check whether the operators of the LNG bunkering vessel and the LNG receiving vessel are familiar with the procedures for safe operation.
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30. In preparation for black-out case, operators are to be familiar with the countermeasures such as ESD operation, emergency power recovery, etc.
31. In preparation for the event of an accident such as collision and contact, operators are to be familiar with the reporting system (including port authority reporting procedures) and countermeasures.
32. When the communication between the LNG bunkering vessel and LNG receiving vessel is unavailable, operators are to be familiar with the countermeasures such as emergency communication device, hand signal, etc.
33. In preparation for the event of an accident related to mooring work such as cutting of mooring lines, operators are to be familiar with the countermeasures such as waiting for a tugboat to ensure safety, etc.
34. In preparation for accidents caused by detachment and damage of fenders, operators are to be familiar with the countermeasures such as reporting and responding to accidents.
35. In preparation for accidents related to operator's safety, operators to be familiar with the countermeasures such as reporting and responding to accidents.
36. In preparation for accidents related to leaks of hose connection, operators are to be familiar with the countermeasures such as reporting and responding to accidents.
37. In preparation for accidents related to the saddle damage, operators are to be familiar with the countermeasures such as reporting and responding to accidents.
38. In preparation for accidents related to the LNG leakage, operators are to be familiar with the countermeasures such as ESD activation and emergency escape & evacuation, etc.
39. In preparation for accidents related to the major valve failure, operators are to be familiar with the manual operation procedures.
40. In the event of an accident, operators are to know who is responsible for making decisions on whether to stop or continue bunkering operations.
41. In preparation for accidents related to the personnel falling into water, operators are to be familiar with the rescue procedures, and periodic rescue training to be required.
42. Operators are to be familiar with the procedure for emergency escape, evacuation and rescue.
43. In the event of ERS activation, operators are to be familiar with the response procedure for each emergency situation.
44. LNG bunkering vessel and LNG receiving vessel are to comply with mooring equipment guidelines (MEG).

45. Operators are to wear the life jackets and safety belts during outboard operations such as saddle installation and hose connection work.

104. Self-safety management plan

1. The procedures of operation, inspection and maintenance for the safety of operators are to be prepared in accordance with the ISM code.
2. Designation of responsible person for safe STS LNG transfer operation and authority and obligations of person in charge are to be prepared.
3. The guidelines for bunkering operation manual including bunkering procedures for the safety of operators are to be prepared.
4. The conditions (environmental conditions, conditions in the port, etc.) for allowing bunkering operation and for stopping bunkering operation to be prepared.
5. Suspension of bunkering operation is to be considered in case of poor environmental conditions such as wind direction, speed and temperature based on the results of gas dispersion analysis.
6. In order to minimize property, human and environmental damage through safe and quick response in the event of an accident, periodic safety-related training for operators is to be prepared.
7. In preparation for the event of an accident such as collision/contact, operators are to be familiar with the reporting system (including port authority reporting procedures) and countermeasures.
8. The guideline for crane operation is to be prepared, because operators' communication that has not been clearly discussed in advance and carelessness can cause a heavy weight fall accident, which can damage LNG piping and equipment, resulting in a major accident.
9. Warning signs and guidelines for communication are to be prepared.
10. Prohibition of hot work on board during the STS LNG transfer operation is to be prepared.
11. Emergency response procedures are to be prepared for emergency situations that may occur during STS LNG transfer operation.
12. The necessity of inspection of working methods is to be prepared to conduct the deck work safely, such as removing saddles and handrails.
13. The procedure for connecting LNG transfer hoses is to be prepared.
14. The location of Manual push button for emergency shutdown of STS LNG transfer (open space separated from manifold, etc.) to be indicated.

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15. The need for periodic inspection of the drip tray temperature sensor on the drip tray is to be prepared.
-
16. The need to establish a plan before bunkering operation and to share it between LNG bunkering vessel and LNG receiving vessel.
-
17. Shipping company operating LNG bunkering vessels is to store the pre-inspection procedures and results of inspections.
-
18. The information of LNG bunkering vessel and LNG receiving vessel is to be provided.
-
19. The need for inspection of the main propulsion system of the LNG bunkering vessel is to be prepared in accordance with the requirements of the ISM code.
-
20. The inspection of the propulsion system is to be conducted upon the arrival and departure of all ships through checklists/entry/departure checklists, etc., and must be stored.
-
21. The appropriateness of the safety line for the fall prevention of LNG bunkering hose is to be reviewed.
-
22. To check whether the operators of the LNG bunkering vessel and the LNG receiving vessel are familiar with the procedures for safe operation.
-
23. The suitability of the hose curvature limit is to be reviewed based on the maximum draft difference between the LNG bunkering vessel and LNG receiving vessel.
-
24. The method and compatibility of ship-to-ship link (SSL) is to be discussed, and the results of SSL simulation test are to be reviewed.
-
25. The suitability of bunkering hose is to be reviewed.
-
26. The qualifications and training requirements of bunkering operation are to be reviewed.
-
27. The water curtain system around the bunkering manifold is to be reviewed.
-
28. The drip tray under the bunkering manifold is to be reviewed.
-
29. The fire extinguishing system around the bunkering manifold is to be reviewed.
-
30. Gas detection, low temperature detection around the bunkering manifold and related alarm functions are to be reviewed.
-
31. The compliance of procedures for safe work by operators on the LNG bunkering vessel and LNG receiving vessel is to be prepared.
-
32. Emergency stop and follow-up procedures in case of abnormal operation are to be prepared.
-
33. Manual operating procedures are to be prepared in case of major valve failure.
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34. The effects and response procedures are to be prepared in case of operation/malfunction of various alarms and safety devices.

35. The response procedures for excessive hull movement during bunkering operations are to be prepared.

36. The response procedures in case of SSL simulation test failure or malfunction are to be prepared.

37. The means of exchanging information through wireless communication are to be secured.



ANNEX 2 CHECKLIST – STARTING AND ENDING OF THE STS LNG TRANSFER OPERATION

201. LNG supply (bunkering) vessel approach/departure – Ship operation

1. The arrangement of tugboats to secure the safety of the sea area in the port during the LNG transfer operation is to be reviewed.
2. The schedule of other operating vessels during the LNG transfer operation is to be reviewed.
3. The LNG transfer operation is to be carried out after installing fenders on LNG bunkering vessel or LNG receiving vessel through prior discussion.
4. The vessels are to be operated after checking the ship speed limit in port.
5. Loading and unloading, maintenance work, etc. that cause changes in the draft of the ship are to be prohibited.

202. LNG supply (bunkering) vessel approach/departure – Operators

1. Operators are to be familiar with bunkering signals, shapes and lights according to the international regulations for preventing collisions at sea (COLREG) and the international code of signals (INTERCO).
2. To share and agree on the location of the fenders between the LNG bunkering vessel and LNG receiving vessel in advance.
3. To conduct a preliminary inspection using the checklists for major propulsion systems of supply vessels.
4. Prior inspection of mooring winches is to be required.

203. LNG supply (bunkering) vessel approach/departure – Self-safety management plan

1. The information of LNG bunkering vessel and LNG receiving vessel and the procedure for bunkering operations are to be prepared.
2. To check whether the LNG bunkering vessel operator qualifications and training requirements are acquired and whether the training complies with international standards such as TR-56 (Singapore) and STCW, etc.
3. The need for continuous monitoring of weather conditions (deteriorating weather, visibility, etc.) for bunkering work is to be prepared.

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4. Information on the LNG receiving vessel (type of fuel, supply method, etc.) is to be provided in advance.
-
5. The conditions (environmental conditions, conditions in the port, etc.) for allowing bunkering operation and for stopping bunkering operation to be prepared.
-
6. Whether the installation of fenders are appropriate is to be reviewed considering the position of fenders between the LNG bunkering vessel and LNG receiving vessel and the situation of transverse/vertical inclination of ships.
-

204. STS mooring connection/disconnection – Ship operation

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1. The arrangement of tugboats to secure the safety of the sea area in the port during the LNG transfer operation is to be reviewed.
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2. After completion of mooring, it is necessary to hold a onboard meeting between the operators of the LNG bunkering vessel and LNG receiving vessel, and discuss/confirm the process of bunkering operation.
-
3. The conditions (environmental conditions, conditions in the port, etc.) for allowing bunkering operation and for stopping bunkering operation to be prepared.
-

205. STS mooring connection/disconnection – Operators

-
1. Prior to LNG transfer operation, it is necessary to prepare and share the operation plan in advance, and to check whether the operators are familiar with it.
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2. Prior to the LNG transfer operation, it is necessary to ensure that the vessel is safely moored according to the agreed/approved mooring plan.
-
3. Weather (wind, current/sea current, wave/swell, drift ice, etc.) and vessel conditions (drifting, vessel motion, draft, trim, etc. due to operation of nearby vessels) are to be continuously monitored.
-
4. The tension of mooring line is to be continuously monitored through periodic patrols, tension checklists, monitoring equipment, etc.
-
5. It is to be checked whether sufficient mooring distance is secured between the LNG bunkering vessel and LNG receiving vessel. At this time, mooring distance can be secured with the size of the fender, and a baby fender can be used in case of an emergency.
-

206. STS LNG transfer hose connection/disconnection - Ship operation

1. The arrangement of tugboats to secure the safety of the sea area in the port during the LNG transfer operation is to be reviewed.
2. To install the means of safe transportation between LNG bunkering vessel and LNG receiving vessel for operators who will conduct the hose connection/disconnection for LNG transfer.

207. STS LNG transfer hose connection/disconnection - Operatros

1. To check whether there is an object that may fall to the top of the LNG transfer hose.
2. To check whether the test for LNG leakage and ESD function are conducted.
3. To check whether the LNG bunkering manifold flange is pre-inspected for airtightness.
4. The overall condition of the hoses and manifolds used for LNG transfer is to be inspected.
5. To confirm the location of activation switch for the fire extinguishing system activation and check the condition of them.
6. Airtightness inspection is to be performed using one or more methods, such as a bubble test, on the hose flange connection for LNG transfer.
7. The inside of the hose for transporting LNG is to be inspected.
8. Before the LNG transfer operation, the test history of vessel separated detection (VSD) system is to be checked.
9. The operation of the water curtain system is to be checked.
10. After disconnecting the hose for LNG transfer, the remaining LNG inside the pipe is to be removed through N2 gas purging.
11. Operators are to be familiar with the procedure for connecting the LNG transfer hose.
12. To check the gas leakage before and after connecting the LNG transfer hose.
13. To check whether the measures to prohibit access to the area of LNG transfer operation are in place such as warning signs, warning sounds, safety lines, etc.
14. Weather (wind, current/sea current, wave/swell, drift ice, etc.) and vessel conditions (drifting, vessel motion, draft, trim, etc. due to operation of nearby vessels) are to be continuously monitored.
15. Operators are to familiar with the N2 gas capacity check and countermeasures in case of shortage.

16. To check whether a remote control for emergency stop is installed on the LNG bunkering vessel.

208. LNG transfer operation – Ship operation

1. The arrangement of tugboats to secure the safety of the sea area in the port during the LNG transfer operation is to be reviewed.
2. During normal operation, LNG are not to be discharged into the atmosphere.

209. LNG transfer operation – Operators

1. Periodic inspection for the equipment (loading arm or hose) is to be required to prevent LNG leakage.
2. Weather (wind, current/sea current, wave/swell, drift ice, etc.) and vessel conditions (drifting, vessel motion, draft, trim, etc. due to operation of nearby vessels) are to be continuously monitored.
3. The operation of the water curtain system is to be checked.
4. During the LNG transfer operation, the pump operation status is to be monitored.
5. During the LNG transfer operation, the vicinity of the LNG transfer hose and manifold is to be constantly monitored with methods such as visual observation of workers in the safety area, CCTV monitoring, etc.
6. During the LNG transfer operation, the internal condition of the hose (temperature, pressure, flow rate, etc.) is to be constantly monitored.
7. The abnormalities in the saddle is to be checked.
8. A safe distance is to be secured between the LNG bunkering station and the operators.
9. Cleanliness around the tank and related piping is to be maintained.
10. Pre-inspection of the alarm system related to LNG transfer operation is to be required.
11. Pre-inspection is to be conducted for any major valve operation abnormalities.
12. The operations of emergency release system (ERS) and the linkage of emergency shutdown (ESD) between LNG bunkering vessel and LNG receiving vessel are to be inspected in advance.



GUIDELINES FOR SAFE STS LNG TRANSFER OPERATION

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