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Pakistan Gas Port

STS Operations Manual

Port Qasim Pakistan

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1 INTRODUCTION

This STS Operations Manual shall be read in conjunction with the Terminal Operations Manual.

This document contains information required to conduct safe and efficient STS operations between visiting LNG carriers and the FSRU BW Integrity in Port Qasim. It has been developed by BW, the FSRU owner and operator.

Please refer to the Terminal Operations Manual, developed and maintained by PGPC/FOTCO for port entry and departure procedures and information, requirements and guidelines from authorities, port or terminal.

The pieces of information comprised in this document come from reliable sources and are correct to the best of their extent. BW or PGPCL must not be held accountable for errors or omissions in this publication since the present document is intended only to supplement – as opposed to substituting or altering – official legislation, instructions, industry standarards, guidelines or publications, either national or international.

The Terminal reserves the right to alter any of its operational characteristics presented herein without prior notice. Should any mistaken or diverging information be found in this document, which may need correction, please contact the address below:

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2 SHIP-SHORE COMPATIBILITY

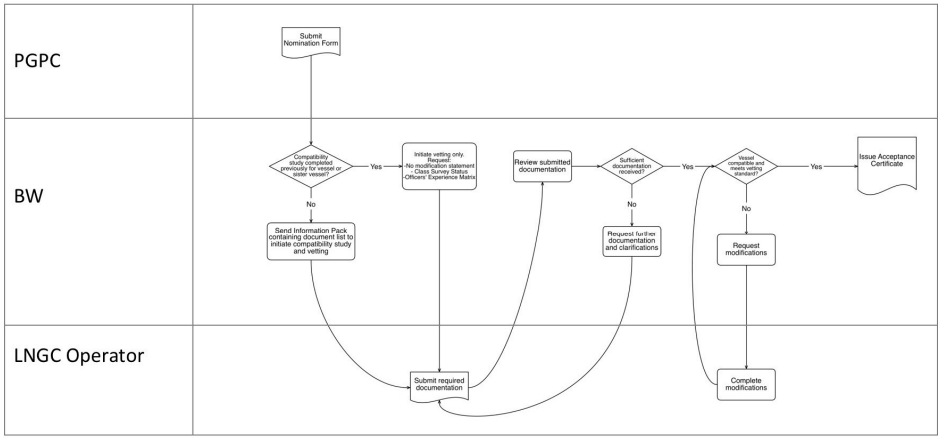
A compatibility study and safety vetting must be carried out by BW prior to any STS operation between the FSRU and an LNGC.

The process is initiated by PGPCL, who completes the nomination form for a specific delivery and submits it to BW.

If neither the LNGC nor a sister vessel of the LNGC has been accepted previously for STS operation with the FSRU in Port Qasim, BW will issue an Information Pack to the LNGC Operator, containing a list of required documentation and other information pertaining to the site and the STS operation.

If the LNGC or a sister vessel of the LNGC has already been accepted previously for STS operation with the FSRU in Port Qasim, BW will as a minimum request a Non-modification statement, Officers' Experience Matrix and the vessel's Class Survey Status.

When all documentation has been reviewed by BW and all issues (if any) have been closed out, BW will issue a formal Acceptanc Certificate to the Operator, with a copy to PGPCL.



3 STANDARD OPERATING PROCEDURES FOR LNG VESSELS

Commented [TV1]: "Communication"

3.1 Arrival Notices

The Vessel's Master shall give BW/ PGPCL the following notices:

A. **First Notice**

This shall be sent upon the departure of the LNG Vessel from the Loading Port and shall detail:

- Time and date that loading was completed,
- The volume (expressed in Cubic Meters) of LNG loaded on board the LNG Vessel,
- The estimated time of arrival (ETA) of the LNG Vessel at the Arrival Location,
- Any operational deficiencies in the LNG Vessel that may affect its performance at the Facility or berth;

B. **Second Notice**

This shall be sent ninety-six (96) hours prior to the ETA set forth in the First Notice, and shall detail:

- The ETA.
- The average cargo temperature in each of the ship's cargo tanks
- The cargo tank vapor space pressure, in millibars Absolute, in each of the ship's cargo tanks.
- If, thereafter, such ETA changes by more than six (6) hours, the Vessel Master shall promptly give notice of the corrected ETA.

C. **Third Notice**

This shall be sent seventy-two (72) hours prior to the ETA set forth in the Second Notice, confirming or amending such ETA.

D. **Fourth Notice**

This shall be sent forty-eight (48) hours prior to the ETA set forth in the Third Notice, and shall detail:

- The ETA.
- The average cargo temperature in each of the ship's cargo tanks
- The cargo tank vapor space pressure, in millibars Absolute, in each of the ship's cargo tanks.

E. **Fifth Notice**

This shall be sent twenty-four (24) hours prior to the ETA set forth in the Fourth Notice (as corrected), confirming or amending such ETA and shall detail:

- The average cargo temperature in each of the ship's cargo tanks
- The cargo tank vapour space pressure, in millbar Absolute, in each of the ship's cargo tanks.
- Additionally in this notice the master will confirm that the ship's deck cargo lines will be cooled and drained back to the cargo tanks, before, but as close as possible to, the time at which the pilot will board the ship for entering Port Qasim.
- If, thereafter, such ETA changes by more than three (3) hours, the Vessel Master shall promptly give notice of the corrected ETA.

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F. **Sixth Notice**

This shall be sent twelve (12) hours prior to the ETA set forth in the Fifth Notice (as corrected), confirming or amending such ETA.

If, thereafter, such ETA changes by more than one (1) hour, the Vessel Master shall promptly give notice of the corrected ETA;

G. **Seventh Notice**

This shall be sent twelve (6) hours prior to the ETA set forth in the Fifth Notice (as corrected), confirming or amending such ETA.

H. **A Notice of Readiness**

This shall be given at the time prescribed in the contracted commercial agreement

3.2 Cargo Condition on Arrival

1. LNGC which deliver LNG cargo to the FSRU, should comply with the following:

Cargo tanks pressure is required to be as low as possible. 100 mbarg is reccomended, but in any case, not above 130 mbarg.

FSRU BW INTEGRITY

3.3 FSRU BW Integrity Particulars

BW INTEGRITY	
PORT OF REGISTRY:	Singapore
FLAG:	Singapore
CALL SIGN:	9V5308
IMO NUMBER:	9724946
OFFICIAL NUMBER:	400903
MANAGEMENT:	BW FLEET MANAGEMENT AS
E-Mail ADDRESS:	integrity@bwfleet.com
INM.-FBB ID NO.: VOICE, FAX	+47 8522 6684, +870783403342
INMARSAT – C ID NO.1 & NO.2:	456600882 & 456600883
MMSI:	563005900
BUILD YEAR:	2017
BUILD YARD:	Samsung Heavy Ind. CO., LTD. Korea
PLACE OF BUILD:	Geoje Shipyard, Korea
CLASS:	DNV-GL
CLASSIFICATION DESIGNATION:	+1A1, Tanker for liquefied gas ship type 2G (Membrane tank, Maximum pressure 70kPaG, Minimum temperature -163 C and specific Gravity 500kg/m3, NAUTICUS

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	(Newbuilding) E0, BIS, TMON, COAT-PSPC(B), NAUT-0C, GAS FUELLED, COMF-V(3)C(3), CSA-2, CLEAN, Recyclable, REGAS-2
TYPE OF VESSEL:	LNG FSRU/ LNG Carrier
LIGHTSHIP:	33120.90 t
GROSS REGISTERED TONNAGE:	106793
NET REGISTERED TONNAGE:	33219
SUEZ GROSS / NET TONNAGE:	110840.54 / 100791.91
SHIPS CRANE:	1 x port provision crane SWL 5 ton 1 x stb provision crane SWL 10 ton 2 x hose handling crane SWL 5 ton 1 x Regas Service crane SWL 10 ton
LOA:	292.57 m
LBP:	281.00 m
BREADTH MOULDED:	43.40 m
DEPTH MOULDED:	26.60 m
SUMMER DRAFT:	12,3 m
SUMMER DEADWEIGHT:	87190.5 mt
MAX HEIGHT FROM KEEL:	58,86 m
MAIN ENGINE:	Diesel Electric
TYPE OF PROPELLER:	5 – Blade, Fixed Pitch Propeller
BOW THRUSTER:	NA
SERVICE SPEED:	19.5 kts
CARGO CAPACITY:	170,212.8 m3 at 100%, 167,659.6 M3 at 98.5%
FUEL CAPACITY:	HFO: 4759.9cbm, MDO 1364.2 cbm
BALLAST:	58393.8 cbm
FRESH WATER:	502.6 cbm
LUBRICATING OIL:	445.9 cbm

3.4 FSRU BW Integrity Contact

BW LNG Operation Department.

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2) Riju Cherian, Phone: DID (+47) 6721 1684, MOB (+47) 4625 7666

Department Email: fsruops@bwgas.com
Fax: (+47) 6721 1602

4 MOORING / UNMOORING OPERATIONS

4.1 FSRU Mooring arrangement to Shore

Jetty mooring system between FSRU and jetty:

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- 18 jetty lines (7 breast lines front, 4 spring lines, 7 breast lines aft).
- 6 jetty connection points.
- All lines assumed 44 mm wire ropes with 11 m /22 m soft tails.

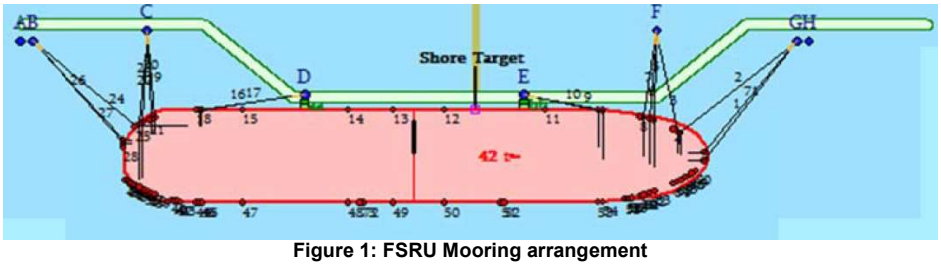

Figure 1: FSRU Mooring arrangement

FSRU is equipped with double quick release hooks (QRH) with safe work load 150 ton.
The LNG carriers will arrive on Starboard side of FSRU.

4.2 LNGC Mooring to FSRU

All mooring operations shall be conducted in compliance with the approved Optimoor mooring plan which will be required to be performed by the visiting vessel to the Terminals satisfaction prior to arrival.

All Optimoor studies will be conducted based on an OCIMF criteria and the max safe wind sweep speed that can be achieved.

4.3 Positioning and Running Lines

- An FSRU crew member will be positioned at the Vapour manifold and will liaise with a LNGC crew member to ensure correct fore and aft alignment for the transfer connections. The information will be communicated with the Pilot / Master to take action as they deem necessary.
- The vessels crew will position themselves where best suited, and complete their last checks.
- Traditionally it will be the springs run first, however the order of receiving the mooring lines is to be confirmed by Master with the Pilot, before the vessel closes the jetty.
- Heaving Line should be available at each end. With an eye splice at each end. A removable “Monkey’s Fist” can be attached using a cow hitch at one end. This will allow the FSRU to attach messenger lines that will heave across the mooring lines.
- No mooring lines will be run until the LNGC is alongside the FSRU and held in position by the tugs whilst the mooring lines are connected.
- All moorings are to be passed from the LNGC to the FSRU by messenger line, one at a time in the sequence as agreed between Master and Pilot.
- The Mooring Team should only use the internationally recognized signals for mooring. Moorings are not hauled tight until all lines are on hooks and FSRU personnel clear.
- The SWL of the mooring hooks is 150 tonnes, per hook. Only 1 mooring line can be made fast to any individual quick release hook. Care to be taken to ensure none of the mooring lines are crossed.

4.4 Conducting unmooring operations

- No mooring line should be released until instructed by the Master / pilot
- The line should then be slacked sufficiently to allow the safe release of the FSRU QRH
- The mooring crew shall stand clear of the mooring rope at all times.

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- Care should be taken to avoid fowling of the fenders with the mooring line when heaving in.
- If any member of the mooring crew encounters a problem or is instructed to deviate from the mooring plan then he should stop what he is doing and report the situation to the mooring supervisor immediately.

4.5 LNGC Emergency Release of Lines

In the event of a required emergency release, all lines will be released independently to the Pilots/Captains requirements, any line being released shall be done so in a manner that allows for the controlled recovery of the lines and minimises the risk of fowling on fenders or on the vessels own rudder or propeller.

4.6 Manoeuvring alongside

The move with tug assistance can be supported by a LNG vessel main engine astern manoeuvre. Any engine movement shall be carefully applied to avoid any unintended propeller effects such as transverse thrust.
The tug will be used to generate movement and to control the speed and bring the LNG vessel to a halt.
The LNG vessel will be manoeuvred until its manifolds are in alignment with the shore manifold/FSRU manifold.
At no time during the manoeuver should the speed exceed 1knot.
The final positioning should be approximately 40metres from berth/FSRU to allow a safe working area for the tugs. Once the LNG vessel is in a position parallel to the Berth/FSRU it can start its final positioning. If the LNG vessel has difficulty maintaining this position then the berthing will be aborted.

4.7 Final Positioning

The LNG vessel will not be placed alongside until it has completely stopped moving and is under control.
For the final Positioning alongside one of the main considerations is the amount of available room for the tugs, for the vessels moving alongside the stern tug due to lack of available sea room will move abeam of the LNG vessel to assist in controlling the closing speed.
The LNG vessel shall not be brought alongside at a speed greater than 0.1m/s, it shall also remain parallel to the Berth/FSRU during the closing

4.8 Vessel Position during cargo transfer operations

Both vessel, FSRU and LNGC are expected to maintain their respective positions alongside, by prudent tending of the mooring lines, with careful regard to the spring lines.
Mooring line tension for the LNGC lines can be given from the FSRU control room, alarms are set at 40mt, which can be adjusted to suit the situation.
Regular checks on the moorings shall be made by both vessels, including a check on the vessels position relative to the reference, either ashore or on the FSRU. Any movement of the vessel shall be reported to the CCR and the situation assessed and monitored.
The following describes the maximum movement allowable before operations should be suspended and the vessels repositioned.

- FSRU movement relative to shore – +/- 1.0m maximum
- LNGC movement relative to FSRU - +/- 2.0m maximum

The vessel drift system (sec 6.5) system on the MIB equipment will also give a “pre-alarm” if the first pin is broken should the vessels move excessively.

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5 CARGO OPERATIONS

5.1 Transfer of Personnel

For the pre- and post cargo operations meetings only FSRU personnel who are essential for the safe coordination of operations will be transferred to the LNGC via ship-to-ship Gangway or Billy Pugh.
If the gangway or Billy Pugh is not suitable for use due to weather or vessel compatibility issues, then service boats will be utilized.

5.1.1 Pre-Lift Planning

All equipment and rigging to be visually inspected and certification is to be in date and valid, including;

- Certification of the crane stating certified for personnel transfer.
- Billy Pugh to be certified and maintained as per manufacturer's instructions.
- All crew involved have been trained in the use of the Billy Pugh and have watched the manufacturers video within the last month.
- Personnel transfer operations shall be the subject of a risk assessment.
- Any defects for the cranes, Billy Pugh and the lifting accessories reported in the vessels planned maintenance system and remedied satisfactorily prior to using.
- Billy Pugh certification to be provided to nominated vessel prior to deployment.
- The capacity of the Billy Pugh must not be exceeded. It is recommended that passenger load in any case should not be more than **4** persons and the weight distributed evenly.
- Transfer basket to be inspected prior to operation. To include checks of passenger securing, integrity of basket and the fixed lifting point.
- Hook to be secure snap lock type.
- Tag lines in place.
- As part of the pre arrival compatibility assessment it shall be confirmed that the LNGC has a suitable landing area within reach of the FSRU crane.
- The area on the LNGC shall be at least 3m x 3m (Based on 1m landing accuracy)
- All communications, including backup systems to be tested and confirmed as operational. Method of communications agreed and set up with Deck/Bridge/Crane Operator.
- Lift controlled by suitably qualified personnel on both vessel and FSRU.
- Crane planned maintenance must be up to date with no critical systems regimes overdue.
- Cranes and lifting gear to be checked prior to operation. Lifting to be conducted by FSRU cranes only.
- All crane checks to be completed and confirmed by the crane operator.
- Permit to Work prepared. To be issued when all checks are confirmed as completed.
- Tool box talk, attended by all involved in the lift, held on the FSRU and vessel respectively.
- Conduct test lift of empty transfer basket.

5.1.2 Personnel Protective Equipment

- All personnel involved in the lifting operation to be wearing correct PPE as required.
- The FSRU should have a spare set of Hard hats, and life jackets that are compatible for use with the Billy Pugh
- Consideration should be given to the compatibility of the lifejackets with the securing belts in the Billy Pugh
- Means of rescue should be prepared prior to lifting.
- Personnel in charge of the operation on their respective vessels shall wear suitably identifying clothing, ideally a Hi vis jacket.

5.1.3 Environmental Conditions

The Billy Pugh personnel transfer carrier is normally stable in high winds of up to 25kts Limiting factor is usually crane operability or control of Load. If there are any expected issues then transfer can be delayed.

Sig.wave Height(m)	Max. wave height (m)	FSRU Staff
Up to 2	Up to 3.7	✓
2.5	4.6	✓*

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2.5+	4.6+	✗

✓	Low risk of high landing or take-off velocity,
✓*	Increasing risk of high landing or take-off velocity. Consideration of hook speed and consideration of all other factors is recommended to ensure controlled landing and take-off. Dry run to gauge risk (without personnel) also recommended.
✗	High risk of high landing or take-off velocity. Not suitable for routine operations unless a specific hazard analysis can demonstrate otherwise

5.1.4 Personnel

The FSRU responsible officer with suitable training must be present on site at all times for the duration of the passenger transfer phase and ensure that;

- A Fully trained member of the crew is operating the crane.
- The passenger list is confirmed.
- Reception facilities are prepared on the vessels.
- The order of transfer and numbers of personnel transferred are agreed between the vessels
- Vessels personnel are stationed at the landing/loading area, transit area and reception.
- Passengers have been assessed for fitness for transfer.
- Sufficient barriers are in place to prevent unauthorized access to the lifting/landing area.

5.1.5 Passenger Loading to Transfer Basket

- Passengers to be escorted to landing/loading area for loading to the Billy Pugh.
- Passengers are to approach the Billy Pugh one at a time.
- Passengers to be secured in the Billy Pugh as per Manufacturer's User Guidance before commencing the lift;

1. Attach Main Lifting Frame Link to Crane Hook
2. Lift main ring vertically until side ropes are taut
3. Place small items of baggage or equipment inside the net arrangement
4. Stand on Main outer ring, attach safety harness, place hands around netting, lean inwards. Lifejackets to be worn throughout operation
5. Crane to commence with transfer
6. When not in use the Personnel Basket should be stored in a GRP container to avoid damage
7. Visually Inspect ropes etc. prior to every transfer.

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Figure 2: Billy Pugh basket

- The capacity of the Billy Pugh must not be exceeded. It is recommended that passenger load in any case should not be more than 4 persons.
- No large baggage or items are to be taken into the Billy Pugh. Baggage to be transferred in separate baggage container.

5.2 FSRU Responsibilities:

- Ensure BW's operating procedures are followed, and the STS operation is in compliance with all local regulatory requirements
- Attend pre-STS planning meeting
- Ensure that all transfer checklists are completed
- Ensure completion of declaration of inspection and Ship-to-ship check lists.
- Oversee placement of primary and secondary fenders
- Conduct pre transfer conference with the visiting vessels.
- Discuss current and expected weather conditions anticipated for the duration of the operation.
- Liaise with Harbour Pilot (if required) and agree mooring arrangement
- Coordinate on site risk assessment with vessel master(s) and Harbour authorities.
- Assist Pilot, if utilised, as necessary ensuring that the approach and manoeuvre of the ship to be lightered follows agreed passage planning
- Assist with communications and coordination of mooring
- Monitor the connection of liquid and vapour transfer hoses/quick disconnect system
- Monitor cargo transfer and discharge rates
- Monitor weather and sea/swell conditions throughout operation
- Monitor mooring arrangement
- Monitor communications throughout operation
- Monitor the draining of the cargo and vapour transfer hoses
- Monitor the disconnection of liquid and vapour hoses
- Assist the Pilot as necessary with the planned unmooring sequence.

5.2.1 Additional Safety Precautions and monitoring measures

To highlight pertinent areas from the SIGTTO checklist.

1) Both vessels shall have their nitrogen plant in operational condition at all times during the cargo transfer operation to afford a supply of compressed nitrogen, as may be required for purging cryogenic systems.

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2) Both vessels shall take measures to minimize the amount of vapour generated during the STS transfer. This is to be realised through proper cargo temperature management and adequate piping cool down before the STS operation, and reduced transfer rates during cargo operations. Where possible, both ships shall consume generated vapour within their capacities.
3) Both vessels shall have all cargo safety and monitoring systems in operational condition during the transfer operations.
4) Both vessels shall conduct checks on main deck, manifold and compressor rooms hourly
5) Both vessels shall have crew conduct routine and frequent deck rounds to monitor the condition of the moorings as they lead through the chocks and apply grease, if necessary, to minimize the risk of chafing. The frequency of deck rounds shall be increased if deemed necessary.
6) During cargo transfer, the hull protection water curtain and if required by owners, additional under manifold water spray system shall be in use at the cargo manifolds on both vessels.
7) All VHF Radios should be set on 1W, all MF/HF radios should be grounded.
8) The Automated Identification System (AIS) to be operated on lowest power setting possible for the entire operation.
9) Smoking regulations are to be strictly enforced. Warning notices shall be displayed and smoking designated rooms must be clearly marked.
10) Faulty circuits indicated by an Earth indicator light must be traced and isolated immediately to avoid the risk of arcing.
11) Soot blowing shall be performed prior to arrival. Ships must not perform this task during the STS operation.
12) Cargo transfers will be stopped in the event of a LNG leak on either vessel and not resumed until the vapour has dispersed, the leak identified, repaired or isolated.
13) All access doors to the accommodation shall be kept closed during the STS operation. The master shall designate those doors which shall be used to enter and leave the accommodation. Additionally air conditioning shall be switched to re-circulation mode.
14) Unauthorised craft shall not be allowed alongside during the STS operations.
15) Bunkering and vessels stores shall not be brought aboard during STS operations.
16) Fire fighting equipment shall be set out and prepared for use in the vicinity of the cargo manifold during cargo transfer operations.
17) Impressed current cathodic protection must be shut down 24 hours prior to arrival.

5.3 Testing Main Engines

Under no circumstances must tankers main engines be tested at any time whilst alongside until the unloading arms have been disconnected and the tugs are secured alongside.
The Master of the LNGC shall request permission from the Master on the FSRU to disengage the Main engine turning gear and commence testing of main engines.
The LNGC shall have in place sufficient experienced engineers to ensure safe warming through / Main Engine preparation.

5.4 LNGC Safety Inspection and Security

A FSRU Cargo Officer with a LNGC Cargo Officer or shall, referring to the Ship to Ship Safety Checklist, conduct an inspection of the LNGC cargo system and safety measures aboard the LNGC prior to the pre-transfer conference.

The Ship – Ship Safety Checklist shall be completed by the FSRU Cargo Officer, LNGC Cargo Officer and Terminal Manager at the pre-discharge meeting.

The Port Facility Security Officer and the Ship Security Officer shall confirm and exchange a Declaration of Security (DOS) in accordance with the Port Facility Security Plan.

BW/SONKER has established a security zone of 30m around the LNG carrier when cargo is transferred.

5.4.1 Pre-Transfer Conference

The FSRU Chief Officer shall conduct a pre-transfer conference on board the LNGC prior to commencing LNG transfer operations. The pre-transfer conference shall be attended by at least the LNGC Chief Officer, the FSRU Chief Officer, and the Terminal manager.

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The purpose of the pre-transfer conference is to ensure that persons in charge of cargo operations aboard both vessels, understand and are in agreement regarding how the LNG transfer operation will proceed and the terminal to ensure safe cargo transfer practices are followed so as not to endanger the terminal or the FSRU send out.

The pre-transfer meeting shall include, as a minimum, discussion of the following:

- Safety issues pertinent to the discharge
- Potential weather considerations
- Communications, including primary and secondary means
- Custody Transfer Procedure and all meter readings shall be confirmed
- Cargo Specification including temperatures and pressures
- Ordered flow rates, nominations and potential changes
- Maximum flow rates
- Minimum and maximum tank vapour pressure (both vessels)
- Maximum LNG transfer pressure
- Ramp-up considerations including rates
- Ramp-down considerations including rates
- Identification of measures to be taken in the event of an incident
- Ship – Shore Safety Checklist
- Any scheduled maintenance or repair work to be carried out on the LNGC or jetty
- Notice required for Main Engines (60mins)
- Schedule of persons in charge
- Port Security requirements for the crew members.
- Garbage collection services.

The ERC arrangement and breakaway procedure shall also be discussed as below
Criteria for an emergency breakaway may comprise of the following:

- Unexpected deterioration in wind, wave, or swell conditions
- Primary fender failure
- Mooring system failure
- Cargo hose failure
- Cargo containment failure
- Vapour release
- Any other shipboard emergency or failure which presents a risk to either ship involved in the operation

All aspects of the STS are to be discussed and an “STS transfer checklist” is to be completed.

Permission to proceed with connections shall be granted by mutual agreement between the FSRU Master, LNGC Master and Terminal Manager.

6 LNG TRANSFER SYSTEM

The hose handling and connection will take place when the vessels are alongside and be coordinated by the manifold crew of the FSRU
Personnel will transfer from the FSRU to the LNGC to assist and direct the operation of the LNGC crew, the crane operation will be undertaken by the crew of the FSRU, under the supervision of the LNGC officers and crew.
There will be a number of items of equipment that will need to be transferred from the FSRU to the LNGC, all of these are within the load limits of the normal manifold cranes.
The details of any preparation needed on-board the LNGC before arrival will be detailed below and the cooperation of the LNGC prior to arrival is appreciated in making the connection process as smooth as possible.
The LNGC crew will not be required to operate any of the ERC equipment as this is located on the FSRU

6.1 Equipment

The following section contains details of the equipment that will be deployed or used during the hose handling operations.
The figure below shows an overview of system components that will be deployed from each manifold.
The actual configuration on both vessels will be:

- Liquid lines:
  - Single Liquid to liquid hose on 3 liquid lines with with 16''-10'' reducer, double liquid line on 1 liquid line with 16''-10'' Y piece reducer, OR
  - Single Liquid to liquid hose on all 4 liquid lines with 16"- 10" reducers
- Vapour line:
  - Double vapour line with 16"-10" Y piece reducer

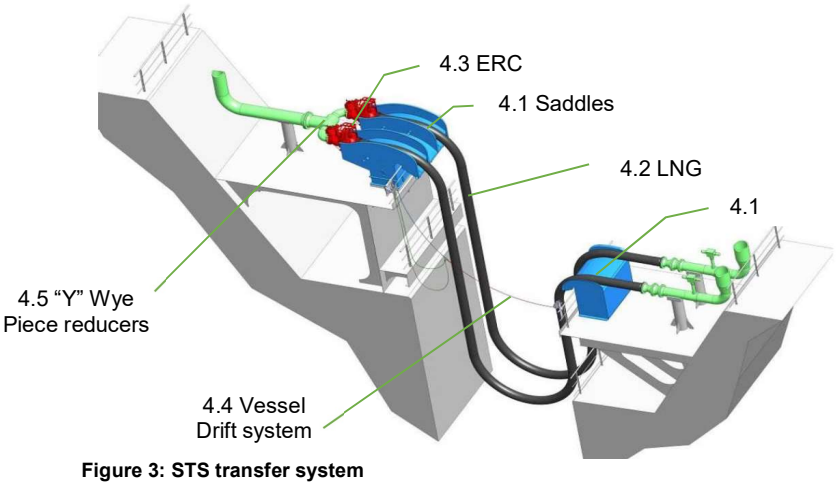

Figure 3: STS transfer system

6.2 Saddles

The saddles provided are made from stainless steel and provide support for the flexible hose connected to the vessels manifold.
They are covered with a Teflon sheet to provide protection to the hose and saddle.

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Once in position, they are filled with water, either fresh or seawater, which serves to counter weight them against the hose weight.
Further nylon ratchet straps are used to securely hold them down against the manifold structure.

6.3 Hoses

The flexible hoses are manufactured by Guttling of Holland and have been proven through extensive use in the LNG STS business for a considerable number of years. They have numerous different Class certification, and comply with EN standards for this application.
These are composite hoses, made up of numerous layers of material, supported internally and externally by stainless steel wires, this provides a flexible but resilient hose, with the outer fabric being a protective layer against abrasion and other contacts.
Whilst the stainless steel wire provides some support to the hose shape, it is not fully supportive and as such, care should be taken when handling the hoses to avoid crushing the hose.
Hose buns should be used for lifting the hoses, and wide nylon strops used for positioning them on the manifolds.
Hoses will be pressure tested annually and certificates kept by the FSRU, which should be available on request.
The hoses have a working pressure of 10bar.

Figure 4: Hose standby position

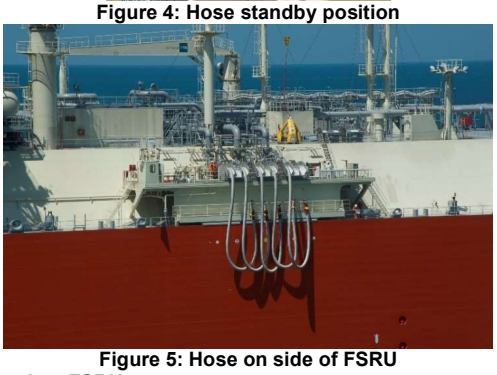

Figure 5: Hose on side of FSRU

Figure 24: Hoses prepared on FSRU

The hoses will be prepared on the side of the FSRU, they will be blanked and filled with low pressure nitrogen. They will be suspended from the side of the FSRU manifold by nylon strops and should be in positions ready to be picked up by the crane of either vessel.
The FSRU crew will assess the weather conditions and vessel movements alongside as to whether to use the LNGC crane or FSRU crane to connect the hoses.

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6.4 ERC

The purpose of the ERC is to provide an emergency release of the hose in the event of an emergency situation.
The ERC in this situation will be located on the FSRU and as such the LNGC has little interaction with them. It provides a double ball valve dry break system.
The vessels ESD systems will be linked with an electrical ESD cable (FSRU provides) to allow an ESD1 shutdown, with a "Vessel Drift System" between the vessels providing the ESD2 emergency breakaway component.

6.5 Vessel drift system

The vessel drift system serves the function of protecting the operation against vessels breaking out of their moorings and the hoses not being released.
There are 3 stages in the system,

1. Vessel drifting out of position activates the first stage alarm
2. If the vessel continues to drift then the second stage will activate the ESD1 system
3. Should the vessels continue to move out of position, then the third stage will operate the ESD2 and release the ERC automatically.

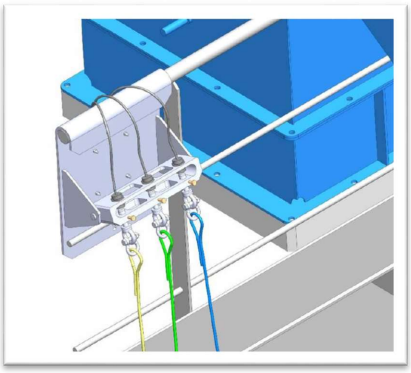

Figure 6: FSRU SWPS system

The LNGC will be asked to place a tension unit on the ships rail opposite the FSRU unit. This will tighten the ESD and Vessel Breakaway cables to the required tension
This portable and removable unit simply fits on the ships rails and uses a ratchet style drum to tension the link between the vessels.

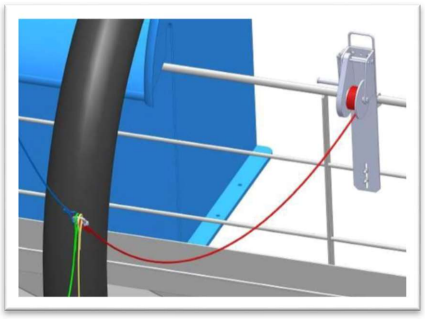

Figure 7: LNGC SWPS connection

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6.6 Gaskets

Compressed fiber gaskets will be used on the connections, the 16” connection for the Y reducer is for ships supply
10” gaskets for the hose connection will be supplied by the FSRU.
An insulation Gasket and set will be placed on the FSRU end of the hose string. T
The bolts shall be torqued to the following values

Flange	Torque value for
16”	(Depending on ship supplied gasket)
10”	230Nm / 170ft-lb

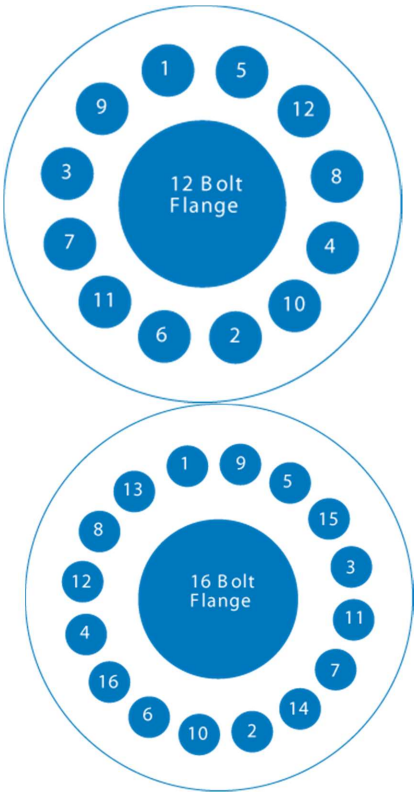

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Figure 8: Bolt tightening sequence

6.7 Water curtain / water pool

The underneath of the manifold is always protected by a water curtain, however should the ship owner decide to do so, the underneath of the manifold can be protected by a water pool.

6.8 Ancillary Equipment

The FSRU will provide most of the items to be used for the connection of the hoses and other transfer equipment.
All equipment passed between the vessels will be slung with nylon or stainless steel wire slings.
There will be a set of slings or strops used to position the hoses when connecting and disconnecting and these will be supplied by the FSRU and placed around suitable strong points on the manifolds, typically the base of the manifold support.
An air hose shall be supplied for the air tools used in connection and disconnection
The ship should create or use a AIR spray connection for the removal of the ice on completion of operations, this is preferable to the use of water for de-icing.
Seawater fire hoses should be rigged forward and aft of the manifold for spraying water on to the lower bight of the hose string between the vessels to warm the remaining liquid up to facilitate the gas freeing.

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6.9 Rigging equipment on LNGC

If possible the LNGC should make available a length of plastic matting, similar to the switch board matting, of around 5m length, this will be placed under the manifolds as they are connected and used to catch and prevent bolts or dropped fasteners from falling into the drip tray.

6.9.1 Reducers

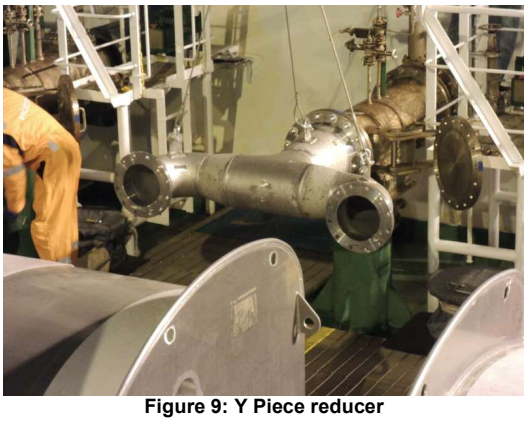

Figure 9: Y Piece reducer

Liquid and vapour lines will have reducers fitted in accordance with Section 6.3.
Reducers shall be fitted as normal practice, using SHIP SUPPLIED 16” gaskets, and FSRU supplied 10” gaskets

6.9.2 Hoses

The following guidelines will be applicable to which ever method is used to rig the hoses.

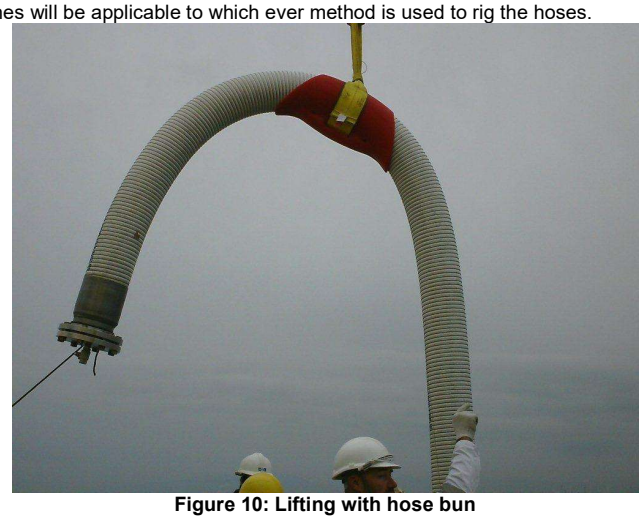

Figure 10: Lifting with hose bun

The Hosebun® should be positioned about 30cm from the end of the flange, clear of the metal ferrule, where a nylon strop also looped around the metal ferrule. See Figure 10: Lifting with hose bun for approximate position of hose bun. The hose bun should be held in position with a small piece of rope to stop it slipping down the hose when loose.
The hose should be lifted vertically and laid over the saddle of the LNGC, where a 25mm polypropylene rope will be placed around the hose about 2m from the end with a Timber hitch (see Figure 11: Timber hitch), or nylon strop and

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rope, secure on the manifold with a number of turns round the base of the manifold, this will stop the hose from falling down when the crane is slacked back, allowing the rope to be slacked should the flange of the hose to be positioned relative to the manifold face.
The polypropylene rope with care can be slacked and adjusted to allow the flanges to meet correctly.

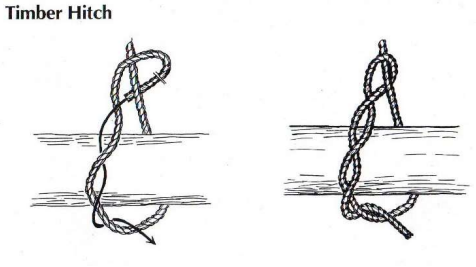

Figure 11: Timber hitch

scaffolding spanner spike should be used to guide the flanges into position, NEVER USE FINGERS to position the flange faces. The flange face on the hose is a floating flange and can be rotated and manoeuvred into alignment with the ships flange easily.
Once the flanges are together, with a minimum of four bolts in the flange, the ships crane can then be disconnected and swung clear.

6.9.3 Inventory of Equipment

- Saddles
- 6 piece stainless steel
- Teflon covered top
- Adjustable height
- Rope
- 10m of 25mm or similar polypropylene rope for securing the flange to the manifold.
- Hoses
- 6 piece Guttling LNG-White LNG hose
- Hand tools
- 2 x Scaffold spanner
- Extension pipe
- Wire brush to clean flange face
- Pneumatic tools
- Pneumatic air tools can be used if available
- 2 x impact wrench
- ¾” drive
- 3 x socket
- Split airline for 2 impact wrenches, 3m long hoses from T piece.
- Torque wrench
- Range around 100-1000Nm / 200-750lbf.ft
- ¾” drive
- Gaskets
- 6 x compressed fibre 10” gaskets
- Slings and lifting equipment
- 6 x 3m nylon strop
- 6 x 2m strop
- 6 x bow shackle 2t
- Hose buns
- 6 x hosebuns

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6.10 Hose and Manifold Pressure test and Inerting.

Once the cargo hoses are connected, both the manifolds and hoses shall be purged of oxygen using dry nitrogen supplied by the STBL. The pressure is to be raised to 5.0 bar in the liquid lines and 1.0 bar in the vapour line. The pressure is to be maintained while a leak test is carried out on the manifolds and hoses. Once the leak test is complete the pressure is to be released to atmosphere from the LNGC and the atmosphere tested. Purging is considered complete once the O_2 is <5% Vol. All hoses shall be depressurised to 0.5-1.0 bar after the test.

6.11 Emergency Shut Down Systems (ESDS)

Each ship involved in the STS must have an Emergency shutdown system to enable a rapid and controlled means of stopping cargo in the event of an emergency.
Modified arrangements may be required for ships engaged in a ship-to-ship cargo transfer in order that both ESD systems are compatible. This will be addressed in compatibility study should the vessels have not conducted an STS previously together
Where feasible, a controlled manual shut down system shall be preferred.

6.12 Linked Emergency Shut Down System

The method of shutting down cargo in an emergency must be discussed and agreed by both ships prior to commencement of the cargo transfer.
Vapour management and the actions surrounding an emergency shut-down must also be agreed.
The primary ESD link consists of an electric ESD, this also allows for communications via the electrical cable, using a Pyle National connection.
If the vessel is equipped with a modern Seatechnic Ship/shore communication system, then the visiting LNGC should be ship – ship SLAVE

The LNGC must have her pin configuration set as follows to be compatible with the FSRU.

PIN	Function
5/6	Hotphone
13 / 14	ESD SHORE TO SHIP
15 / 16	ESD SHIP TO SHORE

The back-up to the Electrical system will be the Pneumatic ESD link, the FSRU will have a pneumatic hose ready on the main deck should it be required.

- Set point - 5.0 bar
- Trip – 3.5 bar

6.13 Testing of ESD System

Prior to arrival at the STS location, the ESD system must be thoroughly tested as required by the IGC code. All methods of activation should be tested and the timing of the ESD closure shall be noted. The closing times and sequencing of the ESD valves should be more than 15 and less than 30 seconds ensuring pressure surges do not occur.
The FSRU ESD valves are timed to close within 30 seconds. The LNGC should set its valves to close within 25 seconds.
Prior to commencement of the cargo transfer, the linked ESD system must be tested in accordance with the IGC code. The ESD is to be tested once hoses are connected and purged. It is important that the ESD v/v's are not operated before purging has been completed.
The Electric cable will be connected on the STBL and then on the SS.
The LNGC will check that it has a healthy ESD signal and then open it's ESD v/v's.

7 CUSTODY TRANSFER MEASUREMENT

Gauging will be performed after the warm ESD tests. At the same time the gas flow meters to engine room and GCU, shall be recorded. Upon completion of cargo transfer, after liquid draining, closing CTMS will be carried out and counters taken again.

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The certified Custody Transfer Management System (CTMS) on board the shuttle tanker, shall be used for measuring volume of LNG being transferred between the shuttle tanker and FSRU in compliance with international LNG industry standards, guidelines, recommendations and best practice, including;

- GIIGNL's LNG CUSTODY TRANSFER HANDBOOK 4rthEdition Ver.4.00
- SIGTTO – LNG Ship to Ship Transfer

Commented [TV3]: Update to latest revision

The certified CTMS fitted on the FSRU will only be used for its internal LNG inventory management and to verify the quantities of LNG loaded from the LNG shuttle tanker.

7.1 Trim

Vessels shall limit their trim to less than 3.0m throughout the operation, including periods of stripping
Any trim to forward shall be avoided as far as practical

7.2 Vapour Management

The FSRU will return vapour to the LNGC as required to allow control of the LNGC tank pressures.
In case of high pressures both vessels will utilise re-liquefaction equipment (if installed) or other gas consumption methods i.e. boilers using steam dump to the main condenser on steam driven ships or gas combustion units (GCU) on Dual Fuel Diesel Ships.

The design of the FSRU and LNGC cargo containment system impose pressure limits for the operation of the boil off gas system. The design and operating limits for the FSRU containment are in the table below. The operating limits of the LNGC are likely to be lower than the values in the table below. Caution should be taken in the event of returning vapour to the LNGC under normal or abnormal circumstances.

Action	mBarg/kPa(g)
Cargo tank pressure relief valve open	700/70
Vent valve open	680/68
High High pressure alarm	670/67
Vent Valve close	660/66
High pressure alarm	650/65
FO Back up reset	50/5
Low pressure alarm FO Back up order	30/3
Low Low pressure alarm	21/2.1
Very Low pressure alarm	3/3
Cargo tank vacuum relief valve open	-10/-1

The basis of operation and operating parameters shall be discussed during the pre-transfer meeting.
Natural gas vapour shall not be released to the atmosphere during normal conditions throughout the cargo transfer.
During the LNG transfer the FSRU and LNGC will control their tank pressures utilising the installed equipment.
The amount of boil off gas generated will depend upon a number of factors including: transfer rate, saturated vapour pressure of LNGC cargo, amount and temperature of heel aboard the FSRU along with FSRU tank and insulation temperatures.
Vapour will be returned to the LNGC as required for vapour balancing purposes. This is dependent upon commercial agreement. The saturated vapour pressure prior to and during the transfer should be as low as possible to reduce vapour generation; this will require careful cargo management by the LNGC during its laden passage.
The LNGC should arrive with tank pressures as low as reasonably practicable. In order to have optimal transfer rates the cargo condition should have a maximum saturated vapour pressure of 1,120 mbar abs (112 kPa abs, 12kPa), It is imperative that all parties concerned fully understand the vapour management process. The LNGC is to keep the FSRU and terminal informed of cargo pressures and temperatures as part of the pre-arrival communication.
The transfer must commence at a reduced rate and tank pressures monitored continuously. If a rapid pressure rise should occur, the loading rate shall be reduced, or stopped until pressures are within safe limits.
Close communications between the ships are imperative to effectively manage the tank pressures, vapour volumes, and gas burning.

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7.3 Hose and Manifold Cool down

Depending on the operation, the LNGC may be asked during arrival pilotage and hose handling operations to fully cool down loading lines up to the inboard manifold manual double shut v/v. Line cool down is considered to be complete once the fwd and aft liquid 'X' over lines are <110˚C. Line cool down can commence during LNGC pilotage so long as personnel are available for safely conducting the operation.
Cargo hose cool down shall be performed by using one (two if required) of the LNGC's cargo spray pump(s) and should take 1 hours.
During hose and line cool down, the integrity of the hoses, flanged connections and the manifold area shall be closely monitored.
On achieving the desired temperature the cool down is stopped for a cold stroke ESD check after which lining up takes place for the transfer.

7.4 Cargo Transfer

Vapour generation shall be closely monitored and controlled during cargo transfer, with the vapour line open between the LNGC and FSRU to facilitate vapour balancing. The FSRU is equipped with a re-condenser to handle this additional BOG generation.
During the transfer an hourly exchange of information is to take place.
This is to include (but not limited to) transfer rates, cargo ROB quantities, mooring line status etc.
Ramping up and down rates shall be discussed at the pre-transfer meeting. However the ramping up can be slowed down if either party feels uncomfortable with the situation. Normal ramp up is expected to take 1 hour.
The possibility of rollover shall be taken into consideration prior to the transfer.
Starting cargo transfer and subsequent increases shall be authorised by the FSRU to ensure that tank pressures are managed in a safe manner.

MIB 10" system	
Per hose	2,250m3/Hr
Total system Max transfer rate	10,000m3/Hr

If required stripping pumps shall be started in ample time if the discharging ship intends to heel-out her cargo tanks. This will ensure cargo consolidation can be completed if the main cargo pump loses suction due to liquid movement.
Prior agreement is necessary from PGPCL for stripping operations.

7.4.1 Sloshing

Membrane-type LNG carriers' tank structures can be damaged due to the effects of cargo sloshing inside the tanks. Each ship must be operated within the specific limits established by her classification society.
In the event the STS must be suspended, each ship must have a contingency plan to consolidate cargo prior to departing to open waters. It is of utmost importance that throughout the various stages of the unloading sequence a cargo plan is followed. The plan will follow a prepared sequence to give a maximum 5 hours of internal transfer to attain cargo levels outside of the sloshing zone. Sea going stability criteria must be fully met prior to departure.

7.4.2 Topping Off

Topping off shall occur at the pre-agreed reduced rate, one tank at a time. A topping of rate of 500-800m3/hr is normally agreed upon.
There may be an increase in the effect boil off has on tank pressures whilst tanks are being topped off, this is due to the construction shape of the prismatic tanks. Adequate precautionary measures must be taken in order to avoid venting.

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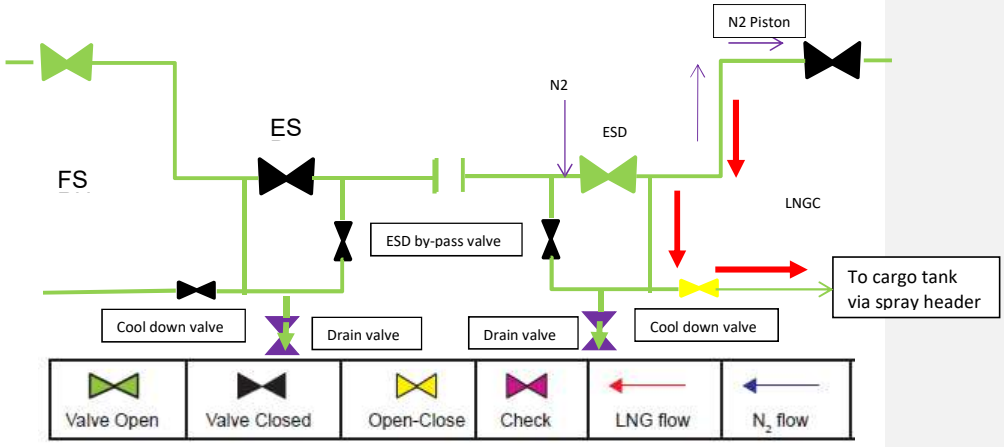
7.4.3 Hose draining and Purging

ESD systems should be inhibited and ERC made safe on completion of cargo transfer operations
Once the transfer operation is completed . The draining and purging for each manifold to be carried out in two stages with procedure and valve settings as described under the illustration 1.55 (a) for 1st stage draining of LNGC manifold section and illustration 1.55 (b) and for 2nd stage draining and purging of transfer hose and FSRU manifold section.
Nitrogen will be connected at the manifolds LNGC and system to be pressurized to 4-5bar. It will aid the operation if the FSRU can supply nitrogen, via a flexible hose, to the LNGC's manifold N2 inlet to aid the pressurization. Suitable adapters shall be made ready to receive a snap type connection from the FSRU.
Hoses shall be drained from the LNGC towards the FSRU.

The draining shall be conducted by repeatedly pressurizing with nitrogen until the pressure reaches 4 to 5 bar and with release of pressure to minimum 0,5 bar. Drain cycles to be continue until manifold sections on the LNGC & FSRU and transfer hoses is confirmed liquid free by responsible officer before final CTMS is carried out.

During this draining operation a sea water spray is to be directed onto the hoses bight to speed up de-icing.
As the LNG boils off it will aid in pressure increase for displacing liquid in the lines. Both vessels will conduct this operation together.
Manifold sections and transfer hoses to be continued purged until HC level below 40% LEL at the LNGC side.
Once purging operation completed, the Double shut valve and ESD valves onboard FSRU and LNGC to be confirmed close before any hose disconnection and blind flanges is installed
An "air lance" utilising the ships GS air through a small pipe to create a powerful jet should be used to loosen and clear the hoses of the ice accumulation, rather than water which will leave everything wet and form new ice.

Illustration 1.55 (a) 1 Stage Purging LNGC Manifold section



1. Verify that FSRU ESD valve closed and double shut valve open.
2. Verify that LNGC has open the ESD valve and double shut valve closed
3. LNGC to introduce N2 and pressurize to 4-5 bar

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4. LNGC slowly release the pressure into spray header by open cool down valve, this allows the manifold drop lines of the LNGC to be emptied into tanks.
5. Repeat step 3 and 4 until the liquid is observed to be gone and only gas is passing into spray header.
6. When LNGC manifold drop line confirmed liquid free, stage 2 purging with draining of transfer hose and FSRU manifold section to continue.

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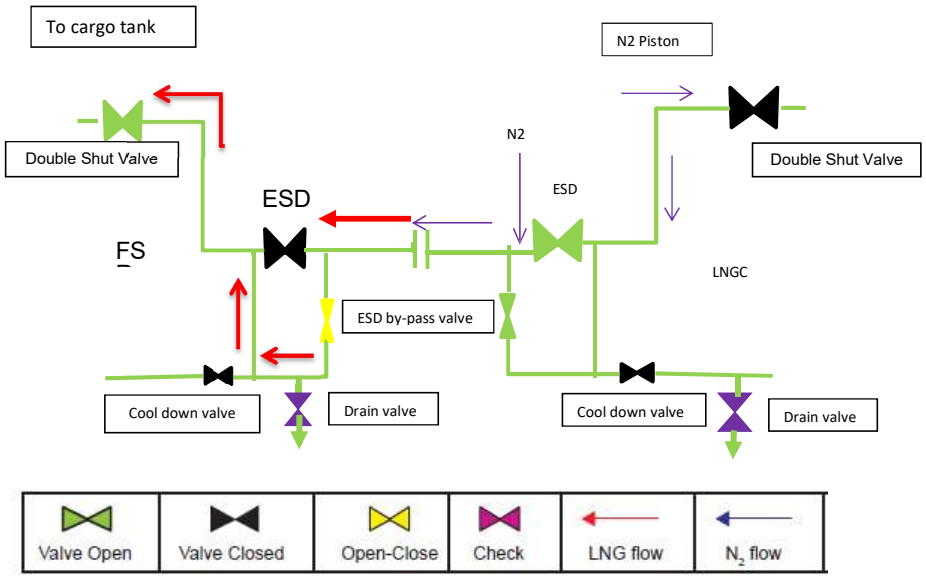
2 Stage Purging Transfer Hose and FSRU Manifold section



1. LNGC cool down valve to be closed
2. LNGC ESD valve to remain open and double shut valve to remain closed
3. FSRU ESD valve to remain closed and double shut valve to remain open
4. LNGC to introduce N2 and pressurize to 4-5 bar
5. FSRU slowly to release the pressure into cargo line via double shut valve and return to tank by open ESD valve. Pressure to be released to minimum 0,5 bar.
6. Repeat step 4 and 5 until the liquid is observed to be gone and only gas is passing into liquid header.
7. Drain valves FSRU and LNGC to be cracked open to verify liquid free
8. When transfer hose and FSRU manifold drop line confirmed liquid free, continue purging until HC less then 40 % LEL at manifold sampling valve
9. Once purging operation completed, the Double shut valve and ESD valve on FSRU and LNGC valve to be confirmed closed before any hose disconnection and installation of blind flanges.
10. After blind flanges installed the LNGC and FSRU to line up cargo system as per own vessel cargo manual to avoid any pressure build up in the cargo system

7.4.4 Hose disconnection and De-rigging equipment

The ESD Electric Cable may be disconnected prior to disconnection of cargo hoses.
Derigging the equipment will only be carried out once the hoses are proved gas free to an acceptable limit with a gas analyser, measuring hydrocarbon in inert atmosphere of less than 2% volume.

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Gas freeing can take a considerable time, depending on how successful the purging was completed.
Water sprayed onto the hose will facilitate this.
Care should be taken to clear the deck of the ice to a safe corner or area, so that crew members do not slip on the ice when working around the hoses.
A piece of rubber matting should be available underneath the manifolds to catch nuts and bolts when released. And prevent them dropping into the drip tray.

7.4.5 LNGC de-rigging

Depending on the weather conditions at the time of disconnection, either the FSRU crane can be used of the LNGC will have to de rig the hoses to the manifold so as to allow the FSRU to pick them up.
If the hoses are to be de-rigged to the LNGC manifold by the LNGC, then additional strops will be required to secure the hoses to the manifold between transfers to the FSRU.
Pneumatic and hand tools should be available for the disconnection operation, with the LNGC providing an air supply if needed.

7.4.6 Hose de-rigging

The hoses on the LNGC will be the first to be disconnected. The hose should be secured against the vessels manifold with the polypropylene rope so as to prevent the flange jumping when let go, and the hosebuns® used to pick the hoses up.
The hose should be checked that it is depressurised before unbolting commences.
Alternate bolts should be undone, keeping four bolts in place until it is ready to release. Once the crane takes a little weight on the hosebun®, the hold down rope should be tightened, this prevents the flange jumping when disconnected. A crew member carefully slacks back the remaining bolts to release the flange. The flange can be disconnected and the blank flange placed back on with the valve cracked open to allow the Nitrogen to be flowed through. This should be kept open and N2 flowing at a low rate for 24hrs after transfer, this allows for the safe removal of any gas that may become trapped in the membrane of the first layers inside.
The hoses can now be swung to the FSRU where the crew on-board will direct the hose to its resting position and hang if off the side of the vessel using nylon strops.

7.4.7 Reducers

Reducers should be unbolted leaving alternative bolts in place, one the crane is connected they can then be fully released and swung clear.

7.4.8 Saddles

During the disconnection process the saddles can be emptied of the water in the base, by unscrewing the drain plug and emptying into the manifold drip tray, the LNGC should open the manifold overboard drain at this time to allow the water to run overboard.
Once the hoses have been lifted clear the ratchet straps can be disconnected and rolled up and placed in the base of the saddles for convenience.
After the other equipment has been disconnected and swung clear the saddles can have the top part lifted and rotated to the transport position, and then the units can be lifted across to the FSRU for storage.

7.4.9 Ancillary equipment

Other items of FSRU equipment shall be collected and placed in the equipment cage or boxes provided by the FSRU