HÖEGH LNG

Ship to Ship Information Manual

LNG Transfer with cryogenic flexible hoses

Rev.	Date	Issue Type
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1 Introduction

This manual has been prepared by Höegh LNG to provide information on Ship to Ship Transfer (STS) of LNG to FSRU. The information contain in the manual should be used to help prepare the STS operations and familiarize with the equipment involved.

Höegh LNG STS Procedure sets the standard for safe STS operation. It contains procedures, checklists and definitions. It applies to all Höegh LNG managed FSRU/vessels and other vessels where a Conditions of Use document has been agreed upon.
Hoeghs crew will go onboard the visiting LNGC to assist the staff to rig and set up the manifold prior to operations commencing.

The Ship to Ship operation described in this manual assert that approval process for LNG/C is performed and pilot / tug operators is agreed.

2 Safety

All persons involved in the operations listed in this manual must be properly trained and familiar with the equipment being used. Crane operators and signal men should be familiar with the correct signals. Everyone must wear the correct PPE as required by the company and industry standards. All personnel should follow the guidance of the LNG STS advisor on site.

3 LNG/C Approach, Berthing and Mooring to FSRU

This document considers the mooring layout proposed to be optimal for most situations; however a mooring analysis is not included within this document, as it will be assessed closely elsewhere within the project.
This document addresses the manoeuvring and berthing of LNG/C only. The equipment required to affect this successfully will be described elsewhere.

The operational limits for the terminal are established and are set in the Marine Terminal Manual.

“Ship/shore” safety checklists and verification checks (with basis in the STS checklists contained in the OCIMF STS Guidelines), with briefing of LNGC crews on berthing procedures will be undertaken prior to commencing the LNGC approach.
All parties agree berthing plan and sequence of connections and communications tested.

Pilots, tugs crew and crew on LNG and FSRU all briefed and ready

3.1 LNG/C Approach and Berthing

The method of berthing may vary depending upon environmental conditions. Experience shows that a successful berthing may be undertaken in a side by side configuration in benign conditions with tugs pushing close alongside the LNGC, secured through starboard side leads/shell bitts. However, pushing will be limited to reasonably calm or low wave height conditions to avoid tug contact damage to the LNGC hull. Therefore, when conditions are suitable, and probably with wave/swell height of below approximately 1 metre (depending upon direction and period), berthing with tugs pushing alongside may be undertaken.

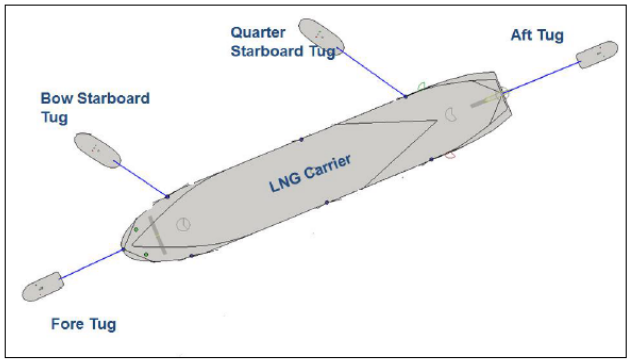

Figure 1 - Layout of Tug

This requires the LNGC to approach the FSRU from a direction on the starboard quarter, and be stopped at a lateral distance from the FSRU of around 50m - 150m. Thereafter tugs can push the LNGC alongside.

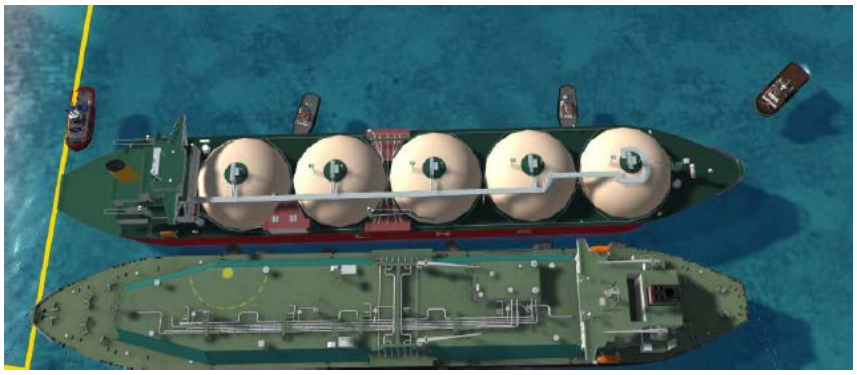

Figure 2 - Pushing alonside. Forward and aft tugs securing the approach ready to pull off

FSRU crew will be positioned at the Vapor manifold and will communicate with the LNGC crew and Pilot to ensure correct fore and aft alignment for the LNG Transfer connections.

3.2 LNG/C Mooring

LNGC mooring lines may be passed to the FSRU when the distance between the vessels has closed sufficiently and final aligning to cargo manifold using the mooring lines to bring the LNGC in position.

The LNGC will deploy moorings, which will normally consist of 18 mooring lines. This considers two springs forward and aft, 2/4 breast-lines and 2/4 stern/bow lines. The LNGC is moored with its own mooring outfit with each line secured to a quick release hook on the FSRU.
Mooring line tension for the LNGC mooring lines are monitored in the mooring station in the FSRU CCR.

Moorings should be pre-tensioned and it is expected (dependant on weather conditions) that tensions of between 10 to 15 tonnes will be achieved on springs and around 5-10 tonnes on brest and head & stern lines.

All mooring operations shall be conducted in compliance with the approved Optimoor mooring plan which will be required to be performed during compatibility study prior to arrival.
All Optimoor studies will be conducted based on an OCIMF criteria and the max safe wind sweep that can be achieved.

Order of mooring lines is dependent on in port STS operations or offshore STS operations with weather vaning mooring system.

The considered normal order of mooring for in port operations is likely to be:

Mooring line	**1st lines**	**2nd lines**	**3rd lines**
Forward	Springs	Breast Lines	Bow Lines
Aft	Springs	Breast lines	Stern lines

This implies two mooring teams, one team working from the fwd. spring lines towards the bow lines, and one team working from the aft. spring lines towards the stern lines.

For offshore mooring with weather vaning, the normal order is likely to be:

Mooring line	**1st lines**	**2nd lines**	**3rd lines**
Forward	Breast	Springs	Bow Lines
Aft	Springs	Breast lines	Stern lines

This is to control the forces and avoid the bow to separate during mooring operations.

The mooring lines should be inspected regularly during the STS operation by both vessels and any movement shall be reported to 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 FSRU LNG Transfer System is equipped with a ship in position system (taut wire) which will give alarm and trigger ESD if the relative movement between the vessels are outside the allowable limits.

4 STS Equipment

The following section contains details of the equipment that will be deployed or used during the hose handling operations.

4.1 Layout of STS LNG Transfer System

The figure below shows the different layouts of system components that will be deployed from each manifold.

The Ship to Ship LNG Transfer Equipment is designed to load LNG liquid from the LNG/C at a rate of 9,000 cubic meters per hour through four liquid hoses and two vapour return hoses.

For transfer lower than 9000 cubic meters per hour the numbers of liquid hoses are reduced, e.g. for 6000 cubic meters per hour is only 3 liquid hoses in use.

Typical layout for an LNG Transfer System with a flowrate of 9.000 m3/hour is shown in Figure 3.

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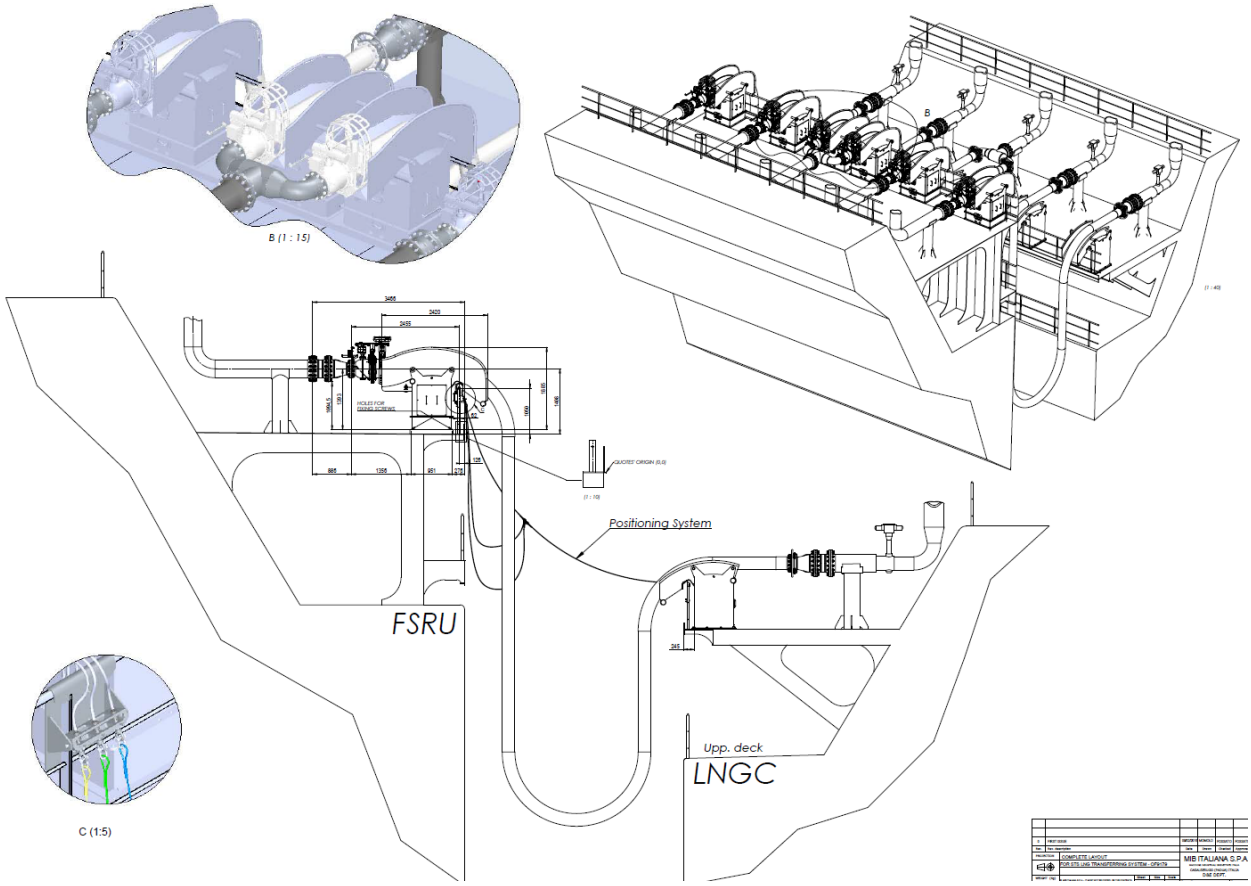


Figure 3 - Typical layout of LNG Transfer System

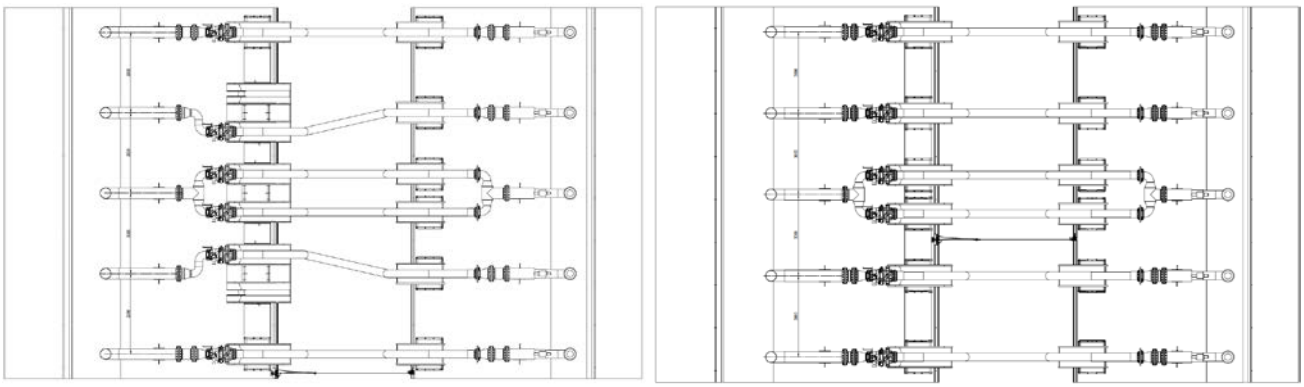


Figure 4 - Layout LNG Transfer System

On each vessel, a y-piece connection is connected to the 16” vapor manifold to allow using 2 x 10” hoses for vapor return. The 16” liquid manifolds are equipped with single reducers to allow using the smaller 10” hose to the 16” manifold connection.

4.2 Main Components

4.2.1 STS Tool Box

One Tool Box will be transferred from FSRU to LNG/C. The FSRU Cargo Engineer leads the connection work aboard the LNG/C. He will hand out tools from the tool box as well as ensure safe return upon completion of operations. See annex 1 for tools list.

4.2.2 Hose Support Saddles

The saddle takes the weight of the hoses over the railing and will prevent short radius bending. The lower part of the saddle is a compartment and has to be filled with seawater or sandbags to be stable.

The saddles lifted from the FSRU to the LNGC and mounted on manifold are made of aluminium.

The saddles will be secured onto four strops and maneuvered into position using the crane from the FSRU. Once in position they will be secured using the ratchet straps and the securing U pieces if required. Once the saddles are in position the ballast tank can be filled with water, or sand bags if in cold climate.

Caution – Saddle is not to touch ship's railings.

Figure 5 - Double hose support saddle on LNGC

The saddles permanently fixed on the FSRU is made from stainless steel and covered with Teflon sheet to provide protection to the hose and saddle.

Each saddle on the FSRU is equipped with a hose brake system consisting of a hydraulic controlled unit allowing the hoses to be lowered in a slow and controlled manner in case of emergency disconnection.

4.2.3 Cargo Hoses

The FSRU is equipped with 6 pcs. of 10” flexible composite hoses for LNG Transfer (4 liquid and 2 vapor).

Y-piece reducer or single reducers will be installed on each LNG/C manifold.
The composite hoses will be bolted to the reducers.

Hoses will be pressure tested annually and certificates kept by the FSRU, which should be available on request.

4.2.4 Emergency Release System

The Emergency Release System (ERS) comprising two ball valves and an emergency coupler device and is installed on the FSRU manifold, together with their common hydraulic power/control unit. The ERS providing quick and safe means of isolating and then releasing each of the flexible hoses under adverse or emergency situations.

The dual ball valves are secured together by a hydraulically activated Emergency Release Coupler (ERC).

Figure 6 - ERS on FSRU manifold

4.2.5 Positioning Monitoring & Shutdown System

The wire positioning system is a non conductive link system that connects the FSRU to the LNGC for the purpose of positioning monitoring and automatic shutdown in case of ship break away triggering automatic alarm and release of the hoses.

The wire positioning system consists of three main elements which are as follows:

- FSRU side rail mounted unit
- LNG carrier ships rail mounted system
- Wire rope assemblies that connects the FSRU to the LNG carrier

The operation of the system will provide both the pre-alarm, and the first alarm and the second alarm stage signals.

The FSRU side rail unit consists of a mounting plate on to which are mounted 3 proximity switches. The proximity switch targets are made up by pins held in place, inside a rotating structure, by shear pins which are designed to break when a load of about 50 – 100 kgs is applied by the wires between the two vessels.

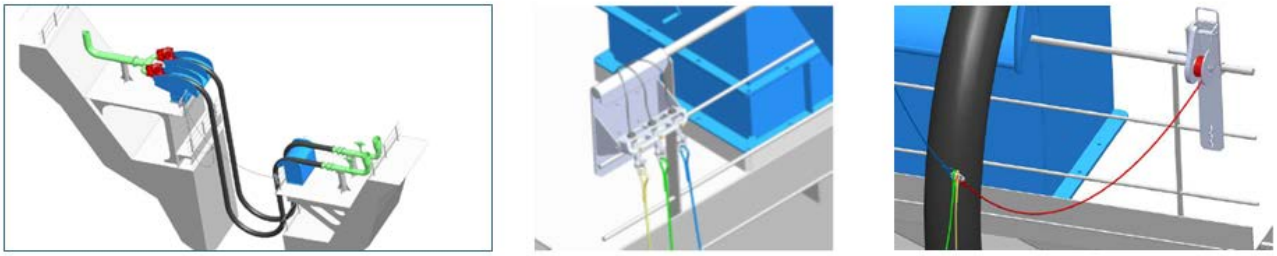


Figure 7 - Wire Positioning System

These pins are connected to different length wires, departing from the same wire rope.

- Pre-alarm: 4 meter
  - Issue an alarm to the vessel's control system (IAS)
- First alarm: 7 meter (LNG-FSRU Large Motion)
  - ERC ESD 1, this initiates a PSD 4.1 to the FSRU ESD system which closes the manifold valves, stops the HD compressors. At the same time signal is sent by the SSL to the LNGC so they will stop their pumps and close LNGC ESD valves.
- Second alarm: 10 meter (LNG-FSRU Too Large Motion)

- ERC ESD 2, this repeats the PSD 4.1 activation to the FSRU ESD and first closes then releases the ERC's.

In any case, these lengths are adjustable since the winch has a total length of wire of 15 meters,

ERC release is only possible either automatically via the 3rd wire (vessel too large motion) or manually from the HPU or Cargo Control Console.

4.2.6 Ship to Ship Link

The SSL cable will be provided from the FSRU and will be either the fibre optic cable or the pyle electrical cable. This is the same as the cable provided on a conventional terminal and is connected straight into the SSL box on the visiting LNGC.

4.2.7 Reducers

Each ship will be equipped with y-piece reducer(s) and single reducers allowing using the smaller 10" hoses to the 16" manifold connections.

Each spool piece is equipped with lifting wires for easy connection. Care has to be taken to make sure the thimbles are straight up when lifting as shown below:

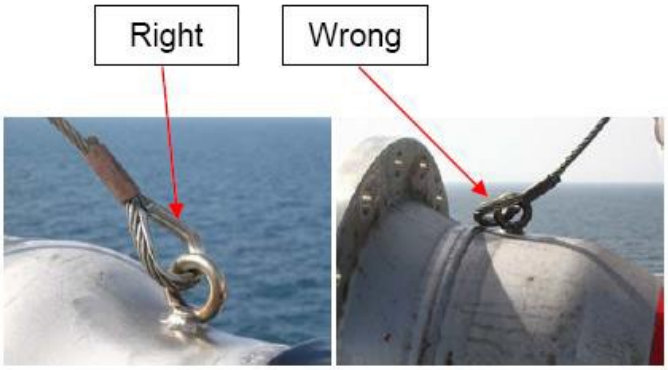


Figure 8 - Picture showing correct fitting on lifting wires

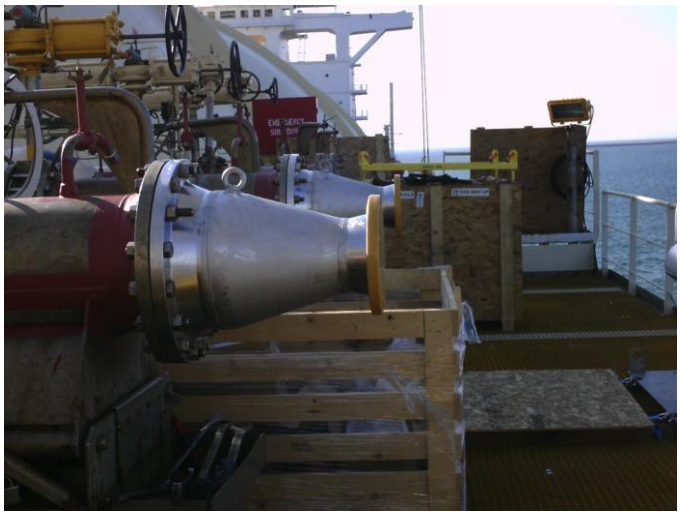


Figure 9 - Reducer in position

4.3 Auxiliary Components

4.3.1 Deluge System

Adequate protection of the vessel's mild steel structure should be provided in areas likely to be affected by LNG spillage.

The water deluge system should be installed to protect the trunk deck and the upper deck on the LNG/C.

4.3.2 Hose Bun

Hose buns will be used to pick up and present the hose in a horizontal position onto the face of the reducers.

The hose bun has to be put in a position approximately 1 meter from the flange to be connected to the LNGC. The hoses will be lifted onto the LNGC manifold using the crane from the FSRU and then a 25mm rope will be used to support the hose whilst it is transferred to the crane on the LNGC. This 25mm rope should be secured to the hose using a timber hitch and the other end secured to a suitable strong point in line with the manifold. The ideal position for this rope is approximately 5m from the end of the hose, but this can be judged when making the connection by the officer in charge.

Figure 10 - Hose bun in position

4.3.3 Centering Pin

The centering pins are used to centre the holes of the flanges. They are used mainly on the sides of the flange enabling bolts to be fitted to the top and the bottom. These pins are provided with the hoses.

Figure 11 - Centering Pins

4.3.4 Electrical Insulation

For electrical insulation of hoses during STS LNG Transfer, SIGTTO recommends the fitting of the insulation gaskets on the opposite end of the hose to the ERC.

Figure 12 - Typical Insulating Flange Gasket Kit

Heavy duty, non-slippery insulation mats are provided for electrical insulation on deck during STS.

5 Personnel transfer during STS

5.1 Equipment for Personnel Transfer

The basket type on the FSRU for personnel transfer is Billy Pugh for jetty moored FSRUs and FROG Capsule for offshore FSRU.

Figure 13 - Billy Pugh basket and FROG capsule

For safe handling of personnel by basket, the service crane is certified offshore crane and fitted with features for personnel transportation like double brake on winch, auxiliary hydraulic power pack and lockable switch with key for selection of personnel lift mode.

5.2 Landing Area for personnel basket / capsule

On the FSRU there are two dedicated landing areas for the basket/capsule which are shown in Figure 12. The figure also shows where the basket and capsule are stored.

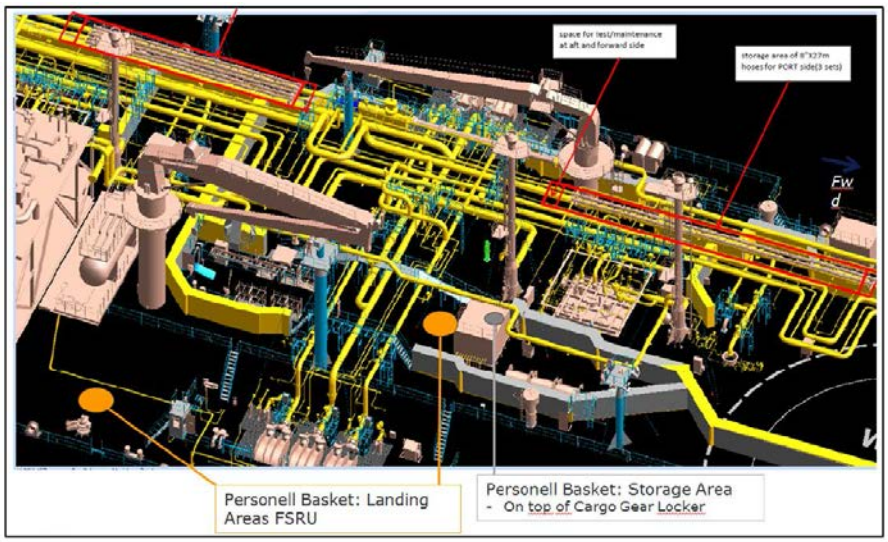


Figure 14 – FSRU Landing and Basket/Capsule Storage Area

While the FSRU has two dedicated landing areas, the LNGC has one as shown in Figure 13.

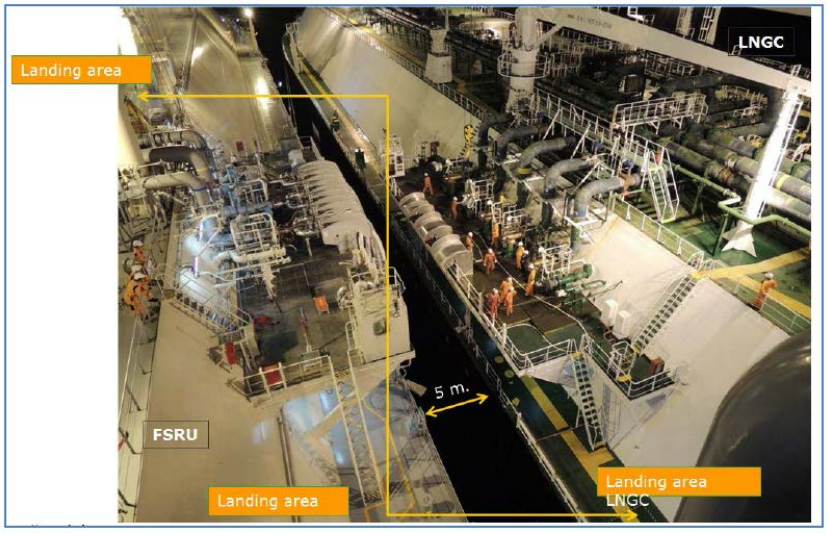


Figure 15 - Landing Areas

5.3 Personnel

Only essential personnel for safe coordination of operations will be transferred either from LNG/C to FSRU for pre-loading meeting or from FSRU to LNG/C for pre-loading meeting and for post cargo meeting.
FSRU connection team will be transferred to/from LNG/C for connection and disconnection of LNG Transfer Equipment.

In addition Client / Cargo Surveyor will be transported during LNG Transfer Operations.

All personnel are to wear proper PPE. The basket is only to be used for personnel transfer and not for transport of equipment, tools etc.

Passengers to be secured in the Billy Pugh/FROG as per Manufacturer's User Guidance before commencing the lift;

For further instructions, reference is made to Höegh STS Procedure.

6 Connection

All hoses will be prepared on the side of the FSRU, they will be blanked and filled with low pressure nitrogen. The hoses are stored hanging from the side of the FSRU, and ready to be deployed to the visiting LNGC.

Figure 16 - Stowage position of cargo hoses

6.1 Before connection to LNGC by both vessels

6.1.1 Preparation

- Ensure all personnel present are wearing the correct PPE and a full safety briefing / tool box talk has been completed prior to any operations taking place.
- Ensure firefighting equipment is laid out and ready for use.
- Carry out a nitrogen purge on the manifolds prior to connection taking place to ensure the atmosphere is less than 1% by volume (20% LEL). This is done at this stage to ensure there is no gas build prior to the manifolds being opened.
- Ensure sufficient gaskets available of the correct type.

6.1.2 Preparations by FSRU prior to arrival LNGC

- Fenders to be inspected and check list filled out. Certificate of inspection sent to incoming LNG/C
- Ensure checklists 1-3 as per Höegh procedures have been completed prior to the arrival of the LNGC to the FSRU.
- Ensure all checks are completed and recorded prior to the arrival of the LNGC as per the checklist in Höegh Procedures.
- Make sure tool box and equipment are ready and inspected prior to transfer LNG/C.
- Prepare Billy Pugh basket / Frog capsule for use. Fill out checklist.
- Prepare saddles for transfer (including separate transfer of sand bags if cold weather)
- Prepare the Y-Pieces/single reducers for connection to the liquid lines and the vapour

line.

- Prepare the insulation kit, making sure all pieces are present.
- Prepare hoses for transfer. Ensure that hoses are purged with N2 well ahead of LNG/C arrival, at least 24h.

6.1.3 Preparations by LNGC

- Ensure checklists 1-3 as per Höegh procedures have been completed prior to the arrival of the LNGC to the FSRU.
- Ensure adequate personnel (3 persons) present to aid with connection.
- All tools to be present and ready at the manifold.
- Adequate gaskets present for the connection.
- Ensure firefighting equipment is present and ready for use. (one fire hose will be used to fill the saddles with ballast water. If in a cold area sandbags will be supplied from FSRU to LNG/C to be used as ballast).
- Ensure that all pre cargo operations checks are completed and satisfactory.
- Make sure the manifolds are clean and free of debris.
- Check the Strainers on the LNGC, to be verified by FSRU cargo engineer.

6.1.4 Transfer of FSRU connection team and FSRU Tool Box to LNGC

- Transfer the FSRU connection team to LNGC with the Personnel Basket.
- Transfer the FSRU Tool Box with equipment to the LNG/C

6.1.5 Transfer and positioning of hose support saddles

- Transfer and position the hose support saddles, using the crane from the FSRU.
- The position should be checked before the saddles are lifted to ensure it is clear and free of any debris.
- Once the saddle is lifted into position the wooden feet should be checked to ensure they are flat on the deck and there is no damage evident.
- Once the position is correct the strops can be removed and the ratchet straps fitted to secure the saddle in position. The saddle may then be filled with water (or sand bags in cold area).
- Double check that the saddles are secured and in the correct position, with all wooden blocks in place.
- The second saddle can then be bought up into position as per above steps.
- Repeat the steps above for the remaining saddles.

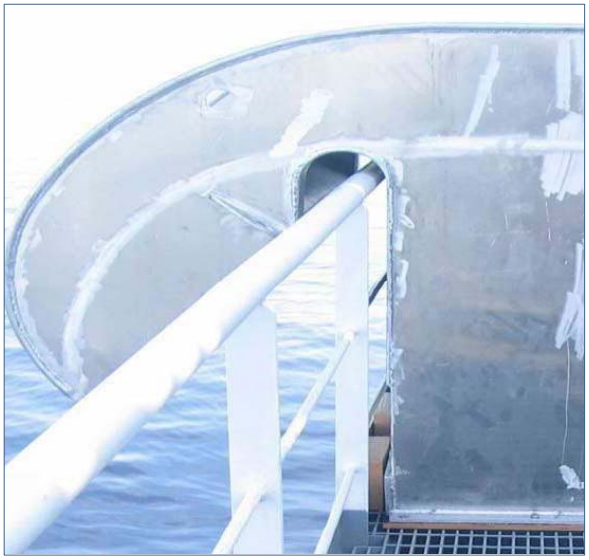


Figure 17 - Correctly positioned saddle

6.1.6 Fit the reducers

- Prepare the Y-Pieces / Reducers for lifting into place.
- Fit strops and shackles to reducer lifting eyes to prepare for lifting.
- Move the crane on the FSRU to pick up the Y-Piece / Reducer.
- Attach the crane hook to the strop fitted to the Y-Piece / Reducer.
- Lift the Y-Piece / Reducer onto the manifold of the LNGC and position them in line with the manifolds and then lower them to the deck of the LNGC Manifold. The crane on the LNGC will then be used to secure the Y-Piece / Reducer in position.
- Remove the blanks from all manifolds that are to be utilized and also the larger end of the Y Pieces / Reducers.
- Check the faces of the manifolds and the Y-Pieces/Reducers for any signs of damage or wear.
- Begin by slowly lifting one of the Y-Pieces/Reducers into place by the appropriate manifold.
- Once positioned, use the centering pins to line up the bolt holes.
- Once the bolt holes are aligned, commence placing in the bolts.
- The gasket should be fitted into position prior to all bolts being fitted.
- Once all bolts are in place, they can be tightened.
- Tighten the bolts to the correct torque. (To Be Advised)
- Once all bolts are tight and checked, carry out a pressure test by pressurizing with nitrogen. Ensure the blank is tight and pressurize up to the agreed pressure during pre-transfer meeting and check for leaks.

6.1.7 Connection of transfer hoses

To make sure that the composite hoses have been connected well to the manifold the following

steps should be taken.

- The composite hoses should always be visually inspected before connection to the manifold.
- Connection should always be done by well trained and qualified staff.
- Don’t put the hose assemblies on metal grids or abrasive material.
- Ensure there is communication between the FSRU & the LNGC
- Prepare the crane on the FSRU for hose connection.
- Connect the crane to the first hose bun.
- Ensure any pressure is released from the hose prior to commencing connection.
- Take up a slight weight of the hose.
- Once the weight is taken by the crane the storage strop can be released.
- Once the securing strop is released from the FSRU the officer in charge will guide the crane operator.
- The hose will then be bought against the saddle on the LNGC.
- The hoses will be lifted across to the LNGC using the crane on the FSRU. Once aligned in a vertical position outside of the appropriate manifold on the LNGC, a 25mm rope can be tied to the hose using a timber hitch approximately five metres from the end of the hose and then the other end secured to a suitable strong point.

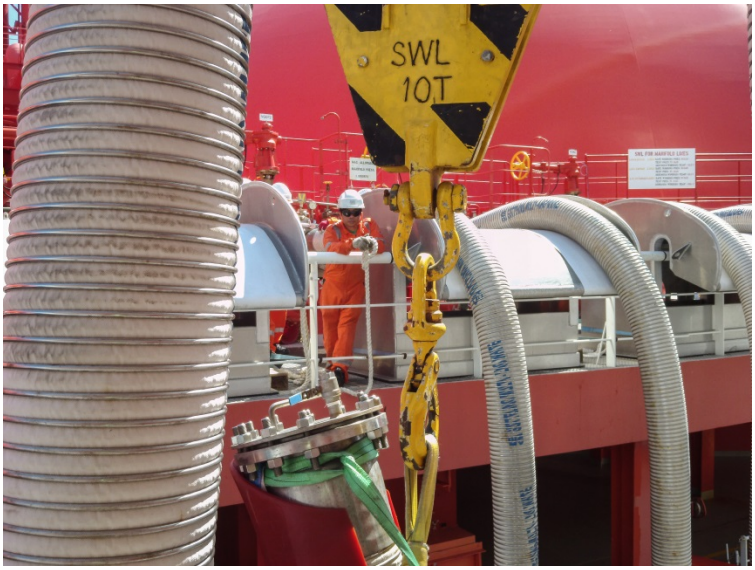


Figure 18 - Transfer of hose from FSRU to LNGC

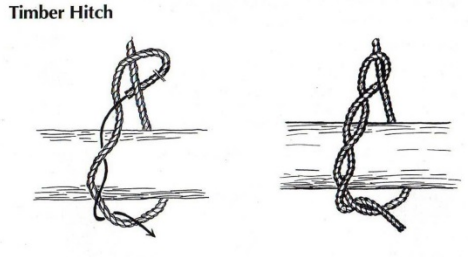


Figure 19 - Timber hitch to be used with 25 mm rope

Figure 20 – Hose is being secured with 25 mm rope

- Once the hose is secured with the rope, the end can be carefully laid down to one side of the manifold, with the weight of the hose coming onto the rope, it should be lowered onto a piece of wood to ensure no damage is made to the end of the hose.
- Once in this position the blanks can be removed from the end of the hose.
- The FSRU crane can then be disconnected and the crane on the LNGC can then be used to position the hose. Pick the hose up higher than the manifold, and bring it into position above the manifold, the securing rope can then be slowly let out and the hose slowly lowered until the hose is positioned in front of the flange. It is a good idea to use a piece of rubber when doing this to protect both the face of the reducer and the hose face. Once the hose is positioned use the centering pins to line up the bolt holes and then position the bolts.
- Once there are some bolts in position, insert a new gasket, (Insulation) torque bolts with nuts (use washers between nut and flange) bolts should be fixed cross-wise.
- Once at the correct torque connection can commence with the second hose.
- The correct torque may differ from FSRU to FSRU, in general see Annex 2
- The second hose connection is exactly the same as the first
- Once all the above is complete, the hoses can be purged with nitrogen, and pressure tested prior to operations commencing.
- Once the oxygen content is below 1% then operations can commence.
- Do not exceed the minimum bend radius of the hoses.
- Route personnel traffic away from the hose assembly.
- Do not use the hose assemblies as tow or mooring lines.

- Do not use ropes, chains or slings to keep the hose assembly on its place.
- Once the hoses are in position and secured, the path of the hose should be checked to ensure there are no obstacles protruding from wither vessel.
- Once all the above is complete, the hoses can be purged with nitrogen, and pressure tested prior to operations commencing. The recommended pressure for pressure testing is 2bar for the vapour manifold and 5-7bar for the liquid manifolds.
- Once the oxygen content is below 1% then operations can commence.
- Once all hoses are connected and all ESD tests completed, all safety pins in the ERC's are to be removed and the HPU started ready for operation.

6.1.8 Connection of communication link (SSL)

- Method of SSL should be decided in pre-loading meeting, fibre optic or electrical (Pyle).
- Once connected it should be tested from both the LNGC and the FSRU to ensure there is adequate communication between the vessels.
- ESD tests should be completed as per the requirements of the FSRU

6.1.9 Connection of wire positioning system

- The ship in position wire is to be secured to the visiting LNGC's railings by the FSRU crew.
- The correct length should be set on the wire to ensure correct activation in the event of a drift off.
- Wire system to be tested once in position.

6.1.10 Cool down of cargo hoses

- Once the hoses are purged and pressure tested then cool down of hoses may commence.
- The cool down rate will be agreed during the pre-transfer meeting between the LNGC and the FSRU but will usually be done using spray pump from the LNGC and should take about one hour to cool down the cargo hoses.
- Cool down should be monitored by the cargo engineer on the LNGC and should be adjusted in order to cool down the cargo hoses evenly.
- Cool down of the hoses will be considered to be complete once there is liquid present at the manifold of the FSRU.

6.1.11 Cargo Loading

- The bulk transfer/cargo operation including BoG management is controlled by the FSRU POAC/Chief Officer who will, in close cooperation with LNG/C and shore if applicable, adjust the vapor management throughout the operation.
- NOTE: The pressure in the FSRU cargo system is normally significantly higher than onboard the LNG/C. The operating pressure in FSRU is up to 60 kPa (600mb). FSRU safety valve relief setting is 70KPa (700mb). The FSRU working pressure will be determined during pre-transfer meeting. Normal working pressure for FSRU is between 18-50kPa (180-500mb). The LNG/C will be asked to keep a normal pressure of 9-14kPa (90-140mb), and the FSRU will control the pressure in the system.
- The bulk transfer procedures detailed in each vessels cargo plan will be discussed and agreed at the pre operations meeting.
- The maximum allowable rate will be determined / set during the compatibility process.
- A careful eye should be kept on the vapour transfer between the two vessels as the LNGC will be operating at a much lower set point than the FSRU, as such the pressure control valve should be used to control the flow.

Figure 21 - Cargo Loading

6.1.12 Completion of Cargo

- Cargo will be stopped by the LNGC when finishing topping up
- Deck officer will read tank level and confirm visually filling valves closed on completed tanks.
- Upon completion of cargo both the FSRU and the LNGC should have personnel standing by the manifold and fire hoses should be rigged ready for use in assisting with the liquid freeing operations.

6.1.13 Liquid freeing of cargo hoses

- Once cargo has been complete and the ESD valves have been closed on the LNGC the liquid freeing of the cargo hoses can commence.
- Supply of Nitrogen will be lined up as agreed in the pre-transfer meeting.
- Start the flow of nitrogen to the liquid hoses and commence bringing the pressure up to 4- 5 bar
- Simultaneously whilst putting nitrogen in the hoses, the fire hoses should be started and water sprayed on the outside of the hose to assist with the liquid freeing process.
- Once the pressure in the hose reaches the agreed pressure, the spray bypass line on the FSRU manifold and releases the liquid to the tanks. All hoses are drained towards the FSRU.
- Continue to drain hoses till no liquid present confirmed (ice formation)

Figure 22 - Liquid freeing of cargo hoses

6.1.14 Purging of cargo hoses

- Once the liquid freeing is completed keep the nitrogen supply on, and ensure there is a path to push the gas to, try to keep the pressure in the hose to approximately 2bar.
- Monitor the gas readings using the sample point at the manifold at both the manifold of the FSRU and the LNGC.
- Purge hoses till methane content confirmed 2% by VOL / 40% LEL at disconnection point.

7 Disconnection

- Once cargo is completed and the hoses have been warmed up and purged, then disconnection can commence.
- Ensure adequate personnel from each ship are available to assist with the disconnection.
- Double check that the ESD system is inhibited.
- Ensure the deluge system is turned off on both vessels.
- Remove alternate bolts from the hose flange.
- Prepare the 25mm rope that was used for connecting the hoses.
- Attach hose bun to the hose just outboard of the flange.
- Take the weight of the hose with the crane on the LNGC.
- Now remove the remaining bolts on the flange.
- Slowly remove the bolts until the hose is free from the manifold.
- Once the hose is disconnected, lift the hose up and secure the 25mm to the same position on the hose that was used for connection and then lower down the crane and allow the weight to come on the rope.
- The hose can then be lowered onto the manifold platform of the LNGC to allow for fitting of the blank.
- The LNGC crane can then be disconnected and the crane on the FSRU can be used for moving the hose back to the storage position on the FSRU.
- Then follow the procedure described above for the remaining hoses.

Once the hose are stowed, a careful eye should be kept on the pressure in the hose. Composite hose have a tendency to absorb some of the liquid during a transfer and this will slowly turn to gas and cause the pressure in the hose to increase. The correct way to control this is to purge the hoses with nitrogen at least 24h after disconnection, with the blind flange check valve crack open.

8 Unmooring and Departure

Unmooring will take into consideration the prevailing environmental conditions. Tugs will secure lines through centre leads of the LNGC. Mooring lines shall be singled up in the following sequence :

STS in Port / benign conditions:

Mooring line	**1st lines**	**2nd lines**	**3rd lines**

Forward	Bow Lines	Breast lines	Springs
Aft	Stern lines	Breast lines	Springs

STS in Offshore conditions:

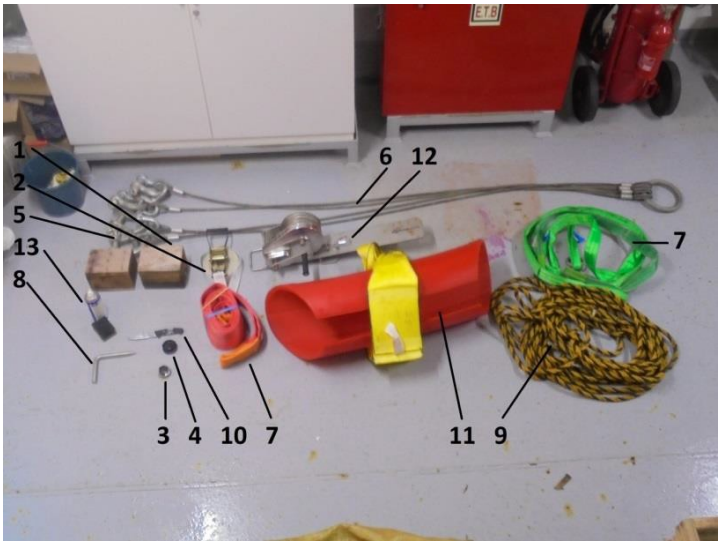
Mooring line	**1st lines**	**2nd lines**	**3rd lines**
Forward	Bow Lines	Springs	Breast lines
Aft	Stern lines	Breast lines	Springs

Tugs will provide a forward and off-berth tension as the last lines are released, with the objective of removing the LNGC from the FSRU fenders as quickly as possible and pulling the LNG parallel to a safe distance of the FSRU.

Tugs shall remain attached until the LNGC is an absolute safe location. Once in a clear location and with tugs released, Pilot and associated personnel will leave the LNGC by tug / pilot boat.

Figure 23 - Departure

Annex 1: STS Tool Box



#	Quantity	Item	Description
01	6	Wooden blocks	Used to keep the saddles off the railing (2 in each saddle)
02	3	Ratchet straps	Used to secure the saddles (1 in each saddle)
03	3	Drain plugs	Plug the saddles when filled with seawater (1 in each saddle)
04	4	Drain plug upper drain	For upper drain hole (1 in each saddle)
05	4	Shackles	Attached to saddles when lifting STS
06	1	4 Cable Attachment	To connect to shackles on Saddles
07	6	Slings	Hose positioning straps
08	4	Centering pins	Help align hoses and pieces
09	2	Lines/ Ropes	Used to secure hose positioning straps around manifold
10	1	Knife	Cut lines to shorter lengths if needed
11	6	Hose Buns	Used to secure STS hoses during lifting

12	1	Winch	Used for tightening the taught wire system
13		Scotch bright pads	Cleaning flange faces
14	1	Torque Wrench	¾” Drive
15	2	Ratchet Wrench	¾” Drive
16	2	Socket	41 (Y-Piece to LNGC)
17	2	Socket	36 (STS Hose to Y.Piece)
18	1	Ratchet Wrench	41/36 Combo with spud
19	1	Ratchet Wrench	32/30 Combo with spud end
20	6	10” Spiral Wound Gaskets	STS Hose to Y-Piece with Spares
21	3	16” Insulation Gaskets	Y-Piece to LNGC with spares
22	72	Bolts; Y-Piece to STS Hose	72 Stud Bolt/144 Heavy Nuts UNC(ANSI) 7/8” *135L(45/45) -Bolt: B/A320 Gr. B8M Class-2 -Nut: A194 Gr. 8M 10% Bolts in spare
23	48	Bolts; Y-Piece to LNGC	Hex. Bolts/96 Nuts M24*140L -Bolt: B/A320 Gr.B8M Class-2 -Nut: A194 Gr. 8M 10% Bolts in spare including insulation kit.

24	4 (2)[1]	Hose saddles singe hose	Dimensions: L=1220mm, W=644 mm. H=870~1360mm Weight: Empty:352 kg W/Ballast: 554 kg
25	1 (3)[2]	Hose saddles dubbed hose	Dimensions: L=1000mm, W=2040 mm. H=1209 mm Weight: Empty:445kg W/Ballast:1445 kg

[1] Some FSRU have 2 single saddles
[2] Some FSRU have 3 dubbed saddles