II. Operation Guidelines for Ship to Ship LNG Transfer
Purpose and Scope of Application

These guidelines specify basic policies related to standard procedures, safety measures, machinery and equipment, and so on, for safely performing LNG fuel supply work (ship to ship LNG transfer) for a LNG fuelled ship berthed at jetty or pier, or alongside an LNG bunker ship.

Some of the items in these guidelines, such as operating conditions, are based on the assumption of a general LNG fuelled ship and an LNG bunker ship as indicated below.

If the LNG fuelled ship is of special ship type or if it is a small ship with overall length not exceeding 100 m, and the LNG bunker ship is much smaller than the standard coastal LNG carrier (tank capacity of 2,500 m3), then these items may not be applicable. In such cases, separate additional studies may be necessary.

The prerequisites of LNG fuelled ships are that they shall satisfy the requirements of the IGF Code, and the prerequisites of LNG bunker ships are that they shall satisfy Chapter 3 of the Regulations for the Carriage and Storage of Dangerous Goods in Ships (Ordinance No. 30 of 1957, the Ministry of Transport) based on the Ship Safety Law (Law No. 11 of 1933) and the requirements of the IGC Code.

---

1 Simulation results of motion of moored bunker ships (overall length of about 100 m) showed that motion tended to be comparatively large for small ships. Thus, if the LNG fuelled ship is about the same size or smaller than a bunker ship, the relative motion between the two ships may become large.

2 International code of safety for ships using gases or other low flashpoint fuels

3 International code for the construction and equipment of ships carrying liquefied gases in bulk
Prerequisites of the study

<table>
<thead>
<tr>
<th></th>
<th>LNG fuelled ship</th>
<th>Bunker Ship</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VLCC</td>
<td>PCC</td>
</tr>
<tr>
<td>LBP (m)</td>
<td>320.0</td>
<td>192.0</td>
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<tr>
<td>Breadth molded (m)</td>
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<td>32.3</td>
</tr>
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<td>Depth molded (m)</td>
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<tr>
<td>Loaded draft (m)</td>
<td>20.5</td>
<td>9.6</td>
</tr>
<tr>
<td>Tank capacity (m³)</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Propellers</td>
<td>-</td>
<td>Two shafts, two rudders, CPP</td>
</tr>
<tr>
<td>Rudders</td>
<td>-</td>
<td>Normal</td>
</tr>
<tr>
<td>Bow thruster (ton)</td>
<td>-</td>
<td>10</td>
</tr>
</tbody>
</table>

Laws, regulations and formalities related to operation

(1) Ship Safety Law

LNG bunker ships, LNG fuelled ships and ship owners shall prepare the Regulations for Handling Dangerous Goods based on Para 5.8 of the Regulations for the Carriage and Storage of Dangerous Goods in Ships (hereafter referred to as “Regulations for Dangerous Goods”) referring to these guidelines, and hand over the same to the master. The master shall familiarize the crew members with these regulations and ensure that they adhere to them.

In case of LNG bunker ships, similar regulations shall be prepared based on these guidelines and referring to the instructions of the Director of the District Transport Bureau based on the regulation equivalent to that of Regulation 140 of the Regulations for Dangerous Goods.

The IGF Code is presently being studied at the International Maritime Organization (IMO).

(2) The Act on Port Regulations (Law No. 174 of 1948)

LNG bunker ships fall under the category of ships carrying dangerous goods in the Act on Port Regulations. Therefore, based on Articles 21 to 23 of the said Act, the orders of the Captain of the port with regard to entering the Specified Port shall be received, the instructions of the Captain of the port such as anchorage or berth in the Specified Port shall be received, and the permission of the Captain of the port related to unloading of dangerous goods shall be received.

To receive these orders, instructions and permissions, measures shall be formulated for procedures, safety measures and machinery and equipment related to LNG fuel transfer based on these guidelines. Moreover, studies to suit individual operating location (port) are necessary for
the items listed below.

- Area-specific unprecedented external forces (long-period waves, strong tidal currents, etc.)
- Status of usage of port

(3) Maritime Traffic Safety Act (Law No. 115 of 1974)

LNG bunker ships of gross tonnage equal or exceeding 1000 tons shall comply with Article 22 of the Maritime Traffic Safety Act as ships carrying dangerous goods similar to LNG carriers, and are required to make transmissions based on the said article when navigating the passage. LNG bunker ships of gross tonnage equal or exceeding 25,000 tons shall be provided with the arrangements of a fire-fighting vessel according to the specifications based on Article 23 of the said law.
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1 General overview

1.1 Provision of safety management system

A safety management system shall be provided that has unified jurisdiction over communications and coordination with maritime authorities and other related organizations for the collection of necessary information such as weather and sea conditions and ship traffic within ports. Such a system is required to ensure safety during maneuvering, mooring and transfer of LNG related to LNG transfer operation by the Ship to Ship (StS) system between LNG fuelled ships and LNG bunker ships.

Fig. 1.1 shows an example of a safety management system.

The roles and duties of every person in this system are given below.

The prerequisite for an LNG bunker ship that has the objective of maintaining the integrity of the ship’s safety management system for deploying LNG fuel transfer is to acquire ISM on a voluntary basis.

* Solid lines indicate formation of a communication system at each implementation and dashed lines the same at implementation, if necessary

Fig. 1.1 Safety Management System related to Ship to Ship LNG transfer
(1) Shipping company (LNG bunker ship)

① Person with overall responsibility

The person with the highest responsibility shall be the person with overall responsibility of the related work. This person shall command and supervise the designated persons.

② Designated person

The designated person shall manage matters related to implementation, safety and disaster prevention during LNG transfer by the StS system under the command and supervision of the person with overall responsibility.

(2) LNG bunker ship

① Person with overall responsibility for transferring LNG (Master)

As the person with the highest responsibility on board the LNG bunker ship, the master is responsible for the LNG transfer work and shall assume total responsibility for the work. For this purpose, the master shall have a firm grasp of the latest weather and sea conditions, forecasts, and other essential information at all times. The master shall make all judgments necessary from the time of approach and coming alongside through the start, completion and continuation, suspension of the LNG transfer, including the departure of the ship in the event of an emergency, until the LNG bunker ship leaves the ship’s side. The person with overall responsibility for transferring LNG has the following responsibilities: If required, the master shall give assistance to the LNG fuelled ship.

- The master shall adhere to the agreed-upon operating procedure between the two ships, adhere to all applicable requirements and operate accordingly
- Complete the items in the checklist specified in 2.1”Checklist”.
- If sea-area specific risks such as strong tidal currents and noticeable effects of long-period waves exist in the sea area where StS is being implemented, the master shall confirm that such risks have been studied and appropriate measures have been adopted.
- Firmly grasp the actual sea and weather conditions and forecasts in the work area from the time of coming alongside the LNG fuelled ship, LNG transfer work is completed and the ship leaves the alongside position.
- Supervise the implementation and agreement of the maneuvering and mooring plans and the fuel transfer plan with the LNG fuelled ship.
- Check leak protection equipment and fire extinguishing system.
- Monitor the mooring status during the LNG fuel transfer.
- Monitor onboard and ship-to-ship communications during the LNG fuel transfer work.
Check the safety connection and ERS\(^4\) connection of liquid hose/arm and vapor hose/arm used in the LNG fuel transfer.

Purge and perform the leak tests of the liquid hose/arm and vapor hose/arm before starting LNG transfer.

Properly connect the signal line for activating ESDS (Emergency Shut Down System)\(^5\) and test it.

Monitor the transfer rate and the vapor pressure.

After LNG transfer, drain the LNG transfer hose/arm and purge them.

Supervise the disconnection of the LNG transfer hose/arm.

Supervise the work of returning materials and equipment.

Check the unmooring work sequence, and monitor unmooring and leaving ship’s side.

Prepare report of LNG fuel transfer by StS system including documents and lesson learned that will become effective for similar LNG fuel transfer work in the future.

② Designated person for transferring LNG (Chief Officer)

The Chief Officer is the designated person for LNG transfer on the LNG bunker ship. He shall command and manage crew members and assume responsibility for the LNG transfer work on the LNG bunker ship.

③ Worker transferring LNG

Shall implement LNG transfer work on board the LNG bunker ship.

(3) LNG fuelled ship

① Person with overall responsibility of receiving LNG (Master)

As the person with the highest responsibility on board the LNG fuelled ship, the master shall unify tasks related to LNG transfer and its safety. For this purpose, the master shall firmly grasp the latest weather information and ensure safety of the ship.

When adjustments to the cargo operation and timings of the ship are necessary, the master shall ensure safety so that no human/physical errors occur.

The person with overall responsibility for receiving LNG has the following responsibilities:

- Adhere to the agreed-upon operating procedure between the two ships, adhere to all applicable requirements and operate accordingly.

---

4 ERS (Emergency Release System): Safety system from bunker station for release of transfer hose and arm within a short time that minimizes leakage of LNG; includes Emergency Release Couplings (ERC).

5 System that closes valve automatically or enables manual closing in an emergency. A system for emergency stoppage of LNG transfer wherein the pump or compressor related to transfer is stopped.
Complete the items in the checklist specified in 2.1 "Checklist".

If sea-area specific risks such as strong tidal currents and noticeable effects of long-period waves exist in the sea area where StS is being implemented, confirm that such risks have been studied and appropriate measures have been adopted.

Firmly grasp the actual sea and weather conditions and forecasts in the work area before the LNG bunker ship comes alongside, the LNG transfer work is completed and the ship leaves the alongside position.

Supervise the implementation and agreement of the maneuvering and mooring plans and the fuel transfer plan with the LNG fuelled ship.

Check leak protection equipment and fire extinguishing system.

Monitor the mooring status during the LNG fuel transfer.

Monitor onboard and ship-to-ship communications during the LNG fuel transfer work.

Check the safety connection and the ERS connection of the liquid hose/arm and the vapor hose/arm used in the LNG fuel transfer.

Purge and perform the leak tests of the liquid hose/arm and vapor hose/arm before starting the LNG transfer.

Properly connect the signal line for activating ESDS and test it.

Monitor the transfer rate and the fuel tank pressure.

Drain the LNG transfer hose/arm after LNG transfer and purge them.

Supervise the disconnection of the LNG transfer hose/arm.

Supervise the work of returning materials and equipment.

Check the unmooring work sequence, and monitor unmooring and leaving ship’s side.

Prepare report of LNG fuel transfer by StS system including documents and drills that will become effective for similar LNG fuel transfer work in the future.

② Designated person for receiving LNG (Chief Engineer)

The Chief Engineer is the designated person for LNG transfer on the LNG fuelled ship. He shall command and manage crew members on the ship and assume responsibility for the LNG transfer work on the LNG fuelled ship.

③ Worker receiving LNG

Shall implement LNG transfer work on board the LNG fuelled ship.

(4) Other LNG transfer related organizations and personnel

① Maritime disaster prevention organization

A system shall be built beforehand so that the support of the maritime disaster prevention organization can be obtained during an emergency such as LNG leak or fire occurrence during
LNG transfer by the StS system.

② Shipping agent (LNG fuelled ship)

The shipping agent shall make adjustments, notifications and communications, etc., related to LNG transfer when a request is received from the person with overall responsibility for the designated person, the person with overall responsibility for receiving LNG or the shipping company of the LNG fuelled ship. The shipping agent shall also make arrangement for pilots, towing boat, linesmen, etc., if required, and make adjustments, notify and communicate with concerned personnel.

1.2 Prior checks related to safety

The LNG fuel transfer deployment and operation manual shall be checked for applicability of these guidelines to the items listed below before implementing the fuel transfer. When these guidelines cannot be applied, evaluation, studies, and so on, shall be carried out for the relevant part and the necessary safety measures shall be adopted.

(1) Sea area or location for implementing LNG fuel transfer (jetty or pier)

Checks ensuring safety of LNG fuel transfer shall be made based on 1.7 “Selection of LNG fuel transfer implementation sea area”.

(2) Coming alongside an anchored vessel

Checks shall be made to ensure safety when coming alongside an anchored vessel bearing in mind the risks of the ship swinging around, and considering 1.9 ”Operating conditions” and 4.3 ”Coming alongside the LNG fuelled ship”.

(3) Compatibility of mooring between the two ships

Standard mooring, which is a prerequisite of 1.9 “Operating conditions” shall be ensured. Checks shall be made to ensure that the fenders balance properly at the parallel body sections of both ships, based on 1.6 “Compatibility between the two ships”, 1.9 “Operating conditions” and 7.4 “Fender”.

(4) Relationship between cargo loading/unloading and passengers embarking/dismounting in a LNG fuelled ship

If a LNG fuelled ship receiving LNG fuel simultaneously and in parallel with loading/unloading operation or embarking/dismounting of passengers, then the following requirements shall be
satisfied (see Figures to Fig. and Table 1.1):

Discussions are scheduled at the IMO related to this matter in the investigative stages of the IGF Code. When results of these investigations are obtained, response considering these results will be necessary.

- Gas hazardous areas shall be set according to IGC and IGF Codes (including the range applicable to gas hazardous areas when these codes are applied around transfer equipment) and gas hazardous areas in a circular range with radius 9 m around ERC\(^6\) as the center shall be set. Ignition sources within these areas shall be removed during LNG fuel transfer.

- The structure of the two ships shall be considered for ensuring that ignition sources are removed from the gas hazardous areas mentioned above, and effective measures shall be adopted to restrict unwarranted access of workers or passengers other than those concerned with the LNG fuel transfer work into the said areas.

- There shall be no air intake ports in the gas hazardous areas mentioned above (if air intake ports are closed so as to be gas-tight, they shall be treated as non-air intake ports. Same applies hereafter.

- In principle, passengers shall not be permitted to smoke even outside the gas hazardous areas. Spaces for smoking shall be set after adopting measures against fire; if sound measures have been adopted outside these spaces by controlling passengers and so on, smoking may be permitted under appropriate controls.

- Transfer equipment shall be protected from damage due to accidental falls of cargo in LNG fuelled ships.

- Cargo operating equipment such as crane or unloader shall not be moved above LNG transfer equipment with no hose and arm protection.

- Cargo operations or embarking/disembarking of passengers shall be suspended immediately when LNG leakage occurs or when ESD activates, and preparations made for passengers to leave ship quickly.

(5) Crew and personnel organization

Checks shall be made to ensure that the necessary crew members who have received the required training based on 1.3 “Management of crew members” are available.

(6) Equipment and systems between ships

Compatibility of the two ships shall be ensured according to 1.6 “Compatibility between the two ships” Checks shall be made to ensure that the required systems and equipment are provided based on 2.4 “Emergency Shut Down System (ESDS)” and 2.10 “Measures for electric

\(^{6}\) ERC (Emergency Release Couplings): Coupling that closes valve in an emergency by equivalent hydraulic power after ESD activates, minimizes LNG leakage and disconnects in a short time.
potential difference between the two ships” and 7 “LNG fuel transfer equipment, materials and machinery”.

(7) Night-time alongside work

- Such work shall preferably be carried out daytime by crew except when experienced personnel are performing StS work at night time.
- When coming alongside at night, deck lights shall be used to illuminate the ship side up the water line so as to properly grasp the distance between the ships. Moreover, the working lights on the LNG bunker ship shall be switched on when moving from the approach to the alongside position so as to correctly understand the speed of the ship coming alongside.
- When coming alongside an anchored vessel, information shall be exchanged closely between the ships, and efforts shall be made to minimize the difference in heading of the two ships.
- Coming alongside an anchored vessel is difficult if the ship swings around, especially at night time when visibility is restricted. Considering this point, measures should preferably be adopted against the swinging of the ship, such as the use of a dynamic information system⁷.

(8) LNG fuel transfer work at night time

- Illumination of 70 lx or greater shall be provided for monitoring hose and arm between the two ships based on 7.11 “Illumination” Consideration shall be given to rest time for workers when the work at the start of transfer requires special precautions to be taken after midnight. Banners used for warnings shall be adequately illuminated and shall be recognizable from ships operating in the surroundings.

(9) Emergency response plan

Appropriate plan shall be made based on 8 “Emergency response”.

---

⁷ System visually shows position relationship of ships, ship’s speed for coming alongside, and angular velocity of turning on display, based on ship’s instrument, AIS, and GPS information.
Fig. 1.2 Hazardous areas specified in the IGC • IGF Codes (Example)

Fig. 1.3 Hazardous areas above hose considering gas diffusion simulation results and broad interpretation of IGC Code (example)
### Table 1.1  Considerations for removal of ignition sources in gas hazardous areas for each typical ship type

<table>
<thead>
<tr>
<th>Tanker</th>
<th>Car carrier</th>
<th>Container carrier</th>
<th>Solid bulk cargo carrier</th>
<th>Ferry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ignition sources shall be removed from gas hazardous areas.</td>
<td>No air intake ports of RoRo compartments shall exist in gas hazardous areas.</td>
<td>Cargo operation shall not be allowed in gas hazardous areas because of possibility of contact with metal.</td>
<td>Grab or unloader shall not enter gas hazardous areas.</td>
<td>Same as car carrier in case of vehicles. In principle, passengers shall be prohibited from smoking even outside gas hazardous areas during LNG transfer, and prohibited from entering such a space. Areas for smoking shall be set after adopting measures against fire; if sound measures have been adopted outside such spaces by controlling passengers and so on, smoking may be permitted under appropriate controls.</td>
</tr>
</tbody>
</table>

Transfer shall be suspended if ignition source (or unauthorized person) is confirmed in gas hazardous areas.

Fig. 1.4  Hazardous areas above arm considering gas diffusion simulation results and broad interpretation of the IGC Code (example)
1.3 Management of crew members

1.3.1 Manning

The manning system in a LNG fuelled ship is similar to that of the conventional bunkering tanker, while that in an LNG bunker ship is similar to that of the conventional LNG carrier.

Labor management of crew members is necessary, however, and if the LNG fuel transfer work extends over a prolonged period, additional crew members may be considered, if required.

Appropriate crew members designated by the masters of both ships shall be stationed as watch keepers during fuel transfer work in the steering room, engine control room (ECR), machinery space and bunker station in case of a LNG fuelled ship, and in the cargo control room (CCR) and bunker station in case of an LNG bunker ship.

1.3.2 Education and training

All crew members on both the LNG fuelled ship and the LNG bunker ship shall be familiar with disaster prevention related to LNG before they board the ships. The Machinery Department of the LNG fuelled ship and the Deck Department of the LNG bunker ship especially responsible for the LNG fuel transfer work shall receive skills training related to all aspects of LNG fuel transfer before they perform the actual work.

The master, Chief Officer or Watch Officer, Chief Engineer and Engineer or Watch Officer of the LNG bunker ship shall be adequately qualified as personnel responsible for handling dangerous goods, based on 117.3 of the Mariners Act.

IMO is presently studying the education and training of crew in LNG fuelled ships. When national laws and regulations, based on the results of the IMO studies are ready, they shall be followed.

1.4 Requirements of LNG fuelled ships and LNG bunker ships

The masters of the LNG bunker ship and the LNG fuelled ship shall confirm that the requirements listed below related to the transfer of LNG fuel from the LNG bunker ship to the LNG fuelled ship are satisfied.

- Bunker station for transfer and acceptance of LNG fuel shall be fully equipped with drip trays, etc., and it shall satisfy the equipment requirements of the IGC Code and classification society.
- If necessary, flexible hoses shall be suspended, and usable auxiliary ropes, etc., shall be provided as measures to prevent falls of supporting equipment and the hoses.
- If necessary, materials and equipment such as saddle for flexible hose shall be provided
- Fire extinguishing system and water sprays shall be in a ready-to-use condition.
- The prerequisite for water curtain system is that it shall be used with the purpose of protecting the hull during LNG fuel transfer.
- Supply of nitrogen to fire extinguishing system of vent post shall always be available assuming that natural gas may be unavoidably discharged from the vent post in an emergency
- Measuring instruments of LNG fuel tank shall be functioning correctly, and they shall be monitored
at all times by fuel tank remote monitoring systems and on site (fuel tank)

- Method of processing BOG that may be generated due to the difference in liquid temperature and composition of LNG fuel has been established
- Overflow control system has been established (especially if multiple fuel tanks exist)
- Operation manual related to LNG fuel transfer has been prepared, and all personnel concerned with the acceptance of LNG are familiar with the contents of this manual
- Work checklist related to LNG fuel transfer has been prepared, and checks are being made properly during all tasks. Methods of adopting measures if a flaw is detected have been defined.
- Crew members required for work and having the required qualifications are available.
- Where LNG fuel tank safety valves are in two stages: “During navigation” and “in port and during cargo operation”, settings shall be confirmed on the safety checklist before start of work, and these settings may be changed if necessary.

1.5 Requirements common to LNG fuelled ship and LNG bunker ship

- ERS has been installed on the LNG bunker ship side during LNG fuel transfer
- Insulated flange or bonding cable shall be used as measures against electric potential difference between the two ships during LNG fuel transfer
- The acceptable volume of the LNG fueled ship, cool-down method for fuel tanks and piping, tank filling sequence, initial transfer rate, maximum transfer rate, completion of filling, and transfer stoppage method in an emergency shall be checked based on the checklist specified in 2.1 “Checklist” before the LNG fuel transfer.
- The person with overall responsibility for receiving LNG shall confirm mutually with the person with overall responsibility of LNG transfer that sea and weather conditions will not obstruct the LNG fuel transfer.
- Mooring equipment shall be adequately provided between the two ships considering the mooring force calculations and the equipment numeral.
- The LNG bunker ship and the LNG fuelled ship shall both be provided with an operation manual and a common checklist.
- Equipment enabling communications shall be available at all times during the LNG fuel transfer with the person with overall responsibility for transferring LNG and the person with overall responsibility for receiving LNG.
- Communications system during an emergency should have been established.
- If an abnormality occurs, the person with overall responsibility for transferring LNG and the person with overall responsibility for receiving LNG shall not perform or resume work until a solution to the abnormality has been found and confirmed.
1.6 Compatibility between the two ships

The compatibility of the two ships for the following items related to LNG fuel transfer shall be confirmed beforehand:

- Manifold arrangement
- Bunkering equipment (reducer shall be arranged by the bunker ship)
- Mooring arrangement (see 1.9 “Operating conditions”)
- Parallel body and fender (see 1.9 “Operating conditions” and 7.4 “Fender”)
- Gas hazardous areas (gas hazardous areas according to IGC and IGF Codes (including the range applicable to gas hazardous areas when these codes are applied around transfer equipment) and gas hazardous areas in a circular range with radius 9 m around ERC as the center (see Fig.1.2 to Fig.1.4) set as areas where ignition sources should be removed.)
- Equipment used for embarkation of persons (see 2.13 “Transfer of persons between the ships”)
- Compatibility of ESDS (connector, channel allocation, etc.) and radio installations
- Emergency response plan and procedures in an emergency
- Conditions of tanks in both ships (liquid temperature and pressure)
- LNG fuel transfer plan and ballasting plan
- Vapor controls or vapor processing ability of both ships

1.7 Selection of LNG fuel transfer implementation sea area

1.7.1 Maneuvering area

The transfer shall be implemented in a sea area adequate for the LNG bunker ship to maneuver to come alongside and move away from the other ship. Area required for emergency unberthing and for turning around shall also be considered.

1.7.2 Effect of navigation of other ships

LNG fuel transfer by the StS system shall be implemented in a sea area where the wave height of waves generated by other ships plying in the vicinity does not exceed 50 cm, and where the safe working load of mooring line is not exceeded by external forces due to suction effect, so as to ensure safety of the two moored ships.

Results of studies on VLCC where the ship-generated waves and the suction effect increases showed that if a distance of 500 m was maintained from ships navigating in the vicinity, then safety can be ensured.

If the distance is less than the distance mentioned above, separate individual study is necessary.
1.7.3 Gas hazardous areas and ensuring safety distance between the ships

The structure of the two ships shall be considered for ensuring that ignition sources are removed from the gas hazardous areas (see 1.2 “Prior checks related to safety” and 1.6 “Compatibility between the two ships”) during LNG fuel transfer, and effective measures shall be adopted to restrict unwarranted access of workers or passengers other than those concerned with the LNG fuel transfer work into the said areas.

Safety distance shall be maintained between the LNG bunker ship and other ships on the water surface within 30 m around the ship during LNG fuel transfer following the Standards for Permission to Handle Dangerous Goods (See Fig. 1.5. The requirement to maintain safety distance between ships is excluded for LNG fuelled ship that receives the LNG fuel). The value of safety distance between ships may be changed after considering the size of the LNG bunker ship, ships anchored, and ship types, sizes and congestion status of ships navigating in the vicinity.

Fig. 1.5 Safety distance between ships according to the Standards for Permission to Handle Dangerous Goods (Example)

1.8 Weather and sea conditions

LNG fuel transfer work by the StS system between two moored ships is affected by weather and sea conditions. Therefore, efforts shall be made to acquire the latest weather and sea conditions data during the LNG fuel transfer.

1.9 Operating conditions

LNG fuel transfer by the StS system shall be implemented under the conditions mentioned below, based on the observed values in the LNG fuelled ship at berth, at pier or when anchored.

Although 500 m is taken as the basic visibility, if the visibility related to ship navigation in the sea area where LNG fuel transfer is implemented is already specified, then the specified value shall be followed.

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8 Specifying anchoring location of ship carrying dangerous goods and Standards for Permission to Handle Dangerous Goods (Japan Coast Guard Notification No. 49, 11 October 2005)
Similarly, if the said sea area is physically restricted, a different area shall be studied.

However, by acquiring the latest forecasts related to weather and sea conditions at all times at the LNG fuel transfer sea area, rough weather can be predicted, and prompt measures to ensure safety can be taken, such as suspending the LNG transfer and moving away from the alongside position.

- Conditions for coming alongside: Wind speed below 10 m/sec., wave height below 1.0 m and visibility exceeding 500 m
- LNG transfer limiting conditions: Average wind speed below 12 m/sec., wave height below 1.0 m
- Conditions for leaving ship’s side: Average wind speed below 12 m/sec., wave height below 1.0 m and visibility exceeding 500 m

The conditions mentioned above are based on assumption of a general LNG fuelled ship and an LNG bunker ship. For this reason, in the cases below and when the above-mentioned conditions are to be relaxed, separate studies are necessary.

- In special sea areas where effects of strong tidal current and effects of noticeably long period waves are received.
- If the LNG fuelled ship is of special form and if it is a small craft with overall length of less than about 100 m.
- If the LNG bunker ship is an extremely small ship compared to a standard coastal LNG ship (tank capacity 2,500 m3).
- If the LNG bunker ship is designed to not have adequate lateral motion capability (not provided with bow thruster or if provided, its power is inadequate; if one shaft and normal rudder is provided).
- If the navigator of the LNG bunker ship is not experienced in StS berthing operation and if there is no equipment supporting transverse motion of the ship (stern thruster, joy stick navigating station based on appropriate controls).
- If mooring line cannot be arranged with proper balance as in the standard mooring plan shown in Fig. 1.6, or if the fender cannot be positioned to properly balance it in the parallel bodies of the two ships.
2 Safety measures

2.1 Checklist

An example of a checklist used in the LNG fuel transfer by the StS system is shown at the end of this document. An appropriate checklist shall be used to suit the stages of each work to ensure safety.

- Checklist 1 Information specific to each ship
- Checklist 2 Before start of work
- Checklist 3 Before coming alongside and before mooring
- Checklist 4 Before start of transfer
- Checklist 5 Before unmooring

2.2 Lookout when ship is moored

After the LNG bunker ship has come alongside the LNG fuelled ship, the lookout work inclusive of the movements of other ships shall be implemented under the guidance of the LNG fuelled ship until all work has been completed and ships are separated. At this stage, radar shall be used together with the lookout.

2.3 Leakage of LNG fuel

To prepare for the eventuality of leakage of LNG fuel, preventive control equipment such as water curtain shall be provided to protect the hull structure from LNG at extremely low temperature.

Measures listed below shall also be taken in case LNG leaks.

① The first person who discovers leakage of LNG shall immediately notify the person with overall
responsibility for transferring LNG and the person with overall responsibility for receiving LNG.

② The person with overall responsibility for transferring LNG or the person with overall responsibility for receiving LNG shall promptly activate the ESD and suspend the transfer operation.

③ The said person shall blow the whistle and notify the crew members of both ships and others in the vicinity the occurrence of the emergency situation.

④ Both ships shall take up the specific emergency arrangements, close the doors connecting to the upper deck or the LNG receiving manifold, stop the ventilation fans, ensure that gas does not enter the ships, and again establish fire controls.

⑤ Both ships shall station personnel in the firefighting department in preparation for a fire break-out.

⑥ The Maritime Safety Department, the fire station, the police, the port controller and other concerned administrative organizations shall be notified.

⑦ Approach of other ships shall be prevented through radio, external speakers and so on.

2.4 Emergency Shut Down System (ESDS)

2.4.1 ESDS connection

During LNG fuel transfer by the StS system, ESDS shall be used and the two ships shall be linked so that LNG transfer can be stopped in an emergency such as when an abnormal condition occurs during the LNG transfer.

Also, ESDS activation requirements, causes and effects when activated, and the actions to be taken by both ships when activated, and vapor controls, shall be discussed beforehand by the two ships.

2.4.2 ESDS link compatibility

The compatibility of ESDS links, including the connector pins and channel allocation shall be confirmed for the two ships.

2.4.3 ESDS tests

Both ships shall test their own ESDS within 48 hours before LNG transfer by StS system, record and preserve the test results. To confirm that ESDS is working correctly before the start of LNG transfer after the two ships have come alongside, tests shall be carried out again in the hot and cold states.

The mechanical decoupling mechanism of ERS shall be checked to ensure that it can be used before start of LNG transfer.

However, only the procedure and hydraulic pressure shall be checked for the actual decoupling of the ERS, and all other components shall be tested. The activation check of the actual ERC shall be carried out once a year or the time recommended by the manufacturer, whichever is shorter.
2.5 Emergency Release System (ERS)

When the LNG bunker ship and the LNG fuelled ship separate during LNG fuel transfer, load exceeding the permissible value may act on the transfer arm/hose and damage them. To prevent this occurrence, automatic release is used by means of the Emergency Release System that allows quick emergency release of transfer hose/arm in the event of a fire, tsunami or other disaster.

For using the ERS, the points listed below shall be considered.

- The working requirements (settings) of ERS shall be checked by both parties.
- ERC shall be used in the vapor return hose/arm similar to its use in the LNG transfer hose/arm.
- Even if the supply of power to the ERS dies, it shall function and be capable of releasing all transfer pipes.
- The ERS work procedure prepared beforehand shall be clearly displayed at the workplace where ERS is used so as to minimize risks from operational errors.
- The ERS system shall be set normally in the automatic release mode and installed at a location that enables manual operation as well so that when the LNG bunker ship and the LNG fuelled ship are to be separated, the transfer hose/arm can be released before the operating limit is reached.
- The ERS shall be designed such that unexpected pressures in piping do not exceed the surge pressure.

Although BAC\(^9\) also exists in addition to ERC, ERC is linked to ESD. While ERC is released after ESD activates, BAC is not linked to ESD. Therefore, there is a fear that BAC may be released before ESD activates. Accordingly, a study shall be made on measures to guarantee the activation of ESD before the release of BAC in case BAC is used as an alternative to ERC and the necessary measures shall be adopted. Other precautions related to the use of BAC shall be followed from the description of ERC in these guidelines.

2.5.1 Hose handling and releasing liquid seal after ERC activates

If the hose is released by ERC, there is a risk of impact or damage to the hull, manifold, or ERC. Supports shall be fitted by an appropriate method to prevent such impact or damage.

Also, the prerequisite is that all impacts shall be absorbed in the hose and hose handling system in which multiple hoses are simultaneously released. If the release occurs without controls and there is a risk of the load limit of the bunker station to be exceeded, a suspension and restraining system shall be installed at a location other than the bunker station to disperse the load. The said system shall be designed such that it prevents sparks or physical damage due to contact of the completely-released hose with the hull structure and also reduces the risks of accident resulting in injury or death.

Liquid seal may be formed between the ESD valve and ERC when ERS activates; therefore, prompt

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\(^9\) BAC (Break Away Couplings) : Coupling arrangement that automatically closes and releases according to the set load (mainly in the tension direction)
response is necessary to remove this liquid seal.

2.5.2 Start of ERS during power failure

Although ERS shall be designed with the prerequisite that the bunker hose releases automatically before the activation limit is reached, mechanical integrity of ERS shall also be ensured so that it activates in an emergency when electricity or hydraulic pressure sources on the ship are not available due to power failure.

2.6 Manual activation of ESD and ERS

If one or more fenders are damaged during LNG fuel transfer, or if the LNG transfer hose/arm is deformed or damaged, or if one or more mooring lines have snapped, the ESD shall be activated manually, and if necessary, the ERS shall also be activated.

The location for activating ESD or ERS manually shall be such that activation is safe and immediate.

The procedure for getting approval for activating ESD or ERS manually shall be clearly defined and kept ready at a specified location. All personnel associated with the work shall be fully trained to use this system correctly and appropriately.

2.7 Inspections and tests of transfer system

The transfer system consisting of all the equipment and devices shall be periodically inspected and tested to ensure safety of the LNG fuel transfer. Frequency of tests and inspections shall be according to the recommendations of each equipment or device manufacturer and the instructions of the ship operator.

2.8 Fire extinguishing system

The LNG fuelled ship and the LNG bunker ship shall maintain the following fire extinguishing systems during the LNG fuel transfer work:

2.8.1 Fire extinguishing system on the LNG fuelled ship

- Gas detection shall be periodically performed near the bunker station of the LNG fuelled ship
- Hose shall extend from the sea water fire hydrant near the bunker station of the LNG fuelled ship. Arrangement shall be capable of discharging two jets of water immediately.
- A fixed dry chemical fire extinguishing system and a portable dry chemical fire extinguisher (5 kg x 1 no.) shall be installed near the bunker station of the LNG fuelled ship such that they can be used immediately.
2.8.2 Fire extinguishing system of LNG bunker ship

- Gas detection shall be periodically performed near the bunker station of the LNG bunker ship.
- Portable dry chemical fire extinguishers (6 kg x 2 no.) shall be installed near the bunker station of the LNG bunker ship such that they can be used immediately.
- Hose shall extend from the sea water fire hydrant near the bunker station of the LNG bunker ship. Arrangement shall be capable of discharging two jets of water immediately.
- Arrangements shall be made such that the cover of one monitor for fixed type dry chemical fire extinguishing system of LNG bunker ship can be removed and the system can be used immediately for the bunker station.
- Arrangements shall be made such that one hand nozzle for dry chemical fire extinguishing system on the LNG bunker ship can be used immediately.

2.9 Occurrence of fire

To prepare for the eventuality of fire, preventive control equipment such as water spray, etc., shall be provided to protect the hull structure from fire.

The following responses shall be taken if a fire breaks out:

① The first person who discovers the fire shall immediately notify the person with overall responsibility for transferring LNG and the person with overall responsibility for receiving LNG.
② The person with overall responsibility for transferring LNG and the person with overall responsibility for receiving LNG shall promptly activate the ESD and suspend the transfer operation.
③ The said person shall blow the whistle and notify the crew members of both ships and others in the vicinity the occurrence of the emergency situation.
④ Both ships shall close the doors connecting to the upper deck or the LNG receiving manifold, stop the ventilation fans, close all kinds of openings to ensure that gas does not enter inside the ship, and again establish fire controls.
⑤ Both ships shall deploy the firefighting stations immediately and start fire extinguishing activities.
⑥ If necessary, water spray shall be activated.
⑦ The Maritime Safety Department, the fire station, the police, the port controller and other concerned administrative organizations shall be notified.
⑧ Approach of other ships shall be prevented through radio, external speakers and so on.
2.10 Measures for electric potential difference between the two ships

Risk for a strong spark to occur exists because of difference of potential of static electricity accumulated in the hull of the LNG bunker ship and static electricity accumulated in the hull of the LNG-fuelled ship. Therefore, during the period from the connection to the disconnection of the LNG fuel transfer hose/arm in the two ships, either the electrical insulation between the two ships shall be maintained, or a bonding cable shall be connected to eliminate the potential difference between the two ships. If the measure to maintain electric insulation is adopted, insulated flanges need to be installed at the ends of all hoses/arms associated with LNG fuel transfer so that they are electrically insulated. However, ERC and insulated flange shall not be connected. When bonding cable is used, the hose/arm connection work shall be started after confirming the cable connection; the cable shall be disconnected after disconnecting the hose/arm.

Special precautions are needed and adequate response taken for the following:

- Against high frequency induction when hose handling crane is used for handling conductive hose
- Deck, crane structure, lifting wire, shackles, and hose form an open-ended inductive loop. Thus care is necessary to guard against arc discharge between hose end and steel deck or other hull structures.
- During hose handling work and LNG fuel transfer, the power supply of the main transmitter in the MF/HF radio shall be turned off and the antenna grounded.
- The insulated flange restricts flow of current and scatters static electricity; therefore, the resistance shall be greater than 1 kilo-ohm but less than 100 mega-ohms.
- If measure to maintain electric insulation is adopted, the insulated condition of hose saddle used or equivalent item shall be maintained considering that the hose may come into contact.
- The hose shall be supported by hose handling crane etc., considering that the disconnected hose may touch the hull and generate sparks.

2.11 Emergency tow-off pendant (fire wire)

If a fire or other emergency situation occurs in the LNG bunker ship, and if the ship needs to be shifted, a fire wire shall be arranged that can be used quickly to separate the ship from the LNG fuelled ship.

The fire wires shall have adequate strength and be in a satisfactory condition positioned at the bow and stern on the opposite side of the berth, and shall be appropriately lashed to bitts having strength greater than the required towing force. The ends of the fire wires shall be maintained near the water surface so that they can be easily secured to the tugboat. The fire wire shall have adequate slackness between the bitt and the fairlead so that the tugboat can tow the ship. The fire wire shall be prevented from slipping and dropping off due to its own weight by using rove yarn or by other securing method such that it can be cut easily.
2.12 Protective gear

For protection against risks accompanying LNG fuel, workers working near the manifolds of the two ships shall use long-sleeved anti-static work uniforms, helmet, leather gloves, safety boots and goggles. Also, tools to guard against static electricity shall be used for work.

2.13 Transfer of persons between the ships

Generally, the transfer of persons between the two ships shall be restricted to a minimum considering that both ships are in motion. Transfer between the ships shall be restricted to a minimum such as for meetings before the start of fuel transfer, connection/release of hose and arm, etc.

The following shall be observed during transfer of persons between the ships:

- All persons transferring between the ships shall wear life vests in addition to protective gear (including safety belt during transfer in addition to 2.12 “Protective gear”)
- Crew members working near the transfer location or performing lift work shall wear protective gear.
- Transfer between the ships shall be witnessed by the person with overall responsibility for transferring LNG (Master) or a person designated by the master (Officer, etc.)
- Use of gangway shall be restricted only to periods when there is practically no motion of the ships
- The gangway used shall be insulated, covered by fence and safety net, and designed such that safety is always ensured (open wharf ladder should preferably not be used).
- When the difference in freeboard is especially large, the pilot ladder and accommodation ladder shall be used in combination.
- The transfer basket shall be used only if it is appropriate for transfer by all the lifts and the required procedures for transfer have been established.

2.14 Action when safety is impeded

Any person discovering that safety in any of the two ships is impeded during the LNG fuel transfer by StS system shall report to the person with overall responsibility for transferring LNG and the person with overall responsibility for receiving LNG, so that the LNG fuel transfer operation is suspended.

LNG fuel transfer shall be re-started only after the situation impeding safety has improved reasonably and after the improvement is confirmed.

2.15 Helicopter operation

Helicopter operation shall be prohibited during approach of LNG bunker ship, during mooring operation between the two ships, and during the LNG fuel transfer.
3 Communications

3.1 Means

Communications between the two ships shall always be maintained in a satisfactory condition so as to ensure safety during LNG fuel transfer. For this purpose, the person with overall responsibility for transferring LNG and the person with overall responsibility for receiving LNG shall agree upon the means of communication beforehand.

3.2 Language

The common language to be used during LNG fuel transfer shall be confirmed before the start of the transfer operation.

3.3 Warnings to other ships operating in the vicinity

The LNG bunker ship shall put up warning banners on the side of the ship opposite to the side alongside the LNG fuelled ship indicating that LNG fuel transfer operation is under way to other ships operating in the vicinity.

During LNG fuel transfer operation at night time, adequate illumination shall be provided so that ships operating in the vicinity can recognize the warning banners.

Also, appropriate warnings shall be given to ships plying in the vicinity through VHF if necessary, considering the conditions in the sea area and the status of operation of ships in the vicinity.

3.4 Communications

Before entering the sea area scheduled for LNG fuel transfer, the two ships shall communicate with each other by VHF at as early stage as possible, and confirm that appropriate communications can be maintained between the two ships. If appropriate communications cannot be ensured, approach, mooring and heaving of anchor shall not be performed. At this stage communications shall be exchanged to complete the items in Checklists 2 and 3.

The explosion-proof transceiver can be used effectively for communications between the two ships while the ships are moored and the LNG fuel is being transferred. Communications and checks using the explosion-proof transceiver are recommended. Officers responsible for mooring work especially, shall have their own explosion-proof transceivers.

The following items shall also be considered:

- During the LNG fuel transfer, communication means including backup arrangement shall be provided at all times on the two ships
- After the masters of the two ships have agreed upon the procedure, course and speed for berthing
of the two ships, the approach work shall be started.

- Items on Checklist 4 shall be completed before the start of fuel transfer operation.

### 3.5 Procedure during a communications error

If communications have stopped during approach, or if the quality of communications is unsuitable for safe approach, then the approach shall be suspended. If necessary, safety shall be ensured by sound signals or by other means.

If communications have stopped during LNG fuel transfer, and if the emergency signal has sounded, both ships shall suspend all operations in progress provided such an action is executable for both ships.

LNG fuel transfer may be resumed after confirming the safety of both ships and after confirming that adequate communications have been ensured.

### 4 Works before the LNG fuel transfer

#### 4.1 Preparations before maneuvering

##### 4.1.1 Preparatory work

Before the start of maneuvering and approach, the masters of the two ships shall confirm the points listed below and make the necessary preparations.

- Check the main LNG transfer equipment and results of tests implemented for safety devices.
- Notify and familiarize crew members the mooring and unmooring work methods and associated risks.
- Confirm that the required items in the checklist specified in 2.1 “Checklist” are satisfied.
- Steering gear, navigation equipment and communications equipment are all working in good order.
- Carry out main engine trials and ensure that astern/ahead operations are normal.
- Both ships are upright and their trims are appropriate.
- Mooring equipment and lines are arranged according to the Mooring Plan.
- Fender and LNG fuel transfer hose/arm are connected and secured at the correction position in accordance with the Operation Manual.
- Manifold and hose handling materials are ready for use.
- Status of weather and sea conditions and their forecasts at the quay/pier or sea area where the transfer is to take place.
- Operation of the ship according to the ISPS Code, etc., and the security level.
- Deck lights and spot lights (if provided) are appropriate and in working order.
- All required ventilation equipment are in operation.
- Fixed gas detection devices are working correctly.
Fire extinguishing system has been tested and water spray also is ready for immediate use if necessary

Protective gear has been tested and is ready for use if required immediately

Air cylinder for breathing apparatus is full and can be used immediately if required

Persons other than authorized bunker station personnel do not have access

Work other than work approved by the master is not being performed at the bunker station

Confirm the quantity and properties of the LNG in tanks of both ships

Safety valves of tanks are in a suitable working condition.

Flame screens or similar devices of the ventilation system are correctly fitted and they do not obstruct the flow of gas.

4.1.2 Lights and day shapes

Lights and day shapes, or sound signals required by the Act on Preventing Collisions at Sea, the Maritime Traffic Safety Act and the Regulations for the Carriage and Storage of Dangerous Goods in Ship shall be used during LNG fuel transfer by StS system. These lights and shapes shall be confirmed as ready before the LNG fuel transfer operation by the StS system.

4.2 Safety of navigation

4.2.1 Navigation of LNG fuelled ship

The LNG fuelled ship shall navigate according to the existing operation standards of ports and harbors, quays and piers used and sea areas navigated, according to traffic rules of routes, and obligation to report, etc., similar to conventional ships carrying oil.

4.2.2 Navigation of LNG bunker ship

The LNG bunker ship shall navigate according to the existing operation standards of ports and harbors used and sea areas navigated, and according to traffic rules of routes, obligation to report, etc., and other rules and regulations such as the Act on Port Regulations, the Maritime Traffic Safety Act, etc., similar to conventional ships carrying dangerous goods.

4.3 Coming alongside the LNG fuelled ship

4.3.1 General overview

Although there is a good track record already of work with StS for heavy-oil burning ships and heavy-oil bunker ships, the LNG bunker ship is larger compared to the heavy-oil bunker ship. Characteristics such as the size of the area receiving wind need to be checked, and their effects confirmed before coming alongside.
When deciding the anchor chain length for anchoring the LNG fuelled ship, the safe mooring of two ships including own ship and the LNG bunker ship alongside by one anchor needs to be considered, in addition to the usual other factors (water depth, type of soil of bed, wind, tidal current, water depth margin). The master shall check the capacity of the windlass (anchor heaving limit) when anchoring at larger water depths or when extending the anchor chain length.

The coming alongside work shall preferably be carried out during daytime by crew except when experienced personnel are performing StS work at night time.

When coming alongside at night, deck lights shall be used to illuminate the ship side up the water line so as to properly grasp the distance between the ships. Moreover, the working lights on the LNG bunker ship shall be switched on when moving from the approach to the alongside position so as to correctly understand the speed of the ship coming alongside. Moreover, when coming alongside an anchored vessel, information shall be exchanged closely between the ships, and efforts shall be made to minimize the difference in heading of the two ships.

Even during daytime, coming alongside is difficult if the ship swings around. Considering that visibility is restricted, especially at night time, measures should preferably be adopted against the swinging of the ship, such as the use of a dynamic information system.

4.3.2 Precautions during mooring of LNG fuelled ship to quay or pier

When being moored at the quay or pier, the prerequisite is that the LNG fueled ship is safely moored according to the operating standards of the quay or pier.

The LNG bunker ship shall come alongside according to the operation standards shown in 1.9 “Operating conditions” At this stage, if the direction of wind and waves and tidal current is such that it is trying to push the LNG bunker ship toward the LNG fuelled ship, adequate care shall be taken to adjust the speed for coming alongside.

4.3.3 Precautions when the LNG fuelled ship is at anchor

For anchoring, the LNG fuelled ship shall use the anchor on the side opposite to the side where the LNG bunker ship comes alongside, and temporarily determine the position by casting anchor. After confirming the holding power, the LNG fuelled ship shall confirm that the swinging of the anchored ship as a result of the effects of wind, waves and current has subsided, and then receive the LNG bunker ship alongside. Regarding swinging of the ship, the heading shall be monitored carefully, and if the tidal current is predicted to change direction during the coming alongside operation of the LNG bunker ship, or if such a tendency is observed, then the LNG bunker ship shall be contacted immediately, and the coming alongside operation suspended or postponed.

The judgement whether coming alongside of the LNG bunker ship is possible shall be made considering the conditions at the site area based on the operating conditions indicated in 1.9 “Operating conditions”. The maneuverability including equipment of the ship and the effects of wind and waves
shall be considered for this operation. Especially, if the direction of wind and waves, or the direction of the tidal current changes considerably, it becomes difficult to maneuver the LNG bunker ship, therefore, care is necessary. If the sizes of the two ships are different, the two ships will exhibit different ship motions. For this reason, care shall be taken to ensure that the hull of the LNG bunker ship does not come into contact with the hull of the LNG fuelled ship when coming alongside.

The maneuvering characteristics of the LNG bunker ship vary considerably depending on the propulsion system. The precautions during maneuvering of a ship with two shafts and two rudders (CPP) and a ship with one shaft and one rudder (Schilling rudder) are given below.

(1) In case of two shaft, two rudders (CPP)

- If attitude control (turning moment, etc.) and lateral shift speed control of the LNG bunker ship are performed only by the ship’s propulsion system, then adjusting the forward-aft position becomes difficult; therefore the forward-aft position adjustments shall be performed after the mooring system between the two ships has been finalized.
- When turning moment is generated, the ship attitude control and the lateral shift speed cannot be detected easily; therefore, a person well experienced in maneuvering under similar conditions, shall maneuver the ship.
- If an experienced person does not maneuver the ship, either a joystick maneuvering system based on appropriate control shall be provided, or a stern thruster shall be provided, and the forward-aft position control shall be performed by this ship’s propeller, and the lateral movement speed control and hull attitude control (turning moment control) shall be separated.

(2) In case of one shaft, one rudder (Schilling rudder)

- If attitude control (turning moment, etc.) and lateral shift speed control of the LNG bunker ship are performed only by the ship’s propulsion system, then adjusting the forward-aft position becomes difficult; therefore the forward-aft position adjustments shall be performed after the mooring system between the two ships has been finalized.
- When turning moment is generated, the ship attitude control and the lateral shift speed cannot be detected easily; therefore, a person well experienced in maneuvering under similar conditions, shall maneuver the ship.
- If the ship’s propeller is used for forward-aft position adjustments, counterclockwise turning moment is generated during astern motion; therefore, it may have a good effect sometimes and an adverse effect sometimes on attitude control.
- If an experienced person does not maneuver the ship, either a joystick maneuvering system based on appropriate control shall be provided, or a stern thruster shall be provided, and the forward-aft position control shall be performed by this ship’s propeller, and the lateral movement speed control and hull attitude control (turning moment control) shall be separated.
4.3.4 Study on the need for a tugboat

If the maneuvering performance of the LNG bunker ship has deteriorated, if necessary, arranging for a tugboat may be studied after considering the operating conditions, conditions of the sea area, etc.

4.4 Mooring between the two ships in the StS system

4.4.1 Mooring preparations

Checklists 4 and 5 shall be prepared as part of coming alongside procedure.

The points below shall be carefully considered beforehand:

(1) Confirming mooring

Mooring lines shall be checked to ensure that they can be effectively tied and adjusted for mooring the two ships by the StS system. The mooring plan depends on the sizes of the two ships and their difference, the anticipated freeboard difference and difference in displacements, sea and weather conditions, topography and other sea area features, and the number and specifications of mooring lines; therefore, a basic mooring plan that suits the sea area where the LNG fuel transfer is to be implemented should be kept ready beforehand. At the time of analysis of the mooring load, efficiency is considered good when the number of mooring lines is small; however, it is wise to keep an adequate margin.

During LNG fuel transfer by the StS system, two ships with large freeboard difference are expected to be moored parallel to and close to each other. In such cases, the mooring line will make a steep angle, and the mooring force may be difficult to attain in the horizontal direction. Therefore, the freeboard difference between the two ships shall be minimized as far as possible by making adjustments through ballasting/de-ballasting.

(2) Mooring position

The points below shall be considered for studying the mooring position. As far as possible, studies and adjustments shall be made so that the fender installed between the two ships can be accommodated within the parallel body region. If it falls outside this region, confirm that safety can be ensured.

- Position of bunker stations of the two ships and relationship of parallel bodies of the two ships
- The possibility of the hull and structures of an LNG bunker ship with high freeboard to come in contact with the hull (especially flared part) of the LNG fuelled ship if the LNG bunker ship is moored close to the bow or close to the stern of the LNG fuelled ship
(3) Length of mooring line

To avoid excessive force on the mooring line during work, the length of the mooring line should be such that it has appropriate tension.

(4) Specifications of mooring line (material, diameter, etc.)

Generally, the mooring line is expected to be used from the LNG bunker ship; therefore, the same material and the same diameter (same strength) shall be used for mooring lines used in the same direction.

However, depending on the weather and sea conditions, mooring forces may need to be increased so mooring lines may be taken from both the ships. At this stage, similarly, mooring lines of the same material and same diameter (same strength) shall be used in the same direction. Also, it is recommended that additional mooring lines from the bow to the stern be kept ready so that they may be used for additional mooring force, if necessary.

In case of increasing the mooring lines, care shall be taken to ensure that mooring lines are not concentrated on specific fairleads or bitts.

(5) Ship’s equipment

Only closed fairleads shall be used as the equipment in both ships when mooring in the StS system; modification of open fairleads by using stopper bars shall be avoided.

Moreover, agreement shall be reached between the two ships on the mooring sequence and the unmooring sequence before the start of mooring work. If the LNG bunker ship uses a quick release hook, all concerned workers shall be made to understand the role and effects of the quick release hook.

4.4.2 Mooring

When two ships those are moored shift or move considerably, the arm/hose for LNG fuel transfer connecting the two ships is likely to be damaged. For this reason, efforts shall be made to maintain appropriate mooring.

Usually, the mooring requirements are determined by the person with overall responsibility for transferring LNG after considering the weather and sea conditions. For this reason, it is important to check the mooring method between the two ships beforehand.

(1) Adjusting the tension in the mooring line

Excessive or non-uniform tension in the mooring lines between the two ships shall be avoided since the load in specific mooring lines may exceed the SWL. Thus special care shall be taken during LNG fuel oil transfer by the StS system; appropriate adjustments shall be made so that
(2) Wave direction

When wind and waves or current direction varies during LNG fuel transfer by the StS system when the two ships are anchored, the heading of the two ships is not windward, and the ships may receive waves in a direction different from the heading. In such situations, care is necessary since the magnitude of oscillation of the two ships will increase. If waves are received from a direction transverse to the ship especially, the magnitude of oscillation of the two ships tends to increase significantly and special care is necessary.

(3) Long-period waves

If LNG fuel transfer by StS system is to be carried out in a sea area subject to the effects of long-period waves, the magnitude of oscillation of the two ships may increase, and special attention needs to be paid.

5 LNG fuel transfer work

5.1 Items to be checked between the two ships

The following items shall be checked between the two ships:

- Items below that have been agreed upon by the two ships.
  - LNG fuel transfer sequence
  - LNG fuel transfer rate
  - Emergency shut-off procedure, functional test of systems between the two ships
  - Response to fire or other emergency situations
  - Control of traffic and flames (smoking, etc.) in the two ships
- Pressure and LNG temperature and liquid density in cargo tanks of the LNG bunker ship and in the fuel tanks of the LNG fuelled ship.
  
  Note 1: About liquid temperature: This limitation does not apply only if the maximum permissible pressure in the LNG tanks of the LNG fuelled ship can adequately withstand the rise in pressure due to the mixing of LNG of different temperatures.
  
  Note 2: About liquid density: If the composition of LNG continually replenished in the LNG fuelled ship is almost constant, or if it has been confirmed mutually that the density difference is within the allowable range, then this limitation does not apply.

- LNG fuel transfer method (If the LNG in the LNG bunker ship is lighter than the LNG in the fuel tanks of the LNG fuelled ship, bottom fill is a standard feature, and if heavy, top fill is a standard feature)

- If insulated flanges are used, the insulation shall be undamaged.

- If bonding cable is used between the two ships, the bonding cable shall be connected before
connecting the hose.

- The hose used for LNG fuel transfer shall be adequately supported so that it does not have an excessive bend; the manifold shall also be properly supported so that excessive force does not act on it.
- The flange connections in the two ships of the hose/arm used in LNG fuel transfer shall be checked by the responsible personnel on both ships.
- Gaskets used in the hose and arm shall be of appropriate specifications and shall be in a satisfactory condition.
- Blowing of the ship’s whistle in an emergency shall be decided beforehand and agreed upon by both ships.
- If a strainer is installed during hose/arm connection for LNG fuel transfer, care should be taken about the direction in which the strainer is installed.

5.2 Fuel transfer plan

LNG fuel transfer plan shall be prepared and submitted before the start of work. The said plan shall be checked and agreed upon in writing between the two ships. The LNG fuel transfer plan shall include at least the items listed below.

- Clearly-defined list of all the responsible personnel related to LNG fuel transfer (See 1.1 “Provision of safety management system”).
- Liquid volume and estimated transfer volume in the LNG fuel tank before and after the transfer
- Gauging method and documents to be prepared
- Temperature and density of liquid LNG supplied and liquid in fuel tanks receiving LNG (see precautions in 5.1 “Items to be checked between the two ships”)
- Reduction of tank pressure on the LNG fuelled ship, if necessary (shall be reduced as far as possible before receiving fuel supply)
- Change in tank pressure estimated during LNG fuel transfer
- Filling method (light – bottom fill; heavy – top fill) (roll over measures)
- Tank pressure control procedure
- Maximum allowable pressure of tank
- Cool-down procedure
- Initial transfer rate
- Maximum transfer rate
- Procedure for changing transfer rate
- Ballasting and de-ballasting plans considering change in freeboard
5.3 Mooring

Periodically check the mooring conditions when the ships are moored, and monitor them confirming that the mooring force is adequate.

5.4 Preventing shifting of the ship

To prevent unexpected shifting of the ship, the necessary measures shall be adopted so that the propulsive forces of the two ships do not act when not needed during the LNG fuel transfer.

5.5 Inerting of LNG fuel transfer hose/arm (after connection)

After connecting the LNG fuel transfer hose/arm, all the hoses/arms shall be purged, pressurized further and checked for leaks. While purging, the O2 concentration shall be less than 5%.

5.6 Cool-down of LNG fuel transfer hose/arm

When cool-down of the LNG fuel transfer hose/arm starts, checks for leaks from the flange connections and around the LNG fuel transfer hose and bunker station shall be made; attention shall be paid to the cool-down rate.

The piping and manifold shall be confirmed to reach the specified temperatures in both the ships and subsequently, the cool-down shall be terminated.

5.7 Controlling liquid transfer

The LNG fuelled ship shall receive LNG fuel based on the LNG fuel transfer plan agreed to beforehand. However, for changing the LNG fuel transfer rate or for the fuel transfer work, LNG fuel tank pressure, etc., shall be considered, request made by LNG fuelled ship to the LNG bunker ship, and the transfer of liquid controlled.

Excluding the case when the tank has adequate capacity to withstand pressure, when the temperature difference of LNG in both ships exceeds 20°C, the supply rate shall be reduced according to the capacity of the BOG treatment equipment in the initial stage of LNG fuel transfer, and the LNG fuel transfer controlled while confirming the remaining liquid/progress of tank cooling and change in pressure.

When the transfer is by hose, there may be contact with the ships’ structure depending on the behavior of the hose. For this reason, the hose shall be properly strapped by a rope beforehand, and if there is a risk of contact of the hose with the ships’ structure, arrangement shall be made to pull the hose to the other side.

10 Main engine shall be kept warmed up since engine has to be started quickly in an emergency.
5.8 Standards for ship motion and weather

LNG fuel transfer by the StS system shall comply with the operating standards of 1.9 “Operating conditions”, and implemented with the prerequisite that safety has been ensured.

5.9 About BOG treatment

BOG shall be appropriately controlled, and in principle, shall not be discharged to the atmosphere.

To control the quantity of BOG generated during LNG fuel transfer, it is preferable to perform cool-down of the LNG fuel tanks and the LNG fuel transfer piping as far as possible before starting the LNG fuel transfer.

5.10 Completion of loading

The LNG fuel transfer work shall be completed after judging the estimated volume or the liquid volume in the LNG fuel tanks of the LNG fuelled ship.

When LNG fuel is received in multiple fuel tanks of the LNG fuelled ship, the LNG bunker ship shall adjust the rate and temporarily stop the transfer if necessary, based on the request of the LNG fuelled ship. Such actions will be based on the content of the checks and agreement made mutually at the meeting before the start of transfer work.

Offshore operation differs considerably from operation at berth since the ship may exhibit large motions during offshore operation. For this reason, care is required because of the risk of activation of tank floatation system and ESDS. This shall be considered when proposing the LNG fuel transfer plan.

5.11 Checking the density stratification of LNG fuel and inhibiting roll-over

The density distribution status of LNG shall be confirmed in the lower and upper strata of LNG fuel tank approximately 24 hours after completion of LNG loading.

If difference in liquid density is confirmed, the LNG at the lower stratum shall be shifted to the upper stratum using fuel transfer pump, etc. The liquid shall be agitated, mixed and uniform density obtained, thereby inhibiting roll-over.

However, this does not apply to tanks having adequate capacity to withstand pressure.

5.12 Ballasting/de-ballasting

Ballasting/de-ballasting operation may be necessary at the same time as the supply of LNG fuel although this depends on the ship’s design.

The LNG bunker ship is required to have adequate stability and appropriate trim so that it can de-berth within a short time in the event of an emergency situation in the LNG fuelled ship during the LNG fuel
transfer. For this reason, care shall be taken to distribute weights properly so that excessive trim, heel or excessive stresses do not occur, and to ensure appropriate stability and minimization of free-surface effects of liquid in tanks.

6 After completion of LNG fuel transfer

When the LNG fuel transfer hose/arm is disconnected, completion of preparations for leaving ship’s side by the LNG bunker ship shall be ensured and preparations for unmooring the ship shall be made.

6.1 Completion of fuel transfer and purging of piping

After completion of LNG fuel transfer, all LNG fuel transfer hoses shall be drained out and purged. Purging shall be performed until methane density below 2 volume percent is confirmed. Hose shall be disconnected when the methane density is below 2 volume percent.

After hose disconnection, blank flanges shall be fitted to the ends of the hoses and the manifold connections, and the hoses retained appropriately.

6.2 Measurement of LNG fuel

Measurements shall be carried out by Custody Transfer Measurement System (CTMS) installed on the two ships, or by means of flow meter installed between the two ships.

However, while CTMS is being used, the LNG fuelled ship consumes LNG fuel even while receiving the LNG fuel supply. Moreover, the vapor generated during the supply of LNG fuel has to be treated; therefore, the value may not necessarily be equal in both ships. For this reason, in principle, the amount of fuel going out of the LNG bunker ship according to CTMS may be assumed as the final value of amount of LNG fuel transferred.

6.3 Unmooring procedure

For unmooring the two ships that are moored by the StS system, information on external forces associated with wind, waves and tidal current shall be collected beforehand, and checks made to ensure safe unmooring and leaving ship’s side. The two moored ships may swing around, depending especially on the direction and magnitude of external forces; therefore, it is recommended that the timing of unmooring and leaving ship’s side to be postponed until the swinging of the ship subsides and safety can be ensured after confirming the magnitude of the swing.

Information on the status of traffic of other ships in the surrounding area shall be collected at all times so that safety is ensured at unmooring and after leaving the alongside position.
6.4 Unmooring checks

Although unmooring is performed by stationing the appropriate number of crew members forward and aft, special attention shall be given to the following points:

- The unmooring procedure shall be agreed upon by the two ships.
- Communications between the two ships should have been established.
- Communication procedure between the persons in charge of mooring in the two ships should have been established.
- Winch and windlass can be used immediately.
- Messenger ropes and rope stoppers have been arranged forward and aft.
- Axe or other cutting tool has been arranged at the forward and aft parts.
- Checks have been made to ensure that there are no obstructions including derricks or cranes on the berthing side.
- Lines for hoisting and lashing fenders have been confirmed as functioning correctly.
- Ship traffic in the vicinity has been confirmed.
- Checklist 5 has been completed.

6.5 Navigation

The LNG bunker ship after leaving the alongside position shall increase speed, and move away quickly from the LNG fuelled ship.

Navigation of the ship shall conform to the standards and rules prescribed for the port and sea area.

7 LNG fuel transfer equipment, materials and machinery

Appropriate materials shall be selected as equipment, materials and machinery to be used for LNG fuel transfer by the StS system. Before arranging equipment, materials and machinery related to LNG fuel transfer, confirm that loads on the bunker stations of the two ships, flanges, LNG fuel transfer hoses, attached hose saddles, couplings, spool pieces, reducers, ERC, systems controlling these including the equipment materials and machinery have been thoroughly inspected and have been approved by the relevant certifying body depending on the equipment, material and machinery, and they are suited for their application.

Equipment, materials and machinery that require special attention are given below.

7.1 LNG temperature monitoring

If the temperature difference of the LNG in the LNG fuel tank of the LNG fuelled ship and the LNG bunker ship exceeds 20°C, there may be concern of a steep rise in pressure due to generation of BOG in the initial stage of LNG transfer. For this reason, the BOG generated volume shall be estimated beforehand, and temperature gauges fitted in the LNG fuelled ship so as to monitor the temperatures and to prevent steep
rise in pressure. At least one temperature gauge shall be fitted at the tank bottom to suit the form and shape of the LNG tank. However, this requirement does not apply to LNG fuelled ship if the design pressure of the LNG fuel tank is such that it can adequately withstand the rise in pressure due to mixing of LNG with temperature difference.

7.2 Monitoring the LNG density or liquid composition

To judge whether to perform replenishment by top filling or bottom filling, the heaviness of the residual liquid needs to be understood. For this, a liquid densitometer or composition monitoring device (liquid sampling device or gas chromatograph) shall be provided.

The aim is also to judge whether or not to perform agitation after loading the LNG fuelled ship; therefore, at least a device to measure the density of liquid at the top and bottom parts of the tank, or a device to check the liquid composition shall be provided in the LNG fuelled ship. For installing the monitoring device at the upper part, the drop in liquid level due to consumption of LNG fuel (about 24 hours) after loading shall be considered.

However, if the composition of LNG continually replenished in the LNG fuelled ship is practically constant, and if the density difference is mutually confirmed to be within the permissible range, and the tank has adequate capacity to withstand the pressure, then the above requirement may not be applied.

On the other hand, the liquid density in the LNG cargo tank for the LNG bunker ship shall be found from information offered at the loading port.

7.3 Gas-liquid equilibrium calculation tools (chemical process simulator, etc.)

During LNG fuel transfer, if the difference in temperature between the LNG in the LNG fuel tank of the LNG fuelled ship and the LNG in the tank of the LNG bunker ship exceeds 20°C, a steep increase in tank pressure due to formation of BOG during replenishment may occur. If such an operation is expected to be implemented frequently, it is preferable to provide tools on the bunker ship side to estimate pressure change and replenishing rate during LNG fuel transfer to suit the capacity of the BOG treatment system and the properties of residual LNG.

Also, it is preferable to provide liquid sampling equipment or gas chromatograph, as mentioned in the previous section, to accurately study the change in composition due to heaviness of residual liquid in the LNG fuelled ship.

7.4 Fender

Air (pneumatic) fenders shall be provided between the two ships during LNG fuel transfer by the StS system.

The fenders installed shall in principle belong to the LNG bunker ship, which will provide and install
the same. For this reason, the LNG bunker ship side shall confirm that the number and specifications of fenders on board comply with the specifications of ISO 17357 before it comes alongside the LNG fuelled ship.

The points below shall be considered with respect to position of installation of fender.

- Study and make adjustments so that the fender is not installed below the bunker station considering leakage of LNG.
- If the fender is suspended by wire from the drum winch, the fender shall be monitored so that it does not shift as the wire runs out when the brake of the winch drum becomes slack during mooring.
- Sunken bitt shall not be used for fender installation considering SWL and access to it.
- The fender may snap because of the sunken bitt; therefore, the fender shall be installed in such a way as to avoid the position of the sunken bitt.
- If a pilot door is installed on the ship side, both ships shall study and adjust the fender so as to avoid the pilot door.

Installation of secondary fenders (baby fenders) at deck height of the LNG bunker ship shall be studied considering the mooring positions and mooring conditions of both ships, so as to avoid contact of the two hulls. The wire suspending the secondary fender at the ship side shall also be monitored ensuring that the slackness in the wire does not increase. Also confirm beforehand that chocks through which these wires pass are adequately coated with grease.

It is preferable for the LNG bunker ship to carry secondary fenders based on the precondition that the LNG bunker ship will encounter various kinds of mooring conditions. Thus, from the mooring condition of the two ships, secondary fenders may also become necessary.

### 7.5 LNG fuel transfer hose

The LNG fuel transfer hose shall be one that has been approved by a certifying organization and shall be carried by the LNG bunker ship. The person with overall responsibility for transferring LNG shall understand thoroughly the hose characteristics, tests, inspections and storage methods, and shall manage the hose.

#### 7.5.1 Specifications

The diameter of the LNG fuel transfer hose to be used shall be determined mainly from the liquid transfer rate and the vapor flow rate and shall be in line with the manufacturer’s recommended value. The maximum size of the hose is directly linked to the weight of the hose; therefore, if hoisting equipment is installed on the ship, its capacity, the manifold structure and specifications shall also be considered. Especially, the items listed below shall be considered for deciding the size and length of the hose to be used.

- Allowable flow velocity
7.5.2 Marking and confirming certificates

Confirm that the hoses used for LNG transfer are marked with the items listed below.

- Serial number of hose
- Inside diameter of hose
- Overall weight of hose
- Date of manufacture
- Date of implementation of pressure test
- Stamp of certifying body
- Maximum allowable pressure
- Maximum allowable flow velocity
- Range of allowable temperatures to be used

The following documents issued by the hose manufacturer regarding hose shall be confirmed beforehand:

- Hose certificate
- Hose quality assurance manual
- Surveys, tests and storage plan
- Operation manual
- Hose handling manual

7.5.3 Other check items

The following items shall be specially considered:

- Understand the design characteristics of the hose and the design concept “Leak before failure”, and use the hose according to the method recommended by the manufacturer.
- Check the integrity of the hose before its use, perform tests at intervals not exceeding 12 months in line with the manufacturer’s recommendations, record the results and maintain them.
- Maintain according to the method recommended by manufacturer. As far as possible, take measures to prevent deterioration from humidity and exposure to ultraviolet rays and to prevent physical damage.
7.6 LNG fuel transfer arm

The following considerations shall be made during the use of the arm in the StS operation of LNG:

- Shift and motion of the hull in the vertical and horizontal directions, and its acceleration
- Allowable manifold load
- Moveable range of arm
- Arm support
- Containment of arm
- Effect of vibration on arm
- Arm size
- Maintenance requirements
- Compatibility of connection
- Allowable flow velocity, pressure and pressure loss
- Test requirements

7.7 LNG supply piping to rectangular tank

For rectangular tanks having ring-reinforced vertical girders, pipes for distributing LNG supply to the bottom part are necessary to promote mixing of different types of LNG. However, this limitation does not apply if stratification during bottom fill of light LNG has been validated considering mixing of LNG through drain holes and the size of the girder.

7.8 Drip tray

To protect the hull during LNG leaks, drip trays shall be installed below the LNG fuel transfer hose/arm receiving/discharge parts of the bunker station, or under the working platform, based on the specifications of the LNG fuel transfer system.

7.9 Water curtain

To protect the hull during LNG leaks, water curtain shall be installed on one side of the hull at the bunker station, based on the specifications of the LNG fuel transfer system.

7.10 Hose saddle

When using the hose, a hose saddle shall be installed to prevent large, local bends in the hose, to prevent excessive load from acting on the equipment near the bunker station, and to prevent damage from the
disconnected hose after activating ERC on the equipment near the bunker station.

Hose saddle shall suit the hose specifications and shall be able to maintain and retain the minimum bend diameter of the hose.

7.11 Illumination

Adequate illumination of 70 lx and above shall be installed that allows the tasks listed below to be implemented when performing LNG fuel transfer work at night time. Parts directly below the hose near the water surface are subjected to cyclic bending loads especially, therefore, lights that can adequately illuminate the part directly below the hose shall be installed.

- Check vapor flow and vapor cloud
- Monitor hose/arm conditions and suspend transfer when a leak is discovered
- Evacuation from leakage location
- Unmooring
- Preparations for fire extinguishing system, fire extinguishing assistance

7.12 Auxiliary equipment

The condition of all auxiliary tools such as messenger rope, stopper, shackle, etc., shall be checked before use.

7.13 Mooring equipment

The LNG bunker ship shall be installed with adequate number of winches of appropriate mooring capacity for proper and safe mooring with the LNG fuelled ship, based on the requirements of marine equipment regulations and classification society.

Sometimes if may be difficult to moor the LNG bunker ship at the ideal position considering parallel body, the position of the bunker station of the LNG fuelled ship, etc. Therefore, measures such as flexible mooring and increase in the number of lines, adjustments in the position and number of mooring winches, etc., shall be adopted.
8 Emergency response

The person with overall responsibility for transferring LNG and the person with overall responsibility for receiving LNG shall discuss with each other and decide the response in an emergency after understanding the conditions. All persons associated with LNG fuel transfer on both ships shall abide by the decisions and act accordingly.

All ships associated with LNG fuel transfer by the StS system shall prepare and keep ready the “Emergency Response Procedures” that covers all the operations. A person engaging in fuel transfer work by the StS system for the first time, shall be trained before the start of the work, shall confirm the content of the Emergency Response Procedures, and re-study the same if necessary.

The Emergency Response Procedures shall be installed at positions where it can be referred to immediately when required during the LNG fuel transfer work.

- Procedure when an alarm related to safety of LNG fuel transfer is emitted
- LNG fuel transfer stop procedure in an emergency
- LNG fuel transfer hose/arm release procedure in an emergency
- Emergency unberthing procedure including preparations for machinery
- Unmooring and leaving ship’s side procedure including stationing of personnel
- Emergency response procedures during a leak in the LNG bunker ship or the LNG fuelled ship

9 Earthquake and tsunami measures

9.1 Collecting information when earthquake or tsunami occurs

Efforts shall be made to collect earthquake and tsunami information the moment an earthquake is felt. The moment the Weather Bureau announces earthquake and tsunami information, it is received by NAVTEX through the Japan Coast Guard. The LNG fuelled ship and the LNG bunker ship will be able to receive this information. This information shall be automatically printed on recording paper and alarm settings for notifying receipt of this information may be used, if necessary.

When offshore, it may not be possible to feel an earthquake while on board; also, earthquake information cannot be acquired easily. Therefore, in addition to NAVTEX, a system to receive earthquake and tsunami information as soon as possible should be set up through satellite telephones, etc., so that the LNG fuelled ship can receive such information from the shipping agent and the LNG bunker ship from the operating company.

9.2 Response when an earthquake or tsunami occurs

If either of the ships receives earthquake and tsunami information, it shall immediately share the information with the other ship.

When a tsunami warning or alert is issued, the masters of both ships shall immediately suspend the LNG
transfer operation and if necessary, disconnect the transfer hose/arm and perform emergency de-berthing after considering the LNG fuel transfer limiting conditions and leaving ship’s side conditions.

9.3 Measures when tsunami occurs

Drills shall be implemented so that the following actions can be quickly and safely performed: transfer pump shall be stopped, hose/arm purged, valves closed and hose/arm disconnected. At the same time, the time required for this series of operations shall be noted down beforehand.

Depending on the conditions, emergency stoppage of transfer and hose-arm disconnection may be anticipated when ESD or ERS is set off. Therefore, drills related to these activities shall be regularly implemented, proficiency of work itself enhanced, and the procedure and time required for disconnection confirmed and noted beforehand.

The frequency of LNG fuel transfer work for the LNG bunker ship especially is high, and a higher proficiency is anticipated; therefore, a system should be in place such that proper instructions are issued to the LNG fuelled ship.
10  Flow chart of LNG fuel transfer by the StS System

1. Preparations for coming alongside
   (2. Connecting bonding cable)

2. Transfer of persons
   2. Connect communication and ESDS signal cable / hose

3. Meeting before start of transfer work
   2. Testing of communications equipment

4. Loading of materials and equipment

5. O2 purging

6. Leak test

7. Measurement before transfer
   ERS signal test

8. ESDS functional test at normal temperature

9. Line C/D (tank cool-down)

10. ESDS functional test at low temperature

11. Start of transfer

12. Steady-state transfer

13. Transfer complete

14. Draining

15. Methane purging (liquid line)

16. Measurement after transfer

17. Methane purging (vapor line)

18. Hose disconnection

19. Meeting after transfer completion

20. Transfer of persons

20. Communication and ESDS signal cable/hose disconnected

20. Removal of bonding cable

20. Leaving ship's side

Emergency response (unberthing 1)
In case of unberthing after suspending transfer work without using ESDS

Emergency response (unberthing 2)
In case of unberthing after suspending transfer work by ESDS activation

Emergency response (unberthing 3)
In case of unberthing after suspending transfer work by ESDS activation and disconnecting by ESDS2
11 Check List

11.1 Check List 1

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<th>LNG fuel transfer by StS system</th>
<th>Check List 1 Information specific to each ship</th>
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<tr>
<td>Name of Ship</td>
<td>Company Name</td>
</tr>
<tr>
<td>Call Sign</td>
<td>Working hours</td>
</tr>
<tr>
<td>IMO No.</td>
<td>Location &amp; Sea area</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transfer side/receiving side</th>
<th>Check by ship</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>1. Length overall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parallel body length (at full load and at ballast load)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Is manifold arrangement according to OCIMF/SIGTTO? (Note 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Is lifting equipment according to OCIMF recommendations? (Note 2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Height of manifold from highest and lowest water level during transfer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Are appropriate personnel stationed and available at all stages of the work?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Is the appropriate number of fairleads and mooring bitts according to OCIMF provided? (Note 3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Can all mooring lines be taken from the winch drum?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. If the mooring line is a wire rope or high modulus fiber rope, is a tail rope of at least 11 m length provided?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Is a bit of adequate strength available near the fairlead for receiving mooring line?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Are structural protrusions on both sides including the bridge wings clear?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Is the transfer work area agreed upon?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Transfer side/receiving side

Name: 
Designation: 
Sign: Time: 
Master

Note 1: Shall be according to “Manifold Recommendations for Liquefied Gas Carriers” of OCIMF/SIGTTO
Note 2: Shall be according to the OCIMF recommendation “Oil Tanker Manifolds and Associated Equipment”
Note 3: Shall be according to “Mooring Equipment Guidelines 3” of OCIMF
## 11.2 Check List 2

<table>
<thead>
<tr>
<th>LNG fuel transfer by StS system</th>
<th>Checklist 2 Before start of work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Ship</td>
<td>Company Name</td>
</tr>
<tr>
<td>Call Sign</td>
<td>Working hours</td>
</tr>
<tr>
<td>IMO No.</td>
<td>Location &amp; Sea area</td>
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<table>
<thead>
<tr>
<th>Transfer side/receiving side</th>
<th>Bunker ship</th>
<th>Receiving ship</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Has Checklist 1 been completed?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Check construction of communication means by radio and channels used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Agreement and check on language to be used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Check rendezvous position before entering transfer work area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Has the LNG fuel transfer plan been discussed?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has the approach and maneuvering plan been mutually understood and confirmed?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Have berthing and mooring procedures been agreed upon?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have fender location, number and kinds of mooring lines also been agreed upon?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Have electric insulating systems and methods between the two ships been agreed upon?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Is the hull condition upright with appropriate trim and appropriate draft?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Have the bunkering system and ESDS been tested within 48 hours before the bunkering operation?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Has it been confirmed that the ship’s boiler and smokestack are not covered with soot?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has it been confirmed that Soot Blow is not possible during the StS operation?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Have explanations on ship speed adjustments and use of engine been given to the Chief Engineer?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Has weather information for the transfer sea area been acquired?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Is the hose hoisting equipment appropriate and is it ready for use?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Has the LNG fuel transfer line been correctly tested, validated and in a satisfactory condition?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Are the fenders and associated equipment in a satisfactory condition when visually inspected?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Have mooring work procedures been explained to the crew members?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Have emergency response procedures been agreed upon?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer side/receiving side</td>
<td>Bunker ship</td>
<td>Receiving ship</td>
<td>Remarks</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------</td>
<td>----------------</td>
<td>---------</td>
</tr>
<tr>
<td>18. Have the authorities been notified of the transfer work?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Has a report been made to the Japan Coast Guard? Have ships navigating in the vicinity been warned?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. Has combustible gas detection been carried out within accommodation space, void space and compressor room continuously?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. Is the AIS in 1-Watt mode?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22. Has the LNG fuel transfer piping system been cooled?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. Has the other ship been notified about the completion of Checklist 2?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Transfer side/receiving side**

**Name:**

**Designation:**

**Sign:**

**Time and date:**

**Master**
11.3 Check List 3

<table>
<thead>
<tr>
<th>Name of Ship</th>
<th>Company Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call Sign</td>
<td>Working hours</td>
</tr>
<tr>
<td>IMO No.</td>
<td>Location &amp; Sea area</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transfer side/receiving side</th>
<th>Bunker ship</th>
<th>Receiving ship</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Has Checklist 2 been completed?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Has the primary fender been installed at the correct location?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the fender pennant functioning properly?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Is the secondary fender installed, if required?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Have objects protruding out of the side been pulled in before the ship comes alongside?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Is the helmsman experienced?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Has the LNG receiving connection been kept ready and has it been marked?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Have information on course, speed and swinging (while anchoring) been exchanged and understood?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Are speed adjustments controlled by rpm and propeller pitch angles?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Are indications by lights and day shapes satisfactory?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Is illumination adequate?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Are the starting and operating conditions of the winch and windlass satisfactory?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Have messenger ropes, rope stoppers and heaving lines been arranged?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Are preparations for all mooring lines satisfactory?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Is the stationing of crew members engaged in mooring work satisfactory?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Has a system been established for communications between crew members engaged in mooring work?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Has an anchor been arranged on the side opposite the berthing side in the bunker ship?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Has the traffic flow in the work area been checked?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Are materials and equipment for the prevention of marine pollution and fire extinguishing system ready for use?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Has the other ship been notified about the completion of Checklist 3?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Transfer side/receiving side

Name: 
Designation: 
Sign: Time and date: 
Master
### 11.4 Check List 4

#### LNG fuel transfer by StS system

**Checklist 4 Before start of transfer**

<table>
<thead>
<tr>
<th>Name of Ship &amp; Company Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call Sign &amp; Working hours</td>
</tr>
<tr>
<td>IMO No. &amp; Location &amp; Sea area</td>
</tr>
</tbody>
</table>

1. **LNG fuel transfer volume**

<table>
<thead>
<tr>
<th>Supply LNG fuel</th>
<th>Liquid temperature</th>
<th>Liquid density</th>
<th>Volume at filling temperature</th>
<th>Maximum transfer rate</th>
<th>Maximum line pressure</th>
</tr>
</thead>
</table>

2. **LNG remaining in LNG fuel tanks**

<table>
<thead>
<tr>
<th>Tank No.</th>
<th>Liquid temperature</th>
<th>Liquid density</th>
<th>Remaining volume</th>
<th>Filling method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bottom / Top</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Bottom / Top</td>
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<tr>
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<td></td>
<td>Bottom / Top</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bottom / Top</td>
</tr>
</tbody>
</table>

Note: Regarding liquid density, the filling method should be Bottom Fill if the supplied LNG is lighter than remaining LNG, and should be Top fill if it is heavier than remaining LNG.

Note: If the temperature difference between supplied LNG and remaining LG is about 20 deg. C, steep increase in tank pressure should be considered.

3. **Tank filling volume**

<table>
<thead>
<tr>
<th>Tank No.</th>
<th>Tank volume (@___%)</th>
<th>Tank volume before filling</th>
<th>Filling capacity</th>
<th>Estimated filling volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

II-47
### Before start of transfer

<table>
<thead>
<tr>
<th>Step</th>
<th>Question/Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Has Checklist 3 been completed?</td>
</tr>
<tr>
<td>2.</td>
<td>Has the transfer method been agreed upon?</td>
</tr>
<tr>
<td>3.</td>
<td>Is the gangway condition satisfactory and safe?</td>
</tr>
<tr>
<td>4.</td>
<td>Have communication methods between the two ships been agreed upon?</td>
</tr>
<tr>
<td>5.</td>
<td>Have emergency signal and transfer work suspension procedures been agreed upon?</td>
</tr>
<tr>
<td>6.</td>
<td>During LNG fuel transfer, can persons be stationed in the engine room if necessary, and can the engine used immediately if required?</td>
</tr>
<tr>
<td>7.</td>
<td>Is axe or appropriate cutting tool provided in the forward and aft part of the ship?</td>
</tr>
<tr>
<td>8.</td>
<td>Are bridge watch and anchor watch stationed?</td>
</tr>
<tr>
<td>9.</td>
<td>Are personnel responsible for LNG fuel transfer on both ships clearly assigned and put up on the notice board?</td>
</tr>
<tr>
<td>10.</td>
<td>Are deck watches stationed especially around mooring lines, fender, hose/arm, manifold?</td>
</tr>
<tr>
<td>11.</td>
<td>Have checks been made for LNG in the tanks of both ships?</td>
</tr>
<tr>
<td>12.</td>
<td>Are the cool down method and rate at start of transfer of liquid agreed upon?</td>
</tr>
<tr>
<td>13.</td>
<td>Is the maximum transfer rate agreed upon? Is it written down on paper?</td>
</tr>
<tr>
<td>14.</td>
<td>Are vapor differential pressure and maximum allowable pressure agreed upon?</td>
</tr>
<tr>
<td>15.</td>
<td>Has the maximum distance separating the two ships been agreed upon?</td>
</tr>
<tr>
<td>16.</td>
<td>Check procedure for changing transfer rate.</td>
</tr>
<tr>
<td>17.</td>
<td>Check vapor pressure control procedure.</td>
</tr>
<tr>
<td>18.</td>
<td>Check agreement on ballast/de-ballast procedure.</td>
</tr>
<tr>
<td>19.</td>
<td>Has the person with overall responsibility for transferring LNG been designated?</td>
</tr>
<tr>
<td>20.</td>
<td>Has the rate at completion of loading been agreed upon?</td>
</tr>
<tr>
<td>21.</td>
<td>Is the hose properly supported? Is the hose disconnection area clear of obstacles?</td>
</tr>
<tr>
<td>22.</td>
<td>Are tools to be used for hose disconnection kept ready at the bunker station?</td>
</tr>
<tr>
<td>23.</td>
<td>Has ESDS been properly installed and tested before its use? (Coupling is not disconnected)</td>
</tr>
<tr>
<td>24.</td>
<td>Is the deck watch aware of ESDS starting method and its location?</td>
</tr>
<tr>
<td>25.</td>
<td>Is the LNG fuel transfer safety system and monitoring system activated?</td>
</tr>
<tr>
<td>26.</td>
<td>Has the LNG fuel transfer hose been connected? Is no slackness in the hose confirmed?</td>
</tr>
<tr>
<td>Transfer side/receiving side</td>
<td>Bunker ship</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>27. Has the LNG fuel transfer hose been purged with N2, and is the O2 concentration below 5%?</td>
<td></td>
</tr>
<tr>
<td>28. Is the nitrogen supply equipment activated during transfer work?</td>
<td></td>
</tr>
<tr>
<td>29. Has the water curtain been checked for proper functioning?</td>
<td></td>
</tr>
<tr>
<td>30. Has the emergency tow-off pendant (fire wire) been properly installed?</td>
<td></td>
</tr>
<tr>
<td>31. Has the fire extinguishing system been checked for proper functioning?</td>
<td></td>
</tr>
<tr>
<td>32. Have measures been taken to prevent the action of unwanted propulsion forces?</td>
<td></td>
</tr>
<tr>
<td>33. Has gas detection been carried out at appropriate times near the bunker station?</td>
<td></td>
</tr>
<tr>
<td>34. Has the other ship been notified about the completion of Checklist 4?</td>
<td></td>
</tr>
</tbody>
</table>

Transfer side/receiving side

Name: [Name]
Designation: [Designation]
Sign: [Sign]
Time and date: [Time and date]

Master
11.5 Check List 5

LNG fuel transfer by StS system

Checklist 5 Before unmooring

<table>
<thead>
<tr>
<th>Name of Ship</th>
<th>Company Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call Sign</td>
<td>Working hours</td>
</tr>
<tr>
<td>IMO No.</td>
<td>Location &amp; Sea area</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transfer side/receiving side</th>
<th>Bunker ship</th>
<th>Fueling ship</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Before disconnecting the hose, has it been drained and purged with N2? (Methane concentration below 2 vol%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Has blank flange been fitted to the end of hose/manifold?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Is the side on which LNG fuel transfer is being carried out clear of obstacles including hose lifting equipment?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Has the secondary fender been installed and fixed at the correct location for leaving ship’s side?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Is there agreement on leaving ship’s side and unmooring method?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Is the fender including fender pennant satisfactory?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Have the winch and windlass been started?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Have messenger ropes and rope stoppers been arranged at all the mooring stations?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Have crew members reached their forward and aft stations?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Have communication means been established between crew members engaged in mooring work and crew members of the other ship?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Have swinging (while at anchor) and traffic of ships in the vicinity been confirmed?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Have main engine, rudder and all navigation instruments been tested? Have preparations for leaving ship’s side been made?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Have instructions been given to release mooring ropes to the crew members engaged in mooring work by request from the bunker ship?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Has the other ship been notified about the completion of Checklist 5?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Has the density distribution condition of LNG fuel at the top and bottom of fuel tank been checked? (24 hours after filling)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Transfer side/receiving side

Name:

Designation:

Sign:  

Time and date:

Master
12 References

A part of the references listed below were referred to for preparing these guidelines.

(1) LNG Ship to Ship Transfer Guidelines First Edition 2011 (SIGTTO)
(2) Ship to Ship Transfer Guide (Liquefied Gases), 2nd Edition (OCIMF/SIGTTO)
(5) TANKER SAFETY GUIDE LIQUEFIED Second edition 1995 (ICS)
III. Operation Manual for Ship to Ship LNG Transfer
[Objectives]

This document is an operation manual to be used by the master and the operator when filling LNG fuel from an LNG bunker ship into a LNG fuelled ship.

[Scope of application]

This manual describes the work of berthing an LNG bunker ship alongside a LNG fuelled ship, and the supply of LNG fuel.

[Emergency Release System]

When the LNG bunker ship and the LNG fuelled ship separate unexpectedly during LNG fuel transfer, load exceeding the permissible value may act on the transfer arm/hose and damage them. To prevent this occurrence, automatic release is used, by means of the Emergency Release System (ERS\textsuperscript{11}) that allows quick emergency release of transfer hose/arm in the event of a fire, tsunami or other disaster.

Although BAC\textsuperscript{12} exists in addition to ERC\textsuperscript{13}, ERC is linked to ESD. While ERC is released after ESD activates, BAC is not linked to ESD. Therefore, there is a fear that BAC may be released before ESD activates. Accordingly, a study shall be made on measures to guarantee the activation of ESD before the release of BAC in case BAC is used as an alternative to ERC and the necessary measures shall be adopted. Other precautions related to the use of BAC shall comply with ERC.

\textsuperscript{11} ERS (Emergency Release System): Safety system for release within a short time of hose and arm from the bunker station in an emergency that minimizes leakage of LNG; includes Emergency Release Couplings (ERC).

\textsuperscript{12} BAC (Break Away Couplings): Coupling arrangement that automatically closes and releases according to the set load (mainly in the tension direction)

\textsuperscript{13} ERC (Emergency Release Couplings): Coupling that closes valve in an emergency by equivalent hydraulic power after ESD activates, minimizes LNG leakage and disconnects in a short time.
# Operation Manual for Ship to Ship LNG Transfer

<table>
<thead>
<tr>
<th>Work Item</th>
<th>Ship Side</th>
<th>Contact</th>
<th>LNG bunker ship</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Berthing preparations</td>
<td>Check hull condition</td>
<td></td>
<td>1. Check hull condition</td>
<td>Use of flange size, transfer rate, strainer, etc. before entering port</td>
</tr>
<tr>
<td>2.</td>
<td>Reduce tank pressure</td>
<td></td>
<td>2. Check nautical instruments</td>
<td>Check for existence</td>
</tr>
<tr>
<td>3.</td>
<td>Check nautical instruments</td>
<td></td>
<td>3. Check navigational warnings</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Check navigational warnings</td>
<td></td>
<td>4. Check weather and sea conditions</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Check weather and sea conditions</td>
<td></td>
<td>5. Check fire extinguishing system</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Check fire extinguishing system</td>
<td></td>
<td>6. Keep ready gas detectors</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Keep ready gas detectors</td>
<td></td>
<td>7. Check water curtain</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Check water curtain</td>
<td>⇔</td>
<td>8. Mutual check of mooring arrangement</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Mutual check of mooring arrangement</td>
<td></td>
<td>9. Check mooring equipment</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Check mooring equipment</td>
<td></td>
<td>10. Check illumination</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Check illumination</td>
<td></td>
<td>11. Check charging and operation of communications equipment</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Check charging and operation of communications equipment</td>
<td></td>
<td>12. Check hydraulic valve remote operating equipment</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Check hydraulic valve remote operating equipment</td>
<td>⇔</td>
<td>13. Check ESDS (for consistency)</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Check ESDS (for consistency)</td>
<td></td>
<td>14. Check CTMS activation</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Check CTMS activation</td>
<td></td>
<td>15. Check ERC activation</td>
<td></td>
</tr>
<tr>
<td>17. (Cool down of bunker line)</td>
<td></td>
<td></td>
<td>17. Cool down of bunker line</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Check hose/arm</td>
<td></td>
<td>18. Check fender</td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Check fender</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Preparations before start of berthing and transfer

<table>
<thead>
<tr>
<th>Work Item</th>
<th>Ship Side</th>
<th>Contact</th>
<th>LNG bunker ship</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Installation of fender</td>
<td>←</td>
<td>1. Installation of fender</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Notify start of berthing</td>
<td>⇔</td>
<td>2. Notify start of berthing</td>
<td>(If insulated flange is provided, bonding cable is not be in the SIGTTO requirements.)</td>
</tr>
<tr>
<td>3.</td>
<td>Check berthing position and mooring work</td>
<td></td>
<td>3. Check berthing position and mooring work</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Completion of mooring work and notification</td>
<td>⇔</td>
<td>4. Completion of mooring work and notification</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Monitoring mooring condition</td>
<td></td>
<td>5. Monitoring mooring condition</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Indication by lights and day shapes</td>
<td></td>
<td>6. Indication by lights and day shapes</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Put up fuel transfer warning signs outside the ship</td>
<td></td>
<td>7. Put up fuel transfer warning signs outside the ship</td>
<td></td>
</tr>
<tr>
<td>Work Item</td>
<td>Ship Side</td>
<td>Contact</td>
<td>LNG bunker ship</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------</td>
<td>---------</td>
<td>-----------------</td>
<td>---------</td>
</tr>
<tr>
<td>6. Usage limit of communication equipment</td>
<td></td>
<td></td>
<td>8. Usage limit of communication equipment</td>
<td></td>
</tr>
<tr>
<td>7. Ventilation control in accommodation space</td>
<td></td>
<td></td>
<td>9. Ventilation control in accommodation space</td>
<td></td>
</tr>
<tr>
<td>10. Transfer of persons between the ships (receiving preparations)</td>
<td>⇔</td>
<td>13. Signal line connection for ESDS activation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Tests of communications equipment</td>
<td>⇔</td>
<td>15. Preparations for transfer hose/arm connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Preparations for transfer hose/arm connection</td>
<td>⇔</td>
<td>16. Preparations for fire extinguishing system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Preparations for fire extinguishing system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESDS : Emergency Shut Down System</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Meeting before start of transfer on board

1. Meeting before start of transfer on board
2. Exchange of information such as composition (liquid density), tank pressure and liquid temperature of existing LNG and supply LNG
3. Check estimated receiving volume/transfer volume
4. Confirm checklists mutually
5. Check transfer suspension criteria in an emergency
6. Check liquid level with liquid level gauge
7. Check transfer method (Bottom Fill/Top Fill, etc.) and rate
8. Check information such as limitations in working sea area, warnings, etc.
9. Exchange of information on weather and sea conditions
10. Others
<table>
<thead>
<tr>
<th>Work Item</th>
<th>Ship Side</th>
<th>Contact</th>
<th>LNG bunker ship</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Hose connection</td>
<td><em>When ship side hose hoisting equipment is used</em></td>
<td>1. Stationing of workers</td>
<td>1. Stationing of workers</td>
<td>If necessary, fit reducer</td>
</tr>
<tr>
<td>1. Stationing of workers</td>
<td>←</td>
<td>2. Saddle, reducer, etc.</td>
<td>2. Saddle, reducer, etc.</td>
<td></td>
</tr>
<tr>
<td>2. Loading of materials and equipment</td>
<td>⇔</td>
<td>3. Start water curtain</td>
<td>3. Start water curtain</td>
<td>Use auxiliary rope when handling hose</td>
</tr>
<tr>
<td>3. Start water curtain</td>
<td>⇔</td>
<td>4. ERC connection (only bunker ship)</td>
<td>4. ERC connection (only bunker ship)</td>
<td></td>
</tr>
<tr>
<td>5. O₂ purging</td>
<td>1. Check that ESD valve is closed</td>
<td>1. Check that ESD valve is closed</td>
<td>1. Check that ESD valve is closed</td>
<td></td>
</tr>
<tr>
<td>2. Measure O₂ with vapor purge valve</td>
<td>←</td>
<td>2. Supply nitrogen to vapor line</td>
<td>2. Supply nitrogen to vapor line</td>
<td>SIGTTO standard value</td>
</tr>
<tr>
<td>3. Complete with O₂ concentration below 5% Purge valve closed</td>
<td>⇔</td>
<td>3. Supply nitrogen to liquid line</td>
<td>3. Supply nitrogen to liquid line</td>
<td></td>
</tr>
<tr>
<td>4. Measure O₂ with liquid purge valve</td>
<td>←</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Complete with O₂ concentration below 5% and purge Close valve and then do the leak test.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Leak test</td>
<td>1. Do the leak test of all connected parts such as hose/arm, manifold, etc.</td>
<td>←</td>
<td>1. Raise nitrogen supply pressure up to the required pressure</td>
<td></td>
</tr>
<tr>
<td>2. Leak test completion</td>
<td>⇔</td>
<td>2. Do the leak test of all connected parts such as hose/arm, manifold, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Reduce pressure by opening purge valve</td>
<td>⇔</td>
<td>3. Leak test completion</td>
<td>3. Leak test completion</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>←</td>
<td>4. Stop nitrogen supply</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>←</td>
<td>5. Reduce pressure by closing purge valve</td>
<td></td>
</tr>
<tr>
<td>Work Item</td>
<td>Ship Side</td>
<td>Contact</td>
<td>LNG bunker ship</td>
<td>Remarks</td>
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<td>-----------</td>
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<td>---------</td>
</tr>
<tr>
<td>8. ESDS functional test at normal temperature</td>
<td>1. ESDS functional test at normal temperature</td>
<td>⇔</td>
<td>1. Vapor/liquid ESD valve closed</td>
<td>Once each for ship and bunker ship</td>
</tr>
<tr>
<td></td>
<td>2. Vapor/liquid ESD valve open</td>
<td>⇔</td>
<td>2. Signal “ON” from ship or bunker ship</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Signal “ON” from ship or bunker ship</td>
<td>⇔</td>
<td>3. Check that vapor/liquid ESD valve is closed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Check that vapor/liquid ESD valve is closed</td>
<td>⇔</td>
<td>4. Check that ESDS is normal</td>
<td></td>
</tr>
<tr>
<td>9. Line cool down</td>
<td>1. Ensure transfer gas line</td>
<td>⇔</td>
<td>1. Ensure return gas receiving line</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vapor ESD valve is open</td>
<td>⇔</td>
<td>Vapor ESD valve is open</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Line up of line cool down</td>
<td>⇔</td>
<td>Liquid ESD valve open</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Liquid ESD valve open</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Report completion of preparations for line cool down</td>
<td>⇒</td>
<td>3. Start pump, adjust transfer rate</td>
<td>Check for leak in each part</td>
</tr>
<tr>
<td></td>
<td>4. Check liquid flow and start line cool down</td>
<td>⇒</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Line cool down complete at specified temperature</td>
<td>⇒</td>
<td>4. Stop pump</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Check stoppage of liquid flow</td>
<td>⇒</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. ESDS functional test at low temperature</td>
<td>1. ESDS functional test at low temperature</td>
<td>⇔</td>
<td>=Caution for liquid seal for both ships =</td>
<td>Implement once each for ship and bunker ship</td>
</tr>
<tr>
<td></td>
<td>2. Check tank pressure</td>
<td>⇔</td>
<td>1. Check tank pressure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Check that vapor/liquid ESD valve is open</td>
<td>⇔</td>
<td>2. Check that vapor/liquid ESD valve is open</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Signal “ON” from ship or bunker ship</td>
<td>⇔</td>
<td>3. Signal “ON” from ship or bunker ship</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Check that vapor/liquid ESD valve is closed</td>
<td>⇔</td>
<td>4. Check that vapor/liquid ESD valve is closed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Check that ESDS is normal</td>
<td>⇔</td>
<td>5. Check that ESDS is normal</td>
<td></td>
</tr>
<tr>
<td>Work Item</td>
<td>Ship Side</td>
<td>Contact</td>
<td>LNG bunker ship</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------</td>
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<td>----------------</td>
<td>---------</td>
</tr>
<tr>
<td>11. Start transfer</td>
<td>1. Check that vapor/liquid ESD valve is open</td>
<td>⇔</td>
<td>1. Check that vapor/liquid ESD valve is open</td>
<td>Remarks</td>
</tr>
<tr>
<td></td>
<td>2. Check receiving line up</td>
<td>⇔</td>
<td>2. Check transfer line up</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Request to start transfer</td>
<td>→</td>
<td>3. Start pump, begin transfer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Check inflow</td>
<td>→</td>
<td>4. Inspect each part</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Inspect each part</td>
<td>⇔</td>
<td>5. Adjust to steady rate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Request increase in transfer rate</td>
<td>→</td>
<td>6. Control tank pressure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Control tank pressure</td>
<td>←</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Steady-state transfer</td>
<td>1. Inspect each part, control tank pressure Monitor level, measure inflow rate Monitor hose/arm condition</td>
<td>⇔</td>
<td>1. Inspect each part, control tank pressure Monitor level, measure transfer rate Monitor hose/arm condition</td>
<td>Remarks</td>
</tr>
<tr>
<td></td>
<td>2. Calculate time at completion of estimated transfer and report</td>
<td>←</td>
<td>2. Calculate time at completion of estimated transfer and report</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. When receiving in several tanks, consider completion of loading of each tank (Transfer→Completion of loading→Re-transfer→Completion of loading)</td>
<td>←</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work Item</td>
<td>Ship Side</td>
<td>Contact</td>
<td>LNG bunker ship</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------------------</td>
<td>---------</td>
<td>--------------------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>purging (liquid)</td>
<td>with liquid purging valve</td>
<td></td>
<td>2. Measure methane concentration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Complete when methane</td>
<td>⇔</td>
<td>3. Complete when methane concentration below 2 vol%</td>
<td>SGTTO standard value</td>
</tr>
<tr>
<td></td>
<td>with liquid purging valve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Reduce pressure in liquid hose*</td>
<td>⇔</td>
<td>4. Stop nitrogen supply</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Vapor ESD valve is closed</td>
<td></td>
<td>5. Reduce pressure in liquid hose</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15. Methane Methane</td>
<td></td>
<td>6. Vapor ESD valve is closed</td>
<td></td>
</tr>
<tr>
<td>purging (vapor)</td>
<td>1. Measure methane concentration</td>
<td>←</td>
<td></td>
<td>Measurements in both ships simultaneously</td>
</tr>
<tr>
<td></td>
<td>with vapor purging valve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Complete when methane</td>
<td>⇔</td>
<td>1. Final measurement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>with vapor purging valve</td>
<td></td>
<td>2 Check transferred volume</td>
<td>Measurements in both ships simultaneously</td>
</tr>
<tr>
<td></td>
<td>3. Reduce pressure in vapor hose</td>
<td>⇔</td>
<td>(received volume)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Vapor ESD valve is closed</td>
<td></td>
<td>(delivered volume)</td>
<td></td>
</tr>
<tr>
<td>17. Methane</td>
<td>1. Measure methane concentration</td>
<td>←</td>
<td>1. Supply nitrogen</td>
<td></td>
</tr>
<tr>
<td>purging (vapor)</td>
<td>with vapor purging valve</td>
<td></td>
<td>2. Measure methane concentration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Complete when methane</td>
<td>⇔</td>
<td>3. Complete when methane concentration below 2 vol%</td>
<td>SGTTO standard value</td>
</tr>
<tr>
<td></td>
<td>with vapor purging valve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Reduce pressure in vapor hose</td>
<td>⇔</td>
<td>4. Stop nitrogen supply</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Supply nitrogen</td>
<td></td>
<td>5. Reduce pressure in vapor hose</td>
<td></td>
</tr>
</tbody>
</table>

18. Hose

disconnection

<table>
<thead>
<tr>
<th>Work Item</th>
<th>Ship Side</th>
<th>Contact</th>
<th>LNG bunker ship</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Operate hose hoisting equipment</td>
<td>←</td>
<td>1. Start disconnection of liquid hose</td>
<td>*Fit blind flange to manifold/hose end when disconnecting hose</td>
<td></td>
</tr>
<tr>
<td>2. Start disconnection of liquid hose*</td>
<td>→</td>
<td>2. Complete the disconnection of liquid hose*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Complete the disconnection of liquid hose*</td>
<td>→</td>
<td>3. Receive hose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Hose hoisting, swinging, lowering</td>
<td>←</td>
<td>1. Start disconnection of liquid hose</td>
<td>ESDS may be switched off</td>
<td></td>
</tr>
<tr>
<td>5. Start disconnection of vapor hose</td>
<td>→</td>
<td>2. Complete the disconnection of liquid hose*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Complete the disconnection of vapor hose*</td>
<td>→</td>
<td>3. Receive hose</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Supply nitrogen</td>
<td></td>
<td>4. Start disconnection of vapor hose</td>
<td></td>
</tr>
<tr>
<td>Work Item</td>
<td>Ship Side</td>
<td>Contact</td>
<td>LNG bunker ship</td>
<td>Remarks</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------</td>
<td>--------------------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>7. Hose hoisting, swinging, lowering</td>
<td></td>
<td>←</td>
<td>5. Complete the disconnection of vapor hose*</td>
<td>after completion of transfer or</td>
</tr>
<tr>
<td>9. Stop water curtain</td>
<td></td>
<td>⇔</td>
<td>7. ESDS “OFF”</td>
<td></td>
</tr>
<tr>
<td>10. Return reducer, saddle and other materials and equipment</td>
<td></td>
<td>⇔</td>
<td>8. Stop water curtain</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9. Receive materials and equipment</td>
<td></td>
</tr>
</tbody>
</table>

19. Meeting after completion of transfer

1. Meeting on board after completion of transfer
2. Wrapping up
3. Others

20. De-berthing

1. Transfer of persons between the ships                                   |                                                                           | ⇔       | 1. Transfer of persons between the ships                                         |
2. Disconnect signal line for ESDS activation                              |                                                                           | ⇔       | 2. Disconnect signal line for ESDS activation                                     |
3. Remove bonding cable                                                    |                                                                           |         | (3. Remove bonding cable)                                                        |
4. Store warning signs for outboard transfer work                          |                                                                           |         | 4. Store materials and equipment                                                  |
5. Store fire extinguishing system                                         |                                                                           |         | 5. Store warning signs for outboard transfer work                                 |
6. Remove restrictions such as fire restrictions, ventilation control,    |                                                                           |         | 6. Store fire extinguishing system                                                |
usage restrictions on communication equipment, etc.                        |                                                                           |         | 7. Remove restrictions such as fire restrictions, ventilation control,            |
                                                                           |                                                                           |         | usage restrictions on communication equipment, etc.                               |
7. Store lights and shapes                                                 |                                                                           |         | 8. Store lights and shapes                                                         |
8. Remove mooring lines                                                    |                                                                           |         | 9. Remove mooring lines and leave ship’s side                                      |
9. Check LNG density distribution at the top and bottom of fuel tank       |                                                                           |         |                                                                 |
                                                                           |                                                                           |         | (24 hours after filling; however, this does not apply if tank has adequate       |
                                                                           |                                                                           |         | pressure withstanding capacity)                                                  |
                                                                           |                                                                           |         |                                                                 |

III·8