IV. Operation Guidelines for Shore 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 (Shore to Ship LNG transfer) for a LNG fuelled ship berthed at jetty and pier which has LNG supply facilities.

The prerequisites of LNG fuelled ships are that they shall satisfy the requirements of the IGF Code\(^1\), and the prerequisites of LNG supply facilities are that they shall satisfy the High Pressure Gas Safety Act (Low no.204 of 1951) and built based on the Port and Harbor Act (Law No.218 of 1950).

[Laws, regulations and formalities related to operation]

(1) Ship Safety Law

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 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.

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

(2) High Pressure Gas Safety Act

Any person who intends to do LNG fuel supply work shall obtain the permission of the prefectural governor for each place of business based on the paragraph 5.1.1 of the High Pressure Gas Safety Act. The application for the permission shall be in conformity with the requirements of the article 6 of the Security Regulation for General High-Pressure Gas.

Also, Hazard Prevention Rule, which is required by the article 26 of the High Pressure Gas Safety Act, shall be established based on the paragraph 63.2 of the Security Regulation for General High-Pressure Gas and it shall be submitted to the prefectural governor.

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\(^1\) International code of safety for ships using gases or other low flashpoint fuels
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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 for LNG transfer operation by the Shore to Ship system.

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

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

* 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 Shore to Ship LNG transfer

(1) LNG supply company

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 Shore to Ship system under the command and supervision of the person with overall responsibility.

③ Person with overall responsibility for transferring LNG

As the person with the highest responsibility on board the LNG bunker ship, the person is responsible for the LNG transfer work and shall assume total responsibility for the work. For this purpose, the person shall have a firm grasp of the latest weather and sea conditions, forecasts, and other essential information at all times. The person shall make all judgments necessary from the time of approach and berthing 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 fuelled ship leaves. If required, the person shall give assistance to the LNG fuelled ship.

④ Designated person for transferring LNG

The person is responsible for the LNG transfer work and supervises workers in LNG supply facility. The designated person for transferring LNG has the following responsibilities:

- The person shall adhere to the agreed-upon operating procedure between the ship and the supply facility, adhere to all applicable requirements and operate accordingly
- Complete the items in the checklist specified in 2.1 "Checklist".
- Before start of LNG transfer work, have meeting with crews of the LNG fuelled ship including the person with overall responsible for receiving LNG.
- Firmly grasp the actual sea and weather conditions and forecasts.
- If sea-area specific risks such as strong tidal currents and noticeable effects of long-period waves exist, the person shall confirm that such risks have been studied and appropriate measures have been adopted.
- Check the safety connection and ERS 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 the LNG transfer
- If required, properly connect the signal line for activating ESDS (Emergency Shut Down System) and test it

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2 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).
3 System that closes valve automatically or enables manual closing in an emergency. A system
Monitor the transfer rate and the vapor pressure
Monitor onboard and Shore to Ship communications during the LNG fuel transfer work.
After LNG transfer, drain the LNG transfer hose/arm and purge them
Supervise the disconnection of the LNG transfer hose/arm

⑤ Worker transferring LNG

Shall implement LNG transfer work in the LNG supply facility.

(2) LNG fuelled ship

① Person with overall responsibility for 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.

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

➢ Adhere to the agreed-upon operating procedure between the ship and the facility, adhere to all applicable requirements and operate accordingly
➢ Complete the items in the checklist specified in 2.1 "Checklist”.
➢ Before start of LNG transfer work, have meeting with crews of the LNG fuelled ship including the person with overall responsible for receiving LNG.
➢ Firmly grasp the actual sea and weather conditions and forecasts.
➢ If sea-area specific risks such as strong tidal currents and noticeable effects of long-period waves exist, the person shall confirm that such risks have been studied and appropriate measures have been adopted.
➢ 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
➢ If ESDS is not linked and multiple fuel tanks exist, ensure management system for supervising overflow from the tanks.
➢ Monitor onboard and ship-to-ship communications during the LNG fuel transfer work.
➢ Drain the LNG transfer hose/arm after LNG transfer and purge them
➢ Supervise the disconnection of the LNG transfer hose/arm

for emergency stoppage of LNG transfer wherein the pump or compressor related to transfer is stopped.

IV-3
② Designated person for receiving LNG (Chief Engineer)

The Chief Engineer is the designated person for receiving LNG 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.

(3) Other LNG transfer related organizations and personnel

① Related administrative organization

A system shall be built beforehand so that the support of administrative organizations such as police and fire department maritime can be obtained during an emergency such as LNG leak or fire occurrence during LNG transfer. If necessary, support from organizations related to marine disaster prevention shall be arranged.

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 1.6 "Compatibility between the supply facility and the ship”.

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

If a LNG fuelled ship receiving LNG fuel simultaneously and in parallel with loading/unloading operation or embarking/disembarking of passengers, then the following requirements shall be satisfied:

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 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\(^4\) or DBC\(^5\) as the center shall be set. Ignition sources within these areas shall be removed during LNG fuel transfer (See Table 1.1).
- The structure of the LNG fuelled ship (such as arrangement of passageway) 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.

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4 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.
5 DBC (Dry Break Coupling): Coupling that has automatic closing mechanism and can be connect/disconnect by hand.
(3) 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.

(4) Equipment and systems between ship and facility

Compatibility between the ship and the facility shall be ensured according to 1.6 “Compatibility between the supply facility and the ship” Checks shall be made to ensure that the required systems and equipment are provided based on 2.3 “Emergency Shut Down System (ESDS)” and 2.9 “Measures for electric potential difference between the” and 7 “LNG fuel transfer equipment, materials and machinery”.

(5) LNG fuel transfer work at night time

For LNG fuel transfer work at night, illumination of 70 lx or greater shall be provided for monitoring hose and arm based on 7.10 “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.

(6) Emergency response plan

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

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.
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. 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.

For LNG fueled ship, appropriate crew members designated by the masters shall be stationed as watch keepers during fuel transfer work in the steering room, engine control room (ECR), machinery space and bunker station.

1.3.2 Education and training

All crew members on the LNG fuelled ship shall be familiar with disaster prevention related to LNG before they board the ship. The Machinery Department of the LNG fuelled 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.

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

The master of the LNG fuelled ship shall confirm that the requirements listed below related to the transfer of LNG fuel are satisfied.

- Bunker station for acceptance of LNG fuel shall be fully equipped with drip trays, etc., and it shall satisfy the equipment requirements of the IGF 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 supply facility

- ESDS or ERS has been installed on the LNG supply facility side during LNG fuel transfer
- Insulated flange or bonding cable shall be used as measures against electric potential difference between the ship and the facility 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 transferring LNG that sea and weather conditions will not obstruct the LNG fuel transfer.
- Mooring equipment shall be adequately provided considering the mooring force calculations and the equipment numeral.
- The LNG supply facility 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 receiving LNG and the person with overall responsibility for transferring LNG.
- Communications system during an emergency should have been established.
- If an abnormality occurs, the person with overall responsibility for receiving LNG and the person with overall responsibility for transferring LNG shall not perform or resume work until a solution to the abnormality has been found and confirmed.

1.6 Compatibility between the supply facility and the ship

The compatibility of the LNG supply facility and the LNG fuelled ship for the following items related to LNG fuel transfer shall be confirmed beforehand:

- Manifold arrangement
- Bunkering equipment (reducer shall be arranged by the supply facility)
- Mooring arrangement
- Parallel body and fender
- Gas hazardous areas (gas hazardous areas according to IGF Code (including the range applicable to gas hazardous areas when IGF code is applied around transfer equipment) and gas hazardous areas in a circular range with radius 9 m around ERC or DBC as the center set as areas where ignition sources should be removed.)
- Equipment used for embarkation of persons
- Compatibility of ESDS (connector, channel allocation, etc.) and radio installations
- Emergency response plan and procedures in an emergency
- Conditions of the fuel tanks (liquid temperature and pressure)
- LNG fuel transfer plan and ballasting plan
- Vapor controls or vapor processing ability

1.7 Gas hazardous areas and ensuring safety distance

The structure of the LNG fuelled ship (such as arrangement of passageway) 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 supply facility and the ship”) 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.

1.8 Weather and sea conditions

LNG fuelled ship is affected by weather and sea conditions so the ship shall follow the operating condition of the berth or jetty. Also, efforts shall be made to acquire the latest weather and sea conditions data during the LNG fuel transfer.

2 Safety measures

2.1 Checklist

An example of a checklist used in the LNG fuel transfer by Shore to Ship 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.

2.2 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 the ship and others in the vicinity the occurrence of the emergency situation.

④ The LNG fuelled ship 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 ship, and again establish fire controls.

⑤ The LNG fuelled ship 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.

2.3 Emergency Shut Down System (ESDS)

2.3.1 ESDS connection

During LNG fuel transfer by the Shore to Ship system, ESDS shall be used so that LNG transfer can be stopped in an emergency such as when an abnormal condition occurs during the LNG transfer. If hose/arm used for LNG transfer is larger than 8 inches, ESDS shall be linked between the LNG supply facility and the ship.

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

2.3.2 ESDS link compatibility

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

2.3.3 ESDS tests

Both the LNG fuelled ship and the LNG supply facility shall test their own ESDS within 48 hours before LNG transfer by Shore to Ship system, record and preserve the test results. To confirm that ESDS is working correctly before the start of LNG transfer after the ship has 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.

2.4 Emergency decoupling system (such as ERS)

2.4.1 Use of emergency decoupling system

When the LNG fuelled ship and the LNG supply facility 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/quick release is used by means of the ERS or DBC that allows quick emergency release of transfer hose/arm in the event of a fire, tsunami or other disaster.

If LNG transfer hose is bigger than 6 inches or transfer arm is bigger than 8 inches, then ERC shall be installed and ERS shall be used.

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

(1) For using ERS

➢ 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 supply facility 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.

(2) For using DBC

➢ The working requirements (settings) of DBC shall be checked by both parties.
DBC shall be used in the vapor return hose/arm similar to its use in the LNG transfer hose/arm.

LNG transfer operation shall be closely watched in order to activate ESD and DBC quickly.

Activation of ESD shall come before the release of DBC in operation procedure.

Although BAC\(^6\) 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.

2.4.2 Hose handling and releasing liquid seal after emergency decoupling system 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) or DBC (when DBC is decoupled); therefore, prompt response is necessary to remove this liquid seal.

2.4.3 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.

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\(^6\) BAC (Break Away Couplings) : Coupling arrangement that automatically closes and releases according to the set load (mainly in the tension direction)
2.5 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.

2.6 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.

2.7 Fire extinguishing system on the LNG fuelled ship

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

- 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 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 the ship and others in the vicinity the occurrence of the emergency situation.

④ The LNG fuelled ship 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 The LNG fuelled ship 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.

2.9 Measures for electric potential difference between the supply facility and the ship

Risk for a strong spark to occur exists because of difference of potential of static electricity accumulated in the hull of the LNG fuelled ship and the supply facility. Therefore, during the period from the connection to the disconnection of the LNG fuel transfer hose/arm, either the electrical insulation between the ship and the facility shall be maintained, or a bonding cable shall be connected to eliminate the potential difference between the ship and the facility. 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.

2.10 Protective gear

For protection against risks accompanying LNG fuel, workers working near the manifolds of the ship 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.

2.11 Action when safety is impeded

Any person discovering that safety is impeded during the LNG fuel transfer by Shore to Ship 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.

3 Communications

3.1 Means

Communications between the LNG fuelled ship and the LNG supply facility 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 Procedure during a communications error

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

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

4.1 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 Preparatory work

Before the start of maneuvering and approach, the person with overall responsibility for receiving LNG 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.
- 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
- 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
- Safety valves of LNG fuel tank 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.

4.3 Mooring

When the moored ship shifts or moves considerably, the arm/hose for LNG fuel transfer 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 ship and the facility beforehand.

4.4 Preventing shifting of the ship

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

4.5 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. These lights and shapes shall be confirmed as ready before the LNG fuel transfer operation by the LNG fuelled ship.

5 LNG fuel transfer work

5.1 Items to be checked between the ship and the supply facility

The following items shall be checked between the ship and the supply facility:

- Items below that have been agreed upon between the ship and the facility.
  - LNG fuel transfer sequence
  - LNG fuel transfer rate
  - Emergency shut-off procedure, functional test of systems between the ship and the facility
  - Response to fire or other emergency situations
  - Control of traffic and flames (smoking, etc.) in the ship and the facility
- Pressure in cargo tanks of the LNG fuelled ship
- Temperature and density of LNG in the fuel tanks of the LNG fuelled ship and supply LNG

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

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7 Main engine shall be kept warmed up since engine has to be started quickly in an emergency.
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 supply LNG 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 ship and the facility, 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 between the ship and the facility of the hose/arm used in LNG fuel transfer shall be checked by the responsible personnel on both parties.
- 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 parties.
- 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 ship and the supply facility. 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 supply LNG and LNG in the fuel tanks (see precautions in 5.1 “Items to be checked between the ”)
- 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 ship is moored, and monitor them confirming that the mooring force is adequate.

5.4 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%.

5.5 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 parties and subsequently, the cool-down shall be terminated.

5.6 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 supply facility 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 the tank of the LNG fuelled ship and supply LNG 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.

5.7 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.

5.8 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 supply facility 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.

5.9 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.

5.10 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 fuelled 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 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

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 ship and the facility, or by means of flow meter installed between the ship and the facility.

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 between the ship and the supply facility. 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 Preparatory work for unberthing

While getting alongside, main engine, boiler, steering device, mooring equipment and other necessary equipment shall be ready to start for unberthing.

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 Shore to Ship system. Before arranging equipment, materials and machinery related to LNG fuel transfer, confirm that loads on the bunker stations of the LNG fuelled ship and working platform of the LNG supply facility, flanges, LNG fuel transfer hoses, attached hose saddles, couplings, spool pieces, reducers, ERC or DBC, 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 supply LNG 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 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.

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 supply LNG 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 transfer facility.

7.4 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 transfer facility. The workers transferring LNG shall understand thoroughly the hose characteristics, tests, inspections and storage methods, and shall manage the hose.

7.4.1 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
- Allowable pressure
- Minimum allowable bending radius of the hose
- Distance between the manifold and the ship’s side
- Pressure loss due to difference in head and flow velocity
- Shift of the ship and amount of swing
- Change in ship’s freeboard
- Requirements for handling flange-connected hose and limitations of equipment on board ship

7.4.2 Marking and confirming certificates

Confirm that the hoses used for LNG transfer are marked with information such as inside diameter of hose, date of manufacture, maximum allowable pressure, and range of allowable temperatures to be used, etc.

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

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

7.4.3 Other check items

The following items shall be specially considered:

- 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.
- Manage the service life of the hose (usage interval/cycles)

7.5 LNG fuel transfer arm

LNG transfer arm shall be managed by the LNG supply facility. Worker transferring LNG in the supply facility shall understand specifications, inspection method, and storage system of the transfer arm.
7.5.1 Specifications

The following considerations shall be made during the use of the arm in the Shore to Ship 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

7.5.2 Design of movable range

Movable range of LNG transfer arm is designed based on the following items.

- Difference of tidal level at berth/pier
- The minimum and maximum freeboard of the largest and smallest ships allowed to the berth/pier
- The maximum and minimum distance between the ship’s side and the manifold
- Horizontal travel limit of the ships
- In case of using multiple transfer arms, the maximum and minimum distance between the arms

7.5.3 Other check items

The following items shall be specially considered:

- Workers of the fuelled ship and the supply facility shall check mooring condition properly. Measures shall be taken for preventing the ship from moving beyond the movable range of the transfer arm.
- Adjust transfer rate for avoiding excessive vibration caused by LNG transfer

7.6 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.

7.7 Drip tray

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

7.8 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.

7.9 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.

7.10 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

7.11 Auxiliary equipment

The condition of all auxiliary tools such as messenger rope, stopper, shackle, etc., shall be checked before use.
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 including criteria of activating ESDS and ERS/DBC 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 shall prepare and keep ready the “Emergency Response Procedures” that covers all the operations. A person engaging in fuel transfer work 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
- Emergency response procedures during a leak in the LNG fuelled ship or the supply facility.

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 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.

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.

9.2 Response when an earthquake or tsunami occurs

If the LNG fuelled ship or the supply facility receives earthquake and tsunami information, it shall immediately share the information with the other party.

When a tsunami warning or alert is issued, the master 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/DBC 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.
# Flow chart of LNG fuel transfer by the Shore to Ship system

1. Preparations for coming alongside
2. Preparations before coming alongside and LNG transfer
   (2. Connecting bonding cable)
3. Meeting before start of transfer work
4. Loading of materials and equipment
5. O2 purging
6. Leak test
7. Measurement before transfer
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/arm disconnection
19. Meeting after transfer completion
20. Communication and ESDS signal cable/hose disconnected

## Emergency response (unberthing 1)
- In case of unberthing after suspending transfer work without using ESDS
  - 14. Draining
  - 15. Methane purging (liquid line)
  - 16. Measurement after transfer
  - 17. Methane purging (vapor line)
  - 18. ESDS "OFF"

## Emergency response (unberthing 2)
- In case of unberthing after suspending transfer work by ESDS activation
  - ESDS1 "ON" (suspend transfer work)
  - Investigate cause
  - 14. Draining
  - 15. Methane purging (liquid line)
  - Measurement
  - 17. Methane purging (vapor line)
  - 18. ESDS "OFF"

## Emergency response (unberthing 3)
- In case of unberthing after suspending transfer work by ESDS activation and disconnecting by ESDS2
  - ESDS1 "ON" (suspend transfer work)
  - Hull protection measures
  - ESDS2 "ON" (hose/arm automatically disconnected)

## Emergencies
- Liquid seal removed
- Measurement
- 20. Transfer of personnel
- 20. Communication and ESDS signal cable/hose disconnected

## Finishing
- 20. Accessway removed
- 20. Communication and ESDS signal cable/hose disconnected
- 20. Unberthing
- 20. Bonding cable removed
- 20. Unloading of materials and equipment ashore

## In case of unberthing after suspending transfer work without using ESDS
- 14. Draining
- 15. Methane purging (liquid line)
- Measurement
- 17. Methane purging (vapor line)
- 18. ESDS "OFF"

## In case of unberthing after suspending transfer work by ESDS activation
- ESDS1 "ON" (suspend transfer work)
- Investigate cause
- 14. Draining
- 15. Methane purging (liquid line)
- Measurement
- 17. Methane purging (vapor line)
- 18. ESDS "OFF"

## In case of unberthing after suspending transfer work by ESDS activation and disconnecting by ESDS2
- ESDS1 "ON" (suspend transfer work)
- Hull protection measures
- ESDS2 "ON" (hose/arm automatically disconnected)

## In case of unberthing after suspending transfer work by ESDS activation and disconnecting by ESDS2
- Liquid seal removed
- Measurement
- 20. Transfer of personnel
- 20. Communication and ESDS signal cable/hose disconnected

## Finishing
- 20. Accessway removed
- 20. Communication and ESDS signal cable/hose disconnected
- 20. Unberthing
- 20. Bonding cable removed
- 20. Unloading of materials and equipment ashore
11 Check list of LNG fuel transfer by the Shore to Ship system

Port: ___________________ Date: ___________________

Name of ship: ___________ LNG supply facility: ______________

Master: __________________

Person with overall responsibility for transferring LNG: __________________

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>
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<td>Bottom / Top</td>
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<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>
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</tr>
</tbody>
</table>
4. LNG transfer

<table>
<thead>
<tr>
<th>LNG transfer</th>
<th>Ship</th>
<th>Supply Facility</th>
<th>Code</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have the bunkering system and ESDS been tested within 48 hours before</td>
<td></td>
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<tr>
<td>the bunkering operation?</td>
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<tr>
<td>2. Meeting before LNG transfer</td>
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<tr>
<td>□ Emergency response</td>
<td></td>
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<tr>
<td>□ Agreement on emergency signal and procedure of suspension of LNG transfer</td>
<td></td>
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<tr>
<td>□ Method of cool down</td>
<td></td>
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<tr>
<td>□ Check temperature and density of supply LNG and remaining LNG in the fuel</td>
<td></td>
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<tr>
<td>tank</td>
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<tr>
<td>□ Check filling method</td>
<td></td>
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<tr>
<td>□ Fuel transfer plan</td>
<td></td>
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<tr>
<td>□ Initial transfer rate</td>
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<tr>
<td>□ Maximum transfer rate</td>
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<tr>
<td>□ Monitor vapor pressure</td>
<td></td>
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<tr>
<td>□ Rate at completion of loading</td>
<td></td>
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<tr>
<td>3. Is electrical insulation established? (Or is bonding cable connected?)</td>
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<tr>
<td>4. Is banker hose/arm in good condition?</td>
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<tr>
<td>5. Is mooring of the ship in good condition?</td>
<td></td>
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<td>R</td>
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<tr>
<td>6. Has safe accessway between the ship and the supply facility been</td>
<td></td>
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<td>R</td>
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<tr>
<td>established?</td>
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</tr>
<tr>
<td>7. Has communication mean been established between persons with responsibility</td>
<td></td>
<td></td>
<td>A R</td>
<td>(VHF/UHF Ch )</td>
</tr>
<tr>
<td>for LNG transfer?</td>
<td></td>
<td></td>
<td></td>
<td>Main:</td>
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<tr>
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<td></td>
<td></td>
<td>Reserve:</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Emergency signal:</td>
</tr>
<tr>
<td>8. Are fire hose and fire extinguishing system ready for use?</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>LNG transfer</td>
<td>Ship</td>
<td>Supply Facility</td>
<td>Code</td>
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<td>------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>9</td>
<td>Have all scupper plugs been closed? Has drip tray around connecting part been properly installed?</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Overboard discharge valves of cargo, engine room bilge, fuel lines have been closed and sealed?</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Is equipment for the prevention of marine pollution ready for use?</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Has the LNG fuel transfer hose/arm been connected? Is no slackness in the hose/arm confirmed?</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Has the LNG fuel transfer hose/arm been purged with N₂ and is the O₂ concentration below 5%?</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Is loading line up correct? Has blank flange been fitted to the unused connection points by bolts?</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Has ESDS been properly installed and tested before its use? (Coupling is not disconnected)</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Has the bunker line been cooled down?</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Has the fuel tank been cooled down?</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Is the LNG fuel transfer safety system and monitoring system activated?</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Have proper lookouts assigned during LNT transfer?</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Have all hatches of the fuel tank been closed?</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Has fuel tank level been checked periodically?</td>
<td></td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>LNG transfer</td>
<td>Ship</td>
<td>Supply Facility</td>
<td>Code</td>
<td>Remarks</td>
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<tr>
<td>----------------------------------------------------------------------------</td>
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<tr>
<td>22. Has gas detection been carried out at appropriate times near the bunker station?</td>
<td></td>
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<tr>
<td>23. Has transmitter of the main radio been grounded? Has the radar been turned off?</td>
<td></td>
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<tr>
<td>24. Have VHF/UHF radio and AIS been in proper output condition, or been turned off?</td>
<td></td>
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</tr>
<tr>
<td>25. Has smoking room been specified? Has the rules for smoking been properly followed?</td>
<td>A</td>
<td>R</td>
<td></td>
<td>Smoking room specified :</td>
</tr>
<tr>
<td>26. Has the rules for naked flame been properly followed?</td>
<td></td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27. Have all doors and openings connected to outside in accommodation area been closed?</td>
<td></td>
<td>R</td>
<td></td>
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<tr>
<td>28. Have measures been taken to prevent the action of unwanted propulsion forces?</td>
<td></td>
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<tr>
<td>29. Before disconnecting the hose, has it been drained and purged with N₂? (Methane concentration below 2 vol%)</td>
<td></td>
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<tr>
<td>30. 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>
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<td></td>
</tr>
</tbody>
</table>

A（Agreement）: Items ensured by checklist or mutual understanding  
R（Re-check）: Items re-checked at the certain interval mutually agreed
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)
   (ICS/OCIMF/IAPH)
(5) TANKER SAFETY GUIDE LIQUEFIED Second edition 1995 (ICS)
V. Operation Manual for Shore 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 supply facility into an LNG fuelled ship.

[Scope of application]
This manual describes the work of berthing an LNG fuelled ship at an LNG supply facility, and the supply of LNG fuel.

[Emergency Release System]
When the LNG supply facility 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{8}) that allows quick emergency release of transfer hose/arm in the event of a fire, tsunami or other disaster.

Although BAC\textsuperscript{9} exists in addition to ERC\textsuperscript{10}, 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{8} 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{9} BAC (Break Away Couplings) : Coupling arrangement that automatically closes and releases according to the set load (mainly in the tension direction)

\textsuperscript{10} 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.
## 1 Operation Manual for Shore to Ship LNG Transfer (by LNG transfer hose)

<table>
<thead>
<tr>
<th>Work Item</th>
<th>Ship Side</th>
<th>Contact</th>
<th>LNG supply facility</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Preparations before entering port</td>
<td>1. Check hull condition</td>
<td>1. Check fender</td>
<td>Use of flange size, transfer rate, strainer, etc. before entering port</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>2. Reduce tank pressure</td>
<td>2. Check hose</td>
<td></td>
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<tr>
<td>3.</td>
<td></td>
<td>3. Check nautical instruments</td>
<td>3. Check weather and sea conditions</td>
<td>Check for existence</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>4. Check navigational warnings</td>
<td>4. Check fire extinguishing system</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>5. Check weather and sea conditions</td>
<td>5. Keep ready gas detectors</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>6. Check fire extinguishing system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>7. Keep ready gas detectors</td>
<td></td>
<td></td>
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<tr>
<td>8.</td>
<td></td>
<td>8. Check water curtain</td>
<td></td>
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<tr>
<td>9.</td>
<td></td>
<td>9. Mutual check of mooring arrangement</td>
<td>⇔ 6. Mutual check of mooring arrangement</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td></td>
<td>10. Check mooring equipment</td>
<td>7. Check mooring equipment</td>
<td></td>
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<tr>
<td>11.</td>
<td></td>
<td>11. Check illumination</td>
<td>8. Check illumination</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td></td>
<td>12. Check charging and operation of communications equipment</td>
<td>9. Check charging and operation of communications equipment</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td></td>
<td>13. Check hydraulic valve remote operating equipment</td>
<td>⇔ 10. Check hydraulic valve remote operating equipment</td>
<td></td>
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<tr>
<td>15.</td>
<td></td>
<td>15. Check CTMS activation</td>
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<tr>
<td>16.</td>
<td></td>
<td>16. Keep ready drip tray</td>
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<tr>
<td>17.</td>
<td></td>
<td>(17. Cool down of bunker line)</td>
<td></td>
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<tr>
<td>2.</td>
<td>Preparations before start of berthing and transfer</td>
<td>1. Notification of start of berthing and mooring work</td>
<td></td>
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<tr>
<td>3.</td>
<td></td>
<td>2. Check berthing position and mooring work</td>
<td>⇔ 1. Check berthing position and mooring work</td>
<td></td>
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<tr>
<td>4.</td>
<td></td>
<td>3. Completion of mooring work and notification</td>
<td>⇔ 2. Completion of mooring work and notification</td>
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<tr>
<td>5.</td>
<td></td>
<td>4. Monitoring mooring condition</td>
<td>⇔ 3. Monitoring mooring condition</td>
<td></td>
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<tr>
<td>6.</td>
<td></td>
<td>5. Put up fuel transfer warning signs outside the ship</td>
<td>4. Establish work area</td>
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<tr>
<td>7.</td>
<td></td>
<td>6. Stop radars</td>
<td>Put indication of “No Entry”, “Keep Fire Away”</td>
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<tr>
<td>8.</td>
<td></td>
<td>7. Ventilation control in accommodation space</td>
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<tr>
<td>9.</td>
<td></td>
<td>8. Notify fire restrictions</td>
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<tr>
<td>10.</td>
<td></td>
<td>9. Usage limit of communication equipment</td>
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<td></td>
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<td>10. Indication by lights and day</td>
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</table>

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<thead>
<tr>
<th>Work Item</th>
<th>Ship Side</th>
<th>Contact</th>
<th>LNG supply facility</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>shapes</td>
<td>(11. Bonding cable connections)</td>
<td>⇔</td>
<td>(5. Bonding cable connections)</td>
<td>(Not required if insulated flange is provided)</td>
</tr>
<tr>
<td>12. Set up accessway between the ship and the facility</td>
<td></td>
<td>⇔</td>
<td>6. Set up accessway between the ship and the facility</td>
<td>(Not required if ESDS linkage is unnecessary)</td>
</tr>
<tr>
<td>(13. Signal line connection for ESDS activation)</td>
<td></td>
<td>⇔</td>
<td>(7. Signal line connection for ESDS activation)</td>
<td></td>
</tr>
<tr>
<td>15. Preparations for flexible transfer hose connection</td>
<td></td>
<td>⇔</td>
<td>9. Preparations for flexible transfer hose connection</td>
<td></td>
</tr>
<tr>
<td>16. Preparations for fire extinguishing system</td>
<td></td>
<td></td>
<td>10. Preparations for fire extinguishing system</td>
<td></td>
</tr>
</tbody>
</table>

3. Meeting before start of transfer on board
1. Exchange of information such as composition (liquid density), tank pressure and liquid temperature of existing LNG and supply LNG
2. Check estimated receiving volume/transfer volume
3. Confirm checklists mutually
4. Check transfer suspension criteria in an emergency
5. Check liquid level with liquid level gauge
6. Check transfer method (Bottom Fill/Top Fill, etc.) and rate
7. Check information such as work limitations at berth, warnings, etc.
8. Exchange of information on weather and sea conditions
9. Others

4. Hose connection
*When ship side hose hoisting equipment is used
1. Stationing of workers
2. Loading of materials and equipment
3. Start water curtain
4. Hoisting and connecting vapor hose
5. Hoisting and connecting liquid hose

<table>
<thead>
<tr>
<th>Work Item</th>
<th>Ship Side</th>
<th>Contact</th>
<th>LNG supply facility</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Stationing of workers</td>
<td></td>
<td>←</td>
<td>2. Saddle etc.</td>
<td></td>
</tr>
<tr>
<td>(3. ERC/DBC connection)</td>
<td></td>
<td></td>
<td>4. Connecting vapor hose</td>
<td>(If necessary) If necessary, fit reducer</td>
</tr>
<tr>
<td>ERC: Emergency Release Coupling</td>
<td></td>
<td></td>
<td>DBC: Dry Break Coupling</td>
<td>Use auxiliary rope when handling hose</td>
</tr>
<tr>
<td>Work Item</td>
<td>Ship Side</td>
<td>Contact</td>
<td>LNG supply facility</td>
<td>Remarks</td>
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</tr>
<tr>
<td>5. O₂ purging</td>
<td>1. Check that ESD valve is closed</td>
<td>←</td>
<td>1. Supply nitrogen to vapor line</td>
<td>SIGTTO standard value</td>
</tr>
<tr>
<td></td>
<td>2. Measure O₂ with vapor purge valve</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>3. Complete with O₂ concentration below 5% Purge valve closed</td>
<td>←</td>
<td>2. Supply nitrogen to liquid line</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Measure O₂ with liquid purge valve</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>5. Complete with O₂ concentration below 5% and purge Close valve and then do the leak test.</td>
<td></td>
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</tr>
<tr>
<td>6. Leak test</td>
<td>1. Do the leak test of all connected parts such as hose, manifold, etc.</td>
<td>←</td>
<td>1. Raise nitrogen supply pressure up to the required pressure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Leak test completion</td>
<td>⇔</td>
<td>2. Do the leak test of all connected parts such as hose, manifold, etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Reduce pressure by opening purge valve</td>
<td>←</td>
<td>3. Leak test completion</td>
<td></td>
</tr>
<tr>
<td>7. Measurement</td>
<td>1. Measurement</td>
<td>⇔</td>
<td>1. Measurement</td>
<td>Measurements in both the ship and the facility simultaneously</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 supply facility</td>
</tr>
<tr>
<td></td>
<td>2. Vapor/liquid ESD valve open</td>
<td>⇔</td>
<td>2. Signal “ON” from ship or supply facility</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Signal “ON” from ship or supply facility</td>
<td>⇔</td>
<td>3. Check that vapor/liquid ESD valve is closed</td>
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<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>
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<tr>
<td></td>
<td>5. Check that ESDS is normal</td>
<td></td>
<td></td>
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<tr>
<td>9. Line cool down</td>
<td>1. Ensure transfer gas line Vapor ESD valve is open</td>
<td>⇔</td>
<td>1. Ensure return gas receiving line</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Line up of line cool down Liquid ESD valve open</td>
<td>⇔</td>
<td>2. Line up of line cool down</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Report completion of preparations</td>
<td>→</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work Item</td>
<td>Ship Side</td>
<td>Contact</td>
<td>LNG supply facility</td>
<td>Remarks</td>
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<tr>
<td>for line cool down</td>
<td></td>
<td>←</td>
<td>3. Start pump, adjust transfer rate</td>
<td>Check for leak in each part</td>
</tr>
<tr>
<td>4. Check liquid flow and start line cool down</td>
<td></td>
<td>→</td>
<td></td>
<td></td>
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<tr>
<td>5. Line cool down complete at specified temperature</td>
<td></td>
<td>←</td>
<td>4. Stop pump</td>
<td></td>
</tr>
<tr>
<td>6. Check stoppage of liquid flow</td>
<td></td>
<td>→</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. ESDS functional test at low temperature</td>
<td></td>
<td>=</td>
<td>=Caution for liquid seal for both ship and facility</td>
<td>Implement once each for ship and supply facility</td>
</tr>
<tr>
<td>2. Check tank pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Check that vapor/liquid ESD valve is open</td>
<td></td>
<td>=</td>
<td>1. Check that vapor/liquid ESD valve is open</td>
<td></td>
</tr>
<tr>
<td>4. Signal “ON” from ship or supply facility</td>
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<td>=</td>
<td>2. Signal “ON” from ship or supply facility</td>
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<tr>
<td>5. Check that vapor/liquid ESD valve is closed</td>
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<td>=</td>
<td>3. Check that vapor/liquid ESD valve is closed</td>
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<tr>
<td>6. Check that ESDS is normal</td>
<td></td>
<td>=</td>
<td>4. Check that ESDS is normal</td>
<td></td>
</tr>
<tr>
<td>1. Check that vapor/liquid ESD valve is open</td>
<td></td>
<td>←</td>
<td>1. Check transfer line up</td>
<td></td>
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<tr>
<td>2. Check receiving line up</td>
<td></td>
<td>←</td>
<td>2. Start pump, begin transfer</td>
<td></td>
</tr>
<tr>
<td>3. Check inflow</td>
<td></td>
<td>→</td>
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<td></td>
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<tr>
<td>4. Inspect each part</td>
<td></td>
<td>←</td>
<td>3. Inspect each part</td>
<td></td>
</tr>
<tr>
<td>5. Request increase in transfer rate</td>
<td></td>
<td>←</td>
<td>4. Adjust to steady rate</td>
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<td>6. Control tank pressure</td>
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<td></td>
<td>5. Control tank pressure</td>
<td></td>
</tr>
<tr>
<td>1. Inspect each part, control tank pressure</td>
<td></td>
<td>←</td>
<td>1. Inspect each part, control tank pressure</td>
<td>Monitor level, measure inflow rate</td>
</tr>
<tr>
<td>2. Calculate time at completion of estimated transfer and report</td>
<td></td>
<td>←</td>
<td>2. Calculate time at completion of estimated transfer and report</td>
<td>Monitor level, measure transfer rate</td>
</tr>
<tr>
<td>3. When receiving in several tanks, consider completion of loading of each tank (Transfer→Completion of loading→Re-transfer→)</td>
<td></td>
<td>←</td>
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</tr>
<tr>
<td>Work Item</td>
<td>Ship Side</td>
<td>Contact</td>
<td>LNG supply facility</td>
<td>Remarks</td>
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<td>----------------------------------------------</td>
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<tr>
<td>Completion of loading)</td>
<td></td>
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</tr>
<tr>
<td>13. Transfer completion</td>
<td>1. Check stoppage of liquid flow</td>
<td>←</td>
<td>1. Flow rate adjustment ← 2. Stop pump and report transfer completion</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2. Complete preparations for draining</td>
<td>→</td>
<td></td>
<td>*It is desirable that BOG is used for draining.</td>
</tr>
<tr>
<td></td>
<td>3. Check gas liquid with manifold drain valve</td>
<td>←</td>
<td>4. Supply nitrogen, pressurize</td>
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<tr>
<td></td>
<td>4. Report drainage completion</td>
<td>→</td>
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<tr>
<td></td>
<td>5. Liquid ESD valve closed</td>
<td>⇔</td>
<td>5. Continue methane purging</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Complete when methane concentration below 2 vol% Report completion of methane purging</td>
<td>⇔</td>
<td>3. Complete when methane concentration below 2 vol% Report completion of methane purging</td>
<td>SIGTTO standard value</td>
</tr>
<tr>
<td></td>
<td>3. Reduce pressure in liquid hose</td>
<td>→</td>
<td>4. Stop nitrogen supply</td>
<td></td>
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<tr>
<td></td>
<td>4. Vapor ESD valve is closed</td>
<td>→</td>
<td></td>
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</tr>
<tr>
<td>16. Final measurement</td>
<td>1. Final measurement</td>
<td>⇔</td>
<td>1. Final measurement</td>
<td>Measurements in both ship and facility simultaneously</td>
</tr>
<tr>
<td></td>
<td>2 Check transferred volume (received volume)</td>
<td>⇔</td>
<td>2 Check transferred volume (delivered volume)</td>
<td></td>
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<tr>
<td></td>
<td>2. Complete when methane concentration below 2 vol% Report completion of methane purging</td>
<td>⇔</td>
<td>3. Complete when methane concentration below 2 vol% Report completion of methane purging</td>
<td></td>
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<tr>
<td>3. Reduce pressure in vapor hose</td>
<td></td>
<td>←</td>
<td>4. Stop nitrogen supply</td>
<td></td>
</tr>
<tr>
<td>18. Hose disconnection</td>
<td>1. Operate hose hoisting equipment</td>
<td>⇔</td>
<td>1. Attendance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Start disconnection of liquid hose</td>
<td>→</td>
<td>2. Receive hose, storing</td>
<td>Fit blind flange to manifold/hose end when disconnecting hose</td>
</tr>
<tr>
<td></td>
<td>3. Complete the disconnection of liquid hose</td>
<td>→</td>
<td>3. Receive hose, storing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Start disconnection of vapor hose</td>
<td>→</td>
<td>4. ESDS “OFF”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Complete the disconnection of vapor hose</td>
<td>→</td>
<td>5. Receive materials and equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. ESDS “OFF”</td>
<td>⇔</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>7. Stop water curtain</td>
<td>→</td>
<td>6. ESDS “OFF”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Return reducer, saddle and other materials and equipment</td>
<td>→</td>
<td>2. Remove accessway between ship and facility (3. Remove bonding cable)</td>
<td></td>
</tr>
<tr>
<td>19. Meeting after completion of transfer</td>
<td>1. Meeting on board after completion of transfer</td>
<td></td>
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<tr>
<td></td>
<td>2. Wrapping up</td>
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<td></td>
<td>3. Others</td>
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<tr>
<td>20. De-berthing</td>
<td>1. Disconnect signal line for ESDS activation</td>
<td>⇔</td>
<td>1. Disconnect signal line for ESDS activation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Remove accessway between ship and facility (3. Remove bonding cable)</td>
<td>⇔</td>
<td>2. Remove accessway between ship and facility (3. Remove bonding cable)</td>
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<td></td>
<td>4. Store warning signs for outboard transfer work</td>
<td>⇔</td>
<td>4. Store materials and equipment</td>
<td></td>
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<tr>
<td></td>
<td>5. Store fire extinguishing system</td>
<td></td>
<td>5. Remove indication of “No Entry”, “Keep Fire Away”.</td>
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<td></td>
<td>6. Remove restrictions such as fire restrictions, ventilation control, usage restrictions on communication equipment, etc.</td>
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<td>7. Store lights and shapes</td>
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<td></td>
<td>8. Remove mooring lines</td>
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<td></td>
<td>9. De-berthing</td>
<td></td>
<td>6. Attend de-berthing work</td>
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<tr>
<td></td>
<td>10. 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)</td>
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</tbody>
</table>
## 2 Operation Manual for Shore to Ship LNG Transfer (by LNG transfer arm)

<table>
<thead>
<tr>
<th>Work Item</th>
<th>Ship Side</th>
<th>Contact</th>
<th>LNG supply facility</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Preparations before entering port</td>
<td>1. Check hull condition</td>
<td>1. Check fender</td>
<td>Use of flange size, transfer rate, strainer, etc. before entering port</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Reduce tank pressure</td>
<td>2. Check arm</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>3. Check nautical instruments</td>
<td>3. Check weather and sea conditions</td>
<td>Check for existence</td>
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<tr>
<td></td>
<td></td>
<td>4. Check navigational warnings</td>
<td>4. Check fire extinguishing system</td>
<td></td>
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<td></td>
<td></td>
<td>5. Check weather and sea conditions</td>
<td>5. Keep ready gas detectors</td>
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<tr>
<td></td>
<td></td>
<td>6. Check fire extinguishing system</td>
<td>6. Mutual check of mooring arrangement</td>
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<tr>
<td></td>
<td></td>
<td>7. Check nautical instruments</td>
<td>7. Check mooring equipment</td>
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<tr>
<td></td>
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<td>8. Check navigational warnings</td>
<td>8. Check illumination</td>
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<tr>
<td></td>
<td></td>
<td>9. Check weather and sea conditions</td>
<td>9. Check fire extinguishing system</td>
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<td></td>
<td></td>
<td>10. Check fire extinguishing system</td>
<td>10. Check mooring equipment</td>
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<td></td>
<td></td>
<td>11. Check fire extinguishing system</td>
<td>11. Check illumination</td>
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<td></td>
<td></td>
<td>12. Check mooring equipment</td>
<td>12. Check charging and operation of communications equipment</td>
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<td></td>
<td></td>
<td>13. Check mooring equipment</td>
<td>13. Check hydraulic valve remote operating equipment</td>
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<td></td>
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<td>14. Check CTMS activation</td>
<td>14. Check ESDS (for consistency)</td>
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<td>15. Check CTMS activation</td>
<td>15. Check CTMS activation</td>
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<td></td>
<td></td>
<td>(17. Cool down of bunker line)</td>
<td>17. Cool down of bunker line)</td>
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</tr>
<tr>
<td>2.</td>
<td>Preparations before start of berthing and transfer</td>
<td>1. Notification of start of berthing and mooring work</td>
<td>1. Check berthing position and mooring work</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Check berthing position and mooring work</td>
<td>2. Check berthing position and mooring work</td>
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<tr>
<td></td>
<td></td>
<td>3. Completion of mooring work and notification</td>
<td>3. Completion of mooring work and notification</td>
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<td></td>
<td></td>
<td>5. Put up fuel transfer warning signs outside the ship</td>
<td>5. Establish work area</td>
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<td></td>
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<td>6. Stop radars</td>
<td>Put indication of “No Entry”, “Keep Fire Away”</td>
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<td></td>
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<td>7. Ventilation control in accommodation space</td>
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<td>8. Notify fire restrictions</td>
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<td>9. Usage limit of communication equipment</td>
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<td>10. Indication by lights and day</td>
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<tr>
<td>Work Item</td>
<td>Ship Side</td>
<td>Contact</td>
<td>LNG supply facility</td>
<td>Remarks</td>
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<tr>
<td>shapes</td>
<td></td>
<td>⇔ (5. Bonding cable connections)</td>
<td>(Not required if insulated flange is provided)</td>
<td></td>
</tr>
<tr>
<td>(11. Bonding cable connections)</td>
<td>⇔ (5. Bonding cable connections)</td>
<td>(Not required if ESDS linkage is unnecessary)</td>
<td></td>
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<tr>
<td>12. Set up accessway between the ship and the facility</td>
<td>⇔ 6. Set up accessway between the ship and the facility</td>
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<tr>
<td>(13. Signal line connection for ESDS activation)</td>
<td>⇔ (7. Signal line connection for ESDS activation)</td>
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<tr>
<td>15. Preparations for transfer arm connection</td>
<td>9. Preparations for transfer arm connection</td>
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<td></td>
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<tr>
<td>16. Preparations for fire extinguishing system</td>
<td>10. Preparations for fire extinguishing system</td>
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</tr>
</tbody>
</table>

3. 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 work limitations at berth, warnings, etc.
9. Exchange of information on weather and sea conditions
10. Others

4. Arm connection
1. Stationing of workers
2. Loading of materials and equipment ⇔ 2. Materials etc.
3. Start water curtain
5. Connecting liquid arm ⇔ 5. Connecting liquid arm

If necessary, fit reducer

5. O₂ purging
1. Check that ESD valve is closed
2. Measure O₂ with vapor purge valve
3. Complete with O₂ concentration below 5%
Purge valve closed

1. Supply nitrogen to vapor line
SIGTTO standard value
<table>
<thead>
<tr>
<th>Work Item</th>
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</tr>
</thead>
<tbody>
<tr>
<td>4. Measure (O_2) with liquid purge valve</td>
<td></td>
<td>←</td>
<td>2. Supply nitrogen to liquid line</td>
<td></td>
</tr>
<tr>
<td>5. Complete with (O_2) concentration below 5% and purge</td>
<td></td>
<td></td>
<td></td>
<td>Close valve and then do the leak test.</td>
</tr>
<tr>
<td>6. Leak test</td>
<td></td>
<td>←</td>
<td>1. Raise nitrogen supply pressure up to the required pressure</td>
<td>1. Do the leak test of all connected parts such as arm, manifold, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>⇔</td>
<td>2. Do the leak test of all connected parts such as arm, manifold, etc.</td>
<td>2. Leak test completion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>←</td>
<td>3. Leak test completion</td>
<td>3. Reduce pressure by opening purge valve</td>
</tr>
<tr>
<td>7. Measurement</td>
<td>1. Measurement</td>
<td>⇔</td>
<td>1. Measurement</td>
<td>Measurements in both the ship and the facility simultaneously</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 supply facility</td>
</tr>
<tr>
<td></td>
<td>2. Vapor/liquid ESD valve open</td>
<td>⇔</td>
<td>2. Signal “ON” from ship or supply facility</td>
<td>2. Signal “ON” from ship or supply facility</td>
</tr>
<tr>
<td></td>
<td>3. Signal “ON” from ship or supply facility</td>
<td>⇔</td>
<td>3. Check that vapor/liquid ESD valve is closed</td>
<td>3. Check that ESDS is normal</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 Vapor ESD valve is open</td>
<td>⇔</td>
<td>1. Ensure return gas receiving line</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Line up of line cool down Liquid ESD valve open</td>
<td>⇔</td>
<td>2. Line up of line cool down</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Report completion of preparations for line cool down</td>
<td>→</td>
<td>Check for leak in each part</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Check liquid flow and start line cool down</td>
<td>→</td>
<td>3. Start pump, adjust transfer rate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Line cool down complete at specified temperature</td>
<td>→</td>
<td></td>
<td></td>
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<tr>
<td>Work Item</td>
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<td>-------------------------------------------------------------------------</td>
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<tr>
<td>6. Check stoppage of liquid flow</td>
<td></td>
<td>←</td>
<td>4. Stop pump</td>
<td></td>
</tr>
<tr>
<td>10. ESDS</td>
<td>1. ESDS functional test at low temperature</td>
<td>⇔</td>
<td>1. Check that vapor/liquid ESD valve is open</td>
<td>Implement once each for ship and supply facility</td>
</tr>
<tr>
<td>functional</td>
<td>2. Check tank pressure</td>
<td>⇔</td>
<td>2. Signal “ON” from ship or supply facility</td>
<td></td>
</tr>
<tr>
<td>test at low</td>
<td>3. Check that vapor/liquid ESD valve is open</td>
<td>⇔</td>
<td>3. Check that vapor/liquid ESD valve is closed</td>
<td></td>
</tr>
<tr>
<td>temperature</td>
<td>4. Signal “ON” from ship or supply facility</td>
<td>⇔</td>
<td>4. Check that ESDS is normal</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 transfer line up</td>
<td></td>
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<tr>
<td></td>
<td>2. Check receiving line up</td>
<td>←</td>
<td>2. Start pump, begin transfer</td>
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<tr>
<td></td>
<td>3. Check inflow</td>
<td>→</td>
<td>3. Inspect each part</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Inspect each part</td>
<td>→</td>
<td>4. Adjust to steady rate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Request increase in transfer rate</td>
<td>←</td>
<td>5. Control tank pressure</td>
<td></td>
</tr>
<tr>
<td>12. Steady-state transfer</td>
<td>1. Inspect each part, control tank pressure</td>
<td>⇔</td>
<td>1. Inspect each part, control tank pressure</td>
<td>Monitor level, measure transfer rate</td>
</tr>
<tr>
<td></td>
<td>Monitor level, measure inflow rate</td>
<td>⇔</td>
<td>2. Calculate time at completion of estimated transfer and report</td>
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<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>
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<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>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>
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<tr>
<td></td>
<td></td>
<td>←</td>
<td>2. Stop pump and report transfer completion</td>
<td>2. Stop pump and report transfer completion</td>
</tr>
<tr>
<td>Work Item</td>
<td>Ship Side</td>
<td>Contact</td>
<td>LNG supply facility</td>
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<td>----------------------------------------------</td>
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<tr>
<td></td>
<td>2. Complete preparations for draining</td>
<td>→</td>
<td></td>
<td>*It is desirable that BOG is used for draining.</td>
</tr>
<tr>
<td></td>
<td>3. Check gas liquid with manifold drain valve</td>
<td>← 4. Supply nitrogen, pressurize</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Report drainage completion</td>
<td>→</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Liquid ESD valve closed</td>
<td>⇐ 5. Continue methane purging</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Complete when methane concentration below 2 vol% Report completion of methane purging</td>
<td>⇐ 3. Complete when methane concentration below 2 vol% Report completion of methane purging</td>
<td>SIGTTO standard value</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Reduce pressure in liquid arm</td>
<td>→</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Vapor ESD valve is closed</td>
<td>→</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Final measurement</td>
<td>1. Final measurement</td>
<td>⇐ 1. Final measurement</td>
<td>Measurements in both ship and facility simultaneously</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Check transferred volume (received volume)</td>
<td>⇐ 2 Check transferred volume (delivered volume)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Complete when methane concentration below 2 vol% Report completion of methane purging</td>
<td>⇐ 3. Complete when methane concentration below 2 vol% Report completion of methane purging</td>
<td>SIGTTO standard value</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Reduce pressure in vapor arm</td>
<td>→</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Arm</td>
<td>1. Attend arm handling operation</td>
<td>⇐ 1. Operate arm handling equipment</td>
<td>Arm is operated by workers in</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Start disconnection of liquid arm</td>
<td>→</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work Item</td>
<td>Ship Side</td>
<td>Contact</td>
<td>LNG supply facility</td>
<td>Remarks</td>
</tr>
<tr>
<td>-------------</td>
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<td>---------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>disconnection</td>
<td>3. Complete the disconnection of liquid arm</td>
<td>→</td>
<td>2. Store arm</td>
<td>Fit blind flange to manifold/arm end when disconnecting arm</td>
</tr>
<tr>
<td></td>
<td>4. Attend storing arm</td>
<td>⇔</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Start disconnection of vapor arm</td>
<td>→</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Complete the disconnection of vapor arm</td>
<td>→</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Attend storing arm</td>
<td>⇔</td>
<td>3. Store arm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. ESDS “OFF”</td>
<td>⇔</td>
<td>4. ESDS “OFF”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9. Stop water curtain</td>
<td>→</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10. Return materials and equipment</td>
<td>→</td>
<td>5. 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. Disconnect signal line for ESDS activation | ⇔ | 1. Disconnect signal line for ESDS activation |
2. Remove accessway between ship and facility | ⇔ | 2. Remove accessway between ship and facility |
(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 | | |
6. Remove restrictions such as fire restrictions, ventilation control, usage restrictions on communication equipment, etc. | | |
7. Store lights and shapes | | |
8. Remove mooring lines | | |
9. De-berthing | | |
10. 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) | | |

6. Attend de-berthing work