Ship to Ship Transfer Guide (Petroleum)

(Fourth Edition 2005)

For Use with Crude Oil and Petroleum Products
Foreword

This guide was first published in 1975 and was revised in 1986 and again in 1997. The guide, reflecting best advice from industry, has been used as the basis for national regulations on Ship-to-Ship (STS) petroleum transfer operations. STS transfer operations are routine in many parts of the world and considerable experience has been built up. This 4th edition of the guide has been substantially updated to take account of the latest good operating practice and to include reference to a new International Standard - “Ships and Marine Technology - Floating Pneumatic Rubber Fenders” (ISO 17357). Similarly, recommendations regarding foam fenders have also been expanded. The role of the human element in ensuring safety is also given greater prominence and in this context attention is drawn to the potential dangers associated with fatigue. The results of a study on STS mooring load analysis have been taken into account in the enhancement of guidance on mooring operations and mooring equipment. The risks inherent in transferring personnel by basket using ship’s equipment are recognised, and an enhanced section devoted to this topic has been included.

The guide is aimed at providing advice for Masters, marine superintendents and others responsible for planning STS transfer operations. It is primarily directed to the transfer of crude oil and petroleum products between oceangoing ships. Although intended for operations taking place at sea, and therefore often beyond normal port services, it will also be of relevance in inshore waters or within harbour limits, although in such cases special regard will have to be given to local regulations. The guide does not refer directly to situations in pilotage waters where one ship may be brought alongside another that is already berthed at a jetty. Such operations, sometimes known as “double-banking”, should be subject to local regulation and will normally be conducted with the full benefit of all port services. As with previous editions, the guide does not deal specifically with transfers between ships and barges or estuarian craft but can be used as guidance for such operations. Similarly, the operation known as “reverse lightering” (e.g. bringing a laden Suezmax size ship alongside a VLCC) is not dealt with specifically, but the guide can be used to provide advice on such operations, in particular with regards to issues like fender selection.

If a ship becomes disabled or stranded, it may be necessary to transfer all or part of the cargo to another ship. While the guide does not deal specifically with disabled or stranded ships or other salvage type operations, many of the same principles will apply. In this regard reference should also be made to the ICS/OCIMF publication “Peril at Sea and Salvage - A Guide for Masters” (Reference 1).

The guide does not cover STS transfer operations at offshore production units, where it can be expected that terminal operators will enforce local regulations. However, the guide may be of benefit to operators of such facilities when they formulate their own regulations.

Finally the guide is not a book of rules. It contains recommendations on safety, minimum equipment levels and good operating practices, but it must always be remembered that if more stringent international, national or local regulations apply, they must take precedence.

ICS and OCIMF always welcome suggestions for improvements that can be considered for inclusion in future editions. Comments may be forwarded to these organisations at the following addresses:

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Table of Contents

FOREWORD ................................................................. III
GLOSSARY ................................................................. VI
REFERENCES .............................................................. VIII
LIST OF ILLUSTRATIONS ................................................ IX
LIST OF FIGURES ......................................................... X

CHAPTER 1  GENERAL PRINCIPLES ........................................ 1
       1.1 Preamble ....................................................... 1
       1.2 Background ................................................... 1
       1.3 Scope .......................................................... 1
       1.4 Control of Operations ......................................... 1

CHAPTER 2  CONDITIONS AND REQUIREMENTS ......................... 5
       2.1 Ship Compatibility ............................................ 5
       2.2 Approval from Authorities ................................... 5
       2.3 Transfer Area ................................................ 6
       2.4 Weather Conditions .......................................... 7
       2.5 Quality Assurance ........................................... 8

CHAPTER 3  SAFETY ......................................................... 9
       3.1 General Safety ............................................... 9
       3.2 Safety Drills ................................................. 10
       3.3 Check-Lists ................................................. 10
       3.4 Action in Case of Infringement of Safety ................. 11
       3.5 Safety During Cargo Transfer ............................... 11
       3.6 Safe Watchkeeping .......................................... 15
       3.7 Helicopter Operations ...................................... 16

CHAPTER 4  COMMUNICATIONS ........................................... 17
       4.1 General Communications .................................... 17
       4.2 Language ...................................................... 17
       4.3 STS Instructions ............................................. 17
       4.4 Initial Communications Between Ships .................... 18
       4.5 Navigational Warnings ..................................... 18
       4.6 Communications During Approach, Mooring and Unmooring
              .............................................................. 19
       4.7 Communications During Cargo Transfer Operations ........ 19
       4.8 Procedures for Communication Failure .................... 20

CHAPTER 5  OPERATIONAL PREPARATIONS BEFORE MANOEUVRING .... 21
       5.1 Preparation of Ships ........................................ 21
       5.2 Navigational Signals ........................................ 22

CHAPTER 6  MANOEUVRING AND MOORING ................................ 23
       6.1 Basic Berthing Principles .................................... 23
       6.2 Manoeuvring Alongside with Two Ships Under Power ...... 23
       6.3 Manoeuvres with One Ship at Anchor ....................... 27
       6.4 Mooring Preparations ....................................... 28
       6.5 Mooring Considerations ..................................... 31
CHAPTER 7 PROCEDURES ALONGSIDE
7.1 Pre-Transfer Procedures 33
7.2 Responsibility for Cargo Operations 33
7.3 Planning for Cargo Transfer 33
7.4 Cargo Transfer — General Guidance 34
7.5 Operations After Completion of Cargo Transfer 36

CHAPTER 8 UNMOORING
8.1 Unmooring Procedure 37
8.2 Unmooring Checks 38
8.3 Procedure for Unberthing 38

CHAPTER 9 EQUIPMENT
9.1 Fenders 41
9.2 Hoses 46
9.3 Mooring Equipment 50
9.4 Personnel Transfers 51
9.5 Lighting 54
9.6 Ancillary Equipment 54
9.7 Equipment Noise Levels 54

CHAPTER 10 EMERGENCIES
10.1 Contingency Planning 55
10.2 Emergency Signal 55
10.3 Emergency Situations 55
10.4 Advice on Some Emergencies 56
10.5 State of Readiness for an Emergency 57

APPENDICES
APPENDIX 1 OPERATIONAL/SAFETY CHECK-LISTS
Check-List 1 Pre-Fixture Information (for each ship) 59
Check-List 2 Before Operations Commence 60
Check-List 3 Before Run-in and Mooring 61
Check-List 4 Before Cargo Transfer 62
Check-List 5 Before Unmooring 63

APPENDIX 2 Fender Selection Calculation
Fender Selection Assistance Request Form 64

APPENDIX 3 Ship-to-Ship Transfer Study
Conclusions 74
Glossary

Within this guide, the terms below have the following meanings.

AT SEA
The term "at sea" is used throughout this guide. It is intended to indicate offshore waters or partially sheltered waters. It may be, however, that an STS transfer operation at sea is to be conducted within the jurisdiction of a local (port) authority or national government, in such cases reference has to be made to local regulations and it may also be necessary to obtain local approval.

BALLAST
The term "ballast" covers water ballast carried in ships' tanks.

CLOSED OPERATIONS
Ballasting, loading or discharging operations carried out without recourse to opening ullage and sighting ports. In these cases ships will require the means to enable closed monitoring of tank contents, either by a fixed gauging system or by using portable equipment passed through a vapour lock.

CONSTANT HEADING SHIP
During manoeuvring and mooring, the ship that maintains course and speed to allow the manoeuvring ship to approach and moor is referred to as the constant heading ship.

DEDICATED LIGHTERING SHIP
A dedicated lightering ship is a ship designed to perform multiple STS operations. These ships are usually fitted with adequate primary and secondary fenders, which upon completion of an STS transfer are capable of being lifted and stowed in onboard cradles. They are usually fitted with their own hoses and are generally capable of performing STS operations without external assistance such as support craft.

DISCHARGING SHIP
The ship containing cargo for transfer to the receiving ship, and which may also be known as the Ship To Be Lightened (STBL).

DISPLACEMENT
Ship's total weight including all cargo, ballast, fuel, water, stores and light ship weight. May be found for any draught from ship's tables.

MANOEUVRING SHIP
During manoeuvring and mooring, the ship that approaches the Constant Heading Ship for mooring operations is referred to as the manoeuvring ship.

ORGANISERS
Organisers are shore-based operators responsible for arranging an STS transfer operation. The Organiser may be an STS service provider.

PERSON IN OVERALL ADVISORY CONTROL
The person agreed to be in overall control of an STS operation. It may be one of the Masters (generally the Master of the manoeuvring ship) or it may be an STS Superintendent.

PRIMARY FENDERS
Primary fenders are large fenders capable of absorbing the impact energy of berthing and wide enough to prevent contact between the ships should they roll while alongside one another.

RECEIVING SHIP
The ship to which cargo is transferred from the Discharging Ship. The Receiving Ship may also be known as the lightering ship.
SECONDARY FENDERS
Secondary fenders are fenders used to prevent contact between the two ships, should they be rolling or not parallel to each other. They are especially effective when rigged towards the ends of a ship and are of most benefit during mooring and unmooring operations.

SHIP
Throughout this guide the word ship refers to an oil tanker.

SHIPOWNER
Includes an owner, manager or operator having day-to-day commercial and/or operational control of the ship.

SHIP-TO-SHIP (STS) TRANSFER OPERATION
An STS transfer operation is an operation where crude oil or petroleum products are transferred between tankers moored alongside each other. Such operations may take place when one ship is at anchor or when both are underway. In general, the expression includes the approach manoeuvre, berthing, mooring, hose connecting, safe procedures for cargo transfer, hose disconnecting, unmooring and departure manoeuvre.

STS SERVICE PROVIDER
An STS service provider is a company or organisation that specialises in providing services for the safe control of STS operations. The service provider may also supply the essential personnel and equipment needed such as hoses, fenders and support craft.

STS SUPERINTENDENT
A person who may be designated to assist a ship’s Master in the mooring and unmooring of the ships, and to co-ordinate and supervise the entire ship-to-ship transfer operation. He may also be known as Lightering Master or Mooring Master.

SWL
SWL or Safe Working Load is the operating limit to which equipment is tested for day-to-day use. Equipment should never be used beyond its SWL.

TRANSFER AREA
A transfer area is an area within which an STS transfer operation takes place. Transfer areas should be selected in safe sea areas (see Section 2.3). In coastal areas they will be agreed with nearby coastal authorities and, as appropriate, in accordance with specific port or national regulations.

TRANSFER AT ANCHOR
The expression “transfer at anchor” describes an operation where a cargo transfer is carried out between ships when they are moored alongside each other and one of the ships is at anchor. The operation is an alternative to underway transfer.

UNDERWAY
By definition under the International Regulations for Preventing Collisions at Sea (COLREGS) a ship when underway is not at anchor, made fast to the shore or aground. However, she may be either steaming or drifting freely with current and weather.
### List of Illustrations

<table>
<thead>
<tr>
<th>Illustration</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. An STS transfer operation should be under the advisory control of one individual, usually one of the Masters</td>
<td>2</td>
</tr>
<tr>
<td>2. Manoeuvring to go alongside with both ships making way in good weather conditions</td>
<td>7</td>
</tr>
<tr>
<td>3. STS transfer operations require hose connections to be well made. Since this is an operation not frequently carried out by ship’s crews, extra care should be taken</td>
<td>11</td>
</tr>
<tr>
<td>4. Helicopter operations may be permitted, subject to prior approval of all interested parties and after all transfer operations have been stopped</td>
<td>16</td>
</tr>
<tr>
<td>5. Approach manoeuvre should not be attempted until proper effective communication has been established</td>
<td>19</td>
</tr>
<tr>
<td>6. Manoeuvring ship reduces distance by appropriate rudder and engine movement until the fenders touch</td>
<td>25</td>
</tr>
<tr>
<td>7. The ships should make parallel contact at the same speed</td>
<td>26</td>
</tr>
<tr>
<td>8. Lines should only be led through closed fairleads, using all available fairleads and bitts to avoid concentration of loads</td>
<td>31</td>
</tr>
<tr>
<td>9. Freeboard differences should be kept to a minimum</td>
<td>35</td>
</tr>
<tr>
<td>10. Special care needs to be taken when unmooring to avoid the two ships coming into contact</td>
<td>37</td>
</tr>
<tr>
<td>11. Unless the STS transfer is carried out by a dedicated lightening ship, a service craft will normally assist in positioning the fenders</td>
<td>44</td>
</tr>
<tr>
<td>12. The lights and shapes to be shown during STS transfer operations are those required by the “International Regulations for Preventing Collisions at Sea” (COLREGS)</td>
<td>44</td>
</tr>
<tr>
<td>13. Where hoses or fenders are provided by an STS service provider checks should be made to ensure they are fit for the intended purpose</td>
<td>45</td>
</tr>
<tr>
<td>14. Hose lengths equal to twice the maximum difference in manifold heights are usually sufficient but should be considered on a case by case basis</td>
<td>47</td>
</tr>
</tbody>
</table>

Acknowledgement:
Pictures kindly supplied by Captain Knut Riebensahm, Lightering Master.
List of Figures

6.1 A Possible Final Approach Manoeuvre 24
6.2 Typical STS Mooring Arrangement 29
8.1 Use of Release or Toggle Pins 39
9.1 Fenders Rigged in a Continuous String 42
9.2 Fenders Rigged in Pairs 42

List of Tables

9.1 A Quick Reference Guide to Fender Selection for Standard STS Operations 43
9.2 Flow Rates for Hoses Supplied to BSI Specification 49
Appendix 21—Typical Fender Manufacturers Performance Table 65
Chapter 1

GENERAL PRINCIPLES

1.1 Preamble

This guide covers ship-to-ship (STS) transfer operations of crude oil and petroleum products. It is primarily intended to familiarise Masters and ship operators with the general principles involved. The advice contained in this publication may be supplemented by instructions from individual shipowners or ship managers in order that particular aspects of their own procedures can be covered. In certain Exclusive Economic Zones (EEZs) or Territorial Waters or Port Limits it may be found that national or local regulations apply. National or local regulations should be followed and, where appropriate, the recommendations made in these guidelines can be used as additional advice. Other parties may also benefit from studying these guidelines. Such parties may include ship charterers, traders, STS service providers and those responsible for organising an STS transfer.

1.2 Background

The STS transfer of crude oil and petroleum cargoes has become common practice. Experience gained from these regular operations has proved that STS transfers are safe given the use of suitable equipment and compliance with proper procedures, including suitable weather and sea condition operating limits.

1.3 Scope

The guide is directly concerned with STS transfer operations undertaken at sea and therefore in places that may be beyond the assistance of normal port services. The recommendations apply to seagoing ships when it is intended that they moor alongside each other. However, the guide may also be useful as a reference when establishing rules for transfer operations between seagoing ships and barges or estuarial craft in inshore waters. The guide can also provide background advice to companies operating offshore storage or production facilities where direct transfer to seagoing ships takes place.

In addition the guide may be of assistance when carrying out emergency STS transfer operations when one of the ships involved is disabled or aground. However, in each unique situation the procedures adopted may vary from this guidance according to the circumstances.

1.4 Control of Operations

An STS transfer operation should be under the advisory control of one individual (the person in overall advisory control), who will be either one of the Masters concerned, or an STS Superintendent.
It is not the intention of these recommendations that the person in overall advisory control in any way relieves the ship's Master of any of his duties, requirements or responsibilities.

The principles of "Bridge Team Management" should be observed. See Bridge Procedures Guide (ICS) – Reference 13.

If Masters are unfamiliar with, or inexperienced in, STS transfer operations, it is strongly recommended that an STS Superintendent be employed to advise them. There are companies offering specialised STS services. Before employing such assistance the Master, shipping company, or STS organiser should ensure that the STS service provider will provide trained and experienced STS Superintendents.

Picture 1: An STS transfer operation should be under the advisory control of one individual, usually one of the Masters.

To make such an assessment the Master, shipping company or STS organiser should ensure that the following considerations are addressed to their satisfaction:

- does the STS Superintendent hold an appropriate management level deck licence or certificate from a recognised jurisdiction, meeting international certification standards, with all STCW requirements and dangerous cargo endorsements up to date and appropriate for the ships in question?
- does the STS Superintendent hold valid medical certification required by a recognised licensing jurisdiction?
- how much experience does the STS Superintendent have as a senior deck officer serving on board ships similar to those under consideration for the STS operation?
- has the STS Superintendent completed a suitable number of supervised operations under this programme in addition to the above noted onboard STS experience?
- has the STS Superintendent undergone a supervised STS apprentice or trainee programme?
- has the STS Superintendent satisfactorily completed a recognised ship-handling course?
• Has the STS Superintendent had experience of STS operations within the last four months? If not, a refresher operation under the supervision of an STS Superintendent meeting these minimum recommendations should be performed.

• Has the STS Superintendent been subject to performance assessment on at least an annual basis?

In doing so the STS service provider should provide evidence of the quality and competence of the intended STS Superintendents.
Chapter 2

CONDITIONS AND REQUIREMENTS

2.1 Ship Compatibility

When organisers are planning an STS transfer operation they should ensure that the ships to be used are compatible in design and equipment; that they comply with the various recommendations included in the guide; and that mooring operations, hose handling and communications can be conducted safely and efficiently. The initial information required in Check-List 1 of Appendix 1 should be supplied to the organisers by the shipowners. It is strongly recommended that information relating to the overall dimensions, freeboard, position of manifolds, mooring points and fenders should be passed to the Masters of the ships at the earliest opportunity.

It is recommended that ships that have bridge wings extending beyond the maximum ship's breadth are not used for STS transfer operations. Consideration should be given to any precautions and mitigating measures necessary regarding bridge wings that do not extend to the ship's side.

2.1.1 Cargo Handling Compatibility

The following should be determined prior to berthing:

- the size and number of manifolds to be used.
- the minimum and maximum expected height of the cargo manifold from the waterline during the transfer operation, and the freeboard differences during the cargo transfer.
- whether the cargo cranes or derricks are in a satisfactory condition and of suitable Safe Working Load (SWL).
- that hose supports at the ship's side are adequate to prevent damage to hoses through chafing.
- that both ships have manifold arrangements which comply with OCIMF Recommendations for Oil Tanker Manifolds and Associated Equipment (Reference 6).

2.2 Approval from Authorities

Where an STS transfer operation is to be arranged within the territorial waters or, in some cases, the EEZ of a country, the organiser should check local and national regulations and may need to gain appropriate approval. This may require the organiser and appropriate authority to agree the transfer area to be used and to take into account other requirements. At this time, matters pertaining to contingency plans should also be addressed (see Section 10.1).
When an STS transfer operation is about to begin in territorial waters, the organiser should notify the appropriate authorities and the government agencies concerned. This may be done either directly by the organiser or, once requirements are known, by formally delegating the task to the person in overall advisory control (see Check-List 2, Item 18).

### 2.3 Transfer Area

Transfer areas may be relatively large or quite small; the space available will dictate the type of manoeuvre. In the case of manoeuvres at sea, where it is intended that both ships are to be underway, a relatively large transfer area will be needed to accommodate the necessary manoeuvres. Naturally, a ship approaching another ship at anchor will require a much smaller overall area. Sometimes this can be within port limits, or in specified approved offshore locations.

Points to be considered by an STS organiser when selecting the transfer area are:

- the need to notify and obtain agreement of the applicable coastal authority.
- the shelter provided from the weather, particularly from sea and swell.
- present and forecast weather conditions.
- tidal current conditions.
- safe distances from offshore installations.
- the availability of a designated lightering area.
- the need for sufficient sea-room and water depth required for manoeuvring during berthing and unberthing.
- the need for sufficient sea-room to be available to allow for normal drift or steaming patterns when cargo transfer operations are conducted underway.
- the locations of underwater pipelines, cables, artificial reefs or historic sites.
- the selection of a safe anchorage with sufficiently good holding ground.
- the traffic density.
- the availability of emergency and oil spill response capability.
- distance from shore logistical support.
- security threat.
2.4 Weather Conditions

It is impracticable to lay down limiting weather conditions under which STS transfer operations can be carried out because much will depend on the effect of the sea and swell on the fenders or mooring lines and the rolling movements induced in the participating ships, taking into account their relative freeboard and displacement. The manoeuvring capabilities of the ships involved, the speed of the approaching weather, ship particulars, free surface effect, manning, and workboat capabilities are also factors. Studies have indicated that STS operations in locations subject to long period waves should be treated with caution. It should be expected that mooring loads will increase with wave period or as the period of wave encounter increases. Some jurisdictions may have regulations regarding limiting weather conditions (see also Section 3.1.1 – Risk Management).

If cargo transfer is to take place at anchor the combined effect of current and weather conditions on the yawing movements of the anchored ship and the ultimate strain on the anchor cable should be considered.

Applicable weather forecasts for the area should be obtained before and during operations.

Throughout any berthing operation the visibility should be good enough for safe manoeuvring, taking into account safe navigation and collision avoidance requirements. Manoeuvres should only start when relevant personnel are satisfied that conditions are suitable for mooring and cargo transfer.

Additional guidance on electrical storms is provided in Section 3.5.8.

Picture 2: Manoeuvring to go alongside with both ships making way in good weather conditions.
2.5 Quality Assurance

If an STS service provider is employed, the quality of the services and equipment it can provide are paramount if operations are to be carried out safely, reliably and efficiently. There are currently no international standards for STS service providers and while some form of ISO accreditation, if available, will provide an assurance that an STS service provider has the necessary resources, afloat and ashore, to provide a quality service, this is by no means the only determinant of quality. Performance record, previous experience and reputation within the industry may be just as important when assessing an STS service provider's ability to meet customer and regulatory requirements. In either case, it is recommended that the Master, shipping company or organiser take whatever measures are necessary to ensure that the STS service provider can provide the level of service expected.

STS service providers should be aware that they might be subject to assessment by users of their services.
Chapter 3

SAFETY

3.1 General Safety

For all STS transfer operations each Master remains at all times responsible for the safety of his own ship, its crew, cargo and equipment and should not permit safety to be prejudiced by the actions of others. Each Master should ensure that the procedures recommended by this guide are followed and, in addition, that internationally accepted safety standards are maintained. In this regard, the most prominent international safety manual in use for cargo handling advice is the International Safety Guide for Oil Tankers and Terminals (ISGOTT) – Reference 3.

3.1.1 Risk Management

Before committing to an STS transfer operation, the parties involved should carry out a risk assessment that should include sufficient information to ensure a good understanding of the operation. The risk assessment should cover operational hazards and the means by which they are managed. Many tools are available to assist in this process and operational safety Check-Lists, as provided in Appendix 1, are one such example of a risk management tool.

As a minimum, the risk assessment should:

- identify the hazards associated with the operation (collision risks in the vicinity, cargo vapour pressure, H₂S content etc).
- assess the risks according to the probability and consequence.
- identify the means by which to prevent and/or mitigate the hazard.
- contain procedures for dealing with unanticipated events.

The level of complexity required will depend on the type of operation. For a particular transfer area utilising standard approved STS equipment and ships that are fully operational, a generic risk assessment might be appropriate. For STS operations being undertaken in a new area, or in the event of a deviation from a routine STS transfer, a risk assessment should be carried out for each ‘non standard’ activity.

The overall safety of any STS transfer operation depends on the type and condition of the equipment in use; the weather and sea-state; the ships involved in the transfer operation; the quality of the supervision (whether this is provided by one of the Masters or by an STS service provider); and strict adherence to well documented safety procedures, which should be provided to both ships by the person in overall advisory control. The procedures adopted should be in accordance with these guidelines and should be discussed and agreed with the Masters of both ships before the operation commences. The equipment used in the STS operation, such as fenders and transfer hoses should, where appropriate, conform to internationally recognised standards (see Chapter 9).
3.1.2 Prevention of Fatigue

Recent accident data and research in other industries point to fatigue as a cause of, and/or being a contributor to, human error because of its impact on performance. Human error from fatigue is now also perceived as having contributed to a number of marine casualties. To prevent fatigue during STS transfer operations, the STS Superintendent and/or all the responsible officers for the lightering operation should comply with rest period requirements of relevant ILO, IMO and national regulations. Records of rest and work hour compliance should be retained.

Excess noise levels in the vicinity of rest areas can compound fatigue problems and should be monitored (see Section 9.7).

3.2 Safety Drills

Despite careful attention to safety procedures, emergencies can occur. Often such events can be contained and their effects minimised by preparing ships’ crews, through a system of drills, to deal with a variety of emergencies. An appropriate drill should be held, where practicable, within 24 hours and in any case not more than seven days preceding an STS transfer operation.

Ships and crews should be made aware of emergency signals, procedures and actions, and every effort should be made to hold an emergency drill before starting the operation. It is impossible to anticipate every possible emergency, but moorings failure and fire on either ship are examples of major emergencies. Consideration should be given to:

- procedures for raising the alarm.
- cessation of operations during emergencies.
- emergency stations and preparations to initiate emergency procedures.
- deployment of mooring gangs to stations.
- clearing and emergency disconnection of cargo hoses.
- readiness of engines for immediate manoeuvre.

The examples above are not the only considerations and Masters should ensure all contingencies are evaluated. For example they may need to consider, in particular in the case of fire, whether it is of mutual benefit for the ships to remain alongside or to separate. In this respect contingency plans covering the possible range of emergency scenarios should be considered as part of the ship’s safety management systems.

3.3 Check-Lists

Check-Lists (presented in chronological order) for STS transfer operations can be found in Appendix 1 of this guide. The Check-Lists are intended to assist organisers and Masters to adhere to relevant safety procedures. The Check-Lists should be used not only at the time of transfer, but also when organisers are planning an operation (Check-List 1). Adherence to Check-List procedures will ensure that the most important aspects of an operation are covered.
Check-Lists are essential reminders of the principal safety factors to be considered. They should be supplemented by continuous vigilance throughout the whole operation.

Before mooring operations commence, each ship should confirm with the other that all items on Check-Lists 2 and 3 have been checked and found to be correct.

3.4 Action in Case of Infringement of Safety

If either ship fails to observe any of the safety requirements during the STS transfer operation, this should be brought to the attention of the Master of the ship concerned and operations should be suspended until the situation is rectified.

3.5 Safety During Cargo Transfer

The basic safety requirements for a transfer operation are similar to those for a normal port cargo operation as contained in the latest edition of ISGOTT (Reference 3). The following points are emphasised for an STS transfer operation:

3.5.1 Smoking and Naked Lights

Regulations regarding smoking and the use of naked lights should be strictly enforced. Warning notices should be displayed and smoking rooms should be designated and clearly marked.
3.5.2 Earths on Electrical Switchboards

Earth indicator lights showing on the main switchboard indicate a faulty circuit and such faults should be immediately traced and isolated. This is to avoid the risk of arcing, especially in deck areas where hazardous accumulations of gas may be present.

3.5.3 Boilers and Diesel Engines

On ships fitted with boilers, precautions such as soot-blowing should be carried out prior to commencing the approach manoeuvre in order to avoid hot ash falling onto a ship’s deck during the cargo transfer.

In case of sparking from the funnel, transfer operations should be stopped immediately.

3.5.4 Ship-to-Ship Electric Currents

3.5.4.1 The Elimination of Electrical Current and Electrostatic Charge in Cargo Hoses

In order to eliminate the potential for incendiary arcing between the two ships when presenting the hose string for connection:

- a single insulating flange should be fitted within each hose string (or at one ship’s manifold); or
- one length of electrically discontinuous hose should be fitted in each hose string; or
- hoses that are specially constructed to prevent static build-up or electrical currents transferring between ships should be used.

In the absence of insulation between the ships, the electric potential between them should be reduced as much as possible. Switching off cathodic protection systems of the impressed current type is not, in general, considered to be a feasible method of minimising ship-to-ship currents in the absence of an insulating flange or hose. If both ships have properly functioning impressed current cathodic protection systems, this is probably best achieved by leaving them running. Likewise, if one has an impressed system and the other a sacrificial system, the former should remain in operation.

However, if either ship is without cathodic protection, or its impressed system has broken down, consideration should be given to switching off the impressed system on the other ship well before the two ships come together.

3.5.4.2 Other Places Where Electrical Arcing May Occur

All ship-to-ship mooring lines should be insulated either by using the natural properties of soft mooring lines or by attaching a soft rope tail to the eye of each steel wire mooring line. If using soft rope tails, they should be of suitable length so that they extend to the outboard side of the ship receiving the mooring.

Care should be taken to avoid low resistance ship-to-ship electrical contact in the following areas:
non-insulated metallic ladders or gangways between the ships –
by the fitting of rubber ends.

- derrick or crane wire runners and hooks – by careful operation.
- unprotected bare wires and chains within fender support nets or
cages – by good quality maintenance.

3.5.5 The Use of Radio and Satellite Communication Equipment

3.5.5.1 Main Radio Equipment
Transmissions from a ship’s main radio station can cause electrical
resonance in insulated parts of some ship fittings, such as mast
stays, and this can cause arcing across deck fittings. Similarly, arcing
can occur on a ship’s wireless aerials, especially over the surface of
insulators when they have a coating of salt, dirt or water.

The use of a ship’s main radio equipment during cargo operations
can be dangerous. Radio transmissions should not be permitted
during periods when there is the possibility of flammable gas in the
region of the antennae or where there is doubt about the effective
earthing of stays, derrick equipment and other such fittings.

The main radio transmitting aerials on both ships should be earthed
(grounded) and neither ship should use this equipment while
alongside one another. Satellite communications equipment can be
used for communications; however, the risks described below should
be taken into account.

3.5.5.2 Satellite Communications
Satellite communications equipment normally operates at 1.6 GHz
and the power levels generated are considered to present few ignition
hazards. However, this equipment should not be used when
flammable gas is in the vicinity of antennae.

3.5.5.3 VHF and UHF Radios
VHF and UHF communications are of low energy and therefore do
not produce the same potential dangers as might be expected from a
ship’s main radio transmitter. Accordingly, such communication
equipment may be used, even while ships are together, and may also
be an alternative to the ship’s main radio equipment when within
range of a suitable coast station.

Any hand-held VHF and UHF radios, as used for mooring and cargo
operations, should be of intrinsically safe manufacture.

3.5.5.4 Automatic Identification Systems (AIS)
Where either or both ships involved in STS operations are required to
have an AIS operating while underway or at anchor, the AIS
equipment should remain in use at all times, including during STS
operations.

The VHF equipment used for the AIS broadcasts need not be set to
low power output during STS operations. However, during STS
operations consideration should be given to using the optimal text
entry area in the AIS message to include a phrase to indicate that
the ship is restricted in her ability to manoeuvre, underway or at
anchor, as a result of conducting STS transfer operations. It may
be necessary to abbreviate the optional message to include this
information.
AIS broadcasts should not supplant the recommendation to broadcast navigational warnings by other means.

3.5.5.5 Portable Electronic Devices
It should be noted that portable cellular (mobile) telephones, pagers, cameras using batteries, Portable Data Assistants (PDAs), calculators etc., could constitute a risk to the ships if used in a hazardous area. Precautions should be taken to ensure that all personnel involved in the transfer, especially those who may be visiting the ships on other business (technicians, surveyors etc.) are made fully aware of the dangers and any restrictions on the use of such items.

3.5.6 Radar Use
3.5.6.1 General
The use of radar involves the operation of electrical equipment which is not intrinsically safe. Depending on the relative size of the two ships, during cargo transfer operations, the radar beam of one ship may at times sweep the cargo deck of the other and be close enough to create potentially hazardous power densities in areas where flammable gas mixtures could be present. Consultation between Masters is advisable before radar is used during cargo transfer operations. The following section gives further advice.

3.5.6.2 The Use of 3cm and 10cm Radar
Radiation from radar operating at frequencies above 9000 MHz (3cm) may be considered safe at distances of over 10 metres. The radiated power from such radar should not present an ignition hazard provided scanners are correctly sited above the superstructure. Radar operating in the 3cm waveband will normally be safe but should only be used with discretion.

At the lower frequencies, as used by 10cm radar, the possibility of induced arcing in parts of a ship's structure is present at ranges of up to 10 metres.

Marine radars normally operate with a pulsed signal and a rotating scanner, so people are not continuously exposed to radiation. Therefore the power-scanner interlocks should never be overridden without an appropriate risk assessment.

3.5.7 Gas Accumulation
An STS transfer operation should be suspended if cargo vapour accumulation around the decks or manifolds of either ship constitutes a risk to the ship or personnel, and should not be resumed until it is considered safe to do so. It is worth noting that air carrying flammable or toxic vapours flowing past superstructures can result in eddies or build up of gas on the lee side of the structure. These concentrations may find their way into machinery spaces or accommodation blocks.

The receiving ship should, prior to cargo transfer, provide details of the ship’s previous cargo to the discharging ship (ship to be lightered – STBL). This will enable the discharging ship’s personnel to take suitable precautions in the event that the previous cargo contained toxic vapours that could be displaced onto the deck of the discharging ship. Particular attention should be given to
the potential of high \( \text{H}_2\text{S} \) levels in the cargo vapours and all necessary personal safety precautions should be taken.

3.5.8 Electrical Storms

When an electrical storm is present or imminent in the transfer area, the cargo transfer operation should be suspended and all vent risers, cargo systems and IGS systems secured until such time as it is considered safe to resume operations.

3.5.9 Galley Stoves

Before permitting the use of galley stoves and other cooking appliances while a ship is engaged in STS operations, the ship's Master and the STS Superintendent (if applicable) must, after taking into consideration the location, construction and ventilation of the galley, jointly agree that no associated danger exists. Oil or gas fired stoves or electrical appliances using exposed elements should not be used.

3.5.10 Readiness of Fire-Fighting Equipment

Fire-fighting equipment should be ready for immediate use on both ships. Foam monitors on each ship should be pointed towards the cargo manifold in use and left in a suitable condition for hands-off operation. Additional foam fire-fighting equipment should be immediately available for use on deck.

3.5.11 Accommodation Openings

All access doors to the accommodation should normally be kept closed during cargo transfer operations. The Master of each ship should designate those access doors that are to be used for personnel transit. Where possible, only doors remote from the main deck cargo area should be used. All doors opened for personnel transit should be closed immediately after use.

The air conditioning system for the accommodation should be switched to the re-circulation mode.

3.5.12 Unauthorised Craft

No unauthorised craft should be allowed alongside either ship throughout the transfer.

3.6 Safe Watchkeeping

STS transfer operations can put additional demands on ships' crews. It has to be remembered that personnel are not only required for cargo transfer operations but also to keep a safe navigational or anchor watch throughout the operation (see Section 6.2.3).

Each Master should take into consideration the estimated duration of operations to ensure that safe and fatigue-free watchkeeping can be maintained throughout.
considering the manning required in respect of the STS operation, due regard must be paid to legislation relating to minimum rest periods for the crew (see also Section 3.1.2 and Reference 8). When planning STS operations, shipowners, STS service providers and Masters should bear in mind that statutory minimum manning requirements might not address simultaneous operations, e.g. cargo operations and navigation or anchor watch. Consideration should then be given to additional manning during these periods of high demand.

For reasons of crew workload, transfer operations taking place simultaneously from either side of the STBL are generally not recommended unless fully reviewed by risk assessment (see Section 3.1.1).

3.7 Helicopter Operations

While ships are moored together, helicopter operations should not be permitted without the prior approval of the organisers, both ships' Masters, and STS Superintendent. If approved, the person with overall advisory control will co-ordinate the operations locally.

No helicopter operations are to be carried out during transfer of cargo and/or bunkers and/or ballasting into cargo tanks.

Helicopter operations should be co-ordinated well in advance between the ships, organisers, agents, and helicopter operator.

Both ships are to carry out all helicopter operations in compliance with the ICS Guide to Helicopter / Ship Operations (Reference 7). All helicopters used should be equipped with marine band VHF communications capability.

Picture 4: Helicopter operations may be permitted, subject to prior approval of all interested parties and after all transfer operations have been stopped.
Chapter 4

COMMUNICATIONS

4.1 General Communications

Good communications between the ships is an essential requirement for successful STS transfer operations. The chief recommendations covering this subject are addressed below.

4.2 Language

To avoid any misunderstanding, a common language for communication should be agreed before operations commence. In this connection, attention is drawn to the Standard Marine Communication Phrases using the English language (Reference 5).

Should a serious language problem be detected, then action should be taken to resolve this by, for example, suspending operations until an experienced person fluent in both languages is made available before operations are resumed.

4.3 STS Instructions

The organisers generally provide STS instructions. This may be the operator of the ships if carrying out “in-house” operations or it may be an STS service provider. Normally such providers send advance STS instructions to the ships concerned.

Due to the different circumstances and individual requirements of various organisers, it is not practical to provide a generic STS information message. However, the following advice may be useful.

4.3.1 Advice to be Given TO the Ship by the Organisers

- the organiser’s full title, identification of person in overall advisory control and contact numbers.
- a description of the planned STS operation including the location of the transfer area.
- details of equipment (including confirmation of integrity of fenders, hoses etc), logistical support and personnel to be provided.
- requirements for the preparation of moorings, manifolds and lifting gear.
- local and national STS regulations, where applicable.
- identity of the STS service provider and/or STS Superintendent.
4.3.2 Information Required FROM the Ship

- confirmation of systems integrity e.g. navigational, machinery steering gear, cargo system, COW, IGS, fire-fighting, mooring equipment, derrick or cranes etc.

- confirmation of ETA at agreed intervals.

- confirmation that copies of the Ship-to-Ship Transfer Guide (Petroleum) and International Safety Guide for Oil Tankers and Terminals (ISGOTT) are on board and that ship’s personnel are conversant with the procedures therein.

- cargo details.

- confirmation of arrival draught, freeboard, height of manifold above waterline, including maximum manifold height anticipated during discharge.

- confirmation that the ship complies with applicable local and national requirements.

Individual organisers, whether “in-house” shipping company groups or STS service providers, have their own individual formats. The above suggestions can be expanded to include whatever information is required to ensure a safe STS transfer.

4.4 Initial Communications Between Ships

The ships should establish initial communication as early as practicable to plan operations and to confirm the transfer area.

The person in overall advisory control must be mutually agreed between the two ships and this should be clearly established by both Masters prior to the start of operations if not agreed earlier with the STS organisers (see Section 1.4). Logbook entries to the agreement should be made.

4.5 Navigational Warnings

Prior to commencing an STS transfer operation, and thereafter at intervals according to local requirements or more frequently if the situation warrants it, the person having overall advisory control or his designee (see Section 1.4) should broadcast navigational warnings to all ships advising:

- name and flag of the ships involved.

- geographical position of operations and general headings.

- nature of operations.

- time of starting operations and expected duration.

- request for wide berth.
On completion of the transfer, the person having overall advisory control or his designee should cancel the navigational warning.

4.6 Communications During Approach, Mooring and Unmooring

As the ships come into the transfer area, contact should be established on the appropriate VHF channel at the earliest opportunity, thereafter switching to a mutually agreed working channel. Approach, mooring and unmooring should not be attempted until proper effective communication has been confirmed between the two ships. At this time, in accordance with the information exchanged, Check-Lists 2 and 3 should be satisfactorily completed.

Subject to the precautions in Section 3.5.5.3 portable radios are invaluable for inter-ship communications during mooring and cargo transfer operations. Inter-ship confirmation should be sought that the portable radios on each ship are capable of working on the same frequencies. In the event that the same frequencies are not available, provision should be made to exchange compatible equipment between ships.

Ship's officers responsible for mooring stations should be provided with portable radios.

Ship's emergency portable VHF radios should not be used for routine operations.

Picture 5: Approach manoeuvre should not be attempted until proper effective communication has been established.

4.7 Communications During Cargo Transfer Operations

During cargo operations, essential personnel on both ships should have a reliable, common means of communication at all times, including a back-up system. It is recommended that spare radios and batteries are available on both ships.
4.8 Procedures for Communication Failure

If communication breakdown occurs during an approach manoeuvre, the manoeuvre should be aborted if appropriate and safe to do so and the subsequent actions taken by each ship should be indicated by the appropriate sound signals as prescribed in the *International Regulations for Preventing Collisions at Sea* (COLREGS) – Reference 4.

During cargo operations, in the event of a breakdown of communications on either ship, the emergency signal (see Section 10.2) should be sounded and all operations in progress should be suspended immediately it is safe to do so.

Operations should not be resumed until satisfactory communications have been re-established.
Chapter 5

OPERATIONAL PREPARATIONS BEFORE MANOEUVRING

5.1 Preparation of Ships

The Masters of both ships should make the following preparations before manoeuvres begin:

- a study of the procedures given in this guide, supplemented by any instructions issued by shipowners or organisers.
- testing of essential cargo and safety equipment. Procedures of this type are described in ISGOTT.
- crews fully briefed on procedures and hazards, with particular reference to mooring and unmooring.
- confirmation that each ship will be able to comply with all requirements of the Operational/Safety Check-Lists (see Appendix 1).
- steering gear and all navigation and communications equipment confirmed to be in working order.
- engine controls tested and main propulsion plant tested ahead and astern.
- each ship to be upright (having no list) and at a suitable trim.
- mooring equipment prepared in accordance with mooring plan.
- fenders and transfer hoses correctly positioned, connected and secured as appropriate and as required by the STS transfer procedure.
- cargo manifolds and hose handling gear prepared.
- area weather forecasts for the transfer period obtained.
- an agreement as to actions if the emergency signal on the ship's whistle is sounded.
- confirmation of the Security Level at which the ship is operating in accordance with the provisions of the IMO International Ship and Port Facility Security (ISPS) Code (Reference 11), and the requirements being undertaken on board to ensure compliance.
5.2 Navigational Signals

The lights and shapes to be shown, and the sound signals made, during STS transfer operations are those required by the *International Regulations for Preventing Collisions at Sea* (COLREGS), and local regulations. These lights and shapes should be checked and rigged ready for display prior to the STS operation.
Chapter 6

MANOEUVRING AND MOORING

6.1 Basic Berthing Principles

Berthing and unberthing operations should be conducted during daylight unless the personnel concerned are suitably experienced in night-time STS manoeuvring operations.

For some inshore areas the port authority may require a pilot to be taken. In such circumstances the pilot should advise on all aspects of navigation and piloting, but the Master remains in overall control and in command of his own ship.

6.2 Manoeuvring Alongside with Two Ships Under Power

One of the two ships, normally the larger, maintains steerage way at slow speed (preferably about 5 knots) keeping a steady course heading. Local conditions and knowledge will dictate the appropriate heading with due regard to Sections 2.3 and 2.4. The manoeuvring ship then manoeuvres alongside.

It is recommended that the manoeuvring ship approaches and berths with the port side to the starboard side of the constant heading ship.

Be aware that some local jurisdictions may have regulations specifying some aspects of manoeuvring between the ships.

6.2.1 General Advice for Controlling the Two Ships

Each ship should take the following into account:

- engine controls, steering gear and all navigation and communications equipment should be in full working order.
- proficient helmsmen should be assigned to steer each ship.
- courses requested by the manoeuvring ship must be followed by the constant heading ship.
- ship’s speed should be controlled by adjusting engine revolutions (or propeller pitch). Any adjustment should be limited; for example, to plus or minus 5 rpm rather than using the relatively coarse engine room telegraph system. However normal full operating range must remain readily available.
- for diesel engines, ascertain number of air starts available.
- at night the deck should be adequately lit and, if possible, the ship’s side and fenders should be lit by spot lights (see Section 9.5).
the side for mooring should be clear of all overside obstructions; permanent and otherwise.

the navigation lights and shapes appropriate to STS transfers referred to in Section 5.2 should be displayed.

there should be effective radio communications between the bridge and mooring personnel.

there should be effective communications between the Masters of each ship.

Figure 6.1: A Possible Final Approach Manoeuvre
6.2.2 Advice for Manoeuvring Alongside

Although individual Masters will have their own preference for the method of manoeuvring their ship, the following points are emphasised for STS transfer operations:

- if either of the Masters of the ships or the STS Superintendent has the slightest doubt about the safety of the manoeuvre, the berthing operation should be aborted.

- at all times each ship is responsible for maintaining a proper lookout.

- generally, during manoeuvring, the wind and sea are kept on the port bow of the usually larger constant heading ship; however local conditions or knowledge may indicate an alternative approach.

- the angle of approach adopted by the manoeuvring ship should not be excessive.

- a common method of berthing is for the manoeuvring ship to approach the constant heading ship from the quarter on the side of berthing. On closer approach the manoeuvring ship should parallel the course of the constant heading ship at a safe distance that is appropriate to the conditions, before then positioning itself relative to the constant heading ship. Contact is made by the manoeuvring ship reducing the distance by appropriate rudder and engine movements until the fenders touch. (See Figure 6.1.)

- the two ships should preferably make parallel contact at the same speed with no astern engine movements being necessary.

- no engine movement on the constant heading ship should be made without advising the STS Superintendent or Master of the manoeuvring ship.

- the effects of ship interaction should be anticipated when manoeuvring at close quarters.
6.2.3 Manoeuvring a Combined Two-Ship System to Anchor

On completion of mooring, the constant heading ship will usually power all future manoeuvres and, if a transfer at anchor is planned, will proceed to the agreed anchoring position. During this time, the (former) manoeuvring ship will have its engines stopped and rudder amidships. It should be emphasised that, for this period, in order to avoid problems for the manoeuvring ship the constant heading ship should not use strong astern engine movements. *Speeds through the water should be minimal.*

The constant heading ship should use the anchor on the side opposite to that on which the other ship is moored.

Once at anchor, each ship is responsible for watchkeeping arrangements as required by STCW. It is recommended that the anchored ship maintains an anchor watch (see Section 3.6).

Nothing relieves a ship of the requirement to keep a navigational watch.
6.2.4 Underway Transfer

Local conditions, such as those where water depths are too great for anchoring, sometimes demand that cargo transfer be carried out with the twoship system under power and making way through the water. As long as adequate sea-room is available and traffic conditions, weather, sea conditions and forecasts are suitable, then transfers of this type can be carried out. It should be noted that speeds through the water should be minimal.

The constant heading ship maintains steerage way at slow speed on a steady course and the (former) manoeuvring ship keeps its rudder amidships and remains (with engines stopped) as a towed ship. In order to minimise towing loads on the moorings, the constant heading ship should alter her engine revolutions sparingly, adjusting speed very gradually. The chosen course and speed should be agreed by the two Masters and the STS Superintendent and should result in minimum relative movement between the two ships and minimum turbulence in the gap between the hulls.

Under such circumstances, while the ships are moored together as a unit, safe navigation and collision avoidance is usually the responsibility of the constant heading ship but may be under the direction of the person in overall advisory control aboard the lightering ship.

As an alternative, and provided conditions are suitable and a transfer area of suitable size is available, it can be advantageous to carry out cargo transfer while the two ships are allowed to drift freely.

The use of the underway transfer system requires a full navigational watch to be kept on the bridge of each ship.

If deteriorating weather conditions cause the ships to roll unacceptably, engine and rudder movements can be used to bring the ships to a heading that results in minimum movement.

6.3 Manoeuvres with One Ship at Anchor

STS transfer operations involving one ship already positioned at anchor are quite frequent. For such operations, one ship anchors in a pre-determined position using the anchor on the side opposite to that on which the other ship will moor. A berthing operation should only be carried out after the anchoring ship is brought up to her anchor and is lying on a steady heading with reference to prevailing current and wind conditions.

In addition to the usual factors which have to be taken into account when deciding on the scope of cable (water depth, holding ground, winds, currents and underkeel clearance), the Master of the ship which is to anchor should also allow for the fact that the single anchor will be required to hold both ships. When anchoring in deep water, and using an extended scope of cable, the Master of the ship that is to anchor should also ensure that the windlass is capable of recovering the cable and anchor once the operation is completed (see Section 8.1.1).
The type of berthing operation then undertaken by the manoeuvring ship is similar to a normal approach to a jetty. A risk assessment should be undertaken by the organisers to evaluate the necessity of tug assistance for the manoeuvring ship.

A careful watch should be kept on the heading of the anchored ship and the anchored ship should advise the manoeuvring ship immediately if she has any tendency to yaw. Where there is a tendency to yaw excessively, a tug should be employed to hold the anchored ship on a steady heading. If no tug is available, postponement of the operation should be considered.

This manoeuvre can be preferred for more constrained transfer areas, especially when tug assistance is available, or if the manoeuvring ship is fitted with a bow thruster. Where current and wind are not from the same direction or the wind varies in speed or direction the anchored ship can yaw (or lie cross-current), making it difficult for the manoeuvring ship to berth alongside. Also both ships could experience different effects due to their different freeboards and draughts. In these circumstances tug assistance may be advisable to hold the anchored ship on a steady heading during berthing.

It is recommended that the services of an experienced STS Superintendent be utilised for this type of operation. However, berthing should not be attempted when the tidal stream is due to change.

When approaching a ship at anchor some Masters recommend a wider angle of approach than that adopted for manoeuvres underway. A wider angle of approach, especially when tugs are not available, helps to avoid early ship-to-ship contact in cases where the anchored ship might yaw unexpectedly. It is usually recommended that the manoeuvring ship approaches and berths with her port side to the starboard side of the other ship. When mooring to an anchored ship, care should be taken not to pull the anchored ship quickly towards the manoeuvring ship.

6.4 Mooring Preparations

Mooring operations should be managed to ensure expeditious mooring line handling. Moorings should be arranged and rigged to allow safe, effective line tending when the ships are secured together. This is especially true on board the manoeuvring ship whose mooring lines will normally be used, but this should also be addressed on the constant heading ship where rope messengers have to be made ready between fairleads and deck winches.

The mooring plan adopted will depend upon the size of each ship and the difference between their sizes, the expected difference in freeboards and displacement, the anticipated sea and weather conditions, the degree of shelter offered by the location, and the efficiency of mooring line leads available. Most STS service providers will have a standard mooring plan, suitable for the particular location. It is important to ensure moorings allow for ship movement and freeboard changes to avoid over stressing the lines throughout the operation, but that they are not so long that they allow unacceptable movement between the ships. Mooring lines leading in the same direction should be of similar material. Lines should only be led through close fairleads suitable for STS operations (see Section 8.3). The use of stopper bars to retrofit open fairleads is not recommended.
The order of passing mooring lines during mooring, and of releasing lines during unmooring, should be agreed. Where the STS service providers utilise quick-release mooring hooks, their role and use should be discussed to ensure proper understanding.

As a general guide, Figure 6.2 illustrates a typical and proven mooring plan for an STS transfer operation in offshore waters. Scope for additional head and stern lines is preferred, and at any time spare lines should be readily available to supplement moorings if necessary or in the event of a line failure. While analysis of mooring loads alone may indicate a lesser number of mooring lines would be sufficient, it is prudent to provide for some redundancy. However, where specialised mooring equipment is fitted (e.g. on a Dedicated Lightering Ship) the number of headlines could be reduced to four where this has proven to be reliable for the local operating environment.

Figure 6.2: Typical STS Mooring Arrangement

Lines should only be led through class approved closed fairleads. The use of stopper bars to retrofit open fairleads is not recommended.

Full size mooring bits and enclosed fairleads should be fitted within 35 metres of the centre of the manifold fore and aft.

Additional lines should be readily available to supplement moorings if necessary or in the event of a line failure.
It is normal for the mooring lines to be deployed from the manoeuvring ship. However, when prevailing weather conditions or weather forecasts require it, sending lines from both ships can increase the number of mooring lines. Loads should not be concentrated by passing most of the mooring ropes through the same fairlead or onto the same mooring bitts. Use should be made of all available fairleads and bitts.

STS transfer operations, by their very nature, create situations where two ships are moored close alongside each other with considerable differences in freeboard, which may be more pronounced if only one of the ships has a double hull. The steeper the orientation of the mooring lines, the less effective they will be in resisting horizontal loads. The maximum anticipated freeboard difference should therefore be taken into account when planning the mooring layout in order to ensure that the vertical angle of each mooring line stays as small as practicable throughout the operation. During the operation, freeboard differences should be kept to a minimum, with consideration given to ballasting the higher ship and de-ballasting the lower one where this is possible. Initial ship selection criteria should be considered where large freeboard differences may become significant.

A ship’s standard complement of mooring lines is generally suitable for STS transfer operations but ships equipped with steel wire or high modulus synthetic fibre mooring lines should fit soft rope tails to them. The connection between the primary line and the soft rope tail should be made with an approved fitting e.g. Mandel or Tonsberg Shackle. Additional information on mooring lines and tails is contained in Section 9.3.

Rope tails should be at least 11 metres long and have a dry breaking strength at least 25% greater than that of the wires to which they are attached in accordance with OCIMF Mooring Equipment Guidelines (Reference 2). Soft rope tails fitted to wire moorings also introduce the benefit of making the cutting of mooring lines easier in an emergency and, for this purpose, long-handled firemen’s axes or other suitable cutting equipment should be available at all mooring stations.

Strong rope messengers should be readied on both ships and in addition rope stoppers should be rigged in way of relevant mooring bitts. Where possible, heaving lines and rope messengers should be made of buoyant materials. A minimum of four messengers should be provided and ready for immediate use.

Non-pyrotechnic line-throwing equipment may be used to make the first connection. Crews should be advised beforehand and further warned immediately before the equipment is used.
Picture 8: Lines should only be led through closed fairleads, using all available fairleads and bits to avoid concentration of loads.

6.5 Mooring Considerations

Appendix 3 contains a summary of findings arising from recent detailed computer modelling of mooring loads under typical STS conditions for VLCCs-to-Suezmax and Suezmax-to-Aframax size tankers. It provides a useful insight into the factors that influence the efficiency of STS mooring systems and the following recommendations were derived from the study.

Tension in Mooring Lines
Excessive or uneven tension in mooring lines should be avoided because it can significantly reduce the weather threshold at which the forces in mooring lines will exceed their SWL. Attention should be given to this throughout the STS operation in order to ensure changes to the relative freeboards do not create excessive strain in the moorings.

Mooring Line Lead Angles
The study demonstrated that peak loads on individual head and stern mooring lines can be minimised if the lead angles are similar and thus more effectively share the mooring loads.

Weather Thresholds
In general, the research indicated that higher weather thresholds for mooring loads can be tolerated when the STBL is at or close to fully loaded displacement. Masters and persons in overall advisory control should be aware that weather thresholds may change significantly during the course of an STS operation as the STBL is lightened. It is also apparent that a larger STBL can be expected to have a higher mooring load weather threshold than a smaller STBL.
Long Period Waves
STS operations in locations subject to long period waves should be undertaken with caution. The load on mooring lines at any specific significant wave height greatly increases as the wave period, or period of encounter, increases.

Direction of Wave Encounter
Wave encounter from a beam direction during STS operations should be avoided. This will need particular attention when using exposed anchorage STS locations subject to strong currents, where the ships can lie at a large angle to the wind and waves.

When conducting underway STS operations, the optimum wave encounter direction to control mooring loads is normally considered to be on the port bow, with the STBL to windward. But, depending on the relative size and displacements of the two ships, this may not always be the case. For instance, when both ships are of similar size and as the lightering ship’s displacement increases relative to the STBL, the optimum mooring load wave encounter direction may change to the starboard bow, with the lightering ship to windward. In such a case, it may be advantageous to have sea-room available for course alterations across the wind.
Chapter 7

PROCEDURES ALONGSIDE

7.1 Pre-Transfer Procedures

When the two ships are securely moored and before cargo transfer commences, good communications should be established between the personnel responsible for cargo operations on each ship and the pre-transfer checks should be satisfactorily completed (see Check-List 4). In addition, attention should be given to the appropriate safety Check-List from ISGOTT.

7.2 Responsibility for Cargo Operations

Cargo transfer operations should be carried out in accordance with the requirements of the receiving ship. The person in charge of the cargo operations for each ship should be positively identified on a list posted on the bridge and cargo control room of both ships, together with the names of other persons supervising the cargo transfer.

7.3 Planning for Cargo Transfer

When preparing cargo loading and discharging plans, due regard should be given to ensuring that adequate stability is maintained, hull stresses remain within design limits and free surface effects are kept to a minimum throughout.

The cargo transfer operation should be planned and agreed in writing between the two ships and, where applicable, should include information on the following:

- quantity of each grade of cargo to be transferred.
- sequence of grades, cargo density, temperature and specific precautions such as those that might be necessary for static accumulator products.
- details of cargo transfer system, number of pumps, maximum pressure.
- crude oil washing procedures.
- cargo heating requirements.
- initial and maximum topping off rates and notice period of rate change.
- normal stopping and emergency shutdown procedures.
- emergency and spill containment procedures.
- watch or shift arrangements.
- critical stages of the operation.
• local or government rules that apply to the transfer.

• Material Safety Data Sheet (MSDS) in respect of cargo to be transferred to ensure that the receiving ship is aware of particular properties of the cargo e.g. high Hydrogen Sulphide (H₂S) content, special fire-fighting requirements etc.

• receiving ship to provide details of previous cargo (see Section 3.5.7).

• co-ordination of plans for cargo hose connection, monitoring, draining and disconnection.

Before starting cargo transfer, the discharging ship must be informed by the receiving ship of the flow rates required for the different phases of the cargo operation. If variations in transfer rate become necessary, the receiving ship should advise the discharging ship of its requirements. The discharging ship should similarly inform the receiving ship of any variations in flow rates due to its operations.

The agreed transfer rate should not exceed the manufacturer’s recommended flow rates for the cargo hoses (see Section 9.2.6).

7.4 Cargo Transfer – General Guidance

Throughout cargo transfer operations, the discharging ship and the receiving ship should station a responsible person at the cargo manifold area to observe the hoses and to check for leaks. In addition, throughout the cargo transfer, a responsible person equipped with a portable radio should be stationed at or near the cargo pump controls or in the cargo control room on the discharging ship, to take action as required.

Cargo transfer should begin at the agreed slow rate to enable the receiving ship to check that the cargo pipeline system is correctly set. The transfer rate should also be reduced to an agreed topping off rate when the receiving ship’s tanks are reaching their filling limits. Throughout the transfer, as a minimum hourly transfer rate checks and comparisons should be made between the two ships, and the results logged. Any differences or anomalies should be carefully checked and if necessary cargo operations should be suspended until the differences are resolved.

When agreeing the transfer rate, account should be taken in addition to normal operational considerations of factors including, but not limited to, the following:

• limitations dictated by the cargo hoses (see Section 9.2.6).

• any limitations imposed by flow velocities in the ships’ fixed cargo piping or venting systems.

• weather conditions that might cause movement of the hoses.

Cargo operations should be conducted under closed conditions i.e. with ullage, sounding/sampling ports securely closed. In some parts of the world vapour balancing procedures are enforced and due regard should therefore be given to local regulations.

It should be noted that the incorrect operation of pumps and valves could produce pressure surges in a pipeline system. These surges can be sufficiently severe to damage the pipeline or the hoses. Consideration should be given to the prevention of pressure surges by careful planning and control of pump speeds and the operation of valves.
Static accumulator cargoes will require extra precautions and ISGOTT should be referred to when handling this type of cargo.

During cargo transfer, appropriate ballast operations should be performed in order to minimise the differences in freeboard between the two ships, and to avoid excessive trim by the stern. Listing of either ship should be avoided, except as required for cargo tank draining on the discharging ship.

Picture 9: Freeboard differences should be kept to a minimum.

Most ships engaged in STS operations are fitted with segregated ballast tanks. However, cases may arise where ships are employed which may require the transfer of ballast to the discharging ship. During deballasting from cargo tanks the inert gas system, where fitted, should be operated.

Regardless of the type of ship, any ballast discharged overboard should be clean. All other ballast should be retained on board or, as in the circumstances mentioned above, may be transferred to the discharging ship. On completion of deballasting, lines and pumps should be drained, and all sea valves tightly shut, checked and sealed.

Any national or local regulations controlling discharge of ships' ballast water should be complied with.

Constant attention should be paid to mooring lines and fenders to avoid chafing and undue stress, particularly that caused by changes in relative freeboard. If at any time mooring lines need to be re-positioned or adjusted this should only be done under strictly controlled conditions. Consideration should be given to the need to suspend other operations to attend to these activities.
7.5 Operations After Completion of Cargo Transfer

In accordance with previously agreed procedures, after completion of cargo transfer the following operations should be carried out:

• all hoses should be drained into one ship prior to disconnecting.
• hoses should be disconnected and securely blanked.
• cargo manifolds should be securely blanked.
• authorities should be informed of completion of cargo transfer and the anticipated time of unmooring.
Chapter 8

UNMOORING

8.1 Unmooring Procedure

8.1.1 Unmooring While One Ship is at Anchor

Special care needs to be taken during such operations. There have been incidents and near misses when unmooring with one ship still at anchor, an operation complicated by the unpredictability of environmental conditions and the difficulty of accurately assessing such factors as tidal conditions. It is therefore recommended not to unmoor during a change of tide. It is also recommended that unmooring at anchor be carried out only by persons with considerable experience in STS operations and use of tugs should be considered where available, especially if yawing of the anchored ship is anticipated.

If, in the judgement of the person in overall advisory control, weather and current conditions so require, the constant heading ship should weigh her anchor and unmooring should be carried out while making way.

Picture 10: Special care needs to be taken when unmooring to avoid the two ships coming into contact.
8.1.2 Unmooring After Underway Transfer

Where STS transfer operations have taken place while underway, it is normal to unmoor with the wind and sea on the port side and then bring the combined two-ship system head to the wind to spread apart the ships, unless local conditions dictate otherwise.

8.2 Unmooring Checks

Sufficient crew should be allocated to unmooring stations and consideration should be given to the following points:

- the cargo transfer side of the ship should be cleared of obstructions including derricks or cranes.
- the method of disengagement and of letting go mooring lines should be agreed.
- fenders, including their towing and securing lines, should be checked to be in good order.
- winches and windlasses should be ready for immediate use.
- rope messengers and rope stoppers should be ready at all mooring stations.
- fire axes or other suitable cutting equipment should be available at each mooring station.
- communications should be confirmed between ships.
- communications should be established with mooring personnel.
- mooring personnel should be instructed to let go mooring lines only when directed.
- shipping traffic in the vicinity should be checked.
- Check-List 5 of Appendix 1 should be completed.

8.3 Procedure for Unberthing

Special care needs to be taken when unmooring to avoid the two ships coming into contact. While there are other methods, a common method of unmooring is achieved by singling up fore and aft, then letting go the remaining forward mooring and allowing the bow to swing away from the constant heading ship to a suitable angle, at which time the remaining stern mooring line is let go and the manoeuvring ship moves clear. After disengaging, neither ship should attempt to steam ahead or fall astern of the other until both ships are well separated. The constant heading ship should not independently manoeuvre until advised that the manoeuvring ship is clear.

It should be noted that local conditions or ship configurations may cause difficulties in separating the two ships and alternative plans should be considered.
8.3.1 Unmooring Using Quick Release Apparatus or Toggle Pins

Special care should be taken in regard to letting go the last lines in an expeditious and safe manner. This operation should be planned in advance, be undertaken by experienced crew and requires good communications and supervision.

Different methodologies can be applied by STS Superintendents and ships’ crews to carry out this task safely and effectively. One such method involves the use of quick release hooks secured around the mooring bitt or a “toggle” pin that is used in conjunction with a messenger to take the load of the mooring line while it is removed from the mooring bitt.

The deployment of the toggle pin technique is shown below in Figure 8.1.

![Diagram showing the use of release or toggle pins](image)

**Figure 8.1: Use of Release or Toggle Pins**

Step 1: Shackle the toggle-pennant to the bitts.
Step 2: Run a messenger (with a small eye spliced in the end) from the winch to the mooring line to be released.
Step 3: Take the messenger and make a turn around the mooring line.
Step 4: Pass a bight of the messenger through the eye.
Step 5: Pass the toggle through this bight.
Step 6: Heave in on the messenger.
Step 7: Remove the mooring lines from the bitts.
Step 8: Slack the messenger line, the toggle will release itself, the messenger will be freed and the mooring line will slide through the fairlead over the side. Two lines may be released at the same time.
Chapter 9

EQUIPMENT

9.1 Fenders

9.1.1 Fender Usage

Fenders used in STS transfer operations offshore are divided into two categories:

- primary fenders which are positioned along the parallel body of the ship to afford the maximum possible protection while alongside; or

- secondary fenders which are used to protect bow and stern plating from inadvertent contact if the ships get out of alignment during mooring and unmooring. The point(s) where such contact is likely to occur, which may be relatively high up due to the flare of a bow or a stern, should be identified in advance of the operation and the secondary fenders positioned accordingly. It is necessary to have due regard to the securing points for secondary fenders which may not be adjacent to a bollard, fairlead or hoisting equipment. It is important that secondary fenders are properly secured and it may be necessary to move the secondary fenders prior to unmooring if the likely point(s) of contact have changed due to changes in the freeboards of the two ships.

Primary fenders may be foam filled or of the pneumatic type (0.5 to 0.8 kg/cm²) and should be manufactured, tested and maintained in accordance with industry and international standards. A new International Standard (ISO 17357) now specifies the material, performance and dimensions of floating pneumatic fenders which are intended to be used for the berthing and mooring of a ship to another ship or berthing structure. It also specifies the test and inspection procedures for floating pneumatic fenders. It is strongly recommended that any pneumatic fenders used in STS transfer operations comply with this standard or equivalent. There are, to date, no comparable standards for foam filled fenders. However, it is recommended that materials, verification and inspection for foam filled fenders are in accordance with an ASTM and ISO calibration system that meets ANSI/NCSL Z540 (ISO 10012-1).

Secondary fenders may also be either air or foam filled. It can, however, be advantageous for secondary fenders to be light in weight because, as stated above, they must often be hauled well above the waterline and located in positions with limited access to lifting gear or support points. It may help if fenders can be moved quickly to counter possible inadvertent contact.

Except in cases where the STS transfer is carried out using a dedicated lightering ship, it is most probable that fendering operations will be carried out with the assistance of an STS service provider. Such companies usually have service craft available and these vessels will normally assist in positioning fenders on the relevant ship.
Fenders may be secured in place on either ship. However, landing on an unprotected hull section is less likely if the fenders are rigged on the manoeuvring ship, and it is therefore preferable that fenders be secured to that ship. It should be noted that where fenders are to be rigged on the manoeuvring ship there may be more stresses on the head fender wire, and that the fender wire utilizes one head wire per winch. In addition, being generally the smaller ship, a less effective lee for rigging is maintained.

Figure 9.1: Fenders Rigged in a Continuous String

Figure 9.2: Fenders Rigged in Pairs

The person in overall advisory control should advise the position and method of securing the fenders to the ships in advance of the operation.

When fenders are fitted to the manoeuvring ship, primary fenders should be positioned one at each end of the parallel body, with similar additional units fitted in between (see Figure 9.1). The fender string may be made up to a pre-arranged length. Alternatively in some operations where four fenders are used, it has been found beneficial to position them in two groups of two (see Figure 9.2). In this way, and with each group positioned well forward or well aft on the parallel body, better protection can be provided. Secondary fenders may be positioned fore and aft of the parallel body. Fender moorings should be monitored frequently and tended as necessary to ensure that they do not become too slack or too taut and that the fenders remain in position.

The length of the fender string should be such that the fenders will be able to distribute the maximum anticipated impact load within the parallel body of both ships.
9.1.2 Reference Guide for Fender Selection

Table 9.1 is included to provide a quick reference guide to fender selection and is only intended to be used to provide an indication of suitability under the conditions specified. It should be understood that different approach velocities would give very different energy absorption requirements. It should also be understood that the table is intended to be used with considerable discretion based on knowledge and experience of the type of operation to be carried out. This is particularly the case for values of “C” below 10,000 tonnes, where at least one of the ships involved is likely to have minimal freeboard and where different fender types may be necessary. Note also that in the following calculation the discharging ship characteristics are given for light (ballast) condition and the constant heading ship characteristics are given for operational loaded condition.

The table should be interpreted using the following formula:

\[ C = \frac{2 \times \text{Displacement Ship A} \times \text{Displacement Ship B}}{\text{Displacement Ship A} + \text{Displacement Ship B}} \]

<table>
<thead>
<tr>
<th>Berthing Coefficient</th>
<th>Relative Velocity</th>
<th>Berthing Energy</th>
<th>Suggested Fenders</th>
<th>Typical Pneumatic Fender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonnes</td>
<td>M/Sec</td>
<td>Tonnes.m</td>
<td>Quantity</td>
<td>Metre</td>
</tr>
<tr>
<td>1,000</td>
<td>0.30</td>
<td>002.4</td>
<td>3 or more</td>
<td>1.0 x 2.0</td>
</tr>
<tr>
<td>3,000</td>
<td>0.30</td>
<td>007.0</td>
<td>&quot;</td>
<td>1.5 x 3.0</td>
</tr>
<tr>
<td>6,000</td>
<td>0.30</td>
<td>014.0</td>
<td>&quot;</td>
<td>2.5 x 5.5</td>
</tr>
<tr>
<td>10,000</td>
<td>0.25</td>
<td>017.0</td>
<td>&quot;</td>
<td>2.5 x 5.5</td>
</tr>
<tr>
<td>30,000</td>
<td>0.25</td>
<td>040.0</td>
<td>4 or more</td>
<td>3.3 x 6.5</td>
</tr>
<tr>
<td>50,000</td>
<td>0.20</td>
<td>048.0</td>
<td>&quot;</td>
<td>3.3 x 6.5</td>
</tr>
<tr>
<td>100,000</td>
<td>0.15</td>
<td>054.0</td>
<td>&quot;</td>
<td>3.3 x 6.5</td>
</tr>
<tr>
<td>150,000</td>
<td>0.15</td>
<td>071.0</td>
<td>5 or more</td>
<td>3.3 x 6.5</td>
</tr>
<tr>
<td>200,000</td>
<td>0.15</td>
<td>093.0</td>
<td>&quot;</td>
<td>3.3 x 6.5</td>
</tr>
<tr>
<td>330,000</td>
<td>0.15</td>
<td>155.0</td>
<td>4 or more</td>
<td>4.5 x 9.0</td>
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<tr>
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<td>0.15</td>
<td>231.0</td>
<td>&quot;</td>
<td>4.5 x 9.0</td>
</tr>
</tbody>
</table>

Table 9.1 A Quick Reference Guide to Fender Selection for Standard STS Operations.

Table 9.1 above gives approximate numbers and sizes for typical pneumatic fenders. Foam filled fenders may differ slightly in size and may vary in their energy absorption capacity due to the particular foam density used in manufacture.

It is strongly recommended that individual fender manufacturers or STS service providers are consulted prior to suggesting the number and sizes of fenders for a particular operation. A sample form illustrating the information usually required when requesting assistance in fender selection and other fender guidance is found in Appendix 2.
Picture 11: Unless the STS transfer is carried out by a dedicated lightering ship, a service craft will normally assist in positioning the fenders.

Picture 12: The lights and shapes to be shown during STS transfer operations are those required by the "International Regulations for Preventing Collisions at Sea" (COLREGS).
9.1.3 Fender Requirements

Some shipowners and STS service providers will be able to call upon experience when assessing fender requirements for a particular STS transfer operation. It is advisable, however, to determine the forces that will be generated between berthing ships to provide information relevant to the selection process.

The fenders used should be suitable in terms of energy absorption and result in sufficient stand-off distance such that the compressed diameter of the fenders must always be sufficient to ensure that there can be no contact between ships' structures through rolling, during the period alongside. It is recommended that the fender diameter is less than half the freeboard of the ship, to prevent inadvertent boarding of the ship by a fender during inclement weather.

Individual fenders should be fitted with rubber sleeves and hard wearing tyres in order to reduce the abrasion damage to the outer rubber of the fender and ensure steel to steel contact does not occur between fender cage and ship's hull.

Care should be taken with regard to the safe working load (SWL) of the end fitting of the fenders, and the expected tension load at the end of the fenders should not exceed this limit.

![Picture 13: Where hoses or fenders are provided by an STS service provider checks should be made to ensure they are fit for the intended purpose.](image-url)

The longevity of fenders will be determined by a number of factors including frequency of use, method of storage and standards of maintenance. As a guide, it is suggested that fenders should not be routinely used if they are more than fifteen years old. If fenders are provided by an STS service provider, the Master, shipping company, or organiser, should ascertain the age of the fenders to be used. If the fenders are more than fifteen years old, assurances should be sought that reasonable measures have been taken to ensure that...
they continue to be fit for the intended service. It is recommended that all fender providers have detailed and accurate records regarding the history of the fenders. These records should include particulars of each job they were used for, inspection, testing, maintenance and casualty information.

When selecting fenders for specific operations reference should be made to individual fender manufacturers' specifications and these should be addressed in terms of berthing speed, sea and swell conditions among other factors. It is the responsibility of the person in overall advisory control to determine the fender requirements and to agree these with all of the other parties involved.

This is particularly important when planning to undertake reverse lightering operations (see Foreword) where consideration should be given to utilising fenders with higher energy absorption for the berthing phase than those recommended in Table 9.1. It is strongly recommended that in these situations the further guidance regarding approach velocity as contained in Appendix 2 is taken into consideration.

Berthing speed is one of the most important criteria for determining fender requirements. Generally the berthing speed of small ships (< 10,000 dwt) is 0.1-0.3 m/sec (0.2-0.6 knots) and of larger ships is less than 0.2 m/sec. (0.4 knots).

It should be noted that it is not always possible to judge approach speed accurately when berthing and that it may be prudent to err on the side of caution when selecting fenders. Manufacturers' recommendations for a calm weather situation and a maximum approach speed of e.g. 0.15 m/sec. (0.3 knots) may be inadequate should weather be a factor and approach speed be significantly higher than planned, in which case selection of larger size fenders may be appropriate.

9.2 Hoses

9.2.1 Hose Standards

The hoses used for crude oils or petroleum products should be specially designed and constructed for the product being handled and the purpose for which they are being used. They should be checked at time of issue as being suitable for the intended use. Hoses used should comply with EN1765 (or latest equivalent) with regard to specification for the assemblies and with BS1435-2 (or latest equivalent) and OCIMF Guidelines for the Handling, Storage, Inspection and Testing of Hoses in the Field (Reference 9).

A visual inspection of each of the hose assemblies should be carried out before they are connected to the manifolds to determine if any damage has been caused when taking them on board. If damage to a hose or flange is found that is considered to be critical to the operation, the hose should be withdrawn from use to allow further inspection or repair.

9.2.2 Hose Size and Length

The diameter of a chosen cargo transfer hose is governed mainly by the required flow velocity and some detail on this subject is given in Section 9.2.6. Hoses in excess of twelve inches in diameter will be progressively more difficult to handle and particular care will be needed to avoid damage from kinking, unless the hose assembly is specifically designed to overcome this problem.
Experience has shown that hose lengths equal to twice the maximum difference in manifold height between the two ships, rounded up to the nearest whole number of hoses, are usually sufficient to allow for other variables such as bends in the hoses, differences in fore and aft alignment (offset manifolds), horizontal distance between the ships, distances of manifolds from the ships’ sides, vertical and horizontal ship motions etc. Hose lengths should however be considered on a case-by-case basis, taking into account any special characteristics of the ships or features of the operation.

![Image of a hose connection setup]

**Picture 14:** Hose lengths equal to twice the maximum difference in manifold heights are usually sufficient but should be considered on a case by case basis.

For guidance, a rule of thumb for calculating the minimum-bending radius (MBR) of a rubber hose is given by the formula:

\[ \text{MBR} = \text{Nominal Bore of Hose} \times 6 \]

(For example a hose of twelve inches nominal bore will give a minimum bending radius of approximately seventy two inches.)

### 9.2.3 Hose Connection

STS transfer operations require hose connections to be well made. Flanges or quick release couplings, if used, should be in good condition and properly secured to ensure leak tight connections. The gaskets used at the ship’s manifolds and between each hose should be made from a material suitable for the cargo to be transferred.

Both ships will be expected to provide the necessary personnel to connect the hoses. As this is an operation not frequently carried out by ships’ crews, attention is drawn to the guidance within ISGOTT on hose connecting.

To simplify hose connection, it is recommended that ships be fitted with cargo manifolds designed in accordance with OCIMF *Recommendations for Oil Tanker Manifolds and Associated Equipment* (Reference 6) with regard to flange sizes, manifold strength, hose support arrangements, lifting gear etc.
Adequate provision should be made to support hoses to prevent excessive strain on manifold fittings.

9.2.4 Hose Inspection and Testing

Hoses used should be subject to regular inspection for damage or deterioration. A record of inspection and pressure/vacuum testing, where relevant, should be available.

Periodic testing of hoses should be in accordance with the requirements of the specification to which the hose was manufactured and/or as detailed in accordance with British Standards BS1435-2 as amended, or equivalent. Although the OCIMF publication Guidelines for the Handling, Storage, Inspection and Testing of Hoses in the Field (Reference 9) is written with offshore installations in mind, much of the guidance given with regard to the proper handling and storage of hoses will also apply to hoses used for STS transfer operations. It is therefore recommended that reference also be made to that document.

In consultation with the hose manufacturer, the retirement age for the hoses should be defined to determine when they should be removed from service. The retirement age defined is independent of the hose meeting inspection and testing criteria.

If hoses are provided by an STS service provider, the Master, shipping company or organiser should ascertain the age of the hoses to be used and should satisfy themselves that reasonable measures have been taken to ensure that they continue to be fit for the intended service. The hose certificates should be made available to assist with this.

9.2.5 Marking

Each length of hose should be marked by the manufacturers with:

- the manufacturer's name or trademark.
- identification of the standard specification for manufacture.
- maximum allowable working pressure.
- month and year of manufacture and manufacturer's serial number.
- indication that the hose is electrically continuous or electrically discontinuous, semi-discontinuous or anti-static.
- the type of service for which it is intended e.g. oil or chemical.

9.2.6 Flow Velocities

The maximum permissible flow velocity through a hose is limited by the construction of the hose. The hose manufacturer's recommendations and certification should give details as to recommended flow rates/velocities, which should not be exceeded. Hoses should be properly tested and certified and should therefore be capable of performing to their specification.

Downgrading of hose flow rates or pressures due to age or condition is not recommended and is therefore not covered in these guidelines.
Tables 9.2 (a), (b) and (c) are indicative of flow rates for hoses supplied to BSI specification.

### Velocity 12 metres/second

<table>
<thead>
<tr>
<th>Nominal Inside Diameter of Hose</th>
<th>Throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inches</strong></td>
<td><strong>Millimetres</strong></td>
</tr>
<tr>
<td>6</td>
<td>152</td>
</tr>
<tr>
<td>8</td>
<td>203</td>
</tr>
<tr>
<td>10</td>
<td>254</td>
</tr>
<tr>
<td>12</td>
<td>305</td>
</tr>
<tr>
<td>16</td>
<td>406</td>
</tr>
<tr>
<td>20</td>
<td>508</td>
</tr>
</tbody>
</table>

Table 9.2 (a) Throughput v Inside Diameter at Velocity = 12M/S

### Velocity 15 metres/second

<table>
<thead>
<tr>
<th>Nominal Inside Diameter of Hose</th>
<th>Throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inches</strong></td>
<td><strong>Millimetres</strong></td>
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<td>6</td>
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<td>203</td>
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<td>10</td>
<td>254</td>
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<td>305</td>
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<tr>
<td>16</td>
<td>406</td>
</tr>
<tr>
<td>20</td>
<td>508</td>
</tr>
</tbody>
</table>

Table 9.2 (b) Throughput v Inside Diameter at Velocity = 15M/S

### Velocity 21 metres/second

<table>
<thead>
<tr>
<th>Nominal Inside Diameter of Hose</th>
<th>Throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inches</strong></td>
<td><strong>Millimetres</strong></td>
</tr>
<tr>
<td>6</td>
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<td>8</td>
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<td>10</td>
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<td>16</td>
<td>406</td>
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<tr>
<td>20</td>
<td>508</td>
</tr>
</tbody>
</table>

Table 9.2 (c) Throughput v Inside Diameter at Velocity = 21M/S
Flow rates for different hose velocity ranges can be calculated using the following formula:

\[(\pi r^2 V \times 3600) = \text{cubic metres per hour}\]

Where \(r^2\) is the internal radius in metres and \(V\) is flow velocity in metres per second.

9.3 Mooring Equipment

It is important that both ships are fitted with good quality mooring lines, efficient winches, well placed and sufficiently strong closed fairleads, bollards and other associated mooring equipment which are fit for purpose. Effective leads between fairleads and mooring bitts and mooring winches should be available for the handling of all mooring lines. Only fairleads of the enclosed type should be used, except on a ship that will always have a substantially greater freeboard than the other. This will ensure that the fairleads will remain effective in controlling mooring line leads as the freeboard difference between the two ships changes. Such fairleads should be strong enough to take the anticipated mooring loads and large enough to allow the mooring line (plus any soft rope tail and shackle) to pass through comfortably. Open fairleads, even those fitted with stopper bars, are not recommended for STS operations.

A prime consideration in mooring during STS operations is to provide fairleads and bitts for all lines without the possibility of lines chafing against each other, the ships, or the fenders. This is critical in view of the large relative freeboard changes between the ships.

Steel wire mooring lines should be fitted with synthetic fibre tails to provide the additional elasticity required for STS mooring arrangements. Lengths, connections and properties of such synthetic fibre tails should at least comply with the recommendation of the OCIMF Mooring Equipment Guidelines (Reference 2). Some dedicated lightering ships may be equipped with special mooring line arrangements such that the synthetic fibre tail is of a different length to the Mooring Equipment Guidelines recommendations and is positioned outside the ship's fairleads with a further wire pendant attached to its end to reduce chafing damage.

High modulus synthetic fibre ropes, which are now increasingly being used as ship's moorings, should (depending on type) also be fitted with soft rope tails to provide additional elasticity and to reduce the susceptibility to fatigue failure. (See the OCIMF publication Guidelines on the Use of High-Modulus Synthetic Fibre Ropes as Mooring Lines on Large Tankers (Reference 12) for further details.) Some high modulus synthetic fibre ropes are susceptible to axial compression fatigue due to tight radius bends and care should be taken to follow the manufacturer's recommendations when choosing the connection to the tail. Some types are more susceptible to chafing and may require greater protection in STS service.

Strong rope messengers should be available on both ships. A rope messenger is a light rope that is used for hauling mooring lines between ships. A minimum of four messengers should be available, preferably made from a buoyant synthetic fibre material of 40mm diameter and at least 200m in length and fit for purpose.

It is recommended that the guidance provided for sizing, marking and certifying fairleads and bollards should be applied to these fittings. Further guidance is provided in the OCIMF Mooring Equipment Guidelines (Reference 2) and Recommendations for Ships' Fittings for Use with Tugs (Reference 10); in particular Section 4.3.1 Recommendations for the Tanker Owner, should be applied to such fittings used for STS moorings. In so doing, it is recognised that it may not always be practicable to apply all aspects of these recommendations to existing mooring equipment with the
ship in active service and that changes may have to wait for a dry-docking or repair period. In the case of existing ships where deck fittings do not meet the above recommendations, the Master should be aware of any limitations and should advise the Master of the other ship, the STS Superintendent and person in overall control of this shortcoming so that they may take appropriate precautions.

In practice it has been found that the smaller ship's standard mooring equipment is generally suitable for STS transfers. Larger ships may require additional fittings to allow a proper mooring pattern and it is therefore recommended that tankers over 160,000 dwt, used for STS operations, be fitted with closed fairleads within thirty five metres of the centre of the manifold, fore and aft, on the starboard side to take the spring lines from the smaller ship (see Mooring Equipment Guidelines – Reference 2). It is also recommended that the larger ship does not utilise any fairleads located on a transom stern such that the mooring line will, due to its lead, chafe on the edge between the transom stern and the ship's side.

The recommended minimum number of closed fairleads on the starboard side of the larger ship for STS operations is three aft and four forward. Typically a mooring pattern for exposed locations for lightering vessels not fitted with special mooring arrangements would consist of at least six head lines, two forward and two back springs, and four stern lines. Where specialised mooring equipment is fitted (e.g. on dedicated STS transfer ships) the number of head lines could be reduced to four where this has proven to be reliable for the local operating environment.

The aft closed fairleads should be located as far aft as practicable and the forward closed fairleads should be located on, or to starboard of, the centre line and clear of any protruding anchor housings. In determining the location of closed fairleads consideration should be given to achieving a mooring arrangement that allows mooring lines of the same function (headlines, sternlines, breastlines or springs) to run as parallel as possible to each other in order most effectively to share the mooring load. It is desirable that each designated STS suitable closed fairlead on the larger ship be accompanied by bits capable of taking at least two mooring lines and rated to at least the same SWL as the fairlead. Each set of bits should be sited or arranged for safe use of messengers and attendant winches.

In addition it is recommended that provision be made for securing fender lines.

9.4 Personnel Transfers

In general it is recommended that the transfer of personnel between ships be kept to an absolute minimum. If the transfer of personnel is unavoidable the following recommendations should be considered:

- gangways should only be used where there is little or no movement. If used, gangways should be of a lightweight insulated type fitted with rails and complete with a safety net and should be tended to ensure they remain at all times within safe design operating parameters. **The use of open rung ladders is strongly discouraged.**

- workboat transfer should only take place using appropriate pilot ladder/accommodation ladder combinations taking into account the freeboard. Due consideration should always be given to the sea conditions, the suitability of the workboat and the experience and fitness of transferring personnel.

- personnel baskets should only be used if all the associated lifting equipment is suitable for personnel transfer and adequate procedures are in place (see also Section 9.4.2).
The following factors, although not an exhaustive list, should be among those taken into consideration before making the final selection of transfer option and commencement of transfer operations:

- a risk assessment should evaluate the effects of weather, sea-state, darkness, and any other relevant factors.

- account should be taken of the presence of any national or local regulations, or relevant codes of safe working practice, that govern transfers of personnel in open waters using the method under consideration.

- all transferring personnel should wear full safety and personal floatation devices.

- crew members operating any lifting equipment or working in the vicinity of the transfer area should wear the appropriate personal protection equipment.

- the Master or his designee (e.g. senior deck officer or person in overall charge of the STS operation) should be in attendance throughout the transfer operation.

### 9.4.1 Booms or Derricks

Due to a significant number of injuries and near misses, it is recommended that personnel transfers are **NOT** conducted using booms or derricks.

### 9.4.2 Cranes

Because typical tanker cranes are large, heavy and primarily designed as cargo handling equipment, they can be difficult to control precisely. It is recommended that only cranes suitable for personnel transfer are used for transferring personnel between ships. Alternative safe means, such as workboat transfer, should be considered, keeping in mind that appropriate risk assessments for any method of personnel transfer should be undertaken.

The following factors should be taken into account when considering the use of cranes and transfer baskets:

- transfers by personnel baskets using ships’ cranes should only be undertaken when transfer is essential and it is not practicable to gain access by less hazardous means following the risk assessment.

- any crane utilised should be suitable for the task and equipped with adequate safety devices to prevent free fall. Hoisting and lowering limiters are preferred and their availability (or otherwise) on the equipment intended for use should be addressed in the risk assessment.

- all lifting equipment should be inspected, maintained, weight tested and certified as required. This includes personnel transfer baskets, rigging and straps. Lifting equipment is to be used only for that purpose and must be accounted for on the ship’s planned maintenance schedule. All load certifications or class documents should be kept available for inspection.

- transfer baskets should be of a design and in a condition suitable for the intended purpose.
EQUIPMENT

- all hooks or shackles should be properly closed, moused or wired. Consideration should be given to increasing the safety factor of the lifting equipment to be used for personnel transfer by using one half of the crane's SWL in the risk assessment; i.e. a crane with a rated SWL of 2 tons would be limited to 1 ton SWL for personnel transfers.

- the reach of the lifting equipment should be long enough so that the basket need not be pulled over excessively, jeopardizing the ability of personnel to hold on. (Note: The lack of reach of equipment has been a root cause of some personnel transfer incidents.)

- it is recommended that ship designs, where STS operations may be anticipated, take into account:
  - The diameters of the fenders normally used for the particular size of ship.
  - The potential freeboard differential of the two transferring ships when providing for lifting equipment.
  - The limitations of equipment arms’ minimum or maximum angles. It is recommended that the minimum outboard reach should be five metres at the lowest jib angle.

- proper communications should be provided by the most effective method between the signalman, the equipment controller (crane operator) and the personnel in the basket. Methods to be employed must undergo thorough evaluation prior to operations commencing to assess all scenarios and should include the following considerations:
  - A combination of voice and hand signals may be necessary between personnel in the basket and the signalman and the signalman and equipment controller due to varying operating environments.
  - Personnel in the basket must be instructed to hold on at all times, which will restrict their ability to use hand signals or operate radio equipment. Communications using one particular method between basket personnel and signalman may therefore potentially be one-way.
  - Signalmen are required to keep the basket and equipment controller in full view at all times to maintain effective control of the operation.
  - Operating areas should comply with appropriate noise level codes (see Section 9.7), however high background noise levels and ambient conditions (e.g. hydraulic machinery, wind etc) should be anticipated and may present difficulties with sound communications.

Note: The inability of the signalman on deck to see and/or hear the personnel in the basket, and for the equipment controller to see the signalman, has been the root cause of some incidents.

- operators should be fully trained before using the equipment for personnel transfer. This should not be limited to classroom training, but also include simulated dummy loads being transferred under practice until the operation can be completed with minimal risk.
SHIP-TO-SHIP TRANSFER GUIDE (PETROLEUM)

- when making personnel transfer lifts, the load must be under full control (both in raise and lower modes) and the transfer basket should only be raised high enough off the deck to clear all obstructions and minimise swinging.
- sufficient personnel, trained not to stand in danger areas, should be available to provide assistance.
- equipment should be inspected and tested prior to each use, and the maximum and minimum crane arm angles and safe working load reviewed.

A reliable means of rescue should be agreed for use in the event of failure of the crane.

9.5 Lighting

During STS transfers at night, normal in-port deck lighting should be adequate. The minimum recommended lighting is five footcandles (lumens) at transfer connection points and one footcandle in oil transfer operation work areas (measured one metre above the deck). Portable spotlights, which should be flameproof, and bridge wing spotlights are useful for night mooring and unmooring operations.

9.6 Ancillary Equipment

All ancillary equipment – wires, messengers, stoppers, strops and shackles etc should be inspected for condition prior to commencing the STS operation.

9.7 Equipment Noise Levels

Excess noise levels in the vicinity of equipment can influence operational communication safety, as well as affecting off duty personnel during rest periods and contributing to fatigue. It is recommended that ships involved in STS operations comply with an appropriate noise standard. IMO Resolution A.486 Code on Noise Levels Aboard Ships may be consulted. Reference may also be made to the noise level standards used by some Classification Societies.
Chapter 10

EMERGENCIES

10.1 Contingency Planning

Although STS transfer operations can be carried out safely, the risk of accident and the potential scale of the consequences require that organisers develop contingency plans for dealing with emergencies. For STS operations, a risk assessment study should be carried out as set out in Section 3.1.1. Risk mitigation and contingency plans, which are the products of the risk assessment, should then be drawn up covering all possible emergencies and provide for a comprehensive response. In addition, contingency plans should have relevance to the location of the operation and take into account the resources available both at the transfer area and with regard to nearby back-up support. Where appropriate, the contingency plan should be integrated with similar plans prepared by the responsible local authority.

A contingency plan is a collation of individual emergency procedures. It should be agreed between both ships, the STS organiser and the local or national authorities (as appropriate) before STS operations commence (see Section 2.2).

The lightering/receiving ship will generally be playing the lead role in an STS transfer operation. Accordingly, where organisers have delegated the preparation of a contingency plan, it will normally be incumbent on the Master of such a ship to establish the overall plan that will be reviewed and agreed.

10.2 Emergency Signal

The agreed signal to be used in the event of an emergency on either ship should be clearly understood by the personnel on both ships. An emergency on either ship should be indicated immediately by sounding the ship's internal alarm signal and by sounding seven or more short blasts on the whistle to warn the other ship. All personnel should then proceed as indicated by the contingency plan. It is emphasised that both ships should be in an advanced state of readiness at all times in order to be in a position to deal with emergencies.

10.3 Emergency Situations

It is difficult to anticipate every emergency which could arise and therefore almost impossible to indicate precise remedial action. However, oil spill and fire on either ship are examples of the more likely risk scenarios that organisers should include in the contingency plan.
In an emergency, the Masters involved should assess the situation and act accordingly, bearing in mind that unduly hasty decisions could worsen the emergency. The following actions should be taken, or considered, in the event of any emergency arising during an STS transfer operation:

- stop the transfer.
- sound the emergency signal.
- inform crews on both ships of the nature of the emergency.
- man emergency stations.
- implement emergency procedures.
- drain and disconnect cargo hoses.
- send mooring gangs to stations.
- confirm the ship's main engine is ready for immediate use.
- advise standby boat of the situation and any requirements.

In addition, Masters should decide jointly, particularly in cases of fire, whether it is to their mutual advantage for the ships to remain alongside each other.

The basic actions, as listed above, should be included in individual STS contingency plans and be consistent with the ship's safety management system.

10.4 Advice on Some Emergencies

The following covers some of the emergencies likely to be encountered, and much of the guidance may be applicable in other circumstances. Both tankers involved in an STS operation should have procedures ready for immediate implementation in the event of an emergency. The procedures should be familiar to the personnel involved, who should clearly understand the action they would be required to take when responding to the emergency. STS service providers should have anticipated and fully considered the implication of all types of emergency that might be encountered during an STS operation.

10.4.1 Emergencies During Manoeuvring

The Masters of both ships and the STS Superintendent should always be prepared to abort a berthing operation if necessary. The decision should be taken in ample time while the situation is still under control. The Masters of both ships should be immediately informed of each other's actions. The International Regulations for Preventing Collisions at Sea (COLREGS) (Reference 4) must be complied with.

10.4.2 Procedures in the Event of Gas Accumulation on Deck

An STS transfer operation should be suspended if excessive cargo vapours are detected around the decks or manifolds of either ship, and should not be resumed until the risk to both ships and their personnel is considered to have been averted.
10.4.3 Accidental Cargo Release

Any leakage or spillage should be reported immediately to the officers on cargo watch who should stop the cargo transfer and advise the person in overall advisory control. The transfer must remain suspended until it is agreed between the relevant persons/authorities that it is safe to resume.

10.4.4 Shipboard Oil Pollution Emergency Plan (SOPEP) and Vessel Response Plan (VRP)

Risk of oil pollution during STS transfer operations is no greater than during in-port cargo transfers. However, as a transfer area may be out of range of port services, a contingency plan within the SOPEP or VRP to cover such risk should be available and should be activated in the case of an oil spill.

10.5 State of Readiness for an Emergency

The following arrangements should be made on both ships:

- main engines and steering gear ready for immediate use.
- cargo pump and all other equipment trips relevant to the transfer tested prior to the operation.
- crew available and systems prepared to drain and disconnect hoses at short notice.
- oil spill containment equipment prepared and ready for use.
- mooring equipment ready for immediate use and extra mooring lines ready at mooring stations as replacements in case of breakage.
- fire-fighting equipment ready for immediate use.
Appendix 1

OPERATIONAL SAFETY CHECK-LISTS

CHECK-LIST 1 – PRE-FIXTURE INFORMATION (FOR EACH SHIP)

CHECK-LIST 2 – BEFORE OPERATIONS COMMENCE

CHECK-LIST 3 – BEFORE RUN-IN AND MOORING

CHECK-LIST 4 – BEFORE CARGO TRANSFER

CHECK-LIST 5 – BEFORE UNMOORING
# Operational Safety Check-Lists

## Ship-to-Ship Transfer

**Check-List 1 – Pre-Fixture Information (for Each Ship)**

(Between Ship Operator/Charterer and Organiser)

<table>
<thead>
<tr>
<th>Ship's Name: ____________________________</th>
<th>IMO No: ____________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Ship Operator:</th>
<th>Ship Charterer:</th>
<th>STS Organiser:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Preferred Contact No. (e.g. INMARSAT)</th>
<th>Ship Operator's Confirmation</th>
<th>Remarks</th>
</tr>
</thead>
</table>

1. **What is the LOA?**
   - What is parallel body length at loaded and ballast draughts?

2. **Will the transfer be conducted underway**
   - and, if so, can the ship maintain about five knots for a minimum of two hours?

3. **Is the ship's manifold arrangement in accordance with OCIMF Recommendations for Oil Tanker Manifolds and Associated Equipment?**

4. **Is the ship's lifting equipment in accordance with OCIMF Recommendations for Oil Tanker Manifolds and Associated Equipment?**

5. **What is the maximum and minimum expected height of the cargo manifold from the waterline during the transfer?**

6. **Sufficient manpower will be provided for all stages of the operation?**

7. **Are enclosed fairleads and mooring bitts in accordance with OCIMF Mooring Equipment Guidelines and are they of a sufficient number?**

8. **Can the ship supplying the moorings provide all lines on winch drums?**

9. **If moorings are wires or high modulus synthetic fibre ropes, are they fitted with synthetic tails at least eleven metres in length?**

10. **Full-sized mooring bitts of sufficient strength are suitably located near all enclosed fairleads to receive mooring ropes eyes?**

11. **Both sides of the ship are clear of any overhanging projections including bridge wings?**

12. **The transfer area has been agreed?**

---

**FOR DISCHARGING SHIP / RECEIVING SHIP** (Delete as appropriate)

<table>
<thead>
<tr>
<th>Name:</th>
<th>Rank:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Signature:</th>
<th>Date:</th>
</tr>
</thead>
</table>

This form should not be substituted for other required check-lists. If this form is used, it should be used in its entirety.

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# SHIP-TO-SHIP TRANSFER

## CHECK-LIST 2 – BEFORE OPERATIONS COMMENCE

**Discharging Ship's Name:**

**Receiving Ship's Name:**

**Date of Transfer:**

<table>
<thead>
<tr>
<th></th>
<th>Discharging Ship Checked</th>
<th>Receiving Ship Checked</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The two ships have been advised by shipowners that Check-List 1 has been completed satisfactorily?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Personnel comply with rest requirements of ILO 180, STCW or national regulations as appropriate?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Radio communications are established?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Language of operations has been agreed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>The rendezvous position off the transfer area is agreed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Berthing and mooring procedures are agreed, including fender positions and number/type of ropes to be provided by each ship?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>The system and method of electrical insulation between ships has been agreed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>The ships are upright and at a suitable trim without any overhanging projections?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Engines, steering gear and navigational equipment have been tested and found in good order?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Ship's boilers and tubes have been cleared of soot and it is understood that during STS operations, tubes must not be blown?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Engineers have been briefed on engine speed (and speed adjustment) requirements?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Weather forecasts have been obtained for the transfer area?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Hose lifting equipment is suitable and ready for use?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Cargo transfer hoses are properly tested and certified and in apparent good condition?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Fenders and associated equipment are visually in apparent good order?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>The crew have been briefed on the mooring procedure?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>The contingency plan is agreed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Local authorities have been advised about the operation?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>A navigational warning has been broadcast?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>The other ship has been advised that Check-List 2 is satisfactorily completed?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FOR DISCHARGING SHIP / RECEIVING SHIP** (Delete as appropriate)

**Name:**

**Rank:**

**Signature:**

**Date:**

---

Note that items 13, 14 and 15 can only be checked by the vessel that has them onboard. This form should not be substituted for other required check-lists. If this form is used, it should be used in its entirety.
### SIP-TO-SHIP TRANSFER
### CHECK-LIST 3 – BEFORE RUN-IN AND MOORING

<table>
<thead>
<tr>
<th>Discharging Ship's Name:</th>
<th>Receiving Ship's Name:</th>
<th>Date of Transfer:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Discharging Ship Checked</th>
<th>Receiving Ship Checked</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Check-List 2 has been satisfactorily completed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Primary fenders are floating in their proper place? Fender pennants are in order?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Secondary fenders are in place, if required?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Over side protrusions on side of berthing are retracted?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>A proficient helmsman is at the wheel?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Cargo manifold connections are ready and marked?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Course and speed information has been exchanged and is understood?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Ship’s speed adjustment is controlled by changes to revolutions and/or propeller pitch?</td>
<td>[Specify]</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Navigational signals are displayed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Adequate lighting is available?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Power is on winches and windlass and they are in good order?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Rope messengers, rope stoppers and heaving lines are ready for use?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>All mooring lines are ready?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>All mooring personnel are in position?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Communications are established with mooring personnel?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>The anchor on opposite side to transfer is ready for dropping?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>The other ship has been advised that Check-List 3 is satisfactorily completed?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FOR DISCHARGING SHIP / RECEIVING SHIP (Delete as appropriate)**

<table>
<thead>
<tr>
<th>Name:</th>
<th>Rank:</th>
<th>Signature:</th>
<th>Date:</th>
</tr>
</thead>
</table>

This form should not be substituted for other required check-lists. If this form is used, it should be used in its entirety.
**SHIP-TO-SHIP TRANSFER CHECK-LIST 4 - BEFORE CARGO TRANSFER**

**Discharging Ship's Name:**

**Receiving Ship's Name:**

<table>
<thead>
<tr>
<th>Date of Transfer:</th>
<th>Discharging Ship Checked</th>
<th>Receiving Ship Checked</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. The *ISGOTT* Ship/Shore Safety Check-List has been satisfactorily completed?

2. Procedures for transfer of personnel have been agreed?

3. The gangway (if used) is in good position and well secured?

4. An inter-ship communication system is agreed?

5. Emergency signals and shutdown procedures are agreed?

6. An engine room watch will be maintained throughout transfer and the main engine ready for immediate use?

7. Fire axes or suitable cutting equipment is in position at fore and aft mooring stations?

8. A bridge watch and/or an anchor watch are established?

9. Officers in charge of the cargo transfer on both ships are identified and posted?

10. A deck watch is established to pay particular attention to moorings, fenders, hoses, manifold observation and cargo pump controls?

11. The initial cargo transfer rate is agreed with other ship?

12. The maximum cargo transfer rates agreed with the other ship?

13. The topping-off rate is agreed with other ship?

14. Cargo hoses are well supported?

15. Tools required for rapid disconnection are located at the cargo manifold?

16. Details of the previous cargo of the receiving ship have been given to the discharging ship?

17. The other ship has been advised that Check-List 4 is satisfactorily completed?

**FOR DISCHARGING SHIP / RECEIVING SHIP (Delete as appropriate)**

Name: ____________________________

Rank: ____________________________

Signature: ________________________

Date: ____________________________

This form should not be substituted for other required check-lists. If this form is used, it should be used in its entirety.
### SHIP-TO-SHIP TRANSFER
### CHECK-LIST 5 – BEFORE UNMOORING

**Discharging Ship’s Name:**

**Receiving Ship’s Name:**

**Date of Transfer:**

<table>
<thead>
<tr>
<th></th>
<th>Discharging Ship Checked</th>
<th>Receiving Ship Checked</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cargo hoses are properly drained prior to hose disconnection?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Cargo hoses or manifolds are blanked?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>The transfer side of the ship is clear of obstructions (including hose lifting equipment)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Secondary fenders are correctly positioned and secured for departure?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>The method of unberthing and of letting go moorings has been agreed with the other ship?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Fenders, including fender pennants, are in good order?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Power is on winches and windlass?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>There are rope messengers and rope stoppers at all mooring stations?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>The crew are standing by at their mooring stations?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Communications are established with mooring personnel and with the other ship?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Shipping traffic in the area has been checked?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Main engine(s) and steering gear have been tested and are in a state of readiness for departure?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Mooring personnel have been instructed to let go only as requested by the manoeuvring ship?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Navigational warnings have been cancelled (when clear of other ship)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>The other ship has been advised that Check-List 5 is satisfactorily completed?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FOR DISCHARGING SHIP / RECEIVING SHIP (Delete as appropriate)

| Name: |
| Rank: |
| Signature: | Date: |

This form should not be substituted for other required check-lists. If this form is used, it should be used in its entirety.
Appendix 2

FENDER SELECTION CALCULATION

The following is only a guide and it is highly recommended that individual fender manufacturers, fender rental, or STS service providers be consulted when planning an STS operation.

In order to calculate a suitable fender arrangement it is necessary to calculate the berthing energy of a ship which must be absorbed by the fender at the point of contact.

The surrounding seawater acts to push the ships towards one another upon berthing. Therefore, when calculating the berthing energy, a constant 1.8 is used to adjust for this extra force.

To determine the berthing energy when landing on one fender Quarter Point berthing is assumed.

NOTE: In the following calculation the offloading ship characteristics are given for light (ballast) condition and the constant heading ship is given as in operational loaded condition

Step 1: \( \text{Ship A Displacement} \times 1.8 = \text{Ship A Adjusted Displacement} \)
\( \text{Ship B Displacement} \times 1.8 = \text{Ship B Adjusted Displacement} \)

Step 2: \( \frac{\text{Ship A Adjusted Displacement} \times \text{Ship B Adjusted Displacement}}{\text{Ship A Adjusted Displacement} + \text{Ship B Adjusted Displacement}} = \text{Total Adjusted Displacement} \)

Step 3: Berthing Energy (in tonne.m) = 0.025 x Total Adjusted Displacement x Approach Velocity (in m/sec) squared.

Example:

Ship A: 65,000 Displacement, Ship B: 312,000 Displacement, Approach Velocity 0.2 m/sec, one fender landing.

Step 1: \( 65,000 \times 1.8 = 117,000 \)
\( 312,000 \times 1.8 = 561,600 \)

Step 2: \( \frac{117,000 \times 561,600}{117,000 + 561,600} = 96,827 \)

Step 3: \( 0.025 \times 96,827 \times 0.2^2 = 96.8 \text{ tonne.m Berthing Energy} \)

Now refer to the fender manufacturer’s performance tables and select a fender system that will provide energy absorption capability in excess of that indicated by the calculation above. Indicative tables for pneumatic and foam fenders are shown on the next page but could differ between various manufacturers.
## Fender Selection Calculation

### Pneumatic Fenders
Initial Internal Pressure 50kPa and 80kPa

<table>
<thead>
<tr>
<th>Nominal Size Diameter X Length (mm)</th>
<th>Energy Absorption 60% Compression (tonne.m) 50kPa</th>
<th>Energy Absorption 60% Compression (tonne.m) 80kPa</th>
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<tbody>
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<td>15.6</td>
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<td>134.3</td>
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<tr>
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<th>Nominal Size Diameter X Length (mm)</th>
<th>Energy Absorption 60% Compression (tonne.m) 50kPa</th>
<th>Energy Absorption 60% Compression (tonne.m) 80kPa</th>
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<tr>
<td>4200 8400</td>
<td>459</td>
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</table>

### Foam Fenders

Appendix 2.1 Typical Fender Manufacturers Performance Table.

1 For fenders complying with ISO17357:2002
2 Energy Absorption of foam fender depends on berthing angle and repetitive compression factor. Confirmation from fender manufacturers should be obtained.

### Approach Velocity:

The approach velocity of the ships can have a dramatic effect on the berthing energy absorption requirements of the fender system. The allowance for velocity should take into consideration the effects of local weather, sea and swell conditions, tug or thruster availability and the physical size of the ships involved. It is common to work within a range of about 0.1 to 0.3 metres per second (0.2 to 0.6 knots) and it should be noted that an increase of about 0.02 (m/sec) (0.04 kts) in velocity could result in approximately 28 percent increase in energy absorption requirements should the berthing speed be in the range of 0.15 m/sec, and 20 percent increase should the berthing speed be in the range of 0.20 m/sec in energy absorption requirements. Also note that smaller ships tend to have higher berthing velocities.

During berthing operations between two ships it is rare that they make parallel contact with each other and it is more likely that one fender will absorb the initial contact. Under this condition some of the energy is absorbed by the action of the ship pivoting around the fender and it is generally accepted that about half of the energy is absorbed in this manner. In the event the berthing energy for a parallel berth is desired, the following formula is worked as above:

Berthing Energy (in tonne.m) = 0.051 x Total Adjusted Displacement x Approach Velocity (in m/sec) squared. In the event of parallel contact the load will be spread over the remaining fenders in the system.
# Fender Selection Assistance Request Form

For ship-to-ship use  
To be filled out prior to contacting fender providers

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<tr>
<th>Location of Site</th>
<th>Potential Sea State</th>
<th>Potential Beaufort Scale</th>
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<th>Ship B</th>
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<tbody>
<tr>
<td>Eg. tanker, ore carrier, gas carrier, etc.</td>
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<table>
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<tr>
<th>Displacement Tonnage (at start of STS ops.)</th>
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<th>Gross Tonnage</th>
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<th>Length Between Perpendiculars</th>
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<tr>
<th>Beam</th>
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<table>
<thead>
<tr>
<th>Freeboard when coming into contact</th>
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</table>

<table>
<thead>
<tr>
<th>Relative approach velocity of ships</th>
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<table>
<thead>
<tr>
<th>Other relevant information</th>
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Appendix 3

SHIP TO SHIP TRANSFER STUDY

Introduction
A series of computerised numerical model simulations were conducted in order to estimate typical large crude oil tanker STS mooring loads, with different ship combinations in STS situations and to examine the impact of different environmental conditions on commonly used STS mooring configurations. The results and conclusions derived from the simulations were considered informative and appropriate to include as an Appendix to this 4th Edition of the ICS/OCIMF Ship-to-Ship Transfer Guide (Petroleum). The graphs and data are provided for information and are not intended to be interpreted as specific limiting operating criteria for STS operations.

Description of Numerical Models
The two main components to the numeric modelling consisted of motion response and time domain simulation of interaction between floating bodies related to mooring systems and hydrodynamic interactions. The numerical models took into account a wide range of factors including the following:

- different double hull tanker size range combinations, 307,000 dwt (VLCC), 148,000 dwt (Suezmax) and 105,000 dwt (Aframax).
- different tanker displacements (ballast and loaded conditions).
- wave conditions, including different wave periods and angles of encounter.
- wind conditions appropriate to the sea conditions and assumed to be from the same direction (see modified Jonswap graph below where Hs = Wave height in metres and Tp = Wave period in seconds).
- current (two knots from direction of heading).
- typical mooring arrangements and equipment characteristics, including tension in mooring lines.
- at anchor or underway options.
- reactions of pneumatic fenders.

![Jonswap Graph](image-url)
Mooring lines used in the simulations consisted of typical combinations of mooring lines used in STS operations:

- 42 mm steel wire with 1138 kN Minimum Breaking Load (MBL) (VLCC)
- 36 mm and 38mm steel wire with 814 kN and 924 kN MBLs respectively (Suezmax and Aframax)
- 11 m nylon mooring tail.

For the simulations, a series of different arrangements were tested. Positions of mooring lines were selected from actual ship mooring arrangement drawings. In all cases two fore and two aft springs were assumed and tested out with combinations of six to eight head lines and four to six stern lines.

Fenders used in the simulations consisted of a typical string of:

- 4 of 3.3 x 6.5m pneumatic fenders of 2,982 kN reaction force.

Sensitivity runs were carried out to check on the impact of:

- mooring line pretension
- sensitivity to currents
- sensitivity to wave direction (relative to STS vessel headings)
- sensitivity of mooring line lead angles.

The computer model was run to test sensitivity of a two-ship unit to different currents, changes in relative wave direction, and the influence of different pre-tensions in mooring lines, and their varying lead angles. Pre-tension in mooring lines being defined as the tension set in the simulation before the mooring lines were subject to loads calculated to result from the impact of environmental forces.

The results of the computer study predict the relative movements, interaction and reaction forces between the ships, fenders and mooring lines. The resultant loads on each mooring line were calculated.

**Weather Threshold Graphs**

Weather Threshold Graphs were determined as being the simplest way to present the results of the various simulation runs. Unless otherwise stated, the wave and weather direction was assumed to be fifteen degrees on the port bow. The green bars represent the simulation runs that resulted in no mooring line being subject to loads in excess of its SWL (55% of the MBL) and conversely the red bars represent simulation runs where the SWL of any mooring line was exceeded. The mooring configuration in the graph is represented by the notations “8-4-6” where the “8” represents the number of head lines the “4” represents the total number of spring lines (two fore springs and two aft springs) and the “6” represents the number of stern lines.

Vertical (Y) axis represents Significant Wave Height (Hs) in metres.

Horizontal (X) axis represents Wave Period (Tp) in seconds.

Vessel Types analysed in the study are designated as follows in the graphs:

Suez (SUEZMAX); Afr (AFRAMAX) and VLCC.
Case 1 STBL Suezmax (Suez) – Lightering Ship Aframax (Afra)

**Comment**
The weather threshold tolerance is higher when the STBL is in loaded condition. Little change to weather threshold is noted when the number of head lines is increased from six to eight or the number of stern lines is increased from four to six.

<table>
<thead>
<tr>
<th>Hs, m</th>
<th>Suez Loaded, Afra Ball - Moorings 8-4-6</th>
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</thead>
<tbody>
<tr>
<td>3.0</td>
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<tr>
<td>Tp.s</td>
<td>8  10  12  14  16</td>
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<thead>
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<th>Hs, m</th>
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<tr>
<td>Tp.s</td>
<td>6  8  10  12  14  16</td>
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</tbody>
</table>

© ICS/OCIMF/2005
Case 2 STBL VLCC/Lightering Vessel Aframax

**Comment**
The weather threshold is higher when the STBL is in loaded condition i.e. the operation can continue in worse weather. Larger STBLs (VLCCs) have a higher weather threshold than smaller STBLs (Suezmax). Little change to weather threshold is noted when the number of head lines is increased from six to eight or the number of stern lines is increased from four to six.

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Case 3 Comparison of Sensitivity to Ahead or Astern Weather Direction

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Case 4  Beam Weather Direction Sensitivity

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Case 5 Comparison of Sensitivity to Side Weather Direction (STBL Suezmax in Ballast - Lightering Ship Aframax Loaded)
Conclusions

Comments
The study concluded that throughout different mooring configurations for the different ship size ranges, increasing the number of head lines or stern lines had little or no impact on the weather threshold at which the mooring lines exceeded their SWL. The study investigated nothing less than a six headline, two fore springs, two back springs, four stern line mooring configuration. The study also took no account of the typical STS issue of chafing, the possibility of parting lines and the need for additional moorings to meet line failure contingencies.

The study also confirmed the obvious point that the lead direction is important and that effective load sharing of head and stern lines will help to reduce peak loads on individual lines. Further, the study concluded that mooring line pre-tension had a significant negative impact on induced peak mooring loads.

STBL Size
A direct comparison between a VLCC and Suezmax STBL lightering to an Aframax indicated, as would be expected, higher weather operating thresholds for the larger STBL.

Ship Load Condition
The displacement of the STBL, particularly when there is a significant size differential between the ships (e.g. VLCC to Aframax), had a significant influence on weather threshold. Assuming the weather is kept on the port bow of the STBL, taking the example of a VLCC undergoing STS operations with an Aframax, the weather threshold is significantly higher when the STBL displacement is greater.

In conclusion the study findings show that as the STBL displacement reduces, so will the weather threshold and the operating weather window will become a more significant factor.

Wave Period
The wave period proved to be critical in determining weather thresholds. The longer the wave period, the lower the weather threshold.

Weather Encounter Direction
Beam wave direction produced the lowest weather threshold.

Stern quartering wave directions recorded a lower weather threshold than wave directions onto the port bow of the STBL.

When lightering a Suezmax to an Aframax the optimum weather threshold wave direction changed to the opposite side (starboard) as the displacement of the lightering ship increased relative to the STBL.

Currents
Weather threshold sensitivity to water current direction and speed was not significant.
Mooring Configurations
Throughout the range of different mooring configurations for the different ship size configurations, it was determined that increasing the number of stern lines or headlines had little or no impact on the weather threshold. Note that no computer runs were conducted on the sensitivity to having less than 6 headlines.

Mooring Line Pre-tension
Mooring line pre-tension proved to be quite critical in determining the weather thresholds. The higher the initial pre-tension (that is, the more rigid the mooring arrangement) the lower the weather thresholds. Sensitivity runs were conducted at pre-tensions of 150 kN and 50 kN. All the presented simulation cases assumed a tension of 50 kN. While the study used specific pre-tensions, it is appreciated that this is not a practical option for STS operations. However, it is clear that excessive or uneven tension in the mooring lines seriously degrades their performance.

Head/Stern Line Lead Angles
To assess the sensitivity of head or stern line lead angles the angles of individual lines were gradually changed from being close to parallel in the fore and aft line, to 80 degrees perpendicular to that line. The computer model was able to provide calculated peak loads for each angle assuming that the lines did not part or render. The study demonstrated that peak mooring loads at angles just greater than that of the springs were relatively low but increased as the angle increased and the line became more effective as a head or stern line. As the angle became more effective in sharing mooring loads with other headlines the peak loads then decreased, but increased again slightly as the mooring line angle increased further.

The obvious lesson is that head and stern lines experience lower peak loads when they are angled to share the total load with other mooring lines.

![Graph showing force in mooring lines as a function of angle](image)

Force in sample mooring lines as a function of their angle to the fore and aft line.

The points on the graph represent two different headlines and the maximum load imparted on them as the angle to the fore and aft line of the vessels is changed (zero being parallel to the side of the ship).