INTERTANKO

Guidance on Mooring System Management Plans (MSMP)

TWENTY 19

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** Sections from Mooring Equipment Guidelines, Fourth Edition (MEG4) reproduced with permission from OCIMF*

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Contents

Introduction

The management of mooring operations is a key aspect of the management of ships and ensuring the safety of seafarers. The fourth edition of the Mooring Equipment Guidelines (MEG4) issued by OCIMF recognises this and outlines many of the related requirements. This is further reinforced with references to the various planning procedures in the seventh edition of the Vessel Inspection Questionnaire (VIQ7).

INTERTANKO has developed this guidance to help Members comply with MEG4 and to address the questions in VIQ7. The guidance covers the implementation of the Standard Mooring System Management Plan (MSMP), the Mooring System Management Plan Register (MSMPR) which is a subset of the MSMP and the Line Management Plan (LMP).

These plans are new tools to assist Members with managing equipment and lines from design to retirement. MEG4 states that the plans should remain on the ship throughout its life as part of the management of change records to ensure that documents and records are not lost and it is recommended that all information relevant to the mooring of the ship is considered together as a complete system. The plans should also include a record of any changes that have occurred to the mooring equipment and arrangements since the vessel was built.

Interim measures

It is acknowledged that existing ships may have some difficulty in bringing some of the relevant information together. Because of this, it is stated that an operator should detail interim measures taken to address the recommendations in this publication, with reasons given for why any changes have not yet been implemented. This will be particularly important as such reasons will be needed when a ship is subject to a SIRE inspection and in response to VIQ7 questions 9.2 on the MSMP and 9.3 on the LMP. Similarly, due to the short timeframe between the launch of MEG4 and the implementation of VIQ7, Members should follow this approach and clearly detail the changes that have not been incorporated, the reasons behind that and the steps taken to mitigate for any perceived risk involved.

Standard Mooring System Management Plan (MSMP)

The MSMP should be written to ensure the mooring system is inspected, maintained and operated in accordance with the original design basis. The information contained should be available to anyone who needs to review it. The MSMP does not need to be a comprehensive plan incorporating all information, instead it could be a framework document that links to the information held elsewhere in the ship's records or Safety Management System (SMS). The following guidance is written to provide assistance in writing a comprehensive and complete plan. OCIMF created the MSMP on the basis of the standard International Maritime Organization (IMO) approach of setting a goal and then listing the functional requirements for how to achieve this.

Section 1

Objectives of the MSMP

The objective for the MSMP is to ensure that all assessed risks are effectively managed through the design and operation of the mooring system. Its aim is to ensure that during mooring operations, no harm comes to the ship's crew or terminal staff, no damage is caused to the ship or terminal/facility it is interfacing with and that the mooring system meets any applicable regulations, codes and recommended practices. All stakeholders should ensure the MSMP is appropriately created. Ship operators and ship builders should collaborate from the earliest stage in the ship's design to ensure risks are reduced through mooring design and risk reviews.

Terms and Definitions

Ship Design Minimum Breaking Load – (Ship Design MBL)

The minimum breaking load of new, dry mooring lines for which a ship's mooring system is designed to meet OCIMF standard environmental criteria restraint requirements. The Ship Design MBL is the core parameter against which all the other components of a ship's mooring system are sized and designed, with defined tolerances.

Nylon (polyamide) mooring lines should be specified as break tested wet because nylon lines change strength characteristics once exposed to water and generally do not fully dry to their original construction state.

Line Design Break Force – (LDBF)

This is the minimum force that a new, dry, spliced mooring line will break at when tested according to appendix B. This is for all mooring line and tail materials except those manufactured from nylon which is tested wet and spliced. This value is declared by the manufacturer on each line's mooring line certificate (see appendix B) and is stated on a manufacturer's line data sheet. As outlined in appendix B, when selecting lines, the LDBF of a line shall be 100-105% of the ship design MBL.

The LDBF for nylon (polyamide) mooring lines should be specified as break tested wet because nylon lines change strength characteristics once exposed to water and generally do not fully dry to their original construction state.

Working Load Limit – (WLL)

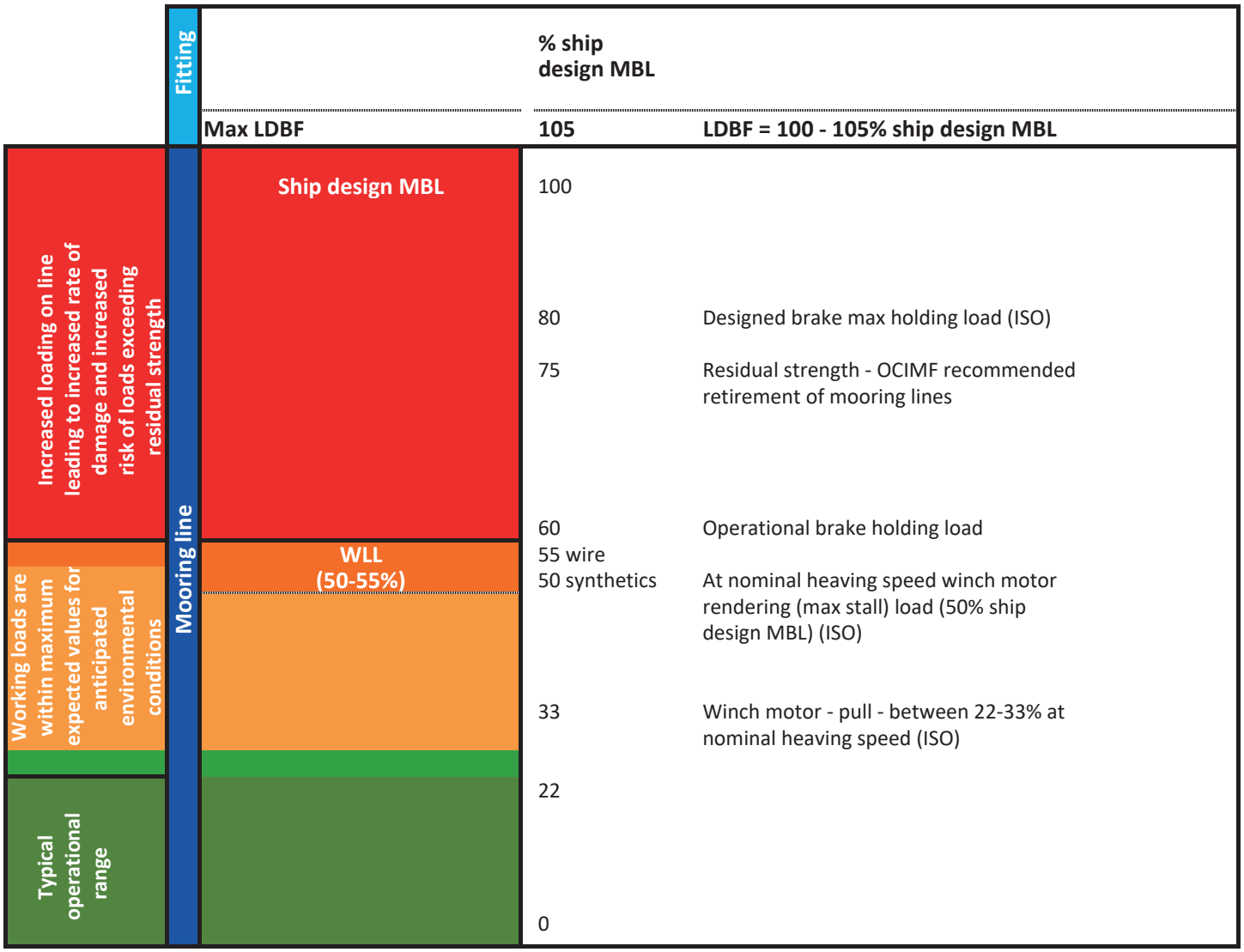
This is the maximum load that a mooring line should be subjected to in operational service, calculated from the standard environmental criteria. The WLL is expressed as a percentage of Ship Design MBL and should be used as a limiting value in both ship design and operational mooring analyses. During operation, the WLL should not be exceeded.

In the same way that SWL is a limit for fixed equipment, the WLL value is used as a limit with the standard environmental criteria and mooring layout when designing mooring systems in establishing mooring system designs. Steel wire ropes have a WLL of 55% of the Ship Design MBL and all other cordage (synthetic) have a WLL of 50% of the ship design MBL.

Tail Design Break Force (TDBF)

The TDBF needs to be higher than the LDBF because tails experience more wear in service than lines. The TDBF of tails should be 125-130% of ship design MBL. TDBF is tested and defined in wet condition (see testing guidance outlined in appendix B of MEG4) and accounts for any material strength loss when wet.

Relationship Between Terminologies



Abbreviations

ALARP	As Low as Reasonably Practicable
CBM	Conventional Buoy Mooring
CSWP	Code of Safe Working Practices for Merchant Seamen
DBL	Design Basis Load
D/d	Diameter of bend divided by diameter of line
DPA	Designated Person Ashore
DWT	Deadweight Tonnage
EN	Equipment Number
GF	Geometric Factor
HCD	Human-Centred Design
HFE	Human Factors Engineering
HMPE	High Modulus Polyethylene
HMSF	High Modulus Synthetic Fibre
IACS	International Association of Classification Societies
IMO	International Maritime Organization
ISGOTT	International Safety Guide for Oil Tankers and Terminals
ISO	International Organization for Standardization
IWRC	Independent Wire Rope Core
LBP	Length between Perpendiculars
LDBF	Line Design Break Force
LMP	Line Management Plan
LOA	Length Overall
MBL	Minimum Breaking Load
MBM	Multi Buoy Mooring
MEG3	Mooring Equipment Guidelines, Third Edition
MEG4	Mooring Equipment Guidelines, Fourth Edition
MSMP	Mooring System Management Plan
MSMPR	Mooring System Management Plan Register
MTIS	Marine Terminal Information System
NDT	Non-Destructive Testing
NSBF	New Straight Break Force
OCIMF	Oil Companies International Marine Forum
OEM	Original Equipment Manufacturer
PMS	Planned Maintenance System
PPE	Personal Protective Equipment
SIRE	Ship Inspection Report Program
SMYS	Specified Minimum Yield Stress
SPM	Single Point Mooring
STS	Ship-to-Ship (transfer operations)
SWL	Safe Working Load
TDBF	Tail Design Break Force
VPQ	Vessel Particulars Questionnaire
WLL	Working Load Limit

Section 2

Model Mooring System Management Plan

Record of Revisions

Issue Number	Revision Number	Effective Date	Reference to Sections – Description of Revision	Approved by

Part A – General Ship Particulars

Part A	General Ship Particulars
Goal A	Maintain a detailed, continuous and up-to-date record of the ship's ownership history
Functional Requirements	The MSMP records should, as a minimum, match those required under the Continuous Synopsis Record, SOLAS regulation XI-1/5, see IMO A 23/Res.959.
Method of Compliance	- to be updated after every change - HVPQ to be updated regularly – electronic copy to be maintained on board

The ship's particulars are recorded in this section and should be maintained for the life cycle of the vessel. When there are changes, a new document should be issued and numbered. Where there are no changes in the details, this should be marked as N/C in the respective row. The previous SP Documents should be retained on board for the life cycle of the vessel. Copies of the previous SP Documents are to be filed electronically by the managers.

A.1	**Ship details including name, date of build, registration, IMO number, Flag/Class**
Ship's name	
IMO number	
Date of Build	
Flag	
Flag registration number	
Class	
Class registration number	
Class notation	
A.2	**Current owners, operators/technical managers, including (where applicable) bareboat owners**
Owners	
Operators	
Technical managers	
Bareboat owners	
A.3	
Vessel's previous name(s) and date(s) of change	
Vessel's previous Flag and date of change	
Vessel's previous technical managers and date of change	
Vessel's previous class and date of change	

Part B – Mooring Equipment Design Philosophy

Part B	Mooring equipment design philosophy
Goal B	Provide comprehensive details of the ship's original design philosophy and show how the philosophy demonstrates that the ship can be effectively and safely moored against standard environmental criteria.
Functional Requirements	The MSMPR records should, as a minimum, contain information that details the requirements for section B as detailed below.

B.1. Design considerations to achieve the ship's optimal mooring pattern including information on the siting of mooring winches and fairleads to provide for direct leads and minimal lines across open decks.

This vessel has been designed to meet the applicable Mooring Equipment Guidelines at the time the vessel was constructed. Every effort is made to ensure the design philosophy used is taken into consideration and the optimal ship's mooring pattern is used by the vessel's crew. The ship's mooring pattern, as far as is practically possible, provides direct leads and minimises unnecessary turns in the standard mooring configuration.

Design considerations provided by the shipbuilding yard are filed under **appendix B1**. If these are not available, insert under the same appendix as the ship's design mooring pattern or mooring plan drawing, siting of mooring winches and other fittings.

Where design considerations from the shipbuilding yard are not available, appendix B1 is to be complemented by a risk assessment for the ship's mooring design. This is additionally to be supported by a periodical mooring review by the ship's crew which should be documented.

The entries under appendix B1 may be replaced by a reference note to subject documentation which is available in another location.

B.2. Mooring force calculations against the standard environmental criteria.

Mooring force calculations will have been conducted by the yard at the time of the design and, based on this information, the ship's design mooring pattern and philosophy was then developed. Where calculations are available, these should be filed in **appendix B2**.

The entries under appendix B2 might be replaced by a reference note to subject documentation which is available in another location.

OCIMF Standard Environmental Criteria for new ships are as follows:

60 Knot Wind from any direction simultaneously with:

3 knots current at 0 degrees or 180 degrees or

2 knots current at 10 degrees or 170 degrees or

0.75 knots from the direction of maximum beam loading.

For existing ships, every effort shall be undertaken by the ship operator to require the shipbuilding yard to conduct a gap analysis between the Environmental Criteria used for the mooring force calculation of the ship at the time of construction and the OCIMF Standard Environmental Criteria. This gap analysis should be filed under appendix B2.

B.3. Mooring restraint calculations to determine the strength and number of mooring lines and winches to balance the forces calculated.

Mooring restraint calculations will have been calculated by the yard at the time of design. Based on that information, the ship's design mooring pattern and philosophy will have been developed. Where calculations are available, these should be filed in **appendix B3**.

Ship designers utilise Standard Environmental Criteria to calculate the mooring forces anticipated and thus total restraint capability. This provides the basis for the Ship Design MBL:

The Total Mooring Restraint Requirement ÷ Number of Mooring Lines = Ship Design MBL.

The entries under appendix B3 might be replaced by a reference note to subject documentation which is available in another location.

For existing ships, every effort shall be undertaken by the ship operator to require the building shipyard and/or the Classification Society to provide the required documentation in order to calculate the Ship Design MBL. A copy of the calculation should be filed under appendix B3.

B4. Design loads, safety factors and strength for required mooring lines and fixed equipment.

The design loads for the mooring lines and fixed equipment have been provided by the yard and the safety factors based on the applicable Mooring Equipment Guidelines at the time of construction.

See **appendix B4** for a list of design loads for fixed equipment which might be complemented by a reference to the Line Management Plan (LMP) in which LDBF and WLL for mooring lines are documented.

B.5. Assumptions on the standard mooring pattern and considerations for redundancy provisions, including sub-optimal line distribution to cover unpredicted events (e.g. storm surges, shore mooring hooks out of service).

The standard mooring patterns are based on the design philosophy used by the yard at the time of construction. This takes into account an optimal design pattern that minimises excessive turns and maintains direct leads where possible.

Ships will be most effectively moored using lines within the length of the ship through a combination of breast and spring lines with:

- Breast lines oriented as perpendicular as possible to the longitudinal centreline of the ship and as far aft and forward as possible.

- Spring lines oriented as parallel as possible to the longitudinal centreline of the ship.

When there is a change to the mooring pattern due to shore mooring hooks out of service or unusual occurrences such as a storm surge the Master, together with the Pilot and terminal representatives, will review the situation and carry out an on-scene risk assessment to ensure the most optimal mooring pattern is used.

This risk assessment will consider:

- Residual capacity to ensure the ship can berth and/or remain berthed in the event of unscheduled occurrences;
- Lines unable to be deployed from optimal locations due to incompatibility with berth facilities;
- Equipment redundancy, including critical equipment and spares;
- Other influencing factors such as locations with peculiar environmental parameters.

The standard mooring configuration as well as the alternate mooring configurations are filed in **appendix B5**.

A standard list of redundant scenarios available on the vessel should also be filed in appendix B5.

Documentation for vessels that are fitted with extra-strength mooring fittings or where additional strength is provided should also be filed in appendix B5.

B.6. Initial mooring line selection inputs, including assumptions, methodology and supplier(s) and information on the agreed rope commissioning process.

When designing a mooring system, the Ship Design MBL is the core parameter upon which the determination of all mooring equipment is based. The following apply:

- The Line Design Break Force of the mooring lines should be between 100-105% of the Ship Design MBL;
- The designed brake maximum holding load should be 80% of the Ship Design MBL.

For existing ships, every effort shall be undertaken by the ship operator to require the building shipyard and/or the Classification Society to provide the required documentation in order to calculate the Ship Design MBL. A copy of the calculations are filed under appendix B3.

It is necessary to determine the original Ship Design MBL. If this is not available, the mooring winch Brake Design Load (brake holding capacity) must be determined from the manufacturer's certification. From that the Ship Design MBL can be determined, which will be 125% of the mooring winch designed brake maximum holding load.

When ordering new mooring lines, the original size and Ship Design MBL should be specified, and the LDBF of a line shall be 100-105% of the Ship Design MBL – See **appendix B6** for Initial mooring line selection inputs, including assumptions, methodology and supplier(s) and information on the agreed rope commissioning process.

The Company's guidelines for ordering mooring lines and tails form an inherent part of the procurement process. The vessel will provide all the information stated in Mooring Equipment Guidelines (MEG4) appendix B when ordering new mooring lines and tails.

B.7. Determining the original mooring line service life expectations, including supporting evidence used to determine criterion. This can be achieved through various means:

- OEM guidance and recommendations.
- References from other operating companies on similar trades.
- Empirical data from similar fleets.
- Historical data related to that type of rope, ship and service, etc.

Based on OEM guidance and recommendations, historical data and empirical data collected, the Company reviews the retirement criteria and service life expectations for mooring lines and tails on a regular basis.

All mooring lines are retired when their residual strength has reached 75% of the Ship Design MBL.

Appendix B7 provides a list or reference to the original mooring line service life expectation from the OEM guidance and recommendations and/or references from other companies and/or data from similar fleets as well as historical data related to all mooring lines from the vessel. The Company utilises this information to establish and monitor the adequacy of the existing retirement criteria. Further consideration will also be given where the D/d ratio is less than 15.

B.8. Alternate mooring patterns to meet the standard environmental criteria assessment and designed-in options when the optimal mooring pattern is unachievable in some real-world scenarios (e.g. hooks, dolphins or mooring winches out of service, breast lines not in an optimal perpendicular lead, etc.).

Vessel crew and operators should carry out a review of the mooring pattern and ensure that alternate mooring plans have been established. The alternate mooring configurations are filed in **appendix B8** together with a copy of (or reference made to) the associated risk assessment documentation.

Ships will be most effectively moored using lines within the length of the ship through a combination of breast and spring lines with:

- Breast lines oriented as perpendicular as possible to the longitudinal centreline of the ship and as far aft and forward as possible.
- Spring lines oriented as parallel as possible to the longitudinal centreline of the ship.

When there is to be a change to the mooring pattern due to hooks, dolphins or mooring winches out of service and breast lines not in an optimal perpendicular lead the Master, together with the Pilot and terminal representatives, will review the situation and carry out an on-scene risk assessment to ensure the most optimal mooring pattern is used. This alternate mooring pattern should be such that it meets the optimal leads as per MEG4.

This risk assessment will consider:

- Residual capacity to ensure the ship can berth and/or remain berthed;
- Lines unable to be deployed from optimal locations due to incompatibility with berth facilities;
- Equipment redundancy, including critical equipment and spares;
- Other influencing factors such as locations with peculiar environmental parameters.

B.9. Limitations and exclusions for initial mooring philosophy, and provisions for modifications.
The limitations relevant to the vessel's initial mooring philosophy (if any) are filed in **appendix B9.** This appendix is further populated with modification plans and risk assessment documents pertaining to the vessel's mooring design modifications.

The limitations and modifications that have been carried out on board are taken into account when preparing and reviewing all mooring-related risk assessments.

Part C – Detailed List of Mooring Equipment

Part C	Detailed list of mooring equipment
Goal C	Provide detailed information on all of the ship's mooring equipment.
Functional Requirements	Documents should contain information that details the ship-specific mooring capabilities and limitations for the following equipment where fitted.

C.1. Permanent fittings (mooring fittings, rollers, fairleads, etc.).
A list of all permanent mooring fittings can be found in **appendix C1**. This should be supplemented by or referenced to drawings (e.g. Mooring Arrangement Plan, provided by the shipbuilding yard) providing detailed information on their strength where available.

Makers' manuals or reference to these shall additionally be filed under appendix C1.

Limitations, if any, should be detailed or be available within the manuals and/or plans.

C.2. Permanent machinery installations (winch motors/drives, etc.).
A list of all permanent machinery installations can be found in **appendix C2**. This may be supplemented by or referenced to drawings (e.g. Mooring Arrangement Plan, provided by the shipbuilding yard) or manuals indicating the design loads and parameters where available.

Limitations, if any, should be detailed or be available within the manuals and/or plans.

C.3. Loose equipment (mooring lines, tails, pennants, joining shackles, etc.).
See **appendix C3** for a complete list of loose equipment. The inventory list should be updated on a regular basis and a full record and history maintained herein. Reference is additionally made to the vessel's LMP.

C.4. Critical and specialist equipment (e.g. winch brake testing equipment) including tools to undertake maintenance and repairs of this equipment.
Specialist equipment such as brake holding test kits are maintained on board and kept under strict control and supervision of a Responsible Officer. See **appendix C4** for a full inventory of all specialist equipment maintained on board. This may be supplemented by or referenced to the makers' manuals.

C.5. Performance standards/requirements for above equipment.
The performance-related standards and requirements are filed in **appendix C5** where available. Mooring equipment on board is built to ISO standards & IACS rules, and always in line with the applicable mooring equipment guidelines applicable at the time of construction of the vessel.

C.6. Details of ship structure and under deck strengthening.

See **appendix C6** for detailed diagrams of the ship structure and underdeck strengthening diagrams for fixed mooring equipment on board the vessel.

In addition, a mooring arrangement plan complementing the above equipment list should be available that clearly indicates the following:

C.7. Location of all permanent/fixed equipment. This should as a minimum include winches and their direct leads and any alternative arrangements. This arrangement plan can be combined with records for part B.

a. Location of hazardous mooring zones including higher risk areas, protective locations, optimal viewing and sight lines for supervisors and other human element considerations included in part E.

b. For ease of use, consideration should be given to marking the plan with basic functional information; e.g. Ship Design MBL, winch brake holding capacity, mooring line WLL/LDBF, SWL of mooring bitts, minimum yield load for bow mooring equipment, location of extra strength bitts for tugs and towing, etc.

c. Any changes to mooring equipment.

Based on the mooring assessment carried out by the operator and on board, the vessel's crew and superintendents have identified the dangerous zones on board the vessel related to mooring operations.

The crew and superintendents have taken into account various factors revolving around human factors and an approach to safer procedures. See **appendix C7** for a detailed plan. The plan highlights protective locations, optimal viewing and sight lines for supervisors as well as other human element considerations where practical.

The plan is additionally marked with basic functional information such as Ship Design MBL (when available), winch brake holding capacity, mooring line WLL/LDBF, SWL of mooring bitts, minimum yield load for bow mooring equipment, location of extra strength bitts for tugs and towing, etc.

Any changes to mooring equipment will be highlighted on the plan. (See details on Management of Change under E.6.)

Part D – Inspection, Maintenance and Retirement Strategies/Principles

Part D	Inspection, maintenance and retirement strategies/principles
Goal D	Provide detailed information on the requirements for inspecting and maintaining all loose and permanent mooring equipment, as well as the management strategies to test, retire and replace equipment and interface with the OEM.
Functional Requirements	Information should as a minimum cover all items of loose or permanent mooring equipment used or deployed by the ship to achieve safe mooring. The information should complement that held in the onboard planned maintenance scheme and ship's SMS. (See part F of the MSMP for further information).

D.1. Detailed list of mandatory and recommended survey requirements for all equipment, including any specific OEM requirements.

All permanent mooring equipment is surveyed by the vessel's Classification Society during annual, intermediate, periodical and renewal surveys. See **appendix D1** for a list of surveys outlining permanent mooring equipment surveyed. This list should be supplemented by, or referenced to, makers' manuals indicating their specific requirements.

A list or reference to the vessel's Planned Maintenance System (PMS) indicating the mandatory and recommended survey requirements for all mooring equipment may be inserted under the same appendix D1.

It is the operator's aim to minimise the risk of the mooring lines failing in service. The operator actively builds up strength degradation data by consulting with manufacturers and other third parties and establishes condition-based monitoring to assess line condition and trends using the following techniques:

- Residual strength testing and analysis.
- Residual fatigue life analysis.
- Other non-destructive testing techniques.

The Company has developed a programme for line maintenance, inspection and retirement. Inspection and discard strategies are based on manufacturer guidance and operational experience. The following industry standards are taken in to account:

- ISO 4309 Cranes – Wire Ropes – Care and maintenance, Inspection and Discard

- CI-2001: Fibre Rope Inspection and Retirement Criteria.

Further product specification instructions are provided by the line manufacturer – see LMP.

D.2. Inspection and planned maintenance schedules including, where necessary, requirements for use of specialist contractors, e.g. OEM representatives.

The vessel's PMS is used as a primary method for inspection and maintenance schedules. Where required, the use of specialist contractors is also incorporated. The PMS is set up based on the OEM guidelines and recommendations and should be approved by the vessel's Classification Society.

See ***appendix D2*** for a list of all mooring equipment-related jobs as per the PMS. This list should be supplemented by, or referenced to, mooring equipment-related jobs where specialist contractors are engaged.

D.3. Critical and specialist equipment should be clearly identified in the inspection and maintenance system, along with any required training and competency requirements for maintenance on this equipment.

Critical and Specialist equipment (e.g. winch brake testing equipment) where fitted should be identified within the vessel's PMS and suitable services arranged in line with OEM requirements.

Maintenance of critical and specialist equipment shall be carried out by the vessel's crew provided proper training has been provided.

See **appendix D3** for a list of critical and specialist equipment-related jobs as per the PMS. These should include both inspection and maintenance requirements.

This list should be supplemented by, or referenced to, critical and specialist equipment-related jobs training and competency requirements for inspection and maintenance on this equipment.

D.4. A Mooring Line Management Plan (LMP) covering all mooring ropes and wires in use, including ancillary equipment, e.g. mooring line tails and joining shackles. See section five MEG4.

A Mooring LMP has been prepared and maintained as a standalone file. Reference is made to the LMP under **appendix D4**.

Alternatively, the LMP can be entered under appendix D4.

D.5. Certificates and documents detailing onboard equipment and spares maintenance, e.g. winch brake test records.

All certificates and mooring-related equipment that are supplied to the vessel can be found in ***appendix D5***.

BHC test records are filed in appendix C4 of this plan.

All mooring line certificates are filed in the Line management plan.

Part E – Risk and Change Management, Safety of Personnel and Human Factors

Part E	Risk and change management, safety of personnel and human factors
Goal E	Provide detailed information on the requirements for identification and management of hazards and risks arising from the mooring system.
Functional Requirements	Information should be readily available covering health, safety and requirements that ensure as a minimum, the safety, health and well-being of all personnel in or around the mooring workspace. Requirements should also cover personnel handling or operating loose or permanent mooring equipment used or deployed by the ship and methods to ensure safe mooring operations, including the following:

E.1. An assessment of safety should be undertaken, including, but not limited to:

- *Reviews undertaken during design or to assess effectiveness of the original design basis of mooring equipment and pattern.*
- *Operations interfaces and exposures for personnel in or around the mooring Workspace (also see E.4).*
- *Measures taken, or required to be taken, to eliminate risks or mitigate harm to personnel and/or damage to equipment.*

Copies of review documentation as undertaken during the design of the vessel, if available, should be filed under **appendix E1**. Alternatively a reference to this documentation will be entered in appendix E1.

The ship operator has developed a generic risk assessment for mooring and unmooring operations. Vessel Officers use this generic risk assessment to develop ship-specific risk assessments. The risk assessments are reviewed prior to every mooring operation and discussed during toolbox talks with all crew involved in the mooring operations.

Copies of the risk assessments are filed in appendix E1. Alternatively, reference to the mooring operations risk assessments is made in appendix E1.

The on-board risk assessment covers hazards such as but not limited to:

- Condition of the ship's mooring lines.
- Condition of the ship's mooring equipment.
- Forces acting on the ship.
- Inadequate mooring configuration due to terminal/berth layout.

- Crew training/familiarisation including possible human error evaluation.
- Work area.

Risk involved from mooring system/mooring operation addresses i.a.:

- Possible injury to ship's crew.
- Possible damage to own ship's structure and mooring equipment.
- Possible damage to shore installation.
- Possible damage to another ship (in STS operation).

The following measures are taken, or required to be taken, to eliminate risks or mitigate harm to personnel and/or damage to equipment:

1. Condition of the ship mooring lines – Risk mitigation measures:

- Line design break force of all mooring lines (wires and ropes) requested/fitted on board must be 100-105% of Ship Design MBL.
- All mooring lines, tails, joining shackle must be provided with certificates. Refer to ship's Line Management Plan for certification and documentation guidelines.
- Synthetic tails should have a tail design break force 25-30% higher than of the Ship Design MBL.
- Refer to MEG4 section 5.5.6 for usage and care of steel wire ropes.
- All mooring lines to be inspected, maintained and tested as per PMS and LMP.
- Records of the inspection results of mooring lines and conditions of tails conditions are maintained as per the operator's SMS and PMS.
- All mooring lines and tails are permanently marked and corresponding certificates for tracking service history are properly recorded and filed.
- Mooring lines retirement criteria as per guidelines stated in the operator's SMS as well as per MEG 4 section 5.4.1. are properly documented.
- Refer to MEG4 table 5.1 for factors influencing mooring lines performance and performance analysis guidelines.
- Maintenance, Inspection and Retirement programme are developed as a part of the mooring line specification selection process and are recorded in the ship's LMP.
- Chafe sleeves are used on fibre ropes to reduce the effect of abrasion and minimise chafe damage, especially during STS operation and at berths which are not sheltered.
- If vessel's crew is in doubt about the requisition of the correct new mooring lines, the operator is contacted for seeking further guidance (also refer to MEG4 Appendix B).

2. Condition of the ship mooring equipment – Risk mitigation measures:

- All mooring equipment and associated fittings are designed and approved by the vessel's Classification Society.
- Relevant mooring system plans and documents are readily available for immediate reference.
- Brake rendering of all mooring winches are set at 60% of the Ship Design MBL.
- Pointers indicating mooring winch brake tightening limits are clearly available.
- All mooring winches are maintained and tested as per operator's SMS and PMS, which reflects the maker's recommendations.
- Any abnormal issues noticed during an inspection should be brought to the operator's immediate attention.
- All mooring equipment, including hydraulic systems, are tested in their normal working pressure prior mooring operation. Abnormalities are addressed immediately.
- Maintenance of all mooring equipment and associated fittings is conducted as per maker's instructions and operator's PMS.
- Vessels have a mooring winch brake testing kit on board for carrying out periodical testing.
- Vessels have appropriate spare brake bands for mooring winches and windlasses available on board as per operator's SMS and PMS.

3. Forces acting on the ship – Risk mitigation measures:

Wind, current, tides, waves, ice, changes in draught, trim or list, and interaction between the vessels are the factors acting on the ship.

- Prior to the vessel calling at the nominated terminal/berth, the Master shall liaise with the port/local agents and collect all information as stated above and prepare a mooring arrangement/configuration plan in advance.
- The vessel will comply with the terminal's regulations on mooring arrangements.
- General guidelines for number of mooring lines to be passed corresponding to the vessel size are provided by the operator.
- The Master will make an on-scene assessment, liaise with the Pilot(s) during Master/Pilot exchange, with the Loading Master during ship/shore interface (SSSCL) and pass additional mooring lines as required or appropriate considering all above external factors and terminal limitations.
- The conditions under which cargo transfer will be suspended and loading arms/hoses disconnected and gangway removed will be properly determined and documented.
- Terminal and environmental operating limits are discussed during ship/shore interface and recorded in the SSSCL.
- A formal risk assessment is prepared and discussed between all Officers and crew during the pre-mooring operation meeting.

- If the nominated terminal/berth is not sheltered, the Master has the authority to request for tug assistance as required, assessing the situation on scene.

- During an STS operation, the weather forecast is permanently monitored as well as the location of the STS operation. Port permission prior to carrying out the STS operation is requested as per the STS transfer plan. *Caution: If local weather deteriorates, the Master has the authority to assess the situation on scene and suspend STS operations as required.*

4. Inadequate mooring configuration due to terminal/berth layout – Risk mitigation measures:

- Prior to the vessel calling at the nominated terminal/berth, the Master should liaise with the port/ local agents and request both the terminal layout and the terminal's minimum mooring configuration requirements.

- Master to liaise with the terminal representative to ensure the vessel mooring arrangement complies with the terminal mooring requirement.

- If the vessel mooring configuration is unable to be deployed from optimal locations due to the incompatibility of the berth/terminal layout, the Master is to notify head office in advance.

- Assess freeboard limitations.

- General guidelines for number of mooring lines to be passed according to the vessel size are provided by the operator.

- Master to make an on-scene assessment, liaise with the Pilot during Master/Pilot exchange, loading Master during SSSCL and pass additional mooring lines as required/appropriately considering terminal layout.

- A formal risk assessment to be prepared and briefed with all Officers and crew during pre-mooring operation meeting.

- Refer to MEG4 section 4.2 for general precautions and section 9.2 to assess mooring arrangement considering terminal layout.

5. Crew training/familiarisation including possible human error evaluation – Risk mitigation measures

- Upon joining and before performing first mooring operation, all crew and officers are briefed on the vessel's specific mooring equipment and its standard operating procedures as per manufacturer's instructions.

- All crew are strictly instructed not to overtighten the mooring winches beyond their rendering capacity which is 60% of Ship Design MBL.

- The installation of stopping arrangements such as locking nuts etc, which can impede the brake setting and reduce the brake holding capacity, is forbidden.

- Once the mooring configuration of the nominated terminal/berth is known, the Master and Responsible Officers carry out a pre-mooring operation meeting with all crew involved and should brief all personnel on the planned mooring operation including the terminal layout, winches, mooring lines to be used, terminal and environmental limitations and hazards, including snap back.

- The entire mooring area is considered a dangerous area. The dangerous areas should be marked on plans as well as physically marked on board the vessel. Refer to MEG4 5.2.5 for snap back and precautions.

- All crew and Officers are engaged on task analysis of the mooring system and operations. Training gaps and training options are analysed.

- All Officers and crew are engaged on periodic refresher training on mooring system, safe mooring operations, correct maintenance, testing and routine care of the mooring equipment in accordance with manufacturer's guidelines, industry norms and planned maintenance system. (Refer further to E.3. for manning and training.)

6. Mooring watch keeping – Risk mitigation measures:

- The operator's SMS details the policy and procedures for watch-keeping requirements.

- Minimum manning level during mooring and unmooring operations are outlined in the operator's SMS.

- A Responsible Officer is appointed – being the person in charge for mooring operations in close communication with bridge / pilots / tugs / shore.

- All mooring lines are tended regularly during the vessel's stay at the nominated terminal/berth.

- Frequency of mooring attendance are reduced as documented if the vessel is berthed at high tidal range ports or encountering strong currents.

- Equal load distribution is ensured on all mooring lines.

- Mooring lines leading in the same direction are of the same material and length.

- Mooring lines are deployed using direct leads to reduce the loss of line strength and potential increase of snap back danger zones.

- A copy of the local tide table should be posted in the cargo control room and gangway; all crew are aware and understand the tidal range to tend the moorings accordingly.

- Channel traffic is closely monitored. If other vessels approach at high speed, Master and Loading Master are immediately notified and the appropriate actions taken.
  Caution: If the vessel surges due to STS interaction, suspend the cargo operations immediately.

7. Human Factors – Risk mitigation measures

- Good communication is maintained between bridge/pilot and mooring stations, winch operators, tugs and terminal.

- Both primary and secondary means of communication are identified and tested prior to the mooring operation.

- All crew members are familiar with the operating procedures of the ship's specific mooring equipment.

- All crew members are well aware of the mooring equipment's limitations, if any.

- Pre-mooring tool box meeting is carried-out and a risk assessment for the intended mooring operation discussed.

- All crew members involved in mooring operations are properly rested.

- Upcoming mooring operations are planned well in advance and crew-members are provided the required rest in order to meet work and rest hours' compliance.
- Work and rest hours of all crew-members are properly monitored and they are not engaged if they are not properly rested prior to mooring operations.
- All crew members comply with the Company's drug and alcohol policy prior to engaging themselves in mooring operations.
- Appropriate personal protective equipment is provided to all crew members considering extreme environmental conditions.
- Crew members engaged in mooring operations should not be stressed.

8. Work Area – Risk-mitigation measures:

- Mooring stations/operation areas are adequately lit including winch controls, gauges, clutches and operator platforms.
- Winch operators have a clear view/line of sight of the Responsible Officer signalling the actions to moor/unmoor the vessel safely.
- When the winches are operated remotely, the winch operator shall not position him/herself in the danger area of any mooring line.
- Mooring stations are clear of any obstructions which could affect safe mooring/unmooring operations.
- The Responsible Officer monitors the entire mooring operation from a higher viewpoint.
- The area is left as soon as work is complete.
- The mooring area is free of noise levels from other machinery.
- Mooring stations are painted with non-slip paint.
- The entire mooring area is considered a dangerous area. The dangerous areas should be marked on plans as well as physically marked on board the vessel. Refer to MEG4 5.2.5 for snap back and precautions.

E.2. Critical equipment including any required additional control measures.

Critical and specialist equipment (e.g. winch brake testing equipment) where fitted are identified within the vessel's PMS.

Maintenance of critical and specialist equipment is carried out by the vessel's crew, on the condition that proper training has been provided.

See appendix D3 for a list of critical and specialist equipment-related jobs as per the PMS.

A detailed risk assessment and control measures for the operation of critical equipment should be filed under **appendix E2**.

E.3. Manning and training.

- *Safe manning levels including minimum required by Class, Flag and/or the ship's SMS.*
- *Manufacturer's instructions and standard operating procedures.*
- *Outline competency requirements for undertaking mooring operations and operating mooring machinery (operator and/or industry).*
- *Induction, familiarisation and training requirements necessary before personnel undertake mooring operations, including any ship-specific requirements and periodic refresher training.*

Copies of safe manning documents including minimum required by Class, Flag and/or the ship's SMS are filed under **appendix E3**. Alternatively a reference to this documentation will be entered in appendix E3.

The operating Company has standard procedures in place for maintaining the number of crew required for safely manning the ship as per industry standards.

- Manufacturer's instructions and standard operating procedures are also filed under appendix E3.
- Competency requirements for undertaking mooring operations and operating mooring machinery are also filed under appendix E3.

The operating company requires all officers and crew to have the required certificate of competencies for the rank in which they serve. This is in line with STCW and Flag requirements and covers safe mooring operations.

- Induction, familiarisation and training requirements necessary before personnel undertake mooring operations, including any ship-specific requirements and periodic refresher training should be filed under appendix E3. Alternatively, reference should be made to the appropriate documentation.

All crew members are provided with a familiarisation and training session for the safe operations of mooring equipment prior to undertaking mooring operations. Upon joining and before performing the first mooring operation, all crew and Officers are to be briefed on the vessel's ship-specific mooring equipment and its standard operating procedures as per manufacturer's instructions and operator's requirements. Records of this familiarisation should be filed properly on board.

All trainees and cadets are given adequate training and supervision during mooring operations as per training record books.

The Officers and crew additionally undergo computer-based training such as but not limited to:

- Safe Mooring
- Theory of Mooring
- Safe Mooring Practice
- Maintenance of Mooring Systems
- Working with Tugs
- Anchoring Safely

Periodic refresher training is carried out as per the training schedule on the vessel and is also discussed in HSSE meetings with the crew when relevant.

E.4. Human factors and personnel risk management

- *A human factors integration plan that establishes the methods by which Human-Centred Design (HCD) has collectively addressed risks to personnel through a hierarchy of elimination, substitution, isolation or mitigation of risk at source, technical or engineering controls and organisational measures.*
- *Hazard identification techniques used to determine opportunities to eliminate or mitigate to ALARP risks to personnel through design or engineering controls.*
- *Residual risks of injury and occupational health for all personnel in or around the mooring workspace should be clearly identified.*
- *Ergonomic assessments to further consider engineering or operational control measures that will enhance the safety and well-being of all personnel operating mooring equipment.*
- *Assessment and identification of all areas of increased or higher risk in the mooring work space, including snap-back danger zones.*
- *Protected locations including clear lines of sight for personnel when operating deck machinery or supervising mooring operations.*
- *Considerations around managing stress, fatigue and hours of rest.*
- *Considerations for managing exposure to extreme environmental conditions.*

The vessel has been designed and built to the applicable Mooring Equipment Guidelines at the time of construction. Due diligence is exercised when carrying out mooring operations taking into account a human -centred approach. This is justified by carrying out risk assessments for various mooring operations that the vessel is exposed to during her lifetime.

In addition to the extensive training provided to the crew through familiarisation, computer-based training and safe mooring campaigns, the Company has elaborated procedures outlined in the SMS for safe mooring operations.

The entire mooring area is considered a dangerous area. The dangerous areas are marked on plans as well as physically marked on board the vessel. A plan indicating dangerous mooring areas can be found in **appendix E4**.

A generic risk assessment is carried out by the vessel's operator. Vessel-specific risk assessments for mooring operations are carried out on board.

The Company and the Master should ensure that all crew are familiar with the operating procedures of ship-specific mooring equipment. They further ensure that all crew are well aware of the mooring equipment's limitations.

The risk assessment also takes into account the design of the mooring layout and limitations of the equipment and minimises the exposure to crew. Every effort is made to minimise excessive turns around fairleads and provide straight leads where possible.

Once the mooring configuration of the nominated terminal/berth is known, the Master and responsible officers will carry out a pre-mooring operation meeting with all crew involved and brief all personal on the planned mooring operation, including the terminal layout, winches, mooring lines to be used, terminal and environmental limitations and hazards, including snap back.

During extreme environmental conditions, the crew exposure is kept to a bare minimum and every effort is made to exercise stop work authority and consider aborting operations as a whole. This is further detailed in the operator's SMS. All crew participating in mooring operations are provided with the appropriate personal protective equipment considering extreme environmental conditions.

The following is further taken into account:

- The whole mooring stations and operations areas are adequately illuminated, including winch controls, gauges, clutches and operator platforms.
- The winch operators have a clear view/line of sight of the Responsible Officer signalling the actions to moor/unmoor the vessel safely.
- When the winches are operated remotely, the winch operator will not position him/herself in the danger area of any mooring line.
- Mooring stations are clear of any obstructions which could affect safe mooring/unmooring operations.
- Responsible Officers monitor the entire mooring operation from a higher point if possible.
- The area is left as soon as work is complete.
- Areas are not subject to excessive noise levels from other machinery.
- Mooring stations are painted with non-slip paint.
- All crew involved in mooring operations are properly rested.

The Company uses a program for managing and control of hours of rest and work. The tool also allows the user to better plan rest and work hours and also incorporates an overview for line managers on board. Every effort is made to minimise fatigue on board and ensure compliance with ILO and STCW regulations for work and rest hours. Managing work and rest hours is incorporated in the Company's SMS which includes a review by the operator on a regular basis.

As part of the familiarisation process, crew members are briefed on the work and rest hour requirements prior to taking over duties. The Master and Responsible Officers will further ensure that stress is properly managed on board.

The crew complies fully with the Company's alcohol and drug policy at any given time they serve on board the vessel.

A copy of all mooring-related risk assessments which encompasses risks related to design, operations, environmental conditions and other external factors can be found in appendix E4. In addition to the risk assessment for safe mooring operations, the following risk assessments are filed in appendix E4 where applicable.

- Mooring/Unmooring operations at SBM.
- Mooring/Unmooring operations at CBM.
- Mooring/Unmooring operations at open berths.
- Tug operations.

Additional risk assessments made for other ship-specific cases, unusual situations and mooring configurations are also filed in appendix E4.

E.5. Mooring operations plans and procedures.

– *Risk-based mooring operations plans and procedures should be detailed and include pre-arrival briefings, ship/shore mooring arrangements, safety and occupational health issues and required crew resources.*

– *Contingency plans for mooring operations with appropriate control measures and operational procedures.*

– *Requirements for operations supervision at each mooring work space and overall control of mooring operations (e.g. Master/Pilot) are to be detailed.*

– *Communication methods, both primary and secondary should form a part of the operations plans.*

The operator has developed detailed mooring operation procedures that are outlined in various sections of the SMS. This includes planning and preparation for mooring operations, the mooring operations at CBM/ SBM/ FPSOs, etc. Copies of the mooring operations plans and procedures are filed under **appendix E5**. Alternatively, a reference may be made to the Operator's relevant part of the SMS.

The shipboard procedures are in addition to engineering design specifications and training requirements and include the step-by-step instructions that are implemented by competent personnel when conducting mooring operations.

Contingency plans for mooring operations are also further addressed in the SMS. Reference to these may be made under appendix E5.

Risk assessments for the various mooring operations can be found in appendix E1.

Risk assessments and toolbox talks are key to safe mooring operations and do identify potential risks and capture mitigation steps to reduce or remove them.

Potential human failures which are included in the risk assessments are categorised as:

- Action errors, such as:
  - Operating the winch in the wrong direction.
  - Forgetting to engage the brake.

- Checking errors, such as:
  - Failure to confirm that personnel are clear of mooring lines before heaving.
  - Failure to de-energise/shut down equipment at completion.
- Communication errors, such as:
  - Signalling 'heave' instead of 'slack out'.
  - Radio does not work.
- Selection errors, such as:
  - Selecting the wrong equipment or mooring line size.
  - Selecting the wrong switch.
- Planning errors, such as:
  - Failing to plan the steps in order.
  - Not enough personnel.
  - Not following maintenance intervals.
  - Not identifying danger zones/risk areas.
- Violations, such as:
  - Intentionally taking a short-cut
  - Walking over tensioned mooring lines.
  - Modifying or adjusting equipment or settings without approval as defined by a Management of Change process.

There is positive reinforcement of safe behaviours, including stop work authorisation. Risk Assessments are reviewed periodically and updated to capture any new risks or modifications to equipment, shared lessons from industry incidents, near misses, etc.

As part of the pre-arrival meeting for the port, the crew is briefed on the planned configurations for the mooring operations based on information provided by the agent and terminal. This is further confirmed at the Master/Pilot exchange and promulgated to the mooring teams which is then finally discussed during tool box talks prior to mooring operations.

Any change in the mooring plan must be carried out only after the Master's approval; the changes must be discussed with all personnel involved in the mooring operation.

Mooring-related health and safety issues are discussed in the regular safety meetings held on board and corrective action taken when needed. Reference to these meetings or copies of same may be filed under appendix E5.

The vessel maintains an STS plan which details the requirements for safe mooring operations.

The structure of the mooring plan teams can be found in appendix E3.

Communication methods used for mooring operations are identified in the operator's SMS with reference made under appendix E5.

E.6. Change management

- The change management process and procedures and lines of authority should be detailed to control and record:

  - Where changes occur to operations, procedures or ship mooring equipment.
  - Where changes may impact personnel safety.
  - Steps to manage changes to mooring plans during operations.
  - Control equipment change out.
  - Changes to the design philosophy, e.g. due to change of owner, trading pattern or ship design.
  - Risk assessments undertaken to manage the impacts of the proposed change.

- The change management process should also detail information to be retained for the ship's lifecycle.

The management of change process is detailed in the operator's SMS. The operator's management of change process is comprehensive and involves a strict approval process.

All superintendents have been provided with training to ensure the Management of Change process is strictly followed. All copies of mooring-related Management of Change documents are filed in **appendix E6**.

The documents, files and drawings for all changes to mooring equipment are also filed in appendix E6. These documents will remain filed for the ship's lifecycle.

All risk assessments that accompany the Management of Change for the modification of the mooring equipment is filed in appendix E6 as well.

No modification or adjustment, change of settings to the mooring system and associated fittings, or to operating procedures, will be carried out on board without formal and documented Operator's approval.

A detailed information about a change proposal, along with support documents including a risk assessment, will be submitted to the operator for review and consideration of a Management of Change process.

Any change in the mooring plan must be carried out only after the Master's approval; the changes must be discussed with all personnel involved in the mooring operation (see E.4).

Part F – Records and Documentation

Part F	Records and documentation
Goal F	Part F provides records of detailed maintenance information on the ship's mooring equipment system, and requirements for documentation management. This may also include upgrades or modifications to mooring equipment. This information should form the historical record of the mooring equipment which should be transferred with the ship.
Functional Requirements	Documentation covering equipment and operational requirements that ensure, as a minimum, the safety, health and well-being of all personnel in or around the mooring workspace, should be available:

F.1. OEM books, operating and maintenance guides, e.g.:

- Inspection, survey, maintenance and retirement records, e.g:
    - Retired equipment records to be maintained with ship throughout lifecycle along with the background/reason for retirement/change.

- Survey and test certificates.

The following documentation is filed under **appendix F1**:

- OEM guidance for the operation and maintenance guides.
- Mooring equipment-related Class Survey certificates
- Mooring equipment-related test certificates.
- All records related to mooring equipment along with reason for retiring the equipment.
- Copies or reference to the Operator's mooring-relevant SMS sections.
- Chain register/certificates.

F.2. Records of all associated management of change reviews should be retained throughout the ship lifecycle to ensure successive owners can fully re-evaluate design and operational changes.

The following documentation is filed under ***appendix F2***:

- Operator's Management of Change procedures.
- Documents, files and drawings detailing all changes to mooring equipment.

Part G – Mooring System Management Plan Register

Mooring System Management Plan Register (MSMPR)

While the MSMPR is part of the MSMP, the functional requirements of this states that for ease of reference it should be kept as a single file. Additionally, OCIMF recommends that an identical MSMPR is held ashore in case of damage. Care should be taken to ensure that the records are kept identical.

The aim of the MSMPR is to be a register of all mooring equipment. This should include records, operating instructions and documentation relating to the equipment so that there is a central point where everything can be referenced. The MSMPR is meant to be a live document and kept up-to-date, recording any changes with minimal delay. To assist in this process, the MSMPR should be integrated into the ship's document control system and be subject to change management controls to ensure a complete history. The MSMPR is intended to be handed over to any future operators of the ship.

Part G	**Mooring System Management Plan Register**
Goal G	Part G provides details of the records that should be retained by the ship throughout its lifecycle from original design to disposal. They should be in a form that enables transfer when ship ownership changes.
Functional Requirements	The relevant information identified in the MSMP covering the mooring equipment system, should be retained on board every ship. It should be maintained as an accurate and up-to-date record, and be readily available for inspection. How this information is kept will vary by ship. It is recommended that the information required by part G is kept in a single file or folder for ease of reference. Its location on board, and the person responsible for maintaining the information or up-to-date record, should be clearly identified in the MSMPR. Table 1.3 is an example of how the central MSMPR may be used to list the information needed to achieve the functional requirement.

MEG4 contains a section of a sample MSMPR as shown in Table 1.3 of section one. This sample table covers Part C of the MSMP. The MSMPR table should contain reference to every Part of the MSMP (Parts A to F). To aid members interpretation, the following table indicates the information required.

MSMP Part	Functional Requirement Scope	Location	Items	Comments
Part A – General Ship Particulars				
A.1	Ship details including name, date of build, registration, IMO number, Flag/Class			
A.2	Current owners, operators/technical managers, including (where applicable) bareboat owners			
A.3	All changes to the above including details of dates of transfer of owners, operators/technical managers, Flag, Class, registration, etc.			
Part B – Mooring Equipment Design Philosophy				
B.1	Design considerations to achieve the ship's optimal mooring pattern including information on the siting of mooring winches and fairleads to provide for direct leads and minimal lines across open decks.			
B.2	Mooring force calculations against the standard environmental criteria.			
B.3	Mooring restraint calculations to determine the strength and number of mooring lines and winches to balance the forces calculated.			
B.4	Design loads, safety factors and strength for required mooring lines and fixed equipment.			
B.5	Assumptions on the standard mooring pattern and considerations for redundancy provisions, including sub-optimal line distribution to cover unpredicted events (e.g. storm surges, shore mooring hooks out of service).			
B.6	Initial mooring line selection inputs, including assumptions, methodology and supplier(s) and information on the agreed rope commissioning process.			
B.7	Determining the original mooring line service life expectations, including supporting evidence used to determine criterion. This can be achieved through various means: • OEM guidance and recommendations. • References from other operating companies on similar trades. Empirical data from similar fleets. • Historical data related to that type of rope, ship and service, etc.			
B.8	Alternate mooring patterns to meet the standard environmental criteria assessment and designed-in options when the optimal mooring pattern is unachievable in some real-world scenarios (e.g. hooks, dolphins or mooring winches out of service, breast lines not in an optimal perpendicular lead, etc.).			

B.9	Limitations and exclusions for initial mooring philosophy, and provisions for modifications.			
Part C – Detailed list of Mooring equipment				
C.1	Permanent fittings (mooring fittings, rollers, fairleads, etc.).			
C.2	Permanent machinery installations (winch motors/drives, etc.).			
C.3	Loose equipment (mooring lines, tails, pennants, joining shackles, etc.).			
C.4	Critical and specialist equipment (e.g. winch brake testing equipment) including tools to undertake maintenance and repairs of this equipment.			
C.5	Performance standards/requirements for above equipment.			
C.6	Details of ship structure and under deck strengthening.			
C.7	Location of all permanent/fixed equipment. This should as a minimum include winches and their direct leads and any alternative arrangements. This arrangement plan can be combined with records for part B. A. Location of hazardous mooring zones including higher risk areas, protective locations, optimal viewing and sight lines for supervisors and other human element considerations included in part E. B. For ease of use, consideration should be given to marking the plan with basic functional information; e.g. ship design MBL, winch brake holding capacity, mooring line WLL/LDBF, SWL of mooring bitts, minimum yield load for bow mooring equipment, location of extra strength bitts for tugs and towing, etc. C. Any changes to mooring equipment.			
Part D – Inspection, maintenance and retirement strategies / principles				
D.1	Detailed list of mandatory and recommended survey requirements for all equipment, including any specific OEM requirements.			
D.2	Inspection and planned maintenance schedules including, where necessary, requirements for use of specialist contractors, e.g. OEM representatives.			
D.3	Critical and specialist equipment should be clearly identified in the inspection and maintenance system, along with any required training and competency requirements for maintenance on this equipment.			

D.4	A mooring Line Management Plan (LMP) covering all mooring ropes and wires in use, including ancillary equipment, e.g. mooring line tails and joining shackles. See section five.			
D.5	Certificates and documents detailing onboard equipment and spares maintenance, e.g. winch brake test records.			
Part E – Risk and change management, safety of personnel and human factors				
E.1	An assessment of safety should be undertaken including, but not limited to: Reviews undertaken during design or to assess effectiveness of the original design basis of mooring equipment and pattern. Operations interfaces and exposures for personnel in or around the mooring workspace (also see E.4.). Measures taken, or required to be taken, to eliminate risks or mitigate harm to personnel and/or damage to equipment.			
E.2	Critical equipment including any required additional control measures.			
E.3	Manning and training Safe manning levels including minimum required by Class, Flag and/or the ship's SMS. Manufacturer's instructions and standard operating procedures. Outline competency requirements for undertaking mooring operations and operating mooring machinery (operator and/or industry). Induction, familiarisation and training requirements necessary before personnel undertake mooring operations, including any ship-specific requirements and periodic refresher training.			
E.4	Human factors and personnel risk management A human factors integration plan that establishes the methods by which Human-Centered Design (HCD) has collectively addressed risks to personnel through a hierarchy of elimination, substitution, isolation or mitigation of risk at source, technical or engineering controls and organizational measures. Hazard identification techniques used to determine opportunities to eliminate			

	or mitigate to ALARP risks to personnel through design or engineering controls. Residual risks of injury and occupational health for all personnel in or around the mooring workspace should be clearly identified. Ergonomic assessments to further consider engineering or operational control measures that will enhance the safety and wellbeing of all personnel operating mooring equipment. Assessment and identification of all areas of increased or higher risk in the mooring work space, including snap-back danger zones. Protected locations including clear lines of sight for personnel when operating deck machinery or supervising mooring operations. Considerations around managing stress, fatigue and hours of rest. Considerations for managing exposure to extreme environmental conditions.			
E.5	Mooring operations plans and procedures Risk based mooring operations plans and procedures should be detailed and include pre-arrival briefings, ship/shore mooring arrangements, safety and occupational health issues and required crew resources. Contingency plans for mooring operations with appropriate control measures and operational procedures. Requirements for operations supervision at each mooring work space and overall control of mooring operations (e.g. Master/Pilot) are to be detailed. Communications methods both primary and secondary should form a part of the operations plans.			
E.6	Change management The change management process and procedures and lines of authority should be detailed to control and record: • Where changes occur to operations, procedures or ship mooring			

	equipment. • Where changes may impact personnel safety. • Steps to manage changes to mooring plans during operations. • Control equipment change out. • Changes to the design philosophy, e.g. due to change of owner, trading pattern or ship design. • Risk assessments undertaken to manage the impacts of the proposed change. The change management process should also detail information to be retained for the ship lifecycle.			
Part F – Records and documentation				
F.1	OEM books, operating and maintenance guides, e.g.: Inspection, survey, maintenance and retirement records, e.g.: - Retired equipment records to be maintained with ship throughout lifecycle along with the background/reason for retirement/change. Survey and test certificates.			
F.2	Records of all associated management of change reviews should be retained, throughout the ship lifecycle, to ensure successive owners can fully re-evaluate design and operational changes.			

Appendices

B1. Design considerations provided by the shipbuilding yard.

B2. Mooring force calculations against the standard environmental criteria.

B3. Mooring Restraint Calculations.

B4. Design loads, safety factors and strength for required mooring lines and fixed equipment.

B5. Assumptions on the standard mooring pattern and considerations for redundancy provisions.

B6. Initial mooring line selection inputs & Ship Design MBL.

B7. Original mooring line service life expectations.

B8. Alternate mooring patterns to meet the standard environmental criteria assessment.

B9. Limitations and exclusions for initial mooring philosophy.

C1. List of Permanent Fittings.

C2. List of Permanent Machinery Installations.

C3. List of Loose Equipment.

C4. List of Critical and Specialist Equipment.

C5. Performance standards / requirements for mooring equipment.

C6. Details of Ship Structure and under deck strengthening.

C.7 Mooring Arrangement Plan.

D1. List of survey requirements.

D2. List of Inspection and Planned Maintenance schedules.

D3. List of requirements for Critical and Specialist Equipment.

D4. Line Management Plan (LMP).

D5. Certificates and Documents for onboard equipment and spares maintenance.

E1. Documents detailing the assessment of Safety.

E2. Documents detailing the safe operation of critical equipment.

E3. Safe manning and training documentation.

E4. Human factors and personnel risk management documentation.

E5. Mooring operations plans and procedures.

E6. Change Management Documentation.

F1. OEM books, operating and maintenance guidance.

F2. Records of all associated Management of Change reviews.

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