140-Norwegian Oil and Gas recommended guidelines for Offshore Loading Shuttle Tankers

Original version
1 PREFACE

This guideline is sponsored by Norwegian Oil and Gas Association’s FPSO and Shuttle Tanker Network, and recommended by Norwegian Oil and Gas Operations Committee. Further, it has been approved for issue by the General Director.

The work group has been composed by members from the following companies:
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Statoil ASA
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Norsk olje og gass

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The guideline has been prepared with the broad-based participation of interested parties in the Norwegian petroleum industry. It forms a jointly agreed set of minimum requirements established between the operating companies and the main OLST contractors operating on the NCS. It will be subject to review after 2 years.

The guideline is owned by the Norwegian petroleum industry, represented by Norwegian Oil and Gas Association. Norwegian Oil and Gas is responsible for administration of these guidelines.

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<td>ASD</td>
<td>Automatic Shut Down</td>
</tr>
<tr>
<td>PARKER PMS</td>
<td>Position Monitoring System</td>
</tr>
<tr>
<td>BLS</td>
<td>Bow Loading System</td>
</tr>
<tr>
<td>BSL D 5-1</td>
<td>“Bestemmelser for Sivil Luftfart”; one of several documents regulating laws and rules regarding civil aviation in Norway</td>
</tr>
<tr>
<td>CAT</td>
<td>Customer Acceptance Test</td>
</tr>
<tr>
<td>CC</td>
<td>Conversion Candidate</td>
</tr>
<tr>
<td>CCR</td>
<td>Cargo Control Room</td>
</tr>
<tr>
<td>CCTV</td>
<td>Closed Circuit Television</td>
</tr>
<tr>
<td>DGPS</td>
<td>Differential Global Positioning System</td>
</tr>
<tr>
<td>DNV</td>
<td>Det Norske Veritas</td>
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<tr>
<td>DP</td>
<td>Dynamic Positioning</td>
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<tr>
<td>DPO</td>
<td>Dynamic Positioning Operator</td>
</tr>
<tr>
<td>EEBD</td>
<td>Emergency Escape Breathing Device</td>
</tr>
<tr>
<td>ESD</td>
<td>Emergency Shut Down</td>
</tr>
<tr>
<td>FAT</td>
<td>Factory Acceptance Test</td>
</tr>
<tr>
<td>FMEA</td>
<td>Failure Mode Effect Analysis</td>
</tr>
<tr>
<td>FPSO</td>
<td>Floating, Production, Storage and Offloading</td>
</tr>
<tr>
<td>GLF</td>
<td>Green Line Failure</td>
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<tr>
<td>HFO</td>
<td>Heavy Fuel Oil</td>
</tr>
<tr>
<td>HIL</td>
<td>Hardware In the Loop</td>
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<tr>
<td>HPU</td>
<td>Hydraulic Power Unit</td>
</tr>
<tr>
<td>HVAC</td>
<td>Heat Ventilation Air Conditioning</td>
</tr>
<tr>
<td>ICMS</td>
<td>Integrated Control and Monitoring Systems</td>
</tr>
<tr>
<td>IMCA</td>
<td>International Marine Contractors Association</td>
</tr>
<tr>
<td>IMO</td>
<td>International Maritime Organization</td>
</tr>
<tr>
<td>ISGOTT</td>
<td>International Safety Guide for Oil Tankers and Terminals</td>
</tr>
<tr>
<td>KLIF</td>
<td>Norwegian Climate and Pollution Agency</td>
</tr>
<tr>
<td>kN</td>
<td>kilo Newton</td>
</tr>
<tr>
<td>MBL</td>
<td>Minimum Breaking Load</td>
</tr>
<tr>
<td>MDO</td>
<td>Marine Diesel Oil</td>
</tr>
<tr>
<td>ME</td>
<td>Main Engine</td>
</tr>
<tr>
<td>NB</td>
<td>New Building</td>
</tr>
<tr>
<td>NCS</td>
<td>Norwegian Continental Shelf</td>
</tr>
<tr>
<td>NM</td>
<td>Nautical Mile</td>
</tr>
<tr>
<td>NMA</td>
<td>Norwegian Maritime Authority</td>
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<tr>
<td>OCIMF</td>
<td>Oil Companies International Marine Forum</td>
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<tr>
<td>OLS</td>
<td>Offshore Loading System</td>
</tr>
<tr>
<td>OLT</td>
<td>Offshore Loading Terminal</td>
</tr>
<tr>
<td>OLST</td>
<td>Offshore Loading Shuttle Tanker</td>
</tr>
<tr>
<td>P/V</td>
<td>Pressure/Vacuum</td>
</tr>
<tr>
<td>PASD</td>
<td>Position initiated ASD</td>
</tr>
<tr>
<td>PLC</td>
<td>Programmable Logic controller</td>
</tr>
<tr>
<td>PMS</td>
<td>Position Monitoring System</td>
</tr>
<tr>
<td>PRS</td>
<td>Position Reference System</td>
</tr>
<tr>
<td>PSA</td>
<td>Petroleum Safety Authority</td>
</tr>
<tr>
<td>SMSC</td>
<td>Ship Manoeuvring Simulator Centre (Trondheim)</td>
</tr>
<tr>
<td>SOLAS</td>
<td>International convention for the Safety Of Life At Sea</td>
</tr>
<tr>
<td>SPM</td>
<td>Single Point Mooring</td>
</tr>
<tr>
<td>STCW</td>
<td>The IMO's International Convention on Standards of Training, Certification and Watchkeeping for Seafarers</td>
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<tr>
<td>------------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>STL</td>
<td>Submerged Turret Loading</td>
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<tr>
<td>SWL</td>
<td>Safe Working Load</td>
</tr>
<tr>
<td>UHF</td>
<td>Ultra High Frequency</td>
</tr>
<tr>
<td>UPS</td>
<td>Uninterrupted Power Supply</td>
</tr>
<tr>
<td>VHF</td>
<td>Very High Frequency</td>
</tr>
<tr>
<td>VIQ</td>
<td>Vessel Inspection Questionnaire</td>
</tr>
<tr>
<td>VOC</td>
<td>Volatile Organic Compound</td>
</tr>
<tr>
<td>WLL</td>
<td>Working Load Limit</td>
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3 OBJECTIVE, TARGET GROUP AND PROVISION

This document and its appendices form a Guideline recommending a set of Operational and Technical requirements for Offshore Loading Shuttle Tankers (OLST), operating on the Norwegian Continental Shelf (NCS).

The guideline has been developed as a joint project initiated by Norwegian Oil and Gas and the operators on the Norwegian Continental Shelf (NCS). The guideline has been reviewed by relevant industry participants.

In general, the existing OLST fleet in service on the NCS at the date of issue of this document is assumed to be in compliance with this guideline.

3.1 Objective

The objective of this guideline is to capture and record industry best practice, and to recommend a set minimum Operational and Technical requirements for OLSTs, to ensure safe loading operations on the NCS.

3.2 Target group and scope

The target group is field operators, charterers, owners and operators of existing and potential OLSTs.

It is anticipated that both before and during an OLST’s service, the vessel and its operation should be subject to inspection to verify its compliance with regulatory requirements. This guideline is not intended to replace Charterers requirements.

The scope of the guideline is OLST operations taking place within the designated Safety Zone for hydrocarbon production, as defined by the Petroleum Safety Authority “Regulations relating to conduct of activities in the petroleum activities” (The Activities Regulations).

For vessels ordered as new-buildings or conversions, requirements marked with NB are applicable for new-buildings and requirements marked with CC are applicable for conversions.

For OLST operations north of 67° N latitude, additional requirements will apply. These requirements will be specified by the field operator.

The document may also act as a guideline for operations in other waters.

3.3 Deviations

Deviations from this guideline should be assessed based on risk evaluation and/or compensating actions according to Field Operator’s practice.
4 LEGISLATIVE AND CLASS REQUIREMENTS
This document will not duplicate requirements established by Class Notations, Regulatory Authorities and other bodies such as IMO, OCIMF and IMCA. The OLSTs shall satisfy the technical requirements of the applicable flag state authority and all applicable regulatory regulations. Inside the Safety Zone, Offloading Operations shall also comply with relevant PSA requirements.

4.1 Class requirements
The OLST should have a design for North-Atlantic trade (25 years) and be classified by class societies recognized by NMA.

On NCS two (2) main categories of OLST operations are conducted and each category should have its own minimum requirement for Class notations.

<table>
<thead>
<tr>
<th>Operation Discipline</th>
<th>DNV Class Notations (or equivalent for other class societies)</th>
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<tr>
<td>Tandem-operations, OLS-operations and Direct Offloading</td>
<td>+1A1 TANKER FOR OIL ESP PLUS(NB) E0 DYNPOS-AUTR ESV-DP(HIL)(NB) F-AMC OPP-F BOW LOADING HELDK-SH(NB/CC) NAUT-AW(NB) TMON CLEAN DESIGN(NB) COMF V(3)C(3)(NB) CSR(NB) CSA-FLS(NB) 1 CCO(NB) VCS-2(CC)</td>
</tr>
<tr>
<td>SPM-operations and Tandem “Taut Hawser” operations</td>
<td>+1A1 TANKER FOR OIL ESP PLUS(NB) E0 DYNPOS-AUTR ESV-DP(HIL)(NB) F-AMC OPP-F BOW LOADING HELDK-SH(NB/CC) NAUT-AW(NB) TMON CLEAN DESIGN(NB) COMF V(3)C(3)(NB) CSR(NB) CSA-FLS(NB) 1 CCO(NB) VCS-2(CC)</td>
</tr>
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Table 1 – Applicable Class notations for OLSTs
5  HULL DESIGN AND STRUCTURAL REQUIREMENTS

5.1  Longitudinal bulkheads
OLSTs should be equipped with the minimum of one solid longitudinal bulkhead throughout the cargo area.

5.2  Structural strength
Cargo and ballast tanks should be designed for any degree of filling in order to avoid structural damage due to sloshing.

5.3  Internal corrosion protection for cargo tanks (NB/CC)
Cargo tanks should have a corrosion protection by the use of coating for stringer decks, bottom part of tanks (1.5 m) and deck head and down (2 m). Pit guard anodes should be installed for protection of suction wells.

5.4  Helideck arrangements
All OLSTs should be equipped with a certified helideck approved for the Norwegian sector. The helideck arrangement should comply with the following regulations and recommendations:
- CAP 437, latest edition
- Applicable national Civil Aviation Authority regulations
- Applicable helicopter operator regulations

For further details, refer to Appendix C

5.5  Securing of anchors
In order to eliminate any possibility of dropped objects in the Safety Zone, anchor chain stoppers of stopper-bar/guillotine type or equivalent means should be fitted to ensure proper stowing of anchors.

Whenever the anchors are not prepared for immediate use they should be secured with a stopper bar/guillotine and a minimum of one lashing. Where the stopper bar/guillotine does not fit when the anchor is fully housed, two lashings are required. The design of the lashings and pad eyes/lifting lugs should comply with relevant OCIMF guidelines.

The pad eyes should be full penetration welded, and all permanent equipment for securing of anchors should be certified according to class requirements.
6 OIL SPILL PREVENTIVE MEASURES

6.1 Coaming arrangement
OLSTs should be equipped with a coaming arrangement as described in Appendix B. For the coaming in the manifold room, refer to A.5.9.

6.2 Oil spill pumping system
For drainage of oil spills, OLSTs should be equipped with a permanently installed pumping or piping system (diaphragm or similar design).

The system should be arranged on both sides of the OLST and as far aft as possible on tank deck and should be capable of transferring oil spills on the weather deck to dedicated cargo or slop tank(s). The system should be arranged to prevent possible back-flow.

The pump should be protected from freezing either by design or by operational procedures.
7 MACHINERY AND PROPULSION

The following general requirements are regarded as a minimum for the OLST:

- Main engine(s) and auxiliary engine(s) should be supplied with fuel from independent systems (tanks, pumps and piping systems) \(^{NB/CC}\)
- Multiple active components should be arranged in parallel (pumps, filters, strainers etc.) in the utility systems of main engine(s) and auxiliary engine(s)
- There should be automatic de-sludging of filters in above mentioned systems
- Instrumentation and alarms in above mentioned systems should be arranged and documented
- All service tanks should be situated above the machinery (engines and boilers) to ensure supply by gravity or an equivalent system to ensure that fuel supply can be maintained \(^{NB/CC}\)
- A buffer tank (mixing tank) should be situated prior to the engine(s) inlet so that change between different fuel qualities can be done independent of the engines load situation \(^{NB/CC}\)
- Large electrical motors should be RPM controlled \(^{NB/CC}\)

7.1 Rudder

The OLST should be equipped with high efficiency rudder(s) \(^{NB/CC}\) eg. Becker Rudder

7.2 Tunnel thruster grating

All tunnel thrusters should be provided with gratings in accordance with thruster manufacturer’s recommendations.
8 CARGO, VENT AND BALLAST SYSTEMS
For details regarding this section, see Appendix D.

8.1 Cargo loading capacity
To reduce risk exposure time the OLSTs’ capacity to receive cargo should be optimized according to the OLST’s total cargo tank volume. For Aframax/ Suezmax size vessels this will typically be min 8000m3/hr.

8.2 Cargo valves
Valves in the cargo system should have a closing time designed to avoid pressure surges in OLST cargo system.

8.3 Cargo and ballast pump monitoring (NB/CC)
For OLSTs with a pump room, online vibration monitoring of all cargo, stripping and ballast pump bearings should be provided as well as temperature monitoring of pump casings.

8.4 Cargo/ballast monitoring system
All cargo tanks should be provided with radar type ullage gauging system. All ballast tanks and bunker tanks should be provided with automatic gauging systems.

All gauging systems should be online with a class approved loading computer.

8.5 De-ballasting capacity
An OLST should have at least two ballast pumps. The pumps should have a design capacity to de-ballast 100% ballast volume within 70% of the total loading time based on a loading rate of 9000 m³/hr.

8.6 Explosive atmosphere monitoring and protection
Ballast tanks, void spaces adjacent to cargo or slop tanks should be equipped with a fixed gas detection system.

8.7 Tank venting system
Each individual cargo and slop tank should be provided with at least:

- One high velocity P/V-valve (NB/CC)

8.8 Vapour handling system
OLSTs should be equipped to meet the applicable Volatile Organic Compounds (VOC) emission requirements as stipulated by the VOC Industry Co-operation and/or enforced by the Norwegian Environment Agency (Miljødirektoratet).
9 BOW LOADING SYSTEM AND MONITORING

9.1 Bow Loading System
All OLSTs should be equipped with a Bow Loading System (BLS) for cargo loading which is described in details in Appendix A.

The Bow Loading System (BLS) described in this document should provide a system for connecting an OLST to an offshore loading terminal with the purpose of offloading crude oil from the terminal. The loading hose from the loading terminal should be connected to the BLS loading manifold on the ship by means of a hydraulic coupler.

All equipment described in this document should be provided, installed and tested in accordance with applicable Class and authority regulations.

The following general requirements should be met for all cargo handling and storage equipment:
- A single failure, in the cargo handling and storage system, should not lead to a pressure rise exceeding the design pressure of the cargo handling and storage system
- No single failure is to cause a single-configured valve to close or open uncontrolled
- The OLST should under all circumstances be able to execute a controlled ESD 1 and ESD 2 operation
- Each active component should be designed with a fail-safe specification

9.2 BLS design requirements
The BLS system should be designed for remote control/monitoring from the bridge, and operation of the following equipment:
- Traction winch
- Chain stopper
- Coupler valve
- Inboard valve
- Inboard by-pass valve NB/CC
- Hydraulic pump station

Connection/disconnection of the loading hose should be done locally from a control console on the forecastle deck, included operation of the following equipment:
- Bow door
- Loading manifold
- Hose handling winch
- Forward/aft movement of the chain stopper, or adjustable roller fairlead

The following equipment should be locally operated from the bow area:
- Rope pulling unit/stowing arrangement
- Service crane

The BLS philosophy, i.e. “green line” manually or automatically initiated ESD 1 and ESD 2 (or any other software/hardware modifications) should be approved by field operator(s).
A single tubing/hydraulic hose rupture should not lead to events outside the affected systems’ design.

9.3 **Green line control system**
The BLS and cargo loading system should be provided with a “green line” control system according to Appendix A.9. Specifications are to be approved by field operator(s)

When the “green line” is completed, a “loading permit” signal should be transmitted to the adjacent offloading installation via the telemetry system. Any interruption in the “green line” should automatically initiate an ESD1 on the shuttle tanker and shut down of the crude export from the installation.

9.4 **Telemetry system**
A telemetry system should be a fail to safe design and capable of securing a safe start, control and stopping of the cargo transfer from the OLT to the OLST. System reliability should be achieved by the use of duplicated fail-safe telemetry systems operating in parallel and duplicated UHF radio transceivers with automatic changeover.

9.5 **Online flow-monitoring**
OLSTs designed for BLS loading operations where the export line/offloading hose (i.e. system from OLT cargo pumps to OLST manifold) is submerged should be equipped with an online flowrate monitoring system.

The flow-monitor’s sensor head should be installed downstream of the BLS inboard valve, whilst the transmitter should be located in sheltered area. Due consideration should be given to the location of the flow-monitor’s sensors in order to secure optimum flowrate readings. Mechanical protection from sea spray should be provided.

Remote monitoring from the bridge should be via the Parker PMS or equivalent.

9.6 **Close circuit colour television monitoring system (CCTV)**
The OLST should be equipped with a close circuit television system ref A.3.5

9.7 **Cargo loading system FMEA**
A Failure Mode, Effect Analysis (FMEA) for the BLS and cargo loading system should be carried out for each OLST prior to first offshore loading. This should be made available for field Operator(s) review.

The BLS and cargo loading system should as a minimum be designed and verified according to these requirements:

- A single failure, in the cargo loading and storage system, should not lead to a pressure rise exceeding the design pressure of the cargo loading and storage system
- No single failure is to cause a single-configured valve to close or open uncontrolled
• The vessel should under all circumstances be able to execute a controlled ESD 1 and ESD 2 operation
• Each active component should be designed with a fail-safe specification

Any finding and observation from the FMEA should be closed or mitigated.

If potential modifications on the BLS system (hardware or software) are identified for OLST, field operator(s) and Charterer(s) should be duly notified and acceptance should be granted prior to any modifications taking place. FMEA revised BLS FMEA verification trial should be carried out for any affected equipment following correction of an equipment breakdown, as applicable, or whenever significant repairs or upgrades of affected systems are made.
10 DYNAMIC POSITIONING

The OLST should be capable of maintaining safe position and heading during connection, loading and disconnection. This should be achieved by Dynamic Positioning (DP) which is described in details in Appendix E.

10.1 Design and operation of DP system
Dynamic Positioning Systems are defined in IMO MSC/Circ.645, latest edition.

- The design and operation of the DP system should as a minimum be in accordance with IMO MSC/Circ.645, latest edition, IMCA M 103, latest edition and IMCA 113, latest edition.
- The intended DP operational philosophy should be established as part of the vessel design and be reflected in the Failure Modes and Effects Analysis (FMEA)
- The DP system with its operational modes should be designed for the intended application of the DP vessel
- The DP system should be operated with open bus tie configuration for all voltage levels
- A Power Management System should be interfaced with the DP system
- Engine, thrusters, and propulsion systems with auxiliary systems should be supplied from dedicated power supplies, without use of change-over systems or cross feedings
- Fuel oil, fresh water cooling and pneumatic systems (part of the DP system) should be redundant
- The DP system should have the latest relevant software releases Charterer

10.2 Auditing, testing and acceptance
All FMEA analyses, examinations and trials should be witnessed by an independent 3rd party which should be subject to field operator(s) acceptance.

Auditing, testing and acceptance of the DP system should be in accordance with IMO MSC/Circ.645, latest edition, IMCA 112 and OGUK, latest edition.

The DP system maker should conduct testing including DP crash stop tests as appropriate following any repairs, modifications or upgrades on any part of the system or adjoining equipment to verify that the DP system is safe and functional.

FMEA desk top study and trials should be conducted by an industry recognized third party and approved by Class in accordance with IMCA M 166, latest edition.
DP Trials should be conducted in accordance with class requirements. A full FMEA trial should be performed with intervals not exceeding 5 years.

FMEA observations of category “A – Immediate Attention” (safety critical and/or non-conformance with regards to Class/Flag/IMO requirements) should be rectified before operation. FMEA Category “B – Action when Reasonably Convenient” (non-safety critical and/or deviation from standards or working procedures) observations should be rectified as soon as practically possible in agreement with Charterer(s) or field operator(s).

HIL testing is required for newbuilds and conversions. The following systems should be HIL tested:

- DP system
- Power Management System
- Steering, Propulsion and Thruster Control System (SPT)

The HIL tests should be in accordance with DNV STANDARD FOR CERTIFICATION, latest edition.

HIL-testing / re-testing should be considered in the following situations:

- When novel functions or control modes are introduced
- After an incident in which software has been identified as root cause

### 10.3 Position reference systems

The DP system should be equipped with a set of Position Reference Systems (PRS). To reduce the risk of interference and shadow zones, the location of the sensors should be optimized.

For further details see Appendix E.6.

### 10.4 Training and competence

Key personnel involved in DP operations should have adequate training and experience in accordance with IMO MSC/Circ. 738. The field operators may have additional competence requirements.

For further reference see Chapter 13.

### 10.5 Documentation

The documentation carried onboard should reflect current vessel design, deck layout and the intended operations, and should be kept up to date.

DP capability should be documented ref Appendix E.2

### 10.6 Incident reports, investigations and industrial experience transfer

The OLST owner or operator should have a DP incident reporting system for reporting in accordance with IMCA M 103, latest edition.
A PMS data logger should be provided as a part of the DP system. Recorded data should be electronically stored and made available for Charterer(s) or field operator(s) on request.

DP related events and incidents should be investigated and reports should be made available to Charterer(s) or field operator(s). The OLST owner or operator should identify a qualified individual within its management structure with responsibility for DP incident and occurrence investigation and closeout.

The OLST owner or operator should be member of IMCA and actively participate in IMCA’s performance and improvement schemes. The OLST owners or operators should have in place a system for experience transfer of operational knowledge.

10.7 DP capability
The DP capability plots should be relevant for the planned operations, and should reflect the following conditions:

- Project specific equipment on deck
- Project specific draught and loading conditions
- Relevant metocean data
- Wind, waves and current should be coincident in direction
- Applicable local environmental phenomena
- Thrust losses due to dynamic effects and other interactions

DP capability plots should be submitted to field operator(s) who reserves the right to evaluate and test the capabilities. DP capability requirements are given in Appendix E.2

10.8 Control, monitoring and communication arrangements
All bridge monitors, instruments and other relevant equipment necessary to carry out a safe offshore crude oil transfer operation should be positioned to give the DP operators the best possible overview.

10.9 Communication systems
Communication, both internally and externally, during an offshore loading operation, should be transmitted on fixed and portable UHF radio sets. The frequencies to be used are defined in the operational manual of the actual oil field. Ref Appendix E.11
11 FIRE FIGHTING FOR OFFSHORE LOADING

A fire water system should be installed in the BLS area. The system should serve two purposes:

- Supply of deluge (water only) to the BLS equipment and bow slot to prevent that any possible sparks created during emergency disconnection (ESD 2) may cause a fire

- Supply of water for the foam fire-fighting system. The foam system should be operated from the fire-fighting panel on the bridge

Further details can be found in Appendix F.
12 SAFETY EQUIPMENT

Specific details of requirements for the following safety equipment refer to Appendix G:

- Emergency towing arrangements
- Pneumatic line throwing device (air gun)
- Messenger line cutter
- Safe walkways

12.1 Free fall lifeboat (NB/CC)
The OLSTs should be equipped with a skid launched, free fall type lifeboat, certified for the number of persons corresponding to the Safety Equipment Certificate.

12.2 Fast rescue Craft (FRC) (NB/CC)
The OLSTs should be equipped with one (1) fast going, water jet powered FRC boat with a single point davit system.

The boat should satisfy the requirements of SOLAS Ch. III and IMO Life-Saving Appliances for rescue boats as well as NMA’s Regulation 853/07 concerning life-saving appliances and evacuation on mobile offshore units (NB/CC).

12.3 Personal protective equipment
The OLST should be supplied with personal protective equipment additional to statutory requirements. Reference is made to Appendix G
13 TESTING AND QUALIFICATIONS REQUIREMENTS

13.1 Testing of OLSTs
Before an OLST can be accepted for offshore loading it should undergo a comprehensive test program.

All tests should be carried out as per approved test procedures and monitored by field operator(s) subject to own policies. The OLST's crew should demonstrate knowledge of the systems and prove its compliance with the requirements. The results of the tests should be documented and made available for field operators.

Details of testing and qualification are found in Appendix H.

13.2 Emergency shut down and “green line” testing operations
Each OLST should utilise and keep updated checklists for regular testing/preparation of the following equipment (but not limited to):

- Communication towards the offshore installations.
- Emergency towing system aft
- Telemetry system
- Interlock, ‘green line’ systems
- ESD1
- ESD2
- GLF, e.g. chain stopper tension, hose in position, cargo system ready, DP/vessel positioning, crude oil pressure high, hydraulic system pressure/accumulated pressure, hose tension
- Mooring and hook up equipment
- Position reference systems
14  COMPETENCE AND MANNING

The OLST operator should have competence and training requirements incorporated in their management system for key personnel involved both in DP operation and Bow loading. This should be in accordance with field operator's requirements and based on recognized standard such as OGUK or OCIMF.

14.1 DP competence requirements
The OLST operator should establish vessel specific manning and training system for all personnel involved in DP operations.

Training and experience should be documented by an IMCA DP logbook in accordance with IMCA M 109, latest edition and IMCA M 117, latest edition.

14.2 BLS competence requirements
For competence and training related to BLS equipment, BLS maker guidelines for operation and maintenance should as a minimum be followed. Adequate competence and training related to BLS equipment will be required.

14.3 Bridge manning during DP-operations
Inside the 10NM Zone and during offshore loading, the minimum manning on the bridge should be one Senior and one Junior DP Officer (DPO).

The Senior DPO is responsible for the DP watch and is assisted by the Junior DPO. The Junior DPO is also performing cargo/loading duties. Senior and Junior DPO should alternate these duties as appropriate.

The master is not part of the ordinary DP-watch scheme, but should be present and available on the bridge as necessary. The master must ensure that sufficient practical experience is maintained to meet the master's DPO-competence requirements.

14.4 Engine room manning
The engine room should be manned as per flag state requirements. However, during offshore loading, the minimum manning in the engine room should be one engineer and one rating.

14.5 Deck manning
The deck should at all times be manned with two persons when connected to an OLT. A continuous watch by a responsible crew member should be maintained on the bow throughout loading. As far as practically possible an effective visual watch should be maintained on the mooring point, mooring system, cargo hose connection, loading hoses and the area of water around the bow.
APPENDIX A  BOW LOADING SYSTEM

A general overview of an FPSO executing tandem offloading to an OLST is shown in Fig 1, this diagram is for indicative purposes only.

![Diagram of Bow Loading System](image)

Figure 1 – Overview of Bow Loading System on an OLST

The BLS comprises equipment located in the following main areas on the OLST:
- Bridge
- Forecastle

In addition to the BLS equipment, related systems (e.g. hydraulics, crude oil, gas detection, fire fighting, etc.) should be provided and installed according to this document and applicable rules and regulations.

Emphasis should be given to simple and effective maintenance of the BLS and it should be possible to replace all essential parts of the BLS on-board the OLST. In this respect, Manager / Owner should ensure that the builder/yard and the BLS equipment vendor will meet this requirement.
### A.1 Equipment

The bow loading manifold, including swivels, pipes from the manifold to the inboard valve and the inboard valve should be designed according to ANSI B16.5, Class 150. All other equipment (piping, tubing, cables etc.) should be designed for the following temperatures:

- External areas (included manifold room): -20º C to + 50ºC
- All other areas: 0 to + 50ºC. It is assumed that air conditioning will be installed if the temperature for these compartments will be outside these limits

All BLS equipment should be designed, manufactured and tested according to:

- DNV’s “Rules for classification of ships,– Offshore Loading Arrangements” or equivalent
- Relevant Authority Regulations
- Relevant OCIMF recommendations

Each active component should be designed with a fail-safe specification.

Hydraulic cylinders should move the loading manifold from stowed- to connecting position. The hose handling winch or the chain stopper/adjustable roller fairlead should lift the loading hose into the mating position.

Final positioning of the coupler’s flange against the Hose End Valve flange should be made by the hydraulically operated coupler claws, in combination with hydraulically operated cylinders positioning the coupler.

### A.2 Operation

The mooring and coupling operation should be performed as per the relevant Field Offloading Manual. Examples of operational modes are described in general below:

#### A.2.1 SPM/Tandem/Taut Hawser

- The messenger line from the OLT should be pulled through the fairlead and the chain stopper by the traction winch. A rope pulling unit maintains the correct back tension for the traction winch and stores the messenger line into a stowing tank/reel
- At the end of the messenger line a chafing chain is connected. When the chafing chain has been pulled through the fairlead it should be locked in the chain stopper
- The loading hose may be:
  - Suspended directly to the chafing chain
    - The loading hose’s Hose End Valve should be hanging in the suspension line in front of/below the loading manifold
    - Transferred separately by a transfer line suspended to the chafing chain. The loading hose should be pulled directly from the OLT
- The hose handling line should be connected to a forerunner from the hose handling winch
- The loading hose’s Hose End Valve should be hauled in and connected to the manifold coupler by the 3 coupler claws
• Free wheel should be activated for the BLS manifold
• Hose handling line should be disconnected from the hose bridle
• The messenger line should be disconnected from the chafing chain
• Before the OLST is ready to receive oil from the OLT the criteria that forms the Green Line must be fulfilled. See Appendix A.9. These criteria include the status of several sensors and software as well as the readiness of the cargo system and opening of the coupler valve and inboard valve
• The OLST should send a telemetry signal to the OLT confirming that the OLST is ready to receive oil
• The OLT can start the interlocked loading pump(s) and/or open the interlocked export valve(s)

A.2.2 SPM Auto
For certain offloading points it should be possible to connect the loading hose’s Hose End Valve to the manifold without using the “hose handling line” (i.e. the SPM-auto function) where:
• The loading hose’s Hose End Valve is connected to the chafing chain by a connection bridle/chain
• When the chafing chain is locked, the loading hose’s Hose End Valve will be positioned next to the loading manifold
• The connection of the loading hose’s Hose End Valve to the loading manifold should be performed by adjusting the chain stopper or the fairlead and at the same time operate the loading manifold.

See also Appendix A.5.3

A.2.3 Direct Offloading
For some fields or projects the selected offshore solution might be direct offloading. For these solutions the requirements will be specified by each field operator.

A.2.4 OLS
• The messenger line from the OLT should be pulled through the fairlead and the chain stopper by the traction winch. A rope pulling unit maintains the correct back tension for the traction winch and stores the messenger line into a stowing tank/reel
• The loading hose is connected directly to the messenger line by a bridle at the Hose End Valve
• The loading hose’s Hose End Valve should be hauled in by the traction winch and connected to the manifold coupler by the 3 coupler claws
• Free wheel should be activated for the BLS manifold
• The messenger line should remain connected to the hose bridle
• Before the OLST is ready to receive oil from the OLT the criteria that forms the Green Line must be fulfilled. See Appendix A.9. These criteria include the status of
several sensors and software as well as the readiness of the cargo system and opening of the coupler valve and inboard valve

- The OLST should send a telemetry signal to the OLT confirming that the OLST is ready to receive oil
- The OLT can start the interlocked loading pump(s) and/or open the interlocked export valve(s)

A.3 Bridge Equipment

The bridge should include all necessary equipment for control and monitoring of the BLS and its operation. This should be reflected in the layout of the bridge where the BLS controls should be installed next to the DP manoeuvring stations.

The following key points should apply:

- Status of the BLS PLC and controllers should be known at all times. An alarm should be initiated upon change of status.
- Override functions should be installed for testing purposes of the BLS and should normally not be used during loading operations.
- The “hose-test” function (i.e. overriding the coupler valve to open when inboard valve is closed on the BLS cabinet with hose-test function) should be inhibited when the “green line” has been established.
- System behaviour in the event of re-instating the power to the BLS PLC should result in a system failing "as set" (i.e. no uncontrolled movements of components).

The following sections 3.1 to 3.5 describe current equipment designs. If alternative equipment is proposed it must provide similar or better functionality than listed here.

A.3.1 Operator Panel

An operator panel should be installed. Examples of control indications currently used are listed below:

- Brake on traction winch (engaged/disengaged)
- Clutch on traction winch (engaged/disengaged)
- Speed selection on traction winch
- Lower/heave of traction winch
- Chain stopper
- Emergency Shut Down class 1
- Emergency Shut Down class 2
- Deluge system in the bow area
- Secondary emergency release systems (in case ESD 1 or ESD 2 is not working)
- Start/stop of the hydraulic pumps
- Selection of standby/working pressure from HPU
- Start/stop of HPU cooling pump(s) (automatic start)
- Alarm indication lamp and buzzer w/alarm reset
- Lamp test function
- Manual selection of loading mode, e.g. SPM, Direct loading or OLS mode
- Coupler claws
- Coupler valve
- Inboard valve
- Pumping/Loading permitted

The following information should be presented on the Operator Panel:
- Selected operation mode
- Crude oil pressure included alarm for high pressure, i.e. above 4.0 barg, measured between inboard valve and coupler valve*
- Loading permitted*
- Loading hose tension*
- Cargo system ready*
- Accumulator pressure*
- Loading hose in position*
- Hawser tension*
- Maximum hawser tension for the last hour
- Traction winch speed
- Maximum hose tension for the last hour
- Status of field specific ESD(s)
- Status of burst discs if installed
- Chain stopper (open/closed)*
- Coupler claws (open/closed)*
- Coupler valve (open/closed)*
- Inboard valve (open/closed)*

*The information should be included in the “green line”

A.3.2 Signals to / from other systems

The following signals should be transmitted as described:
- Common failure to the engine control room
- Hawser tension to DP system and data logger
- Signals as described section of the data logger
- BLS / DP interface - e.g. PASD
- Burst disc status if installed
- Signals dependent upon field specific requirements

A.3.3 BLS data logger

There should be installed a BLS data logger system that should continuously record:
- Hose tension
- Hawser tension
- Status/operation of all equipment in the “green line” system (NB/CC)
- All operator commands/warnings/alarms generated by the BLS control system (NB/CC)
The time for the above activities should be recorded and the timing for the logged data should be based on GMT.

The data logger should have the capacity for storing data for minimum 1 year and the data should be readily available for export.

A.3.4 Tension monitoring

Tension meters for monitoring of hawser and hose tension should be installed. These meters should be readable both from the BLS operator panel and the DP console(s). The meters should be illuminated and have a dimmer unit located in the operator panel.

Equipment for calibration of corresponding load cells should be on-board.

A.3.5 CCTV system/monitors

The OLST should be equipped with a close circuit television system, containing cameras remotely controlled from the bridge for the following locations:

- BLS coupler area, chain stopper and hawser traction winch area
- Cameras for monitoring of the BLS coupler and loading hose
- Pump room\(^{(NB/CC)}\)
- Thruster room(s)\(^{(NB/CC)}\)
- Engine room(s)\(^{(NB/CC)}\)
- Main deck (i.e. coverage of mast riser, manifolds and VOC compartment)\(^{(NB/CC)}\)

The CCTV system should be of a modular type and easily extendable.

All cameras should be of the colour type and should as a minimum be installed as follows:

- One camera with zoom, pan and tilt in the foremast (as high as practical possible)
  - The camera should give a general overview forward of the vessel and of the equipment, included the traction winch, on the forecastle deck
- One fixed camera installed in the foremast for viewing the traction winch
- One camera with zoom, pan and tilt for monitoring of the bow manifold area inclusive manifold and Hose End Valve flange connection
  - This camera should be installed behind the BLS manifold in the manifold room pointing forward
- One camera with zoom, pan and tilt for monitoring of the sea surface forward, the loading hose and the stern of the OLT where applicable
  - The camera should be located in front/to the side of the BLS manifold and be protected by the bow door when this is closed
  - The camera should have a tilt angle to be directed along the hose and up-/forward towards the OLT
All cameras should be of the Ex(d) type, and they should be equipped with heater, wiper and washer. All above functions should be remotely operated from the bridge. Camera- and other housing should be made of stainless steel (AISI 316L or equivalent/better).

Colour monitors of minimum 17” for television coverage should be placed according to the below locations:
- Bridge: Minimum 4 monitors
- Engine control room: Minimum two monitors
- Cargo control room: Minimum two monitors

Keyboard for selection of camera/monitor should be installed at each location. The monitors should be installed without restricting the view from the bridge. All monitors should be viewable without obstruction both from the BLS operator panel and the DP console(s).

### A.4 Bow area, general

The following distances and measurements should apply (side view):
- Vertical distance from maximum draft to platform deck should preferably be between 16 and 17 meters (depending on vessel size).
- Vertical distance from forecastle deck to flange of the loading manifold should be between 1.1m and 1.7m (manifold flange being horizontally positioned) to allow for maintenance access (NB/CC)
- Horizontal distance from the centre of the loading manifold to bow slot should be minimum 0.75m (manifold flange being horizontally positioned)
- Horizontal distance from the centre of the loading manifold to the bulbous bow should be minimum 3m (manifold flange being horizontally positioned)
- The bow roller should be designed to allow safe release (horizontal manifold clearance) of the hawser in the event of an ESD2.
Figure 2 - General arrangement of the bow area.
A.5 Forecastle platform deck

The forecastle platform deck should in principle be arranged as shown below (top view):

![Diagram of forecastle platform deck]

Figure 3 - Arrangement on platform deck

1. Fairlead
2. Hard wood
3. Chain stopper
4. Guide roller with load cell
5. Traction winch
6. Rope pulling unit (stowing tank to be located at the forecastle deck)
7. Stair to the forecastle deck
8. Service crane

A.5.1 Fairlead

The fairlead should be fitted with a roller complete with roller bearings in the “bottom” of the fairlead.

The roller and all parts in contact with the chafing chain should be covered with stainless steel material (non-sparking). The structural strength of the fairlead and its supporting structure should be based on a safety factor of 1.0 against the yield criterion when applying a load equal to MBL (typical 500 tonnes) of the corresponding chafing chain’s weak link. The design force should be established at an angle of 90° off the ship's centreline in the horizontal plane and ± 30° in the vertical plane.
The foundation should be designed to support/guide the lower part of the OLS messenger line in the transverse direction during the connection of the hose. The internal opening in the fairlead should be minimum 500 mm x 500 mm.

A spark-free cladding should cover the substructure of the fairlead-openings (forecastle platform deck, foundations etc.) which may be hit by the chafing chain during an ESD 2 release.

**A.5.2 Hardwood protection on deck**

The deck area between the chain stopper and the fairlead should be protected by 75 mm thick hardwood. The width of the hardwood layer should be twice the width of the fairlead, i.e. 1m.

The hardwood should be fixed to the deck by recessed stud bolts/nuts, and a hardwood plug should cover the top.

**A.5.3 Chain stopper**

The chain stopper should be of the self-locking type, remote operated and designed for Ø84 mm chain (range Ø76 - Ø89 mm). The closing/opening time of the chain stopper should not exceed 30 sec.

The structural strength of the chain stopper including the release mechanism and its supporting structure should be based on a safety factor of 1.0 against the yield criterion when applying a load equal to MBL of 500 tonnes.

A tension meter with a minimum range 0-350 tonnes should be installed to measure the tension in the hawser during the loading operation.

Either the fairlead or the chain stopper should have the possibility to adjust the hose handling wire/rope relative to the loading manifold to enable the SPM-auto function.

**A.5.4 Guide roller**

A guide roller with WLL 900 kN and equipped with a 0-100 T tension meter should be installed in front of the traction winch. The load cell should read the mooring forces during winch operations.

**A.5.5 Traction winch**

The traction winch should be of the twin drum type designed for Ø25-Ø120 mm synthetic fibre rope.

The winch should be designed for bridge- and local control. The winch should be equipped with a failsafe disc brake system suitable for emergency release of the OLS, which requires an automatic release speed adjustable between 1 and 2 m/s. The static weight of the OLS hose should be as per field operator requirements. The “Loading Permitted” signal should not be obtained unless the dog-clutch on the
traction winch has been disengaged in OLS-mode, i.e. interlocked (i.e. chain stopper is open).

A manual break release should be supplied to release the fail safe brake in the event of a power failure. This should be placed in a safe area, which protects the operator for any possible debris during the release of the brake.

Winch capacity requirements:
- Pulling force: minimum 700 kN WLL
- Speeds: minimum 2 steps; approx. 0-8 m/min. and 0-50 m/min
- High speed, minimum: 50 m/min
- Brake capacity, minimum: 900 kN WLL
- Brake disc to be of stainless steel material (NB/CC)
- Rendering function according to field specific requirements or typically, 120% of maximum dynamic hose tension (NB/CC)

The static capacity of the foundations should be in accordance with the capacity of the traction winch. The winch should have a bolted cover to protect the brakes. Motors, cables, valves and pipes should be properly protected from mechanical impact. Any hydraulic piping for the traction winch motor should have a flexible configuration to reduce stress in the pipes during pressure shock. Such pipes should have an “expansion loop” between the deck and the hydraulic motor.

Necessary guide rollers between the traction winch and the rope pulling unit for correct entering of the rope into the rope pulling unit should be installed.

A.5.6 Rope pulling unit

A rope pulling unit should be installed to ensure that the rope enters directly to a stowing arrangement. The rope pulling unit should provide necessary back tension for the traction winch. The back tension should be adjustable from 0 to 4 kN.

For air driven rope pulling units dry and clean air should be provided as well as lubrication pan and water trap.

For rotating stowage arrangements the control panel should include control of the rotation.

The following operational requirements should be fulfilled:
- The operator should be protected from accidental contact with the rotating reels and the rope
- The operator should have a free view to the stowing tank and it should be possible to see the entire bottom of the tank from the operating position
- It should be easy for the operator to reach all the controls from the operating position
- The rope pulling may be automatically controlled via the traction winch and with the possibility of manual/local control
A.5.7 Stair (NB/CC)

Two stairs should be installed from the forecastle platform deck to the forecastle manifold deck. Optimum position of the stairs to be evaluated based on needs during an evacuation scenario.

A.5.8 Service crane

A service crane should be installed on the platform deck. The crane should be designed and installed for general lifting operations and maintenance of the BLS equipment located on the platform deck. It should be installed as far forward as possible, but still being able to service the rope pulling unit and all the other equipment installed on the platform deck. The crane should fulfil the following requirements:

- WLL 50 kN at 10m working radius
- Slewing sector of 360° (continuous)
- Self-contained type (electro/hydraulic)

A.5.9 Manifold room

On the forecastle deck, a manifold room should be installed with bulkheads, doors and coamings.

The principal arrangement should be as indicated in Figure 4. If contractor wants to have an alternative principal arrangement, this should be approved by field operator(s).

![Figure 4 - Example of arrangement in manifold room](image-url)
1. Stowing tank for the messenger line
2. Manifold room bulkhead
3. Crude oil line
4. Gutter bars/open drains leading to main cargo deck (scuppers should be used during offshore loading operations)
5. Flow-monitor
6. Aft coaming, 200 mm. The manifold room should have gutter bars for drainage to main cargo deck
7. Hose handling winch (horizontal offset/distance between winch and top centre of the loading manifold must allow a max. angle of +/- 7º for entering of the wire/line onto the drum, i.e. self-spooling capability)
8. Restricted area for mounting of any kind of tubing/piping/cables etc.
9. Hydrant for flushing of the manifold. The hydrant should have quick connection/disconnection coupling
10. Forward coaming, 250 mm
11. Bow door
12. Doors, self-closing
13. Inboard valve
14. Pressure transmitters
15. Loading manifold
16. Operator console for loading manifold
17. Protective structure for operator
18. A60 windows
19. Watchman’s cabin
20. Pressurised A60 staircase, ref. Figure 4
21. Air lock for the staircase
22. In addition General alarm bells should be mounted inside and outside the BLS manifold room

A.5.10 Loading Manifold

- The loading manifold should be fixed to the underside of the platform deck in the centre line of the vessel and should fulfil the following requirements (additional to class requirements): A 20” hydraulically operated coupler for connection of the loading hose’s Hose End Valve
- Integral hydraulically operated coupler valve
  - The closing time should be adjustable between 15 and 35 sec
  - The coupler valve should have the capacity to open the Hose End Valve with an internal pressure of 4 barg in the loading hose
- Normal closing time for the coupler valve should be 25-28 seconds
- Cylinders to operate the manifold from stowed to loading position
- Ball joint or cardan systems to obtain a moment free system
- Guiding pins and 3 claws for guiding/locking of the Hose End Valve
- Stainless steel cover in the front of the manifold for protection and guiding of the hose handling bridle
- Stainless steel cover in the rear of the manifold for protection from the slack hose handling line and shackles
- Vertical and horizontal stainless steel rollers or other non-sparking material that allow a 40T SWL shackle, under full load, to pass over the top for guiding the hose handling wire
- The coupler should be free to rotate minimum 25° in all directions from the vertical axis (i.e. describes a 50° cone)
  - In addition, the coupler piece/coupler should in total be free to rotate minimum 50° outwards from the vertical axis
- A tension meter (0-120 T) for measuring of the tension from the loading hose
- The BLS loading manifold with coupler and swivels should be designed for minimum 19.6 barg internal pressure (i.e. ANSI B16.5, Class 150)
- Working pressure for lip-seal between manifold and Hose End Valve should be minimum 20 barg
- Contractor should supply a bolted manifold flange to prevent the coupler valve to open (slide down) when the manifold is in stowed position/not in operation
- Proximity sensors (one forward and one aft) in the flange of the manifold.
  - The sensors should give the "green line" signal "loading hose in position" when the distance between the two flanges is less than 1.5 +/- 0.5 mm
  - This distance should be controlled using dedicated test-equipment. The test-equipment should be available on-board.
- A flushing line connection should be arranged for at the aft end of the manifold
  - One ball valve and one non-return valve should be installed on this connection
- The loading manifold, including its claws and foundations, should have an MBL capacity of minimum 1875 kN tension
- All lubricating points should be lubricated from a common system (NB/CC)
- A tubing/hydraulic hose rupture should not lead to unintentional valve/actuator operation
- Safeguards should be in place to prevent a slam-shut situation of the coupler valve.
  - The closing-time for the coupler valve during tubing/hydraulic hose rupture should not be less than 20 seconds during said accidental scenario and not exceed normal closing time of 25-28 seconds

A.5.11  BLS operator console forward

One operator console for the BLS should be installed. The following functions should be operated from this console:
- Position of the loading manifold
- Operation of coupler claws
- Operation of chain stopper movement or operation of the adjustable roller fairlead
- Operation of traction winch
- Operation of hose handling winch
- Operation of bypass valves for relevant cylinders
- Operation of the bow door
- Operation of the retractable bow roller (if installed)
A.5.12 Pressure transmitter

A pressure transmitter (three pressure transmitters (NB/CC)), should be installed on the top of the crude oil line, downstream and next to the swivel of the BLS loading manifold, in order to monitor the pressure inside the crude oil line. All transmitters should be fitted with a test cock and manometer.

The pressure should be monitored locally in the manifold room and remote on the bridge (input from all transmitters (NB/CC)).

Equipment for calibration of the pressure transmitters should be available on-board. The pressure transmitter(s) should be interfaced to the BLS control system/"green line" (2 out of 3 voting (NB/CC)).

A.5.13 Pressure relief arrangement (NB/CC)

A pressure relief arrangement should be provided to cater for possible surge pressures in the event of a blocked outlet/quick closing of valve(s) downstream the loading manifold. Pressure setting for the relief arrangement should be 7.0 barg. Necessary valves for maintenance should be provided. The arrangement should have some means of monitoring, verifying its status.

The status of the pressure relief arrangement should be interfaced to the BLS control system/"green line" system.

A.5.14 Inboard valve

Next to the swivel, a 20" hydraulically operated full-bore ball valve/double-eccentric butterfly valve should be installed. The valve should be activated remotely from the bridge by means of a hydraulic actuator and should have limit switches to indicate open and closed positions. The valve should be designed to have a pre-set closing time (adjustable) with full cargo flow through the piping system between 15 and 35 seconds. Normal closing time for the inboard valve should be minimum 3 seconds after coupler valve is closed.

A tubing/hydraulic hose rupture should not lead to unintentional valve/actuator operation.

Safeguards should be in place to prevent a slam-shut situation of the inboard valve. The closing-time for the inboard valve during tubing/hydraulic hose rupture should be minimum 28 seconds during said accidental scenario (i.e. min. 3 seconds after the coupler valve has closed).
A.5.15  **Hose handling winch**

To handle the loading hose line from the OLT, a winch should be installed in the manifold room. Winch minimum requirements:

- Pulling capacity 400 kN WLL (on the 1st layer)
- Adjustable speed 0-10 m/min
- Brake capacity 600 kN WLL and adjustable
- Split drum with capacity of 200 m x Ø42 mm on the storage part. The working drum should have a width of 300 mm
- Power assisted line change-over from the storage drum to working drum (NB/CC)

A.5.16  **Access to Bow Loading Area and forecastle**

Minimum one A60 staircase with an air-lock at all entrances should be installed for access from the forecastle manifold deck to the main deck level inside the forecastle. (NB/CC)

A positive pressure air-lock at all entrances should be installed for access to the main deck inside the forecastle.

All doors should be self-closing. An airlock should be installed for access/escape via the staircase. All steps should be of a non-slip type.

Loss of pressure in the airlocks should be alarmed (i.e. when 2 doors are open simultaneously). This alarm should be of visual and an audible type. When one door is open a visual alarm should be triggered (i.e. a red lamp flashing), if both doors are open an audible alarm in connection with a visual alarm should be triggered.

A.5.17  **Watchman cabin**

An A60-certified watchman cabin should be provided. The cabin should have windows in the port and forward sides with a clear view of the BLS manifold (NB/CC).

The following equipment should be installed in the cabin:

- General alarm
- Fire alarm
- Fire extinguisher
- Sound powered telephone
- Light
- HVAC (ambient temperature -20/+50ºC) (NB/CC)
- A suitable desk with chair
- 1 off CCTV monitor (NB/CC)
- Minimum 2 escape sets (EEBD)
A.5.18   Stowing arrangement

A stowing arrangement for the messenger line should be installed. A rope pulling unit, ref. section A.5.6, should be installed in conjunction with the arrangement. The stowing arrangement should have a capacity of minimum 400 m x Ø120 mm messenger line.

Means for inspection and draining should be in place if applicable. The stowing arrangement should be properly illuminated.

A.5.19   Hydrant/flushing line

A 2½” or 3” hydrant should be installed and connected to the fire water system. The hydrant should be used for connection of a hose for flushing of the manifold after the loading is completed.

The hose should be tested for electrical continuity in accordance with ISGOTT 11.3.6.2/11.3.6.3.

A.5.20   Crude oil line

A 20” - 24” inner diameter cargo line should be installed between the BLS and the cargo tank distribution system.

In order to avoid unintended closing of valves during loading operations, valves for this line should be slam shut protected e.g. double eccentric butterfly valve.

Cargo piping downstream the BLS should be installed with a straight (and self-draining) section of minimum 15xDiameter.

An isolating valve should be installed aft of the collision bulkhead for easy inerting/gas freeing of the bow cargo piping (ref. SOLAS and class requirements).

A.5.21   Bow door

A bow door should be installed for the protection of the BLS equipment when the OLST is in transit, and for being used as a working platform during maintenance and service of the loading equipment. See Figure 5. The bow door should fulfil the following requirements:

- The bow door should fully cover the bow slot to withstand “green sea” when the vessel is fully loaded and in transit in rough seas (NB/CC)
- The inside of the bow door should be covered with 75 mm hardwood where the bow door is also used as protection in the bow slot for the Hose End Valve
- Appropriate railing and securing wires should be provided for use when the door is used as a working platform
- Arrangements for inspection of hydraulic hoses operating the bow door
The bow door should be remote operated, i.e. for opening/closing of the bow door and for locking the bow door in both open and closed position. The controls for operation of the bow door should be installed at the BLS operator console.

![Diagram of bow door arrangement](image)

**Figure 5 – Bow-door arrangement stowed in open position**

When in stowed position any drain from the coupler should be trapped inside the manifold room.

In case the bow door is serving as protection, or separate protection is installed in the bow slot, no bow door recess, other hull structure or other items should be positioned forward of the protection.

When the bow door is open a detachable rail should be installed across the opening.

### A.6 Hydraulic room

Inside the forecastle and in a safe area at main deck level, a separate hydraulic room with a door to the forecastle area should be installed. The ventilation system for the hydraulic room should be arranged so that any hydraulic oil leakage/mist should not be spread to any other area at the upper deck/forecastle by the ventilation system. There should be coamings of 200 mm, surrounding all equipment in the room.

The equipment listed below should be installed in the hydraulic room.

#### A.6.1 Hydraulic pump station

The dedicated hydraulic pump station should be designed for installation in a non-hazardous area and should consist of the following main units:

- Minimum two (2) hydraulic main pumps with electric motors. 100% capacity should be available if one pump fails
- 1 oil tank with sufficient capacity for operation of all pumps
- The tank should have sloped bottom and main suction situated minimum 200mm above lowest bottom level [(NB/CC)](image)
The tank should have continuous oil-filtering system complete with oil-circulating pump with suction from lowest level in the tank bottom and water/condensate drain from same level (NB/CC)
- 1 oil cooler using fresh water
- 1 oil heater
- Normal working pressure approximate 250 bar, peak pressure approx. 315 bar, standby pressure approximate 20-30 bar
- Full flow return filter with electric clogging indicator
- Silencers on pressure side of the hydraulic pumps
- Level switch with low/low-low indication

The following alarms should be arranged for with bridge warning by light/sound indication:
- Alarm for high/high-high temperature in oil tank
- Alarm for low/low-low oil level
- Alarm for return filter clogged
- Alarm for leak oil filter clogged
- Alarm for motor overload

Shutdown of the main pumps should be automatically performed in case of:
- High-high oil temperature
- Low-low oil level
- Emergency stop-button on HPU

The BLS power pack should not be used for any other purposes than supplying the BLS equipment (NB/CC).

A.6.2 **Hydraulic accumulator rack**

A hydraulic accumulator rack with sufficient capacity for normal operation should be installed, encompassing the following functions:
- Maintain closing pressure to coupler claws
- Provide opening pressure to coupler valve
- For shut-down of the bow loading system
- Release of the shuttle tanker in a safe and controlled manner from the OLT

The system should fulfil the following requirements:
- It should be possible to measure and charge each of the accumulators individually
- Safety valve with melting fuse on each of the nitrogen bottles. The outlet should be routed in a safe direction (in case of relief)
- The accumulator bottle rack with clamps and supports should have the possibility for extension
- A minimum of one nitrogen bottle with fittings and hoses (for fully recharging of the accumulators) should be provided
Hydraulic accumulator rack should be in compliance with A.5.5 enabling sufficient hydraulic pressure in order to make a controlled emergency release of OLS hose (i.e. maintaining brake off capacity for minimum 7,5 minutes).

A.6.3 Hydraulic valve unit rack

Hydraulic control units (solenoid operated valve blocks) for remote control of all necessary equipment/functions should be supplied and installed as one rack. Including but not limited to the following valve blocks:

- Opening and closing of the manifold coupler/inboard valves
- Interlock operation of valves in the BLS manoeuvring console
- Accumulators
- Control of emergency functions
- Control of brake
- Control of traction winch w/clutch
- Control of chain stopper
- Release of loading hose
- High pressure filter

A.7 Electrical equipment room (NB/CC)

To avoid possible spray/mist due to liquid leakage, the electrical equipment related to the BLS should be installed in a separate electric room with A-60 insulation. The temperature in the room should not exceed 35°C when all the equipment is operating simultaneously. The room should be classified as safe area.

No piping/tubing containing liquid (incl. hydraulic tubing) should be installed or pass through the electrical equipment room.

A.7.1 Electric starter and control cabinets

The system with cabinets should be arranged both for remote and local operation/indication. This includes necessary lamps and switches for emergency operation of the system.

If communication to the operator panel on the bridge is lost, the forward operator panel should be able to perform a manually controlled disconnection of the system.

All the relevant cabinets for the BLS should be installed in the electrical equipment room. Including but not limited to the following:

- Starter cabinets
- Control cabinets for auxiliary equipment
- Alarm cabinets
- BLS control cabinet

System behaviour after re-instating the power to the BLS PLC should result in a system failing "as set" (i.e. no uncontrolled movements of components).
A.7.2 Spare control cables
From the electrical equipment room and to the bridge, 10% spare cables should be provided in the multi-core cables for the BLS.

A.8 Other Equipment

A.8.1 Safe access
Necessary access ladders and platforms should be installed for safe access to all relevant maintenance and inspection points. Regular maintenance should be safely accessible to ensure that it is properly performed.

Anti-skid should be used on the deck around the traction winch, around the chain stopper, in the manifold room and on the forecastle platform deck.

A.8.2 Lights
A bridge remote operated search light with pan and tilt functions sufficient to illuminate the area between the OLST and an OLT should be installed in the foremast. It should also be possible to use the searchlight to illuminate the platform deck and the area to port and starboard of the bow.

A.8.3 BLS UPS system
The BLS control systems, inclusive the data loggers, should have a UPS system with minimum capacity of 30 minutes.

- The batteries should be of a maintenance free type
- An audible/visual alarm should be activated on the bridge during loss of power source/supply
- Main power supply to the bridge Operator Panel/controller should be taken from the 220V system.
  - The 24V back-up system should be supplied from a dedicated UPS system
- The PLC/controller in the bow area should be supplied by a dedicated UPS, fed from the 220V system
- Loss of supply to the bridge OP/controller UPS and/or the bow area PLC/controller UPS should initiate an informative alarm and a Green Line Failure (GLF)
A.8.4 Manually operated solenoids for emergency operations

A panel with manually operated 24V switches should be located in the vicinity of the operator panel on the bridge. The panel should have switches for operation of the following functions:

- Close manifold coupler valve and inboard valve.
- Open coupler claws
- Release chain stopper
- Release traction winch disc brake

The switches should be arranged for manual emergency operation, one function at a time, and the function and sequence should be clearly marked on the panel. A transparent cover/lid should protect the switches/buttons in order to avoid accidental use. This is to ensure double-action.

Activation of the 24V system should automatically disable the operator console forward (main PLC) and disable the “Loading on” signal to the telemetry system (i.e. activate pump stop on the OLT).

A.8.5 Manually operated valves for emergency operations

A panel with manual valves for emergency operations should be located in a safe area, preferably in watchman cabin.

The panel should have valves/switches for the following functions:

- Switch to disable the operator console forward (main PLC)\(^{(NB/CC)}\)
- Close manifold coupler valve and inboard valve
- Open coupler claws
- Release chain stopper
- Release traction winch disc brake

The hand-pump for disengaging the brake to the traction-winch should be located in the same area as the panel.

The valves should be arranged for manual emergency operation, one function at a time, and the function and sequence should be clearly marked on the panel. The valves should be protected by a cover/lid and a coaming should be installed under the panel to collect possible oil spill.
A.9  “Green line” specification

The “green line” requirements and functionality for the operator panel should as a minimum include:

<table>
<thead>
<tr>
<th>Step</th>
<th>Operation/sensor</th>
<th>Before connection</th>
<th>After connection/green line established</th>
<th>Status after the ESD is activated/performed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ESD 1</td>
</tr>
</tbody>
</table>

**Before connection takes place, the following signals should be transmitted to the operator panel:**

1. Cargo system
2. Hawser tension
3. Accumulator pressure
4. Crude oil pressure
5. Pressure relief arr. ready

**During connection the sensor status of involved equipment should be presented on the control console:**

6. Chain stopper
7. Loading hose
8. Coupler claws
9. Hose tension
10. Inboard valve
11. Coupler valve

**When correct status is obtained, the system should automatically respond:**

12. Loading

**If acceptable, the bridge operator should now activate:**

13. Loading

**This signal should be transmitted to the telemetry system.**

---

Notes to above numbers:

1. The Cargo System signal should be transmitted to the operator panel when minimum 2 cargo tank or 2 slop tanks, included the relevant cargo line valves, are open. After the loading permitted signal is obtained, it should not be possible to close the open valves, unless other tank/line valves have been first opened. If, by any mistake, it should be possible to close any of the minimum number of open valve(s), the status should be “Not ready”.

2. Hawser tension will be in “normal” mode below 50T. When exceeding 50T, an informative alarm should be given. When exceeding 100T or 200T, depending on field specific pre-set value, an ESD 1 will be initiated automatically.
3. The criteria for “normal” signal for accumulator pressure should be established by the equipment vendor. If the pressure is lower/higher than the pre-set range pressure, the status should be “abnormal”.

4. The “normal” signal should be given when the crude oil pressure is less than the alarm setting at the applicable OLT, typically 4 barg or 7 barg. If the pressure is above the alarm setting, the status should be “abnormal”.

5. If burst discs installed the “normal” signal should be given when the pressure relief arrangement is operative.

6. The chain stopper should remain open in OLS-mode. The “closed” signal should be given when the “over centre mechanism” is completely locked.

7. The two loading hose “in position” signals should be given when the gap between the flanges is less than 1.5 +/-0.5mm.

8. The “open/closed” signal should be given when the coupler claws are completely opened/closed.

9. The hose tension “normal” signal should be based on selected OLT.

10. The inboard valve “open/closed” signal should be given when the valve is completely opened/closed.

11. The coupler valve “open/closed” signal should be given when the valve is completely opened/closed.

12. The “Loading Permitted” signal should not be obtained unless the dog-clutch on the traction winch has been disengaged in OLS-mode, i.e. interlocked (i.e. chain stopper is open).

13. If green line criteria 1-12 are met the “Loading On” signal should be given when activated by the operator. This signal should be transmitted to the telemetry system.

If any of the above signals are interrupted, are abnormal, or do not have the correct status, an Automatic initiated ESD1 should be performed (except for step 13 which only trips the telemetry signal):

- Start the hydraulic pump station
- Trip the telemetry signal, which automatically trips the oil export pump(s)/closes the export valve on the OLT
- Close the coupler valve
- Close the inboard valve

All above activities should start simultaneously when the Automatic initiated ESD1 is activated. The total time of this sequence should be 28-35 seconds.

A.9.1 Telemetry system

A telemetry system, securing a safe start, control and stop of the cargo export from the OLT to the OLST, should be installed. System reliability should be achieved by the use of duplicated fail-safe telemetry systems operating in parallel and duplicated UHF radio transceivers with automatic changeover.

The system should be designed to provide secure communication paths in a potentially noisy environment. The system should be compatible to the telemetry systems fitted on the fields the OLST is intended to serve.
The telemetry system should be linked up to the tankers “green line” system for the purpose as mentioned in section 9.3. A manual control button should be fitted in order to manually enable the tanker to stop the cargo transfer from the offshore loading terminal.

The telemetry system should be powered from the 220V switchboard. Upon failure of the main supply, an alarm should be initiated on the bridge.

A.9.2 Emergency operations

Check lists should be in place to cover restart and testing of equipment in case of a BLS system failure.

In case of an emergency, it should be possible to activate the automatic functions from the bridge as per A.9.2.1 and A.9.2.2.

A.9.2.1 EMERGENCY SHUT DOWN CLASS 1 (ESD 1)

This function should automatically activate the following:

1. Start the hydraulic pump station
2. Trip the telemetry signal, which automatically trips the oil export pumps/closes the export valve on the OLT
3. Close the coupler valve
4. Close the inboard valve

All above activities should start simultaneously when ESD 1 is activated.

Individual closing time for each of the above valves should be adjustable within a range of 15 to 35 sec.

Closing time for the coupler valve should be 25-28 seconds.

Closing time of the inboard valve should be minimum 3 seconds longer.

Total time for the ESD 1 should be 28-35 seconds.

A.9.2.2 EMERGENCY SHUT DOWN CLASS 2 (ESD 2)

This function should automatically activate the following:

1. Start the hydraulic pump station.
2. Trip the telemetry signal, which automatically trips the oil export pumps/closes the export valve on the OLT
3. Close the coupler valve
4. Close the inboard valve
5. Start the (water) deluge system
6. Open the coupler claws
7. Open the chain stopper
8. Release the brake and control the speed of the traction winch where applicable (for OLS or similar systems only -approx. 60 m/minute)
For ESD 2, the total time, excluding opening of chain stopper, should be 38 (+/-2) seconds.

Activation of ESD 2 should automatically provide deluge water before the coupler claws start opening, regardless of sequence of ESD commands initiated.

For systems without mooring, the traction winch should start paying out the messenger line for the loading hose after approximate 30 seconds.

All above functions should be performed in the above stated sequence, but the activities 1,2,3,4 and 5 should all start simultaneously when ESD 2 is activated. The manifold coupler claws should not open before full deluge is present during ESD 2 activation.

In case of hydraulic pump failure, the accumulators should provide for hydraulic pressure. The time delay due to accumulator operation should not exceed 7 seconds for full release of the hawser and hose.

**A.9.2.3 VIOLATION OF OPERATIONAL LIMITS**

For some loading system the DP system should be interfaced to the BLS PLC with the purpose of automatically activating ESD 1 and 2 in case the field specific operational limits (i.e. bow-base distance, drive off detection and/or heading deviation) are violated.

**A.9.3 Monitoring and control (NB/CC)**

In order to accommodate this requirement, certain functions may be combined to simplify the overall system architecture. The monitoring and control requirement is as follows:

- All sensors affecting the green-line, including hose and hawser tension and position of traction winch dog-clutch, should be monitored.
  - A failure in said sensors is to provide an informative alarm and a "green-line" failure (GLF)
- Equipment/systems necessary for ESD-operation should be monitored in order to detect abnormalities (e.g. solenoids). An informative alarm and a green line failure should be provided upon detection.
- Loss of communication between the BLS operator console forward main and the operator panel on bridge/CCR should initiate an informative alarm on the bridge/CCR and a green line failure.
A.10  Piping/tubing and cables

A.10.1  Fittings and material requirements
All hydraulic fittings for piping/tubing < Ø38 mm should be of the flared or “Swagelock”/“Walform” type or similar. Piping ≥ Ø38 mm should have welded flanges.

All weather exposed piping/tubing and fittings outside dry areas are to be of material AISI 316L or equivalent. For welded piping, the material should be AISI 316 L or equivalent.

A.10.2  Supports, trays and penetrations
All piping/tubing (non-hydraulic included) should be properly supported.

All piping/tubing supports and trays exposed to weather, sea-water or outside dry areas should be AISI 316. All other supports and trays should be galvanized steel or AISI 316. For pipes of AISI 316 L, the clamps should be of corrosion resistant materials.

A.10.3  Installation
Hydraulic piping/tubing should be properly installed using the minimum possible number of couplings/fittings. All piping/tubing should be cut and installed such that all couplings/fittings are conveniently placed for access from platforms and decks.

A.10.4  Cables\(^\text{NB/CC}\)
Emergency supply cables and redundant cabling to be routed physically separated from equipment's normal supply cables.

A.10.5  Trays and penetrations
Single cables should be supported by means of steel round bars, otherwise supports should be stainless steel cable trays.

Cable ladders/trays installed above each other should have minimum 200 mm free space between them.

All cables are to be properly secured to their supports using plastic covered stainless steel straps.

All electric cables for the BLS system should be terminated in junction boxes in the various equipment areas.
A.10.6 Junction boxes

All junction boxes should be EX certified according to relevant location. Junction boxes should be placed in easily accessible locations in dry areas. All materials should be AISI 316 stainless steel or equivalent.

A.11 Illumination(NB/CC)

All lighting fixtures, included outdoor emergency lights, should be IP67 and EX proof. All lighting fixtures should be easy accessible for maintenance purposes.

Based on standard methods of measurements, the illumination level should be as shown for the following areas:

- Escape lighting should be equipped with a 30 min. internal back-up source (at minimum design temperature)
- Escape lighting at embarkation stations should be equipped with a 3 hour internal back-up source (at minimum design temperature)

Sufficient lights (minimum 200 lux) should be installed in the BLS coupler area and forecastle area to ensure good working conditions also during the night. The lights should be dimensioned to also provide sufficient working conditions for the CCTV system.

A.12 Other requirements

A.12.1 Surface treatment

All BLS equipment should be delivered with the same painting specification as for other vessel equipment installed on open deck.

The interior of the manifold room should be painted in light colour (typical RAL 9003).

A.12.2 Testing

All the BLS equipment should be FAT approved prior to delivery. After the installation of the equipment, the system should be commissioned and a CAT should be performed. This includes but is not limited to:

- General check of mechanical completion of the installed equipment
- Adjusting and testing of all electrical components
- Start-up of all hydraulic functions
- Adjusting of speeds/pressures
- Calibration of load cells
- Initial start-up and testing of all equipment
- System tests to include all relevant ESD1 and ESD 2 functions, including all relevant sensors and equipment failures
- Pressure tests of the manifold, swivels, piping to the inboard valve and the inboard valve itself
- A trial BLS loading hose connection should be carried out

Procedures for above tests should be prepared, and the tests should be performed after completion of the commissioning.

A.13  **BLS FMEA**

In addition, a cargo handling system FMEA should be performed for the BLS by a recognised 3rd party. Similar format to the IMCA guidelines for FMEA should be followed and should be approved by field operator(s).

A minimum of One service engineer from the maker should be on-board during the cargo handling system FMEA during inshore and offshore testing.

A.13.1  **Hydraulic Pressure Testing**

Testing pressure for all hydraulic connections should at least be according to class requirements.

A.13.2  **Documentation**

Technical documentation deemed necessary by field operator(s) should be provided by contractor upon request. Examples of technical documentation are:

- Specifications
- Operation manuals
- Maintenance manuals
- Product drawings
- Test/inspection manuals/reports
- Certificates
- FMEA-report re. Cargo handling and storage system incl. BLS
APPENDIX B    OIL SPILL PREVENTIVE MEASURES

All OLST should comply with MARPOL and ISGOTT.

In addition to any field specific requirements the OLSTs should be equipped with the following coaming arrangements:

• For the main deck between the bow and the mid ship manifold, the height of the coaming should be minimum 250 mm

• From the mid ship manifold to the aft end of the main cargo tank deck, the coaming should increase gradually and reach a height of minimum 400 mm

• From the aft end of the main cargo tank deck to the accommodation the transverse ships coaming should be 400mm

• Coamings in the BLS area are covered by A.5.9
APPENDIX C  HELIDECK ARRANGEMENTS

All OLSTs should be equipped with a certified helideck approved for Norwegian sector. The helideck arrangement should comply with the following regulations and recommendations:

- “Bestemmelser for Sivil Luftfart, BSL D 5-1”, latest edition
- CAP 437, latest edition
- Applicable national Civil Aviation Authority regulations
- Applicable helicopter operator regulations

The helideck should be approved for at least Sikorsky S-92 with 1.25 D (D-value) (NB/CC).

In addition;

- The helideck should be located off centre line and as close as possible to the mid ship area (NB/CC)
- The helideck be located in a safe distance from the mast riser
- The helideck should be equipped for night operation and for operation under reduced visibility
- The OLST should be provided with permanently installed aeronautical VHF radios and a Non-Directional radio Beacon (NDB), AIS or equivalent
- The OLST should be equipped with a pitch, roll and heave monitoring system reflecting the actual instant motions of the helideck centre, in accordance with latest CAP 437 guidelines. The recordings should be properly displayed at the bridge
APPENDIX D  CARGO, VENT AND BALLAST SYSTEMS

D.1 Cargo valves

All Offshore loading is to be performed to minimum two cargo tanks with respective main cargo tank valves set at >90% open.

All related cargo master valves should be of double-eccentric or ball valve type and interlocked. Two modes should be introduced; loading and topping. Topping mode allows for a reduction in the number of cargo tank valves open to minimum one valve >90% open.

It is strongly preferred that the required tank valves should be interlocked, whereby it should not be possible for the operator to close the minimum number of cargo valves and give a GLF (Green Line control system 9.3). The cargo tank system interlocking should end when the green line is broken. Alternatively, the tank valve may be alarmed and should initiate a GLF when minimum numbers of open tank valves are reached.

D.2 Cargo loading capacity

To reduce risk exposure time the OLSTs’ minimum capacity to receive cargo should be based on total cargo tank volume as follows:

<table>
<thead>
<tr>
<th>Total cargo tank cap. (98% incl. slop)</th>
<th>Loading rate through the bow loading system</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;250,000 bbls</td>
<td>3,000 m³/hour</td>
</tr>
<tr>
<td>&lt; 320,000 bbls</td>
<td>4,000 m³/hour</td>
</tr>
<tr>
<td>&lt; 800,000 bbls</td>
<td>8,000 m³/hour</td>
</tr>
<tr>
<td>≥ 800,000 bbls</td>
<td>8,000 m³/hour</td>
</tr>
</tbody>
</table>

D.3 Ballast Capacity

An OLST should at least have two ballast pumps. The pumps should have a design capacity to de-ballast 100% ballast volume within 70% of the total loading time based on a loading rate of 9000 m³/hr (which includes a safety factor).
D.4 **Explosive atmosphere monitoring and protection**

Ballast tanks, void spaces adjacent to cargo or slop tanks should be equipped with a fixed gas detection system.

Above mentioned ballast tanks, and void spaces should be prepared with necessary arrangement for inert gas filling; references are made to SOLAS 2001 II-2/59.4.3 and SOLAS 2009 II-2/4.5.5.1.3

A connection should be fitted between the inert gas supply main and the BLS cargo piping system. Arrangements should be made to ensure an effective isolation having regard to the large pressure difference which may exist between the systems. This should consist of two shutoff valves with an arrangement to vent the space between the valves in a safe manner or an arrangement consisting of a spool-piece with associated blanks, reference is made to FSS code Ch. 15, Section 2.3.2.7.

Consideration should be given to the installation of H2S sensors where applicable.

D.5 **Cargo/ballast monitoring system**

The OLST’s bridge and cargo control room should be equipped with a complete cargo and ballast operating, monitoring and alarm system. Both stations should be provided with 2 monitors designated for this purpose, including the independent 95% HL and 98% HHL alarms. The online loading computer should be available on bridge.

D.6 **Tank venting system**

The following criteria should be fulfilled:

- Venting capacity should be of a design ensuring a full loading rate into one segregation at the fields the vessel is operating
- The central riser should have a diameter giving a maximum velocity of 5 m/s at full loading rate (NB/CC)
- A system for drainage of the riser oil collector to a cargo or slop tank should be provided
- An air-driven diaphragm pump (Sandpiper or similar) should be permanently connected to the drain line in order to be ready for use in the event of abnormal oil accumulation in the collector
- The valve installed in the common gas line leading to the main riser should be arranged for both local and remote operation from the bridge and cargo control room as applicable
- The main riser should be located at a safe distance from the VOC unit to avoid operational interference due to release of hydrocarbon gas through the riser.
APPENDIX E DYNAMIC POSITIONING

E.1 DP onboard Training System

The DP system should be provided with an onboard training system of the DP CAP type or similar.

E.2 DP Capability Plots

DP capability should be documented for the worst single failure according to the environmental parameters as per Appendices E 2.1 and E 2.2.

The intention of the capability plots is to identify each shuttle’s DP capability given the environmental parameters below (E.2.1. and E.2.2). The plots will generally indicate a window of safe operation with these environmental parameters.

The environmental criteria limits should be calculated based on environmental forces varying ±12° off the bow with a maximum of 80% of the thrust, see Figure 7, for both Connection and Loading. In the event environmental forces of ±12° cannot be met, the operational limits should be adjusted accordingly to ensure safe operations.

Figure 7 – Feasible heading requirements for Connection and Loading
The analyses should be performed according to industry practice for shuttle tankers amongst others the following:

- Worst single failure in accordance with approved FMEA
- Wind, waves and current should be coincident in direction.
- Thrust utilization should be plotted every 2° around the vessel
- 100 % of thruster capacity should be included
- The feasible heading should be read off at 80 % thrust utilization
- Thrust losses should be considered
- Dynamic allowance should not be included

**E.2.1 Capability plot during connection**

These selected, standard environmental parameters should be used in capability plot applicable for ballast condition and up to fully loaded condition:

- Wind speed = 16.4 m/s (1 minute mean at 10 m above MSL)
- Waves:
  - $H_s = 4.5$ m
  - $T_p = 10$ s
  - JONSWAP with peak shape parameter $\gamma = 2.0$
- Current speed = 0.5 m/s

**E.2.2 Capability plot during loading**

These selected, standard environmental parameters should be used in capability plot applicable for ballast condition and up to fully loaded condition:

- Wind speed = 19.7 m/s (1 minute mean at 10 m above MSL)
- Waves:
  - $H_s = 5.5$ m
  - $T_p = 12$ s
  - JONSWAP with peak shape parameter $\gamma = 1.8$
- Current speed = 0.5 m/s

**E.3 Main engine limitations during DP-operations**

OLSTs main propellers should have drive-off safeguards in accordance with recognised standards such as OCIMF or IMCA.

**E.4 Additional requirements for DP FMEA and annual DP Trials**

Additional requirements for DP FMEA and annual DP Trials should be in accordance with recognised standards such as OCIMF or IMCA.
E.5  **DP Crash stop test**

A crash stop test as programmed and witnessed by the DP-system maker should be carried out in ballast condition.

E.6  **Position Reference System (PRS)**

Four independent PRS should be fitted, whereof minimum three should be based on different principles. The PRS configuration should be compatible with existing PRS infrastructure used in connection with offshore loading operations.

When two or more GPS units are installed the GPS units should receive correction signals from independent sources. These are considered as independent PRS.

When two or more GPS units are installed one GPS antenna should be installed at the bridge top and one at the bow in order to utilize position signals for gyro comparison.

Use and interface of differential satellite positioning systems should be in accordance with IMCA M 141, latest edition.

E.7  **Gyro requirement**

The gyros should have a dynamic accuracy of 0,7 deg.

E.8  **Independent position monitoring and logging system**

The OLST should have an independent Position Monitoring System data logger unit (Parker or equivalent) fitted for real-time data acquisition, calculation, logging and displaying designed to monitor DP controlled offshore loading.

The system is subject to acceptance from field operator and should be interfaced with the DP system and all navigational sensors on the OLST. It should calculate position and quality of the navigation systems and display the results on a user configured display by means of various information panels. The system should integrate all available positioning information and compute the best combined position for all connected systems. It should also compute speed and direction over ground.

If required by the OLT, an Ultra-High Frequency (UHF) link should be provided to transfer all data to the offshore installation. The Position Monitoring System should be powered by one (two - with automatic change-over and change-over alarm) separate Uninterruptable Power Supply (UPS).
When in loading phase, the system should give an alarm (both audible and visual) if calculated speed ahead is higher than a pre-set limit. All data from the independent position monitoring system should be made available to field operator(s) in the event of incident investigations. Crude oil flow-monitoring should also be displayed and logged via this system.

The data should be stored for a period of minimum 1 year.

**E.9 Hydro-acoustic transducer trunk**

Hatch(es) and valve(s) enabling both inspection and replacement afloat of the hydro-acoustic transducer should be installed.

The transducer gate valve(s) should be remotely operated and status of these valve positions should be indicated on bridge (NB/CC).

If the hydro-acoustic transducer trunk room is divided with bulkhead(s) providing 2 or more transducers to be placed in separate compartments, all compartments should be fitted with access ladders. The hydro-acoustic transducer trunk(s) should not pass through any cargo tank(s).

**E.10 Special arrangements on bridge**

In addition to the standard bridge equipment required by the Class notation, the OLS should as a minimum be supplied with the following equipment (or similar acceptable to field operator(s)) on the bridge:

- Operation consoles and monitors for each PRS unit
- Wind sensor displays
- 1 independent Position Monitoring System (PMS) data logger unit (Parker Maritime or equivalent)
- DGPS demodulator units
- 1 search light in foremast; remotely operated from bridge
- Telemetry unit including radio equipment for intended operations
- ESD/ASD system as outlined in Appendix A.9
- 4 x 19” monitors for closed circuit colour television systems
- Emergency stops for the ME and thrusters should be located at or nearby the DP operator’s position
- Aeronautical VHF’s for helicopter communication
- Helideck monitoring system
- A “green line control system” (ref. Appendix A.9)
- Two fixed chairs enabling the DP and Cargo operators to sit while the system is being operated (NB/CC)
- Sun screens/curtains (IMO approved)
All monitors, instruments and other vital equipment at the bridge necessary to carry out a safe offshore crude oil transfer operation should be logically mounted to give the operators the best possible overview.

E.11 Communication systems

Communication, both internally and externally, during an offshore loading operation, should be transmitted on fixed and portable UHF radio sets. The frequencies to be used are defined in the operational manual of the actual oil field.

The minimum number of UHF radio sets required on board, are as follows:

- One (1) fixed set in the engine control room
- Two (2) fixed set on the bridge – one (1) located at the DP-control station
- One (1) fixed set in the cargo control room
- Minimum Four (4) portable sets of which minimum two (2) sets should have a helmet-built-in microphone set; specially equipped with filters for high background noise

The portable UHF radio sets should be of approved Ex-type, meeting the Eex ib IIC T4 specification and should be equipped with a sufficient number of extra batteries and battery chargers.

The bridge should be provided with at least 3 fixed VHF-sets and one should be fitted next to the DP-console. The cargo control room should be provided with at least 1 fixed VHF-set.
APPENDIX F  BLS FIRE FIGHTING SYSTEM

The BLS fire fighting system should as minimum meet the following requirements:

- A fire water monitor should be installed in the fore mast or on the forecastle and be remotely operated from the bridge
  - The monitor should have pan and tilt functions that allow coverage of the whole area of the forecastle and platform deck
- Piping/nozzles should not be located in the restricted area as shown in Appendix A 5.9 Fig 4.
- All external piping, with risk of containing water, should have electric heat tracing
  - Alternative means of avoiding freezing may be considered (e.g. high-pressure blowing, drains at low-points etc.)
- The system should be of the ‘self-draining-type’ in order to avoid ice-build-up in the piping during cold weather conditions
- The BLS foam system should as a minimum cover the bow manifold and bow manifold room

F.1  BLS water deluge logic

The deluge logic should include start of a fire pump and opening of required valve(s) within the set time criteria for deluge at ESD2.

Fire pumps connected with the BLS deluge system should be redundant according to DP Class 2 philosophy; if one pump fails to start or stops while deluge is active a second fire pump should automatically start. All fire pumps interconnected to the BLS deluge system should have an auto-priming function ensuring water supply when started.

Activation of ESD 2 should automatically provide deluge water before the coupler claws start opening, regardless of sequence of ESD commands initiated.

The fire-fighting system should have fully pressurized deluge in all water nozzles before the coupler claws starts to open.

It should be possible to activate the BLS deluge system from dedicated operator panels close to the BLS Operator Panel on the bridge and in the watchman’s cabin.

The deluge system should be fully operative in a black-out situation. A prerequisite for this design is that there is power at the emergency switch board to run the emergency fire pump and power the deluge valve HPU.

Valve(s) required for BLS deluge should be possible to open manually in case of valve control failure.
F.2 **BLS water deluge system**

The BLS water deluge system should as minimum meet the following requirements:

- Minimum two nozzles should be installed on the inside (port and starboard side) and minimum two on the outside (port and starboard side) of the manifold.
  - The nozzles should spray the wire rollers and the manifold
- One main deluge valve to be located as close as possible to the deluge distribution piping.
- The main deluge valve should be automatically opened when ESD 2 is activated, or the deluge function is activated from the bridge (applicable for all operational modes)
  - Only the deluge should be activated (no foam), and the fire-fighting system should have fully pressurized deluge in all water nozzles before the coupler claws starts to open
- The deluge valve controls should have dual supply of power, i.e. main and emergency power securing power if any or all main switchboards fail. Alternatively the deluge valve should fail safe to open position in case of loss of power.

F.3 **Fire and gas detection**

In the centre area of the BLS manifold room, detectors should be installed underneath the forecastle platform deck.

The following fixed detection sensors should as a minimum be installed and connected to the vessels fire and gas detection systems, giving alarms on the bridge when activated:

- 2 smoke detectors (for enclosed manifold rooms)
- 2 flame detectors
- 2 gas detectors
- Rotating yellow light(s) when having a fire or gas alarm *(NB/CC)*
APPENDIX G  SAFETY EQUIPMENT

G.1  Emergency towing arrangements

The OLST should be arranged with a specially designed emergency towing system. Details shown below for a typical Aframax size OLST). The system should be arranged as follows:

- A fairlead designed for minimum 225 tonnes SWL should be located at the stern of the OLST.
- A towing wire of approximately 80 metres length with a certified breaking strength of minimum 400 tonnes.
- The towing wire should be stored in a protected environment and be ready for use at any time.
- An automatic/mechanical wire brake device to control the pay out of the towing wire should be fitted.
- A permanent arrangement for safe and efficient recovery of the towing wire should be in place.
- A 140 meter long, 28 mm diameter Dynema type forerunner line with a breaking load of approximately 46 tonnes should be provided.

G.2  Pneumatic line throwing device (air gun)

The OLST should be equipped with 2 complete air gun systems containing as a minimum:

- An air gun of type "Rescue 230" or similar including 4 standard projectiles and a heavy duty type projectile.
- A grapnel hook with barbs.
- A line box containing 100 m of a 5 mm line with minimum breaking load of 1900 kg.

The OLST should be equipped with pivots/brackets for the air gun system, both in the bow and the stern area.

G.3  Messenger line cutter

The OLST should have a messenger line cutter device designed to enable cutting the line if sucked into the thruster(s) / propeller(s).
G.4 Safe walkways

In addition to the OLSTs “Safe Access to Bow”- arrangement, the OLST should be equipped with anti-skid safe walkways as follows:

- On the forecastle deck
- On both sides of the main weather deck
- Around the centre manifold and in the bow manifold area
- On the catwalk from accommodation to bow area; said catwalk to be situated approx. 2.5 m above main deck/centreline

The outline of the safe walkways should cover necessary workstations including:

- Manifolds
- Mooring gears
- BLS – ref. Appendix A
- Deckhouses
- Pump rooms
- Cargo sampling points, etc.

Any obstacles in the safe walkway should be clearly painted / marked

The colour of the safe walkway, or the boundary lines marking the safe walkway, should be of contrasting colour when compared to the colour of the deck.

G.5 Personal protective equipment

G.5.1 Extra life jackets

The OLST should be equipped with additional life jackets corresponding to the life raft capacity in the bow area. The life jackets should be properly marked and stored in the bow area of the OLST.

G.5.2 Survival suits

The OLST should be equipped with survival suits of appropriate sizes corresponding to the crew’s physical size.

G.5.3 Escape hoods

Additionally to the SOLAS requirements, the OLST should be equipped with escape/smoke hoods at each cabin.
G.5.4 Emergency escape breathing devices

The bow thruster room(s) should be equipped with 1 Emergency Escape Breathing Devices (EEBD), reference is made to SOLAS II-2/13.4.3. The watchman cabin should each be equipped with 2 EEBD, reference is made to OCIMF VIQ for shuttle tankers.

G.5.5 Fireman’s outfitting

Additionally to the SOLAS/NMA requirement, 2 sets of fireman’s outfitting should be located in the bow area.
**APPENDIX H  TESTING AND VERIFICATION**

**H.1  Testing of OLSTs**

Depending on the OLST’s status, the test should be performed in 3 different modes:

- In case of a new building or a conversion, an “at yard” test
- In case of a new building or a conversion an “inshore” test
- Regardless of the above the OLST should undergo a first-time “offshore and verification test” (field test)

Table below is an example of OLST tests, each Charterer will specify their own specific requirements:

<table>
<thead>
<tr>
<th>No.</th>
<th>Non exhaustive list of items to be tested</th>
<th>Modes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yard</td>
</tr>
<tr>
<td>DP field test according to Maker’s procedure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLS</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DP FMEA</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Cargo handling system FMEA including BLS.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Telemetry system, including automatic export pump stop/export valve closure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIL-testing (NB/CC).</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Helideck</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Fire-fighting arrangements in BLS and helideck area.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Emergency towing system, aft.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Technical documentation.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Communication systems.</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ESD1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ESD2 (incl. verification of hose/winch pay-out velocity).</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Interlock green line systems.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>ASD (Automatic shut-down due to green line failure).</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>No.</td>
<td>Non exhaustive list of items to be tested</td>
<td>Modes</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yard</td>
</tr>
<tr>
<td>1</td>
<td>PASD (Position initiated ASD, i.e. violation of operational limits).</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Crash stop test.</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>Communication towards field installations and stand by vessel.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>DP test according to Maker’s procedure.</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>Mooring and hook-up and disconnection test.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Loading.</td>
<td></td>
</tr>
</tbody>
</table>