OFFSHORE NORGE

140-Offshore Norge recommended guidelines for Offshore Loading Shuttle Tankers

1 PREFACE

This guideline is sponsored by Offshore Norge and recommended by Offshore Norge Operations Committee.

This guideline is an updated version of the 140 recommended guidelines for Offshore Loading Shuttle Tankers issued May 6th 2015.

In July 2022 the Norwegian Oil and Gas Association change name to Offshore Norge.
The work group for this updated version has been composed by members from the following companies:

AkerBP ASA
Equinor ASA
Vår Energi AS
OKEA ASA
Offshore Norge

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 Offshore Loading Shuttle Tankers contractors operating on the Norwegian continental shelf (NCS).

Offshore Norge
Fjordpiren, Laberget 22, 4020 Stavanger
P.O. Box 8065, 4068 Stavanger, Norway
Tel.: + 47 51 84 65 00
Web site: www.offshorenorge.no
E-mail: firmapost@offshorenorge.no

Contents

2 ABBREVIATIONS

ABS	American Bureau of Shipping
AIS	Automatic Identification System
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASD	Automatic Shut Down
ASME	American Society of Mechanical Engineers
bbls	Barrels
BLS	Bow Loading System
BSL D 5-1	'Bestemmelser for Sivil Luftfart'; one of several documents regulating laws and rules regarding civil aviation in Norway
BV	Bureau Veritas
CAT	Customer Acceptance Test
CCR	Cargo Control Room
CCTV	Closed Circuit Television
CFD	Computational Fluid Dynamics
CHS	Cargo Handling System
CPP	Controllable pitch propeller
DARPS	Differential Absolute and Relative Position Sensor
DNV	Det Norske Veritas
DP	Dynamic Positioning
DPO	Dynamic Positioning Operator
ECR	Engine Control Room
EEBD	Emergency Escape Breathing Device
ESD	Emergency Shut Down
ETS	Emergency Towing System
FAT	Factory Acceptance Test
FMEA	Failure Mode Effect Analysis
FPSO	Floating, Production, Storage and Offloading
FRC	Fast Rescue Craft
FSS Code	Fire Safety Systems Code (IMO)
GNSS	Global Navigation Satellite Systems
HIL	Hardware in the Loop
HMI	Human-Machine Interface
HPU	Hydraulic Power Unit
HVAC	Heat Ventilation Air Conditioning
H2S	Hydrogen sulphate
IACS	International Association of Classification Societies
ICMS	Integrated Control and Monitoring Systems
IMCA	International Marine Contractors Association
IMO	International Maritime Organization
ISGOTT	International Safety Guide for Oil Tankers and Terminals
LNG	Liquid Natural Gas
LR	Lloyds Register of shipping
LVOC	Liquid Volatile Organic Compound
MARPOL	The International Convention for the Prevention of Pollution from Ships
MBL	Minimum Breaking Load
MEPC	Marine Environment Protection Committee (IMO)
NCS	Norwegian Continental Shelf
NM	Nautical Mile
NMA	Norwegian Maritime Authority
OCIMF	Oil Companies International Marine Forum
OGUK	Oil and Gas UK
OLS	Offshore Loading System, (Ugland-Kongsberg OLS / UK-OLS)
OLT	Offshore Loading Terminal
OLST	Offshore Loading Shuttle Tanker

P/V	Pressure/Vacuum
PASD	Position initiated ASD
PCP	Portable Control Panel
PLC	Programmable Logic controller
PLT	Pneumatic Line Throwing device
PMS	Position Monitoring System
PRS	Position Reference System
PSA	Petroleum Safety Authority
PSPC	Performance Standard for Protective Coatings
RPM	Revolutions per minute
SOLAS	International Convention for the Safety of Life at Sea
SPM	Single Point Mooring
SWL	Safe Working Load
UHF	Ultra-High Frequency
UPS	Uninterrupted Power Supply
VFD	Variable Frequency Drive
VHF	Very High Frequency
VIQ	Vessel Inspection Questionnaire
VOC	Volatile Organic Compound
VOCIC	Volatile Organic Compound Industry Cooperation
WLL	Working Load Limit

3 OBJECTIVE AND TARGET GROUP

This document forms a guideline recommending a set of technical requirements for Offshore Loading Shuttle Tankers (OLST) handling crude or crude condensate, operating on the Norwegian Continental Shelf (NCS).

The scope of the guideline is OLST operations within the designated safety zone, as defined by the Activities Regulations provided by the Norwegian Petroleum Safety Authority.

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

3.1 Objective

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

3.2 Target group and scope

The target group is field operators, charterers, owners and OLST operators.

3.3 Deviations

This guideline is not intended to replace field operator’s or charterer’s requirements. Any deviations should be assessed based on a risk evaluation and compensating actions according to field operator’s requirements.

4 LEGISLATIVE AND CLASS REQUIREMENTS

This document will not intentionally 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, loading/ offloading operations shall also comply with relevant field operator and PSA requirements.

4.1 Class requirements

The OLST should have a design for North-Atlantic trade (25 years) and be classified by one of the following recognized classification societies; ABS, BV, DNV or LR.

In this document class notations from DNV have been used as requirement reference, equivalent notations from ABS, BV or LR are acceptable.

For any technology such as battery, LNG, LVOC etc, relevant class notations should be included.
For OLST operations on NCS the following class notations should as a minimum be regarded as mandatory:

DNV class notation:	Description:
+1A	Main class notation
Tanker for oil	For carriage of oil in bulk
ESP	Enhanced survey program
BIS	Built for in-water survey of the vessel bottom and related items
Bow loading	Bow loading arrangement
BWM(T)	Ballast water treatment
CCO	Centralised cargo control for liquid cargoes
Clean(Design)	Additional design requirements for environmental protection
COAT-PSPC(B, C)	Additional requirements for corrosion prevention of ballast and cargo tanks
COMF(C-3,V-3)	Requirements to indoor climate, noise and vibration
CSA(FLS2)	Additional fatigue strength control based on direct load calculations
CSR	Designed and built according to IACS common structural rules
DYNPOS(AUTR)	Dynamic positioning system with redundancy in technical design
E0	Unattended machinery space
F(A, M, C)	Additional fire protection in accommodation, machinery and cargo area
HELDK(S, H)	Requirements to vessels with helicopter deck
LCS	Requirements to loading computer system
NAUT(AW)	Requirements for bridge design, instrumentation and workstation arrangements
Plus	Extended scope of fatigue strength assessment for hull structural detail
Recyclable	Establishment and maintenance of inventory of hazardous materials
TMON	Tailshaft monitoring for condition monitoring of the ship’s propeller shaft and propeller shaft bearing.
VCS(2, 3)	Systems for control of vapour emission from cargo tanks and systems for onboard vapour processing

5 HULL AND ARRANGEMENT

5.1 Internal corrosion protection of cargo tanks

The internal corrosion protection of cargo tanks should as a minimum be in compliance with the IMO-PSPC standard. In addition to the standard, the following areas should also be protected by coating:

- Upper side of stringer decks including faceplate
- Flat inner bottom and all structure to height of 1.5 m above inner bottom

Pit guard anodes should be installed for protection of suction wells.

5.2 Helideck arrangements

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

- Forskrift om luftfart med helikopter – bruk av offshore helikopterdekk (Regulations relating to helicopter operations - use of offshore helidecks) BSL D 5-1
- CAP 437: Standards for offshore helicopter landing areas
- 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).
In addition to these standards the following should be complied with:

- The helideck should be located off centre line and as close as possible to the mid ship area
- The helideck should be located at a safe distance from the mast riser and gas vent risers
- 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. The recordings should be properly displayed at the bridge

5.3 Safe access

In general, all vertical ladders and platforms should be provided according to IACS recommendation no.132.

5.4 Equipment for securing of anchors

Equipment for securing of anchors should be fitted to eliminate the possibility of dropped objects in the offshore installation safety zone, and in the vicinity of offshore subsea infrastructure and pipelines. Anchor chain stoppers of stopper-bar/ guillotine type or equivalent should be fitted.

Whenever the anchors are not prepared for immediate use, they should be secured with a stopper bar/guillotine and a minimum of one lashing. Two lashings are required if the stopper bar/guillotine does not fit when the anchor is fully housed. The design of the lashings and pad eyes/lifting lugs should comply with relevant OCIMF guidelines. Equipment for securing of stowed anchors should be designed to resist a load at least corresponding to twice the anchor mass plus 10 meters of cable.

The pad eyes should be full penetration welded, and all permanently installed equipment for securing of anchors should be certified according to class requirements.

5.5 Hydro-acoustic transducer trunk

The hydro-acoustic transducer(s) should be fitted with hatches and valves enabling both inspection and replacement of the transducer when the OLST is afloat.

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

Each hydro-acoustic transducer should be placed in a separate compartment, fitted with access ladders and watertight bulkheads. The hydro-acoustic transducer trunk(s) should not pass through any cargo tank(s).

6 BRIDGE ARRANGEMENT AND COMMUNICATION SYSTEMS

6.1 Control, monitoring, and bridge arrangements

Monitors and instruments should be placed at such a distance that information and menus can be read by the naked eye from the DP operator station.
In addition to the standard bridge equipment required by the class notation, the OLST should as a minimum be fitted with the following equipment on the bridge:

- Operation consoles and monitors for each PRS unit
- Wind sensor displays
- 1 independent Position Monitoring System (PMS) data logger unit
- 1 search light in foremast; remotely operated from bridge
- Telemetry unit including radio equipment for intended operations
- BLS control system including ESD/ASD system
- 4 monitors for CCTV systems, see section 10.4.6
- A control panel for the CCTV system should be located within reach of the operator position of either the cargo operator or the DPO
- Emergency stops for the ME and thrusters should be located within reach of the DP operator’s position
- Aeronautical VHFs for helicopter communication
- Helideck monitoring system
- Sunscreens/curtains (According to IMO requirements and type approved by class)

6.2 Communication systems

Communication during an offshore loading/offloading operation, should be by fixed and portable UHF radio sets. The frequencies to be used are defined in the field operational manual.

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

- 1 fixed set in the engine control room
- 2 fixed sets on the bridge – one set should be located at the DP-control station
- 1 fixed set in the cargo control room
- 4 portable sets of which a minimum 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. The vessel should be equipped with extra batteries and battery chargers.

The bridge should be provided with at least 3 fixed VHF-sets, one set should be fitted next to the DP-console. The cargo control room should be provided with at least 1 fixed VHF-set.

7 OIL SPILL AND PREVENTIVE MEASURES

All OLST should comply with MARPOL and ISGOTT, also in the BLS manifold room.

7.1 Coaming arrangement

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 ship coaming should be minimum 400mm.
- Coamings in the BLS manifold room are covered by section 10.8.

7.2 Oil spill pumping system

The OLSTs should be equipped with permanently installed pumping and piping systems for draining of oil spills from the following locations:

- Main deck: 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) without the need to depressurize the tank.
- BLS manifold room: The draining pipes from the BLS manifold room should be connected to a pump located at main deck level, aft of the forecastle bulkhead. The arrangement should be capable of transferring oil spills to a dedicated cargo tank without the need to depressurize the tank. Drainpipes in the enclosed spaces below the BLS deck should be fully welded.

The pumps should be of diaphragm design and should be protected from freezing either by design or by operational procedures.

The system should be arranged to prevent possible back-flow.

8 MACHINERY AND PROPULSION

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

- The fuel oil supply should be arranged with full separation between systems providing required redundancy. There should be at least one service tank serving each redundancy group.
- Active components in the utility systems for main engine(s) and auxiliary engine(s), such as pumps, filters and strainers, should be arranged in parallel.
- There should be automatic de-sludging of filters in utility systems for main engine(s) and auxiliary engine(s). Instrumentation and alarms should be provided for these systems.
- All service tanks should be situated above the machinery (engines and boilers) to enable supply by gravity or an equivalent system to ensure that fuel supply can be maintained.
- Change between different fuels should be possible independent of the engine's load situation. For heavy fuels, a buffer tank (mixing tank) should be situated prior to the engine(s) inlet.
- Large electrical motors, such as thruster motors, ballast pumps and cargo pumps, should be designed to avoid power surge and high peak loads. Design should also consider optimal operation and efficiency of such motors, which may include RPM or VFD controlled motors.
- In case an energy storage system is included, this should be reflected by use of a relevant classification notation.
- To secure the vessel’s ability to manoeuvre in harsh weather, the IMO Guidelines for Determining Minimum Propulsion Power, as amended by MEPC.262(68), should be complied with.
- The OLST should be equipped with high performance rudder(s) suitable for active use in DP operations and safe manoeuvring of the vessel. Other means of heading control may be considered, such as azipull propulsion.
- Tunnel thrusters should be provided with gratings in accordance with thruster manufacturer’s recommendations.
- Hydraulic hoses for thrusters should be renewed at regular intervals.

In addition to the above, features that will improve the environmental and energy performance of the vessel are encouraged as long as this is not in conflict with requirements related to redundancy and safety.

9 CARGO, VENT AND BALLAST SYSTEMS

9.1 BLS cargo loading capacity

The OLST's capacity to receive cargo should be such that the duration of the offshore loading operations is minimized.

The OLSTs' minimum capacity to receive cargo should be based on total cargo tank volume as follows:

Total cargo tank cap. (98% incl. slop)	Loading rate through the bow loading system
< 400 000 bbls	6 000 m^3/hour
≥ 400 000 bbls	9 000 m^3/hour

9.2 Cargo valves

All valves downstream the inboard valve to the cargo tanks and slop tanks should be of double-eccentric butterfly type and have interlock functionality with Green Line.

The above cargo valves should have a closing time of minimum the time it takes to complete the BLS ESD1 sequence.

Fail to safe mode for all double eccentric butterfly valves in the BLS and CHS should be OPEN position when offshore loading to reduce the risk of sudden pressure increase. See Figure 1 below:

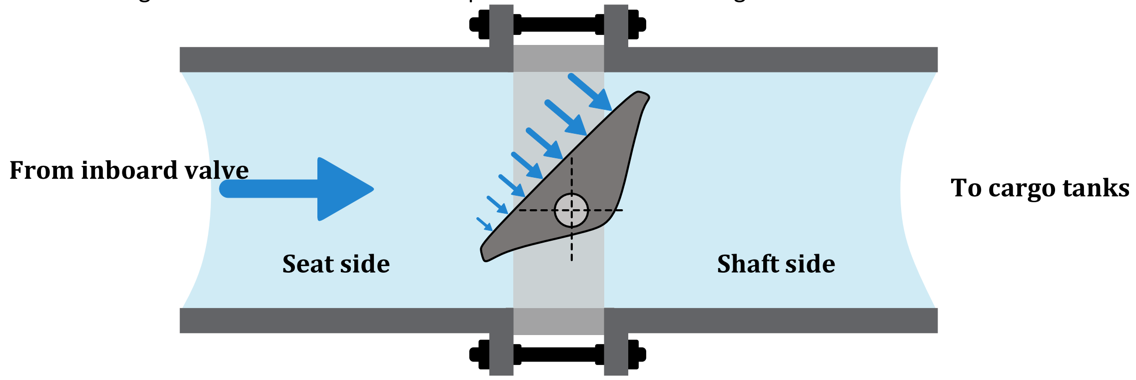


Figure 1 - Double eccentric butterfly valve

A BLS cargo line segregation valve (North Sea valve) should be installed as far aft as possible on the BLS cargo line for double valve segregation of the BLS, see Figure 13 in section 10.4.4

Two modes should be available for offshore loading:

- Loading mode: Loading should be performed to minimum 2 cargo tanks. The respective cargo tank main valves should be at least 90% open.
- Topping mode: Loading should be performed to minimum 1 cargo tank. The respective cargo tank main valve should be at least 90% open.

The Green Line cargo valves should be interlocked, whereby it should not be possible for the operator to close the minimum number of cargo valves and give a Green Line Failure (see section 10.4.1). The cargo tank system interlocking should end when the Green Line is broken.

For vessels equipped with Blue Line functionality the Blue Line cargo valves should be interlocked, whereby it should not be possible for the operator to close the minimum number of cargo valves and give a Blue Line Failure (see section 10.4.2). The cargo tank system interlocking should end when the Blue Line is broken.

9.3 Cargo/ballast monitoring system

The following requirements should apply for gauging systems:

- All cargo tanks and slop 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 connected to the Integrated Control and Monitoring System (ICMS) and be online with a class approved loading computer.

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. Independent 95% tank high level and 98% tank overfill alarm system should be provided at both stations, including operational features. The online loading computer should be available on the bridge and in the CCR, working independently of each other.

Onboard cargo survey equipment should be certified in accordance with the vessel's cargo tank design pressure to enable closed atmosphere cargo survey.

For OLSTs with a pump room, online vibration monitoring of all cargo, stripping and ballast pump bearings should be provided. In addition, all pump casings should be equipped with temperature monitoring.

9.4 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 9 000 m^3/hr. The de-ballasting rate should not be restricted by the ballast water treatment system.

9.5 Explosive atmosphere monitoring and protection

Ballast tanks and void spaces adjacent to cargo or slop tanks should be equipped with a fixed gas detection system as per FSS code Ch. 16.

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, also considering the possible large pressure difference 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.
H_2S sensors should as a minimum be applied for the pump room, bow loading area, engine room supply fan and fresh air intakes for accommodation and galley. Similar exposed areas should also be considered.

9.6 Tank venting system

The following criteria should be fulfilled:

- Each cargo, slop, and residual tank (when fitted) should be fitted with individual high velocity P/V valves
- Venting capacity should be of a design ensuring a full loading rate into one segregation at the fields the vessel is operating, i.e. the total capacity of the individual P/V valves for the minimum segregation should handle 125% of the maximum BLS cargo loading rate (see section 9.1)
- The mast riser should have a diameter giving a maximum gas velocity of 5 m/s at full loading rate to reduce risk of cargo spills during offshore loading
- A system for drainage of the riser oil collector to a cargo or slop tank should be provided. A pump should be permanently connected to the drain line 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 mast riser should be arranged for both local and remote operation from the bridge and cargo control room as applicable
- The mast riser should be located at a safe distance from the VOC unit and helideck to avoid operational interference due to release of hydrocarbon gas through the riser. Both location and height of the mast riser should be considered

9.7 Vapour handling system

OLSTs should be equipped to meet the applicable Volatile Organic Compounds (VOC) emission requirements as stipulated by the VOC Industry Cooperation (VOCIC) and/or enforced by the Norwegian Environment Agency (Miljødirektoratet). For newbuilding projects, owner/charterer should consult with VOCIC to agree on scope for VOC reducing measures.

10 BOW LOADING SYSTEM AND MONITORING

All OLSTs should be equipped with a Bow Loading System (BLS) for cargo transfer, system requirements are described in the following section.

10.1 Introduction to Bow Loading Systems

10.1.1 BLS arrangement

The BLS described in this document should provide a system for connecting an OLST to an offshore terminal with the purpose of a safe, reliable, and efficient cargo transfer operation.

The BLS control and monitoring system should be regarded as an essential system as defined by the classification society.

The cargo hose from the offshore terminal should be connected to the BLS manifold on the OLST by means of a hydraulic coupler.

A general overview of a BLS during a tandem offloading is shown in Figure 2 (for indicative purposes only). See also Figure 3, Figure 4 and Figure 5.

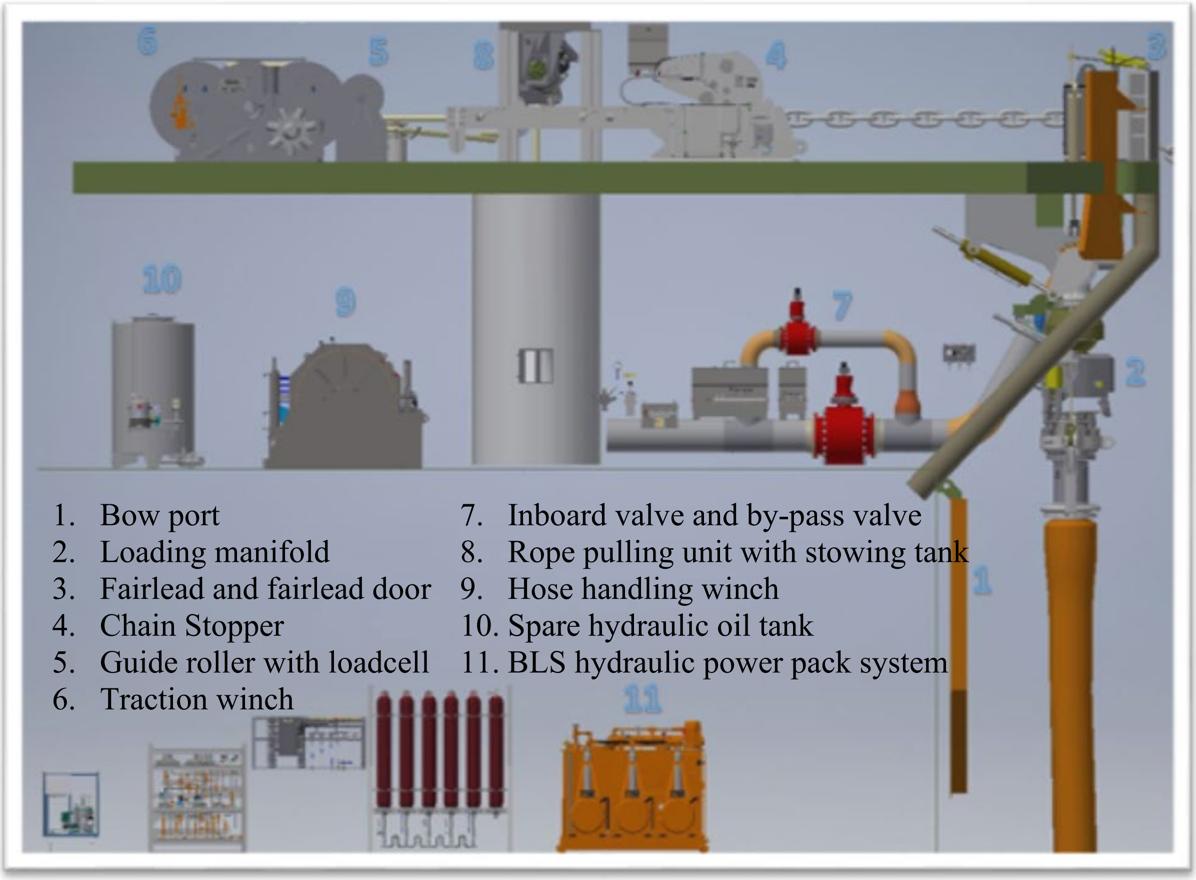


Figure 2 - Bow Loading System general arrangement (Source: APL NOV)

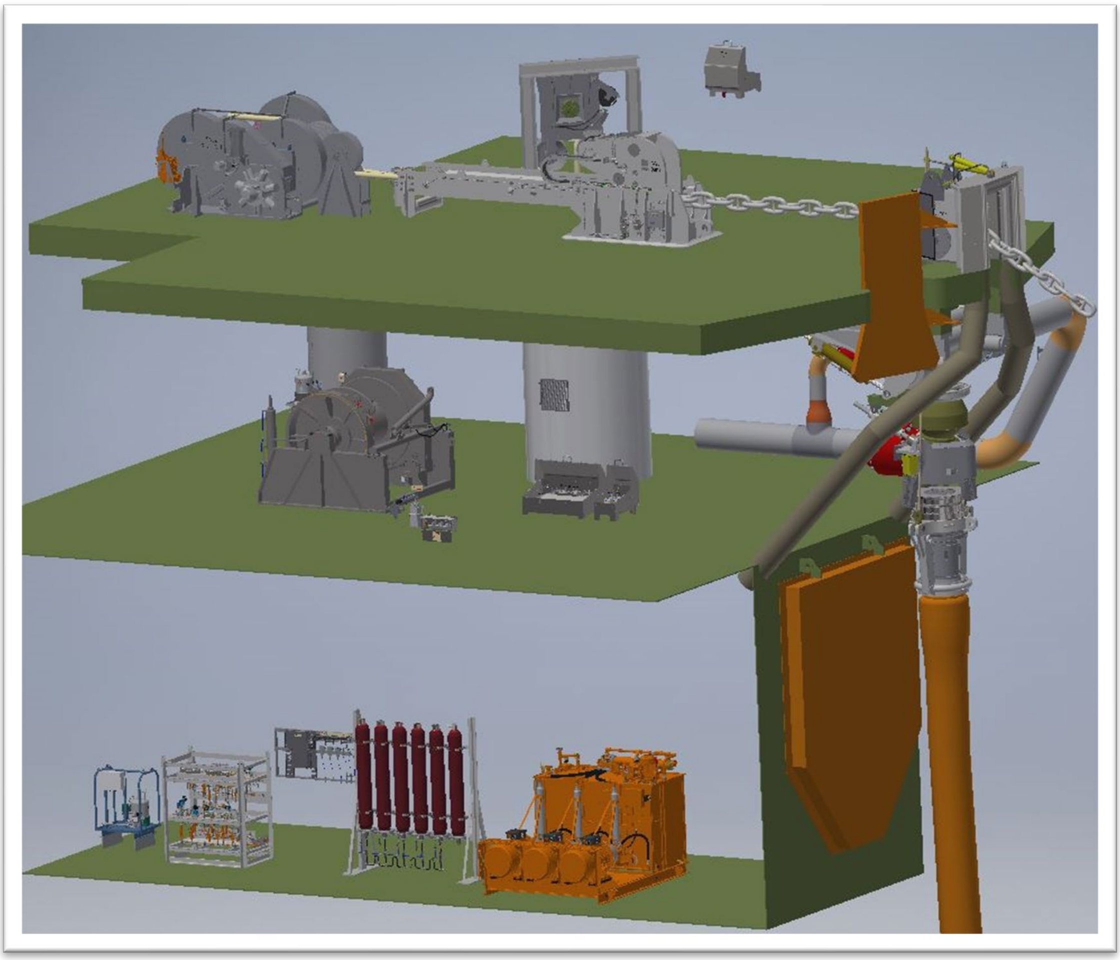


Figure 3 - Bow Loading System 3D view (Source: APL NOV)

1. Bow door
2. Loading manifold
3. Fairlead and fairlead door
4. Chain stopper
5. Guide roller with loadcell
6. Guide roller with loadcell
7. Traction winch
8. Rope pulling unit
9. Hose handling winch.
10. BLS hydraulic power pack system

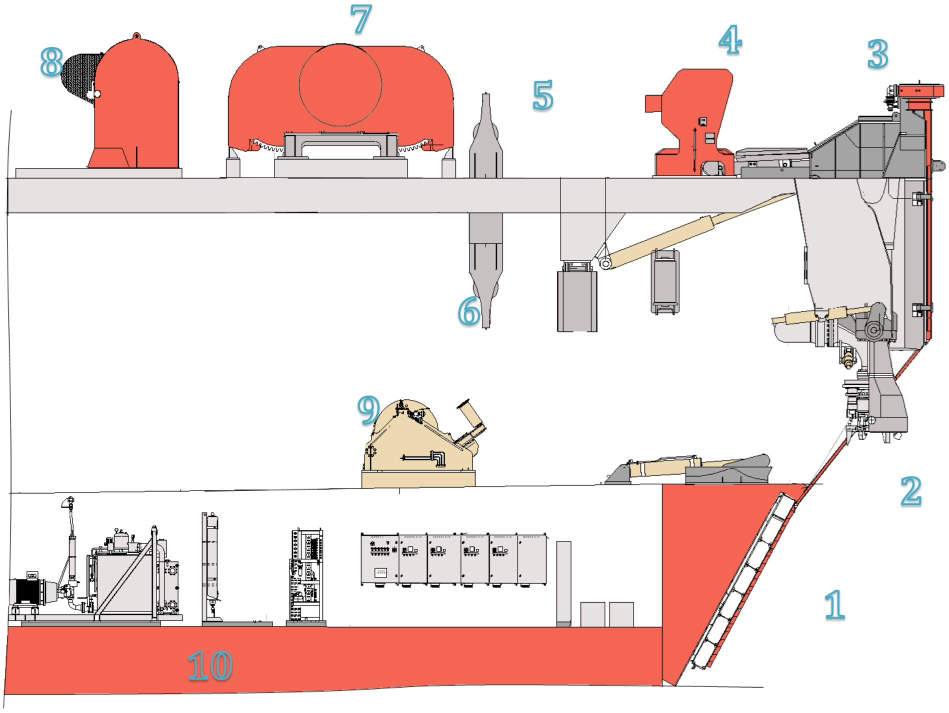


Figure 4 - Bow Loading System general arrangement (Source: MacGregor Pusnes)

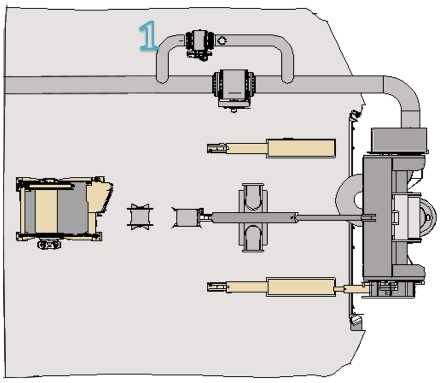


Figure 5 - Cargo line interface (Source: MacGregor Pusnes)

10.1.2 Documentation

All documentation required by field operator(s) should be provided by vessel owner / vessel operator upon request. Examples of such documentation are:

- Technical specifications
- Operation manuals
- Maintenance manuals
- Product drawings
- Test/inspection manuals/reports
- Certificates
- BLS & Cargo Handling System FMEA report

10.2 BLS design philosophy

The BLS design philosophy should be approved by field operator(s).
The following general requirements should be met for all BLS, cargo handling and storage equipment:

- No single failure in the BLS, cargo handling and storage system should lead to a pressure rise exceeding the design pressure of the BLS, cargo handling and storage system
- No single failure should cause a 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 system, equipment or component should be designed with a fail to safe specification
- A single tubing/hydraulic hose rupture should not lead to an undesired event or events outside the affected systems' design
- Galvanic corrosion should be considered when selecting materials

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

- DNV rules for classification: Ships (RU-SHIP) class notation 'Tanker for oil' with additional class notations 'Bow loading', or equivalent notations documented by other class societies
- Relevant Authority Regulations
- Relevant OCIMF recommendations

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

- External BLS areas (including the manifold room): -20º C to + 50ºC.
- All other BLS related areas: 0 to + 50ºC. Required heating or air conditioning should be installed for compartments with design temperatures outside these limits.

10.2.1 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 a light colour (typically RAL 9003).

10.2.2 Safe access

Necessary access ladders and platforms should be installed for safe access to all maintenance and inspection points. In addition, the BLS layout should be designed to facilitate safe replacement of all essential parts. When the bow door is open there should be means of safe access to the BLS manifold, e.g., retractable platforms.

The forecastle platform deck should be accessible by two stairs from the forecastle deck (see Figure 17 in section 10.7). The position of these stairs should be designed for safe and optimized for evacuation of personnel. Both stairs should be protected by the BLS sprinkler system and be sufficiently illuminated. Anti-skid paint should be used on the deck around the traction winch, around the chain stopper, in the manifold room and on the forecastle platform deck. Further details are outlined in section 12.6.

10.2.3 Hydraulic fittings and material requirements

All hydraulic fittings for piping/tubing < Ø38 mm should be of the flared or 'Swagelok'/'Walform' type or similar. Piping ≥ Ø38 mm should have welded flanges. All fittings should be provided by the same manufacturer.

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

10.2.4 Piping supports, trays, and penetrations

All piping/tubing (non-hydraulic included) should be properly supported.

All piping/tubing supports, and trays located in weather exposed areas should be of 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.

10.2.5 Hydraulic piping 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.

10.2.6 Cable routing

Emergency supply cables and redundant cabling should be routed physically separated from equipment's normal supply cables and be marked accordingly.

10.2.7 Cable trays and penetrations

Single cables should be supported by means of round steel bars or stainless-steel cable tray. Group of cables should be supported by stainless steel cable trays.

Cable ladders/trays installed above each other should have minimum 200 mm free space between them. All cables should be properly secured to their supports using PVC covered stainless-steel straps.

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

10.2.8 Junction boxes

All junction boxes should be EX certified according to relevant hazardous area location.
Junction boxes should preferably be placed in easily accessible locations in dry areas.
Junction boxes exposed to weather, sea water, BLS water deluge or outside dry areas should be of AISI 316 quality or equivalent.

10.2.9 Illumination for the BLS and forecastle area

Sufficient lights (minimum 200 lux) of LED type should be installed in the BLS and forecastle area to ensure good working conditions day and night, as well as providing sufficient working conditions for the CCTV system.

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

Escape lighting should be equipped with a 30-minute 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).

10.3 Firefighting for offshore operation

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 firefighting system. The foam system should be operated from the firefighting panel on the bridge.

10.3.1 BLS firefighting system

The BLS firefighting 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. This fire water monitor should have pan and tilt functions that allow coverage of the whole area of the forecastle and platform deck. Remote control should be permanently installed as part of the bridge equipment at a location where at least one CCTV monitor can be observed.
- A fire water monitor should be installed in the BLS manifold room and have self-oscillating functionality that allows coverage in the direction of the BLS manifold.
- Piping/nozzles should not be installed in the restricted area as shown in section 10.8 Figure 18 – Item 8.
- All external piping, with risk of containing water, should have electric heat tracing. Alternative means of avoiding freezing may be considered (high-pressure blowing, drains at low points etc.).
- The system should be of the ‘self-draining-type’ 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.

10.3.2 BLS water deluge system

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

- Deluge coverage
  - 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, spraying the wire rollers and the manifold
  - All escape ways from the BLS platform deck
  - Traction winch and its brake
  - Rope pulling unit
  - Bow fairlead
  - Chain stopper
  - Mooring line (from bow fairlead to the traction winch)
  - Restricted area between BLS room forward coaming and BLS room aft coaming
- Deluge piping material quality should be selected to minimize risk for clogging of pipes and associated nozzles.
- One main deluge valve to be located as close as possible to the deluge distribution piping. The deluge valve controls should have dual supply of power (main and emergency power) securing power if any or all main switchboards fail.
- 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.
- 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.
- Valve(s) required for BLS deluge should be possible to open manually in case of valve control failure.

10.3.3 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.

The main deluge valve should be automatically opened when ESD 2 is activated or when the deluge function is activated from the bridge and from the watchman cabin (applicable for all operational modes). Only the deluge should be activated (no foam).
The BLS loading manifold water nozzles should be pressurised before the coupler claws starts to open, and the fairlead water nozzles should be pressurised before the chain stopper starts to open.

All BLS water deluge nozzles should be fully pressurised by the firefighting system within 10 seconds, after the deluge has been activated - regardless of the ESD command sequence initiated.

10.3.4 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 and cargo control room when activated:

- 2 smoke detectors (for enclosed manifold rooms)
- 2 flame detectors
- 2 gas detectors, measuring Hydrocarbons and H_2S
- Rotating yellow light(s) when having a fire or gas alarm

10.4 Control and monitoring systems

The following requirements should be complied with:

- 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.
- Equipment/systems necessary for ESD-operation (solenoids, etc.) should be monitored to detect abnormalities. An informative alarm and a Green Line Failure should be provided upon detection.
- Loss of communication between the main BLS PLC station and the bridge BLS operator console should initiate an informative alarm on the bridge and a Green Line Failure.

Certain functions may be combined to simplify the overall system architecture.

10.4.1 Green Line control system

The BLS and cargo loading system should be provided with a Green Line control system. Specifications should be approved by field operator(s). Makers' terminology may deviate from Figure 8, but the system properties should be identical (see below examples of Maker's HMI).

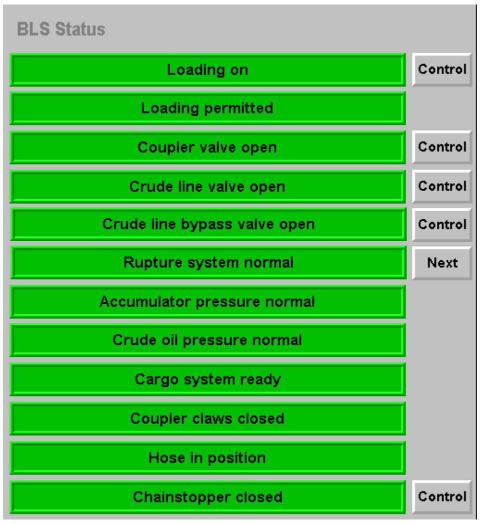


Figure 6 - Green Line (Source: APL NOV)

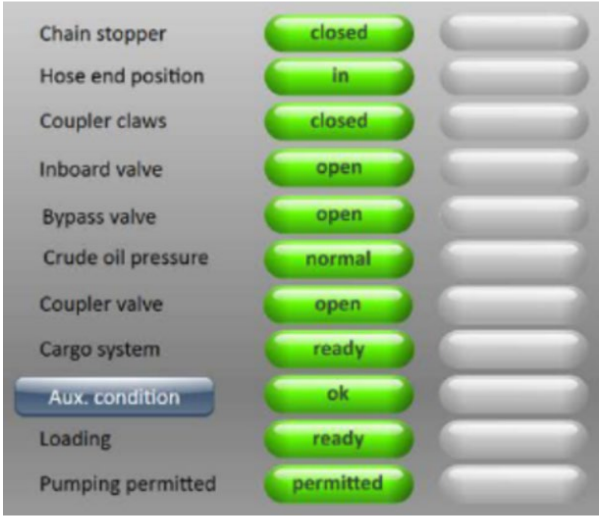


Figure 7 - Green Line (Source: MacGregor Pusnes)

When the Green Line is established, a pumping 'Permitted' signal should be transmitted to the adjacent offloading installation via the telemetry system. Incorrect status of any of the signals included in the Green Line (except for Item 14) should automatically give a Green Line Failure, which initiates the ESD 1 sequence on the OLST and shuts down the crude export from the installation. Incorrect status of Item 14 should only trip the telemetry signal.
The Green Line can be interrupted either automatically by the system (ASD) or manually by the operator (ESD).

The Green Line requirements and functionality for the bridge operator panel should as a minimum include:

Item	Operation / sensor	Status before connection	Status after connection/ Green Line established	Status after the ASD / ESD is activated / performed	
				ASD 1 / ESD 1	ASD 2 / ESD 2
The following signals should be transmitted to the bridge operator panel:					
1	Cargo system	Ready	Ready	Ready[15]	Ready
2	Hawser tension	Normal	Normal	Normal[15]	Normal
3	Accumulator pressure	Normal	Normal	Normal[15]	Normal
4	Crude oil pressure	Normal	Normal	Normal[15]	Normal
5	Rupture disc	Normal	Normal	Normal[15]	Normal
The sensor status of involved equipment should be presented on the bridge control console:					
6	Chain stopper	Open	Open/Closed	Closed[15]	Open
7	Loading hose	Not in position	In position	In position[15]	Not in position
8	Coupler claws	Open	Closed	Closed[15]	Open
9	Hose tension	Normal	Normal	Normal[15]	Normal
10	Inboard valve	Closed	Open	Closed[15]	Closed
11	Inboard bypass valve	Closed	Open	Closed[15]	Closed
12	Coupler valve	Closed	Open	Closed[15]	Closed
When correct status is obtained, the system should automatically respond:					
13	Loading	Not ready	Ready	Not ready	Not ready
If acceptable, the bridge operator should now activate:					
14	Pumping	Not permitted	Permitted	Not permitted	Not permitted
Loading signal should be transmitted to the telemetry system					

Figure 8 - Green Line

Notes to Figure 8:

1. The cargo system 'Ready' signal should be transmitted to the operator panel when minimum 2 cargo tanks or 2 slop tanks, included the relevant cargo line valves, are open. After the pumping permitted signal is obtained, it should not be possible to close the open valves, unless other tank/line valves are open.
2. Hawser tension status will be 'Normal' below either 50 tonnes (default) or below a field specific value. If exceeding this tension, an informative alarm should be given. When reaching 100 tonnes (default) or a field specific value, an ASD 1 will be initiated.
3. Accumulator pressure 'Normal' criteria should be established by the equipment vendor. If the pressure is lower than the set range pressure, the status should be 'Abnormal'.
4. Crude oil pressure 'Normal' signal should be given when the crude oil pressure is less than the alarm setting at the applicable OLT, typically 4 barg (with a warning at 2,5 barg). If the pressure is above the alarm setting, the status should be 'Abnormal'.
5. Rupture disc 'Normal' signal should be given when one or both parallel rupture disc systems are operative. See section 10.4.4.'
6. The chain stopper 'Closed' signal should be given when the over centre mechanism is completely locked. The chain stopper should remain open in OLS-mode.
7. The two sensors for loading hose should give 'In position' signal when the gap between the flanges is less than 1.5 +/-0.5mm.
8. Coupler claws 'Open/Closed' signal should be given when the coupler claws are completely opened or 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 or closed.
11. The inboard bypass valve 'Open/Closed' signal should be given when the valve is completely opened or closed.
12. The coupler valve 'Open/Closed' signal should be given when the valve is completely opened or closed.
13. The loading 'Ready' signal for OLS-mode can only be obtained when the dog-clutch on the traction winch has been disengaged in OLS-mode.
14. If the Green Line criteria 1-13 is met the pumping 'Permitted' signal should be given when activated by the OLST. This signal should be transmitted to the telemetry system.
15. A failure of the signal / sensor will change the indicated status to a failure status.

10.4.2 Blue Line control system

If the OLST is being designed for offshore offloading through the BLS, the BLS and cargo transfer system should be provided with a Blue Line control system. Such specifications are to be approved by field operator(s). Makers' terminology may deviate from Figure 11, but the system properties should be identical (see below examples of Maker's HMI).

Accidental change between Blue Line mode and Green Line mode and vice versa should not be possible. Changing mode should require interlock 'Closed' signals from both the coupler valve and the inboard valve. However, disconnection of the cargo hose should not be required.

The same level of safety barriers and interlock should be included in Blue Line as per Green Line. All cargo valves, pipes, installed equipment, etc. needed for Blue Line operation should be arranged for bidirectional hydrocarbon flow.

Unlike in Green Line mode the OLST cargo pump(s) and Inert Gas system are running when offloading offshore. Therefore, the ballast pumps should have automatic power limitation in the power management system to secure priority to the thrusters and other essential equipment. Offloading cargo rate should not be affected by any power limitation.

The vessel's DP FMEA verification trial at yard should be conducted with all systems required for Blue Line operation at full load. The trial should include, but not be limited to:

- Vessel on 'Auto Position' mode
- Vessel to pump water from cargo tanks through the BLS at maximum rate
- IG system running
- Ballast pump(s) to run at full rate

Worst Single Failure and generator failure should be simulated independently for the above criteria. For Blue Line operation the report should as a minimum include power consumption, cargo transfer rate, verification of trip functions and interlocks.

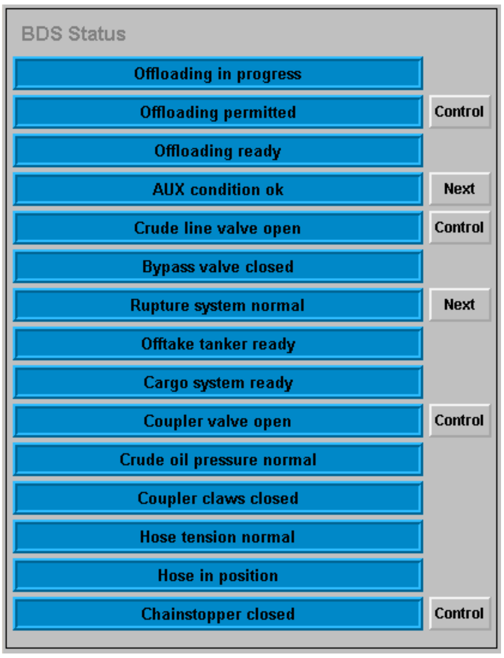


Figure 9 - Blue Line (Source: APL NOV)

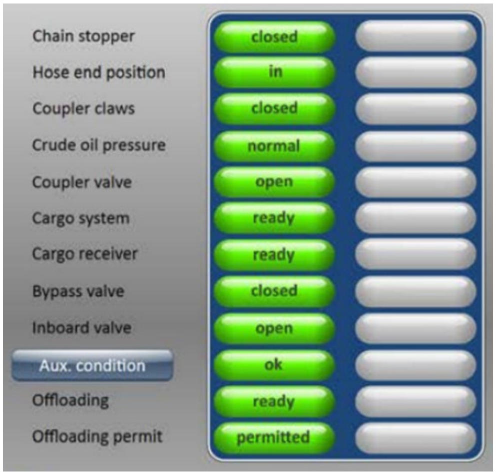


Figure 10 - Blue Line (Source: MacGregor Pusnes)

When the Blue Line is established, an offloading 'Permit' signal should be transmitted from the adjacent offshore installation via the telemetry system. Incorrect status of any of the signals included in the Blue Line (except for Item 15) should automatically give a Blue Line Failure, which initiates the ESD1 sequence on the OLST and shuts down the OLST export pump(s). Incorrect status of Item 14 should only trip the telemetry signal.

The Blue Line can be interrupted either automatically by the system (ASD) or manually by the operator (ESD).

The Blue Line requirements and functionality for the bridge operator panel should as a minimum include:

Item	Operation / sensor	Status before connection	Status after connection / Blue Line established	Status after the ASD / ESD is activated / performed	
				ASD 1 / ESD 1	ASD 2 / ESD 2
The following signals should be transmitted to the bridge operator panel:					
1	Cargo system	Ready	Ready	Ready[16]	Ready
2	Cargo receiver	Ready	Ready	Ready[16]	Ready
3	Hawser tension	Normal	Normal	Normal[16]	Normal
4	Accumulator pressure	Normal	Normal	Normal[16]	Normal
5	Crude oil pressure	Normal	Normal	Normal[16]	Normal
6	Rupture disc	Normal	Normal	Normal[16]	Normal
The sensor status of involved equipment should be presented on the bridge control console:					
7	Chain stopper	Open	Open/Closed	Closed[16]	Open
8	Loading hose	Not in position	In position	In position[16]	Not in position
9	Coupler claws	Open	Closed	Closed[16]	Open
10	Hose tension	Normal	Normal	Normal[16]	Normal
11	Inboard valve	Closed	Open	Closed[16]	Closed
12	Inboard bypass valve	Closed	Closed	Closed[16]	Closed
13	Coupler valve	Closed	Open	Closed[16]	Closed
When correct status is obtained, the system should automatically respond:					
14	Offloading	Not ready	Ready	Not ready	Not ready
If acceptable, the bridge operator should now activate:					
15	Pumping	Not permitted	Permitted	Not permitted	Not permitted
Offloading signal should be transmitted to the telemetry system [17]					

Figure 11 - Blue Line

Notes to Figure 11:

1. The cargo system 'Ready' signal should be sent from ICMS to the operator panel when all cargo valves that are in line, from the cargo pumps upstream to the inboard valve (except valves that are needed for safe start and stop of cargo pumps), are open. Crossover valves should be included if applicable. After the pumping permitted signal is obtained, it should not be possible to close the open valves upstream the cargo pump(s), unless other line valves are open.
2. The cargo receiver 'Ready' signal should be transmitted by telemetry system to the operator panel on the OLST when minimum 2 cargo tanks, included the relevant cargo line valves, are open at the OLT. After the pumping permitted signal is obtained, it should not be possible to close the open valves, unless other tank/line valves are open.
3. Hawser tension status will be 'Normal' below either 50 tonnes (default) or below a field specific value. If exceeding this tension, an informative alarm should be given. When reaching 100 tonnes (default) or a field specific value, an ASD 1 will be initiated.
4. Accumulator pressure 'Normal' criteria should be established by the equipment vendor. If the pressure is lower than the set range pressure, the status should be 'Abnormal'.
5. Crude oil pressure 'Normal' signal should be given when the crude oil pressure is less than the alarm setting at the applicable OLT, typically 10 barg (with a warning at 8 barg). If the pressure is above the alarm setting, the status should be 'Abnormal'.
6. The rupture disc arrangement should either be isolated from the cargo line or the pressure setting for the discs should correspond to the pressure rating of the cargo system (e.g., PN16 should give 16 barg rupture discs) and give a 'Normal' signal when one or both parallel rupture disc systems are operative. See section 10.4.4.
7. The 'Closed' signal should be given when the over centre mechanism is completely locked. The chain stopper should remain open in direct offloading mode.
8. The two sensors for loading hose should give 'In position' signal when the gap between the flanges is less than 1.5 +/-0.5mm.
9. Coupler claws 'Open/Closed' signal should be given when the coupler claws are completely opened or closed.

10. The hose tension 'Normal' signal should be based on selected OLT.
11. The inboard valve 'Open/Closed' signal should be given when the valve is completely opened or closed.
12. The inboard bypass valve should be closed in Blue Line mode. However, the 'Open/Closed' signal should be given when the valve is completely opened or closed.
13. The coupler valve 'Open/Closed' signal should be given when the valve is completely opened or closed.
14. Intentionally left blank.
15. If Blue Line criteria 1-13 are met the pumping 'Permitted' signal should be activated from the operator panel on the OLST. This signal should be sent to ICMS, to allow start of cargo pumps.
16. A failure of the signal / sensor will change the indicated status to a failure status.
17. Cargo pump running signal for offloading should be sent to telemetry system.

10.4.3 Telemetry system

A telemetry system based on a fail to safe design should be installed, capable of securing safe start, control and automatic stop of the cargo transfer between the OLT and the OLST. System reliability should be achieved using duplicated fail to 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 tanker's Green Line and, if applicable, Blue Line system for the purpose as mentioned in sections 10.4.1 and 10.4.2.

The telemetry system should indicate status for if the operation is in progress ('Loading' and, if applicable 'Offloading').

A manual control button should be fitted for manually stop of the cargo transfer from the exporting unit. Upon failure of the main power supply, an alarm should be initiated on the bridge.
In case the OLST will be used for direct loading from production unit(s) without storage, the telemetry system should be powered from a dedicated UPS with minimum 30 minutes capacity.

Figure 12 - Telemetry system for OLST

Blue Line – Offloading operations Green Line – Loading operations

10.4.4 Rupture Disc arrangement for emergency pressure relief

An arrangement, with two rupture discs in parallel, should be provided to mitigate possible surge pressures in the event of a blocked outlet/quick closing of valve(s) downstream the BLS inboard valve during offshore loading. There should be remotely operated isolation valves for each disc and valve status (Open/Closed) should be included in the criteria for rupture disc ready. The isolation valves and their failure mode should be as per section 9.2 cargo valves. The arrangement should be installed as far downstream the BLS inboard valve as possible, without any valves in between. The BLS cargo line segregation valve should be installed as far aft as possible, to facilitate optimum effect of the rupture disc arrangement.

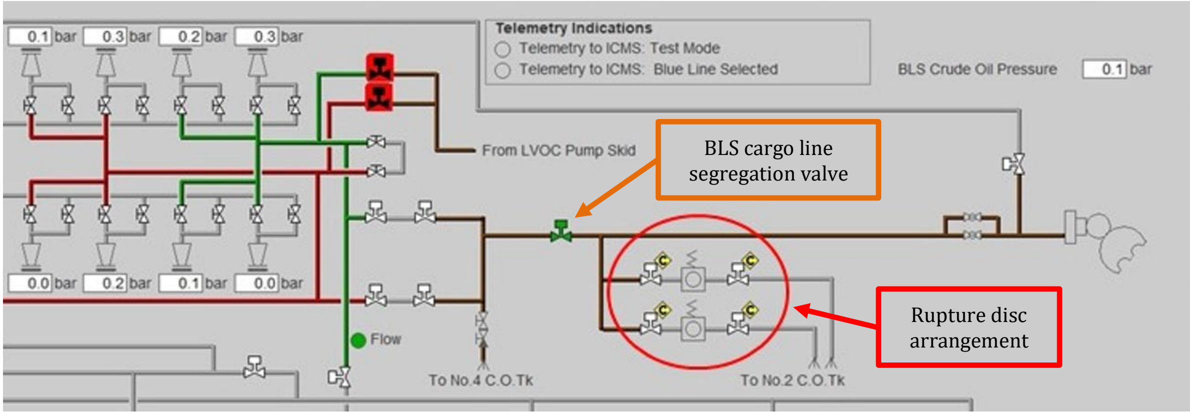


Figure 13 - Rupture disc location

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.
If Blue Line mode is installed, the rupture disc arrangement should either be isolated from the cargo line or the pressure setting for the discs should be increased (typically 16 barg) to enable offshore cargo transfer to an OLT.
The status of the rupture disc arrangement should be interfaced to the BLS control system, see Figure 14 and Figure 15.

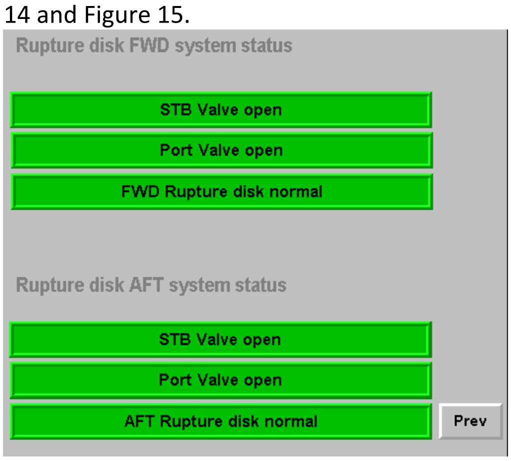


Figure 14 - Rupture disc (Source: APL NOV)

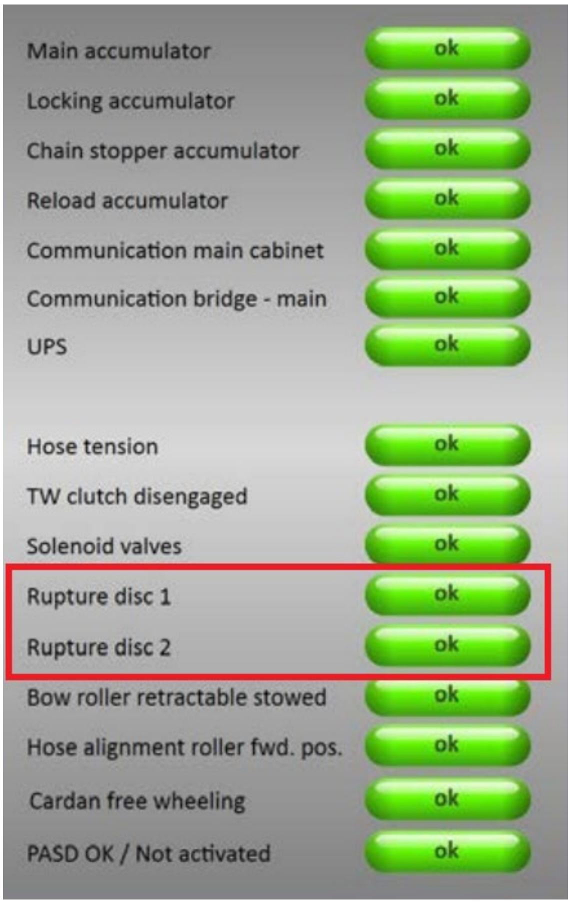


Figure 15 - Rupture disc (Source: MacGregor Pusnes)

10.4.5 Online cargo flowrate monitoring system

All OLST should be equipped with an online cargo flowrate monitoring system for offshore loading and offloading, adapted for relevant oilfield lifting points.
Flowrate readings should be steady throughout the transfer operation for low, high, and intermediate rates, and corresponding to other sources for reading onboard (e.g. online loading computer) within a range of ±10%.

To secure steady flowrate readings, flow-monitor's sensor head(s) should be installed in a suitable location downstream of the BLS inboard valve and as per maker's recommendations. The transmitter should be located in a sheltered area. Mechanical protection from sea spray should be provided.

Online cargo flowrate monitoring system should be integrated with the independent Position Monitoring System (PMS) and be visible for the DPO and the cargo operator at the bridge during the cargo operation.

10.4.6 Closed circuit colour television monitoring system

The OLST should be equipped with a closed-circuit television (CCTV) system which main purposes should be oil spill detection and safe offshore cargo transfer operations.

The CCTV system should be of a modular type and be easily extendable.
It should be considered to have a UPS of minimum 30 minutes capacity for the CCTV system main unit, cameras, and monitors (for critical areas).

The cameras should as a minimum have the following specifications:

All cameras	Additional functions for cameras fitted in the open, inside BLS manifold room, by traction winch and by chain stopper
Ex(d) approved where applicable Colour type 1,920 x 1,080p (FHD) resolution Pan, tilt, zoom function (PTZ)	Heater Wiper Washer

All the above functions should be remotely operated from all control panels.
Camera- and other housing exposed to weather, sea water, BLS water deluge or outside dry areas should be made of stainless steel (AISI 316L or equivalent/better).

The CCTV system should as a minimum include cameras for the following locations:

a) BLS manifold area: One camera for monitoring of the area, including manifold and hose end valve connection flange, should be installed aft of the BLS manifold in the manifold room, pointing forward
b) BLS coupler: One camera for monitoring of the hose connection flange should be installed beside of the BLS manifold
c) Cargo hose: One camera for monitoring of the sea surface forward, the cargo hose and the stern of the OLT (when applicable) should be installed in front/to the side of the BLS manifold. The camera should be protected by the bow door when it is closed. The camera should have a tilt angle to be directed along the hose and up-/forward towards the OLT, and view pick-up of subsea systems
d) Foremast: One camera should be installed in the foremast, as high as practically possible, covering the general area forward of the vessel. If the traction winch, chain stopper and bow roller are installed in the open, it should be possible to present a general overview of the platform deck and its equipment with this camera
e) Chain stopper area: If the traction winch, chain stopper and bow roller are installed below deck and/or cannot be monitored by the foremast camera (d.); one camera covering the chain stopper and the bow roller should be installed
f) Traction winch area: One camera should be installed covering the traction winch from above and overlooking the rope pulling unit

g) Pump room: It should be possible to zoom in on each cargo/stripping pump
h) Thruster room(s): In addition to an overview of the thruster room(s) it should be possible to zoom in on each thruster
i) Engine room(s): In addition to common CCTV coverage of the engine room compartments it should be possible to zoom in on each thruster, main engine and generator
j) Main deck: In addition to common CCTV coverage of the main deck area it should be possible to zoom in on mast riser, manifolds, deck tanks and deck compartments

CCTV colour monitors of minimum 19" and control panels for selection of camera/monitor should be placed at the following locations:

- Bridge: One control panel and minimum 4 monitors. The monitors should be installed without restricting the view from the bridge. Operator positions by the BLS operator panel and by the DP console(s) should have unobstructed view to these monitors. See also section 6.1 for further location guidelines
- Watchman's cabin: One control panel and minimum one monitor
- Engine control room: One control panel and minimum two monitors
- Cargo control room: One control panel and minimum two monitors

10.4.7 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:

- The running health status of all programable logic controllers used to control and operate the BLS should be clearly indicated. An alarm should be initiated upon change of status
- Override functions should be installed for testing purposes of the BLS but should not be possible to use 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' or 'Blue 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)

10.4.7.1 BLS operator panel

An operator panel for the BLS should be installed on the bridge. This operator panel should as a minimum include the following functions:

- Manual selection of operation modes (see section 10.11)
- Portable Control Panel (activate/deactivate) – if installed
- Traction winch control (local/BLS/bridge)
- Brake on traction winch (brake on/brake off) – unless there is an automatic brake
- Dog clutch on traction winch (engage/disengage)
- Speed selection for traction winch
- Joystick for operating traction winch, adjacent to the operator panel
- Chain stopper (open/close)
- 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
- BLS test mode (on/off)
- Hose test (on/off)
- Coupler valve (open/close)
- Inboard valve (open/close)

- Inboard bypass valve (open/close)
- Pumping permitted (permitted/not permitted)

The following information should as a minimum be presented on the operator panel:

- Selected operation mode
- Chain stopper*
- Hose end position*
- Coupler claws*
- Inboard valve*
- Bypass valve*
- Crude oil pressure including alarm for high pressure*
- Coupler valve*
- Cargo system*
- Cargo receiver (only for Blue Line)*
- Aux. condition (such as rupture disc, cardan freewheeling, roller position, PASD)*
- Pumping permitted*
- Hawser tension*
- Hose tension*
- Accumulator pressure*
- Maximum hawser tension for the last hour
- Traction winch speed, tension, brake and dog clutch
- Maximum hose tension for the last hour
- Status of field specific ESD(s)

*The information should be included in the Green Line and the Blue Line (see sections 10.4.1 and 10.4.2).

10.4.7.2 Emergency push buttons

Manually operated emergency push buttons with the below functions should be located adjacent to the BLS operator panel on the bridge:

- Emergency Shut Down class 1
- Emergency Shut Down class 2
- Deluge system in the BLS and forecastle area

10.4.7.3 24V emergency release system

A 24V emergency operator panel should be installed on the bridge (see section 10.5.4).

10.4.7.4 Signals to / from other systems

The following signals should be transmitted as described:

- BLS common failure to the engine control room
- Hawser tension to DP system and data logger
- Signals from items described in section 10.4.7.5
- Other BLS / DP interfaces (PASD, etc.)
- Rupture disc status
- Signals dependent upon field specific requirements

10.4.7.5 BLS data logger

A BLS data logger system should be installed and continuously record:

- Hose tension
- Hawser tension
- Crude oil pressure
- System and accumulator pressure
- Status/operation of all equipment in the 'Green Line' / 'Blue Line' system
- All operator commands/warnings/alarms generated by the BLS control system

The time for the above activities should be recorded and the timing for the logged data should be based on GMT.

Tension and pressure measurements from the BLS data logger system should be presented as graphs on a screen.

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

10.4.7.6 Tension monitoring

Tension meters for traction winch, hawser and hose tension should be installed. These meters should be readable by the naked eye 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 and procedures for calibration of corresponding load cells and tension meters should be on board. Such equipment should also enable physical triggering of the alarm limits for load and tension.

10.4.8 BLS UPS system

The BLS control systems at bow area and bridge should have a dedicated UPS system covering all the below features:

- The UPS batteries should be of a maintenance free type, with minimum capacity of 30 minutes.
- 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.
- 24V back-up power supply should be supplied from the BLS UPS system.
- Loss of power supply to bridge BLS UPS and/or the bow area BLS UPS should initiate an informative alarm and a Green Line Failure.
- In case an electrical inboard bypass valve is installed it should have UPS power supply.
- Data loggers for BLS control system

10.5 Emergency operations

10.5.1 Green Line emergency operations

Checklists 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 sections 10.5.1.1 and 10.5.1.2 below.

10.5.1.1 Green Line 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 and inboard by-pass 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 and inboard by-pass should be minimum 3 seconds longer than for the coupler valve.

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

10.5.1.2 Green Line 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 and inboard by-pass valve.
5. Start the water deluge system.
6. Open the coupler claws when coupler valve is fully closed.
7. Open the chain stopper.
8. Release the brake and control the speed of the traction winch. (Applicable for OLS or similar systems, release speed approximately 60 m/minute).

When activating ESD 2, the ESD 1 sequence is automatically included, see 10.5.1.1 for details.
For ESD 2, the total time, excluding opening of chain stopper, should be 38 (+/-2) seconds.

The fire-fighting system should have fully pressurized deluge in all water nozzles before first coupler claw movement – regardless of the ESD command sequence initiated.

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 coupler claws OPEN signal should have a 10 second delay to secure fully pressurized deluge before first coupler claw movement in case ESD2 is activated subsequent to a completed ESD 1.

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.

10.5.2 Blue Line emergency operations

If the OLST is equipped with a Blue Line control system, checklists 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 sections 10.5.2.1 and 10.5.2.2 below.

10.5.2.1 Blue Line emergency shut down class 1 (ESD 1)

This function should automatically activate the following:

1. Start the hydraulic pump station
2. Trip of the oil export pump(s)
3. Close the inboard valve
4. Close the coupler valve

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

The oil export pump(s) should be tripped within 1 second of ESD 1 being activated, to limit the pressure build-up.

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

Closing time of the inboard valve should be 18-22 seconds.

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

Total time for the ESD 1 should be 25-28 seconds.

10.5.2.2 Blue Line emergency shut down class 2 (ESD 2)

This function should automatically activate the following:

1. Start the hydraulic pump station
2. Trip of the oil export pump(s)
3. Close the inboard valve
4. Close the coupler valve
5. Start the water deluge system
6. Open the coupler claws when coupler valve is fully closed
7. Open the chain stopper

When activating ESD 2, the ESD 1 sequence is automatically included, see 10.5.2.1 for details.
For ESD 2, the total time, excluding opening of chain stopper, should be 28 (+/-2) seconds.

The fire-fighting system should have fully pressurized deluge in all water nozzles before first coupler claw movement – regardless of the ESD command sequence initiated.

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.

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.

10.5.3 Violation of Operational Limits

The BLS system and the DP system should be interfaced and prepared for PASD function. The main purpose of PASD functionalities is to automatically initiate ESD 1 and ESD 2 in case the field specific operational limits (i.e. bow-base distance, drive off detection and/or heading deviation) are violated.

10.5.4 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, inboard valve and inboard bypass 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)
- Or the signals to inboard valve, locking accumulator, coupler valve, chain stopper, telemetry, and coupler claw, keeping the PLC status available

In addition, the 'Loading on' signal to the telemetry system should be disabled (which activates pump stop on the OLT)

10.5.5 Manually operated valves for emergency operations

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

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

- Switch to disable the operator console forward (main PLC) or disable signals as described in 10.5.4.
- 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.

10.6 General arrangement of the bow area

The following distances and measurements should apply:

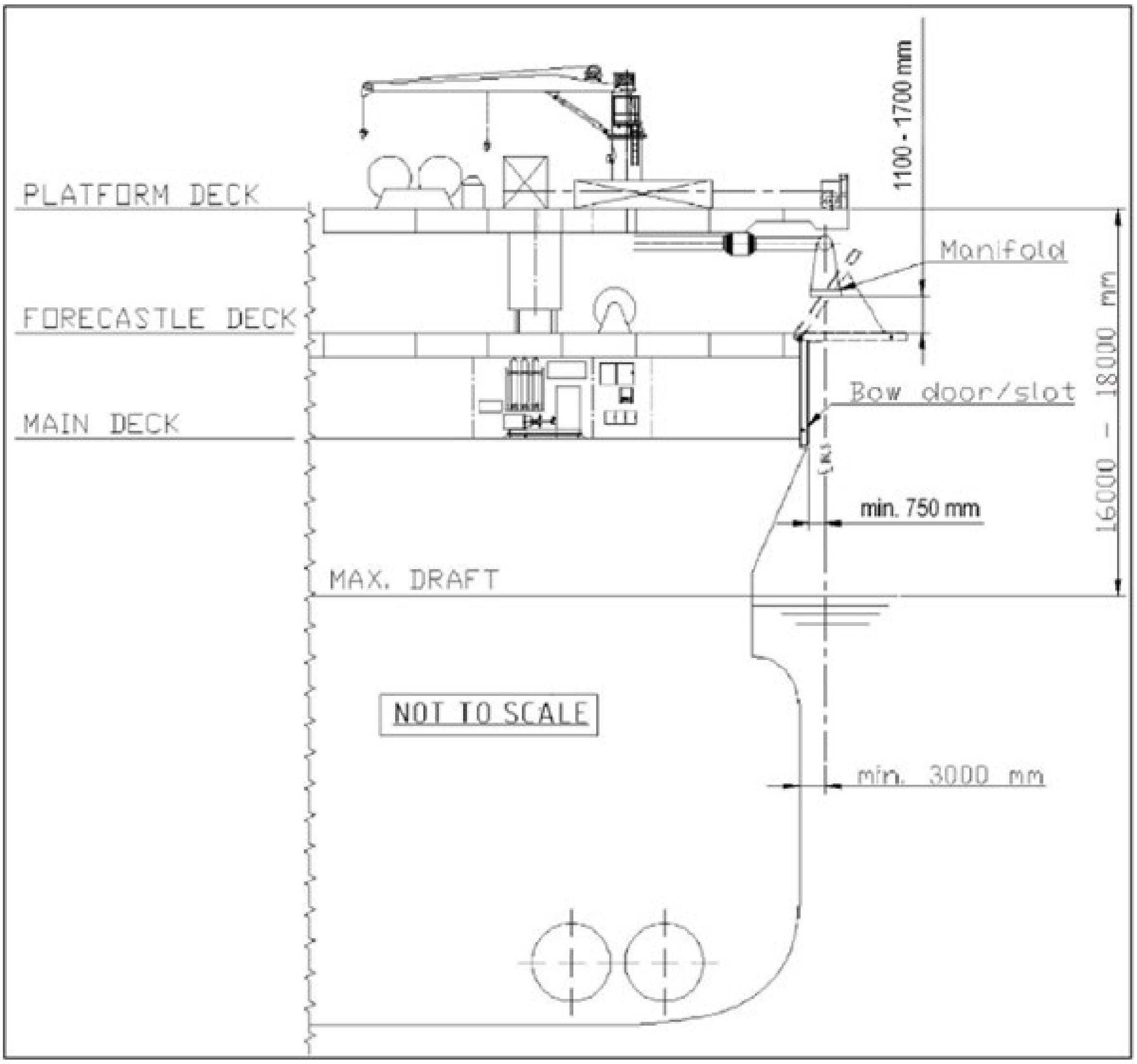


Figure 16 - Bow area general arrangement

- Vertical distance from maximum draft to platform deck should preferably be between 16 and 18 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
- 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
- When designing the curvature and protruding part of the forecastle bulwark and platform deck, focus should be on minimizing the horizontal distance between the foremost part of the arrangement/protruding tip and the bow loading manifold
- The front of the BLS platform deck should have a full width steel bulwark, extending 2 meters aftward on each side

10.6.1 Remote operated searchlight

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.

10.7 Arrangement on platform deck

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

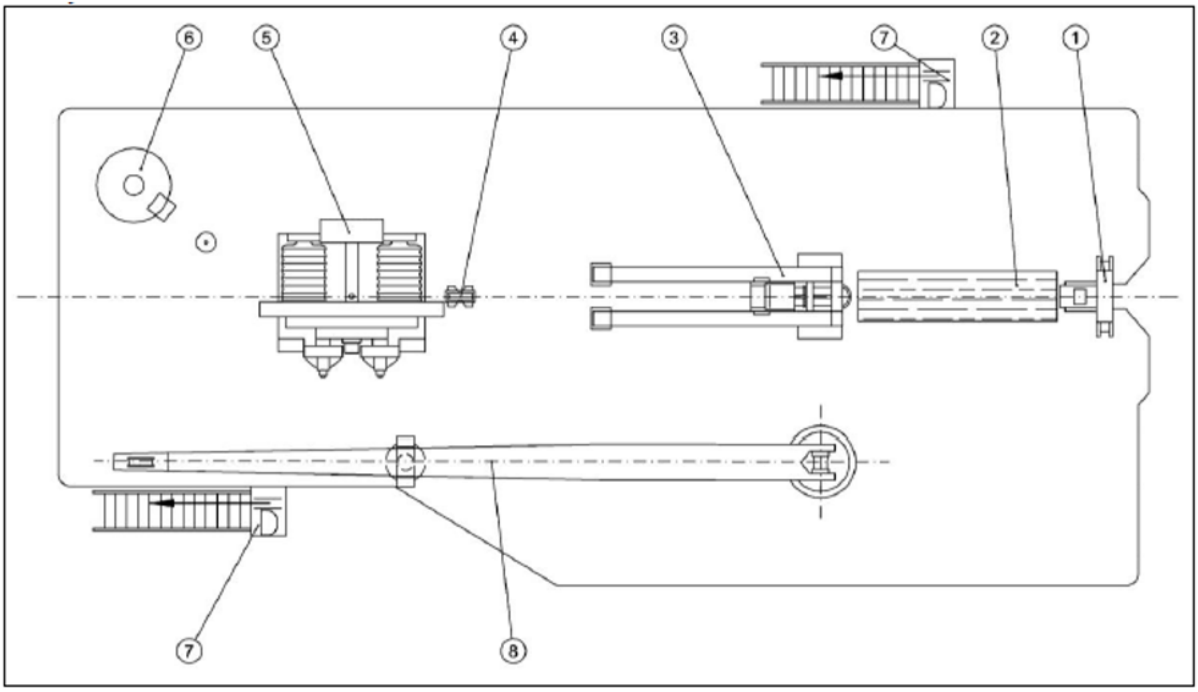


Figure 17 - Platform deck arrangement

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

10.7.1 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). To secure that the OLT chafing chain weak link would break before inflicting any structural damage on the OLST fairlead or OLST chain stopper, 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 of 500 tonnes. 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.

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.

10.7.2 Hardwood protection on deck

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

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

10.7.3 Chain stopper

The chain stopper should be of the self-locking type, remote operated and designed for Ø84 mm chain (offshore) and Ø76 mm chain (OCIMF) with a tolerance up to 89 mm (range Ø76 mm – Ø89 mm). The closing/opening time of the chain stopper should not exceed 30 seconds.

To secure that the OLT chafing chain weak link would break before inflicting any structural damage on the OLST fairlead or OLST chain stopper, 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.

10.7.4 Guide roller

A guide roller with tension meter, both designed for the traction winch capacities and for the OLS ESD2 drop load, should be installed in front of the traction winch. The tension meter should measure the load on the traction winch and the free drop load of an OLS ESD2, which is calculated to be maximum 120 tonnes.

10.7.5 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 control as well as local control with unrestricted view of the traction winch.

The winch should be equipped with a disc brake system with fail to safe mode BRAKE ON. The disc brake system should be designed for emergency release of the OLS, which requires an automatic release speed that can be adjustable between 1 m/s and 2 m/s. The traction winch disc brake automatic release speed should be 60 m/min and be based on a static weight of the OLS hose of 400 kN unless any other field specific requirements should apply.
In OLS mode the 'Loading Permitted' signal should not be obtained unless the dog clutch on the traction winch has been disengaged. In Green Line both the disengaged dog clutch and the open chain stopper should be interlocked.

A manual brake release should be supplied to release the fail to 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. A pull reduction function should be implemented in order to prevent excessive force on ropes, depending on field specific arrangement
- At least two traction winch speed settings:
  - Low speed approximately 0-8 m/min.
  - High speed 0-50 m/min.
- Brake capacity, minimum: 900 kN WLL

- Brake disc to be of stainless-steel material
- Brake rendering function according to field specific requirements or typically, 120% of maximum dynamic hose tension

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.

10.7.6 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 be designed for Ø25-Ø120 mm synthetic fibre rope and should provide necessary back tension for the traction winch. The back tension should be adjustable from 0 kN up to the maximum recommended back tension of the traction winch.

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
- It should be possible to monitor the rope stowing arrangement for correct stowing
- It should be easy for the operator to reach all the controls from the operating position
- The rope pulling unit may be automatically controlled via the traction winch and with the possibility of manual/local control

10.7.7 Service crane

A service crane should be installed on the platform deck. The crane should be designed and located according to the following requirements:

- Enable general lifting operations and maintenance of the BLS equipment
- Be able to service the rope pulling unit and all the other equipment on the platform deck
- Provide lifts from the bow door when this is used as a service platform
- Lifting capacity of minimum WLL 50 kN at 10 m working radius
- Slewing sector of 360° (continuous)
- Self-contained type (electro/hydraulic)
- Access to bow door, minimum 1 m forward of fairlead.
- Limit switches to prevent impact with high structures such as the foremast.

10.8 BLS 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 18. If contractor wants to have an alternative principal arrangement, this should be approved by field operator(s).

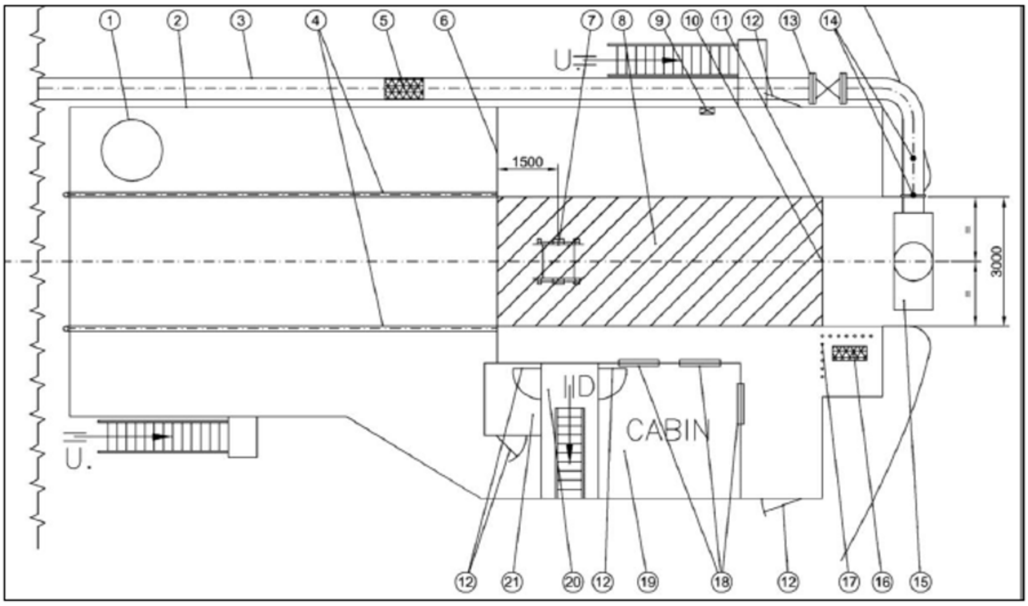


Figure 18 - Example of arrangement in manifold room

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 and offloading operations)
5. Cargo flow-monitor
6. Aft coaming, 200 mm. The manifold room should have gutter bars for drainage to the oil spill pumping arrangement at the main deck, see 8.2 for details.
7. Hose handling winch with self-spooling capability (horizontal offset/distance between winch and top centre of the loading manifold should allow a max. angle of +/- 7º for entering of the wire/line onto the drum)
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(s)
12. Doors, self-closing, with non-slip doorsteps.
13. Inboard valve and inboard by-pass valve (see Figure 2 and Figure 5 for details)
14. Crude oil pressure transmitters
15. BLS manifold
16. Operator console for BLS
17. Protective structure for operator (Also applicable for PCP equipped vessel)
18. A60 windows
19. Watchman's cabin
20. Pressurised A60 staircase
21. Air lock for the staircase

External doors leading to BLS room, should be fitted with arrangements allowing them to be secured in open position.

Visual and audible alarms for PASD, general alarm, fire and gas alarm should be fitted in the BLS manifold room.

10.8.1 BLS manifold

The BLS 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 seconds
  - Normal closing time for the coupler valve should be 25-28 seconds
  - The coupler valve should have the capacity to open the hose end valve with an internal pressure of 4 barg in the loading hose
- 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 40 tonnes SWL shackle, under full load, to pass over the top for guiding the hose handling wire
- The coupler should be designed to swing out minimum 25° in all directions from the vertical axis, known as declination, outlining a 50° cone. However, in forward direction the coupler piece/coupler should be designed to swing out minimum 50° from the vertical axis. See Figure 19
- The coupler should be designed for cargo hose connection at a minimum azimuth of +/- 100° and for offshore loading/offloading at a minimum azimuth of +/- 110°. Azimuth is the cargo hose's angle relative to the heading of the vessel. See red arrow in Figure 20

Figure 19 - Declination
Source: Kongsberg Maritime AS

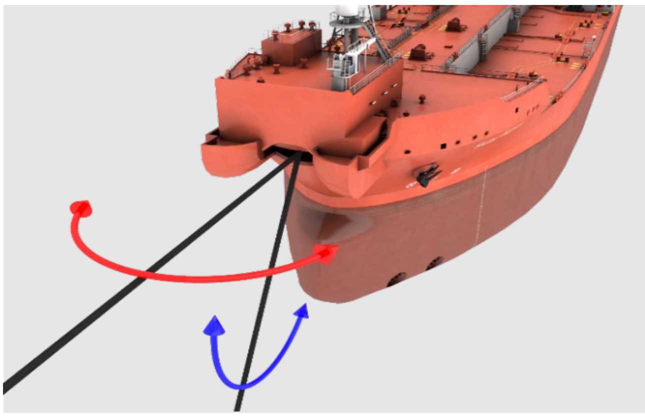


Figure 20 - Azimuth
Source: Kongsberg Maritime AS

- A tension meter (0-120 tonnes) 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., ASME/ANSI B16.5, Class 150)
- Working pressure for lip-seal between manifold and hose end valve should be minimum 20 barg
- A BLS manifold bolted blind flange should be supplied, which should be fitted when the manifold is in stowed position/not in operation to prevent the coupler valve from unintentional opening
- Two proximity sensors should be located opposite of each other on the coupler valve flange. These sensors should give the loading hose 'In position' signal to the Green Line/Blue Line control system 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 - including the bow door hinges -should be lubricated from a common system.
- A tubing/hydraulic hose rupture should not lead to unintentional valve/actuator operation.
- There should be an arrangement for closed draining of BLS coupler manifold
- Safeguards, specifically a flow restrictor / orifice at the 'Open' side of the hydraulic actuator integrated in the coupler, should be in place to prevent a slam-shut situation of the coupler valve in case a tubing/hydraulic hose rupture should occur
  - The closing-time for the coupler valve should not be less than 20 seconds during said accidental scenario and not exceed normal closing time of 25-28 seconds

10.8.2 BLS operator console forward

A fixed or a portable operator console for the BLS should be installed. The following functions should be operated from this console:

- Position and rotation of the BLS manifold. (Including freewheeling)
- 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(s)
- Operation of the retractable bow roller (if installed)
- HPU emergency stop

10.8.3 Crude oil pressure monitoring

Three pressure transmitters for monitoring the pressure inside the crude oil line should be installed directly in front of the inboard valve. The pressure transmitters should be interfaced to the BLS control system/'green line' (2 out of 3 voting), and for remotely monitoring on the bridge.

Vessels designed for offshore offloading operations should have one additional pressure transmitter aft of the inboard valve.

All pressure transmitters should be fitted on the upper part of the crude oil piping and equipped with a test cock and manometer. If pressure transmitter has local visual readouts, no additional manometer is needed for each pressure transmitter.

A manometer (e.g. 0-20 bar) should be connected to crude oil piping in front of the inboard valve and installed inside the BLS manifold room, easily readable from both inside of BLS manifold room and watchman's cabin.

Equipment for calibration of the pressure transmitters should be available on-board.

10.8.4 Inboard valve and inboard bypass 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, specifically a flow restrictor / orifice fitted to the 'Open' side directly on the hydraulic actuator, should be in place to prevent a slam-shut situation of the inboard valve in case a tubing/hydraulic hose rupture should occur. The closing-time for the inboard valve should be within 28-35 seconds during said accidental scenario (i.e., minimum 3 seconds after the coupler valve has closed).

A 12” inboard bypass valve should be fitted. The valve should have the same closing time as the inboard valve and follow the same Green Line logic for loading operation.

10.8.5 Hose handling winch

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

- 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

10.8.6 Access to BLS area and forecastle

A positive pressure airlock should be fitted at all entrances leading into the forecastle.
Minimum one A60 staircase, with an airlock at all entrances, should be installed for access from the forecastle manifold deck to the main deck level inside the forecastle.

All access doors should be self-closing and all steps should be of a non-slip type.

Loss of pressure in the airlocks should have a local alarm (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.

10.8.7 Watchman cabin

An A60-certified watchman cabin should be provided. The cabin should have windows with a clear view of the BLS manifold and in the forward bulkhead.

The following equipment should be installed in the cabin:

- General alarm
- Fire and gas alarm
- Fire extinguisher
- Sound powered telephone
- Light
- HVAC (ambient temperature -20/+50ºC)
- A suitable desk with chair
- One CCTV monitor with control panel
- Minimum 2 escape sets (EEBD)

10.8.8 Stowing arrangement

A stowing arrangement for the messenger line should be installed. A rope pulling unit (see section 10.7.6), 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. The stowing arrangement should be properly illuminated.

10.8.9 Hydrant for flushing of manifold

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 cargo transfer has been completed. The hose should be tested for electrical continuity in accordance with ISGOTT (ref. cargo hoses).

10.8.10 Crude oil line

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

The valves for the crude oil line should be slam shut protected to avoid unintended closing of valves during loading operations, see section 9.2.

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

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).

10.8.11 Bow door(s)

A bow door(s) 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 BLS. See Figure 20. The bow door(s) should fulfil the following requirements:

- The bow door(s) should fully cover the bow slot to withstand ‘green sea’ when the vessel is fully loaded and in transit in rough seas
- The inside of the bow door should be covered with 75 mm hardwood in the part of the bow door which is used as spark protection
- 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 and cylinders operating the bow door(s)
- The bow door(s) should be remote operated for opening/closing of the bow door and for locking the bow door(s) in both open and closed position. The controls for operation of the bow door(s) should be installed at the BLS operator console

Figure 22 - Bow door in open position (Source: APL NOV)

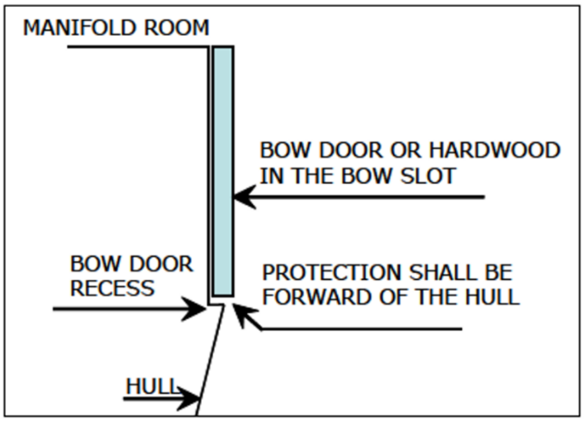


Figure 21 - Bow door arrangement in open position - principles

When in stowed position any drain from the coupler should be contained inside the BLS 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 (see Figure 21).

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

10.9 BLS hydraulic room

A separate room for the BLS hydraulic equipment should be located inside the forecastle, in a safe area at main deck level.

The room should be equipped with an oil mist detector.

The ventilation system for the hydraulic room should be arranged in such a way that hydraulic oil leakage/mist is not spread to other areas. There should be coamings of 200 mm, surrounding all equipment in the room.

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

10.9.1 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 for vertical suction and 80 mm for horizontal suction
- 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
- 1 oil cooler using fresh water
- 1 oil heater
- Normal working pressure approximately 250 bar, peak pressure approximately 315 bar, standby pressure approximately 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 (if installed)
- 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.

10.9.2 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 shutdown of BLS
- Release of the OLST 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. Equipment for local gauging of accumulator pressure should be available
- Safety valve with melting fuse on each of the accumulator 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 section 10.7.5 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).

10.9.3 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 operating console
- Accumulators
- Control of emergency functions
- Control of brake
- Control of traction winch and dog clutch
- Control of chain stopper
- Release of loading hose
- High pressure filter

10.10 BLS electrical equipment room

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 a safe area.

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

10.10.1 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. Examples of such cabinets are:

- 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 the system failing ‘as set’ (i.e. no uncontrolled movements of components).

10.10.2 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.

10.11 BLS operational modes

The mooring and coupling operation should be performed as per the relevant offshore field manual. The below subsections describe modes for different transfer operations, software should be implemented by BLS maker based on charterers preferred operational modes.

BLS / DP PASD interface should be implemented for operational modes without hawser, in accordance with field operators' requirements.

10.11.1 Single Point Mooring (SPM)

SPM mode is utilized at anchored loading buoys (SAL/ALP) and at installations (FSU/FSO/FPSO/SPAR) where the OLST is moored with a mooring hawser or where closing of the chain stopper is part of the Green Line criteria without a mooring hawser.

The chafing chain and hawser is pulled in and secured in the chain stopper by the traction winch. The loading hose's hose end valve is pulled in and connected to the BLS manifold coupler by the hose handling winch.

If the weight of the hose end valve and loading hose is higher than the hose handling winch capacity or if the storage capacity for forerunners and messenger lines is insufficient, the traction winch can be used to connect the loading hose.

In case of an ESD/ASD2 the chain stopper will release the hawser and the coupler claws will release the loading hose.

Single Point Mooring can be used in either loading mode (Green Line) or offloading mode (Blue Line).

10.11.1.1 Single Point Mooring Auto (SPM Auto)

At certain installations the loading hose is transferred together with the mooring hawser and the chafing chain by use of the traction winch.

Once the chain stopper is closed the hose end valve will be in position just below the BLS manifold coupler. The final connection is performed either by moving the chain stopper or by moving the bow fairlead (design dependent).

10.11.2 Offshore Loading System (OLS)

OLS mode is utilized at subsea systems without a mooring hawser but may also be used for loading at installations (FSU/FSO/FPSO/SPAR) without mooring hawser.

The OLST retrieves the loading hose directly from the seabed by use of the traction winch. The chain stopper remains open, and the loading hose bridle remains connected to the messenger line during the whole operation. Traction winch dog clutch must be disengaged after connection. In case of an ESD 2/ASD 2 the traction winch will ensure a controlled drop of the loading hose.

Offshore Loading System is used in loading mode (Green Line).

10.11.3 Direct Loading (DL)

DL mode is utilized at installations (FSU/FSO/FPSO/SPAR) without mooring hawser.
The OLST retrieves the loading hose by use of the traction winch. Once the hose end valve is connected to the BLS manifold coupler the bridle is disconnected from the messenger line. In case of an ESD 2/ASD 2 the loading hose is released directly by the coupler claws.

Direct Loading is used in loading mode (Green Line) or offloading mode (Blue Line).

10.11.4 Framo Submerged Loading System (FSL)

The FSL mode is based on DL mode, but with separate alarm limits.

In case of an ESD/ASD2 the loading hose is released directly by the coupler claws.

10.11.5 Mono Buoy Offloading

MBO mode is utilized when OLST is moored using the BLS chain stopper, but the loading/offloading is completed via the mid-ship manifold.

10.12 Testing and verification

10.12.1 BLS and CHS FMEA

A Failure Mode Effect Analysis (FMEA) including proving/verification trial for the BLS and cargo handling system should be carried out for each OLST prior to first offshore loading or offloading operation. The FMEA should be performed by a recognized 3rd party. Similar format to the IMCA guidelines for DP FMEA should be followed and should be reviewed and approved by field operator(s).

Recommendations should be rated by criticality (A, B and C) and closed by the same criteria as DP FMEA trial recommendations (see section 11.6.1).

The BLS and cargo handling system should as a minimum be designed and verified according to the BLS Design Philosophy (see section 10.2).

A minimum of one service engineer from the maker should be on-board during the FMEA inshore and offshore field testing.

Prior modifications of the BLS system (hardware or software) field operator(s) and charterer(s) should be duly notified, and acceptance should be given.

Whenever modifications or significant repairs (hardware or software) have been made, a revised BLS and CHS FMEA proving/verification trial should be carried out for the affected equipment and involved system(s).

10.12.2 Customer Acceptance 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 heaving and drop speeds/pressures
- Calibration of load cells
- Initial start-up and testing of all equipment
- System tests to include all relevant ESD1 and ESD2 functions, including all relevant sensors and equipment failures
- Pressure tests of the manifold, swivels, piping to the inboard valve and the inboard valve itself
- Trial connection of BLS hose/hose end valve (flange, valve and hang-off) for all relevant loading hoses (MacGregor Pusnes/APL NOV) should be carried out
- Verification of flow restrictor functionality for coupler- and inboard valve

Testing pressure for all hydraulic connections should at least be according to class requirements. Procedures for above tests should be prepared, and the tests should be performed after completion of the commissioning. The CAT should result in a report.

10.12.3 Prearrival periodical verification

Each OLST should utilize 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
- Interlock, Blue Line systems (if relevant for operation)
- ESD1
- ESD2
- PASD1
- PASD2
- Green Line failure
- Blue Line failure (if relevant for operation)

10.12.4 Onboard maintenance and verification

Equipment for calibration of all BLS load cells should be available on board.
All BLS load cells should be calibrated at an annual basis.

BLS maker's recommended service to be performed minimum at 5 years interval.

Hydraulic hoses should be renewed at 30 months (±3 months) intervals for on-deck equipment and 60 months (±3 months) interval for equipment below deck.

11 DYNAMIC POSITIONING

The OLST should be capable of maintaining safe position and heading during offshore connection, loading/offloading, and disconnection. This should be achieved by Dynamic Positioning (DP) in accordance with DNV class notation DYNPOS (AUTR) or equivalent notation provided by other class societies as defined in section 4.1.

11.1 Design and operation of DP system

Dynamic Positioning systems are defined in IMO MSC.1/Circ.1580, the design and operation of the DP system should as a minimum be in accordance with this standard and IMCA M 103.

A DP design and operational philosophy should be established and be reflected in the Failure Modes and Effects Analysis (FMEA).

The DP system software should be designed for the intended operation and location. This includes DP modes and functionality as described in the relevant DP field manuals. Examples are field specific DP software for OLS, direct loading, and tandem loading/offloading operations.

The DP system should be designed for open bus tie configuration for all voltage levels. Any operation with closed bus tie configuration, should be subject to the relevant field operator approval with reference to their specific requirements. Such operations should be based upon class approved DP systems with increased functionality for robust closed bus ties operation, reference is made to DNV-RP-0591.
A Power Management System should be interfaced with the DP system.

Engines, thrusters, and propulsion systems, including their control and auxiliary systems, should be designed with supply from dedicated power supplies, without use of change-over systems, dual- or cross feedings. Any use of supplementary change-over systems, dual- or cross feedings is at the discretion of the field operator.

OLST CPP main propellers should have drive-off safeguards such as ‘zero pitch’ function or similar.
Fuel oil, freshwater cooling, lub oil, hydraulic- and pneumatic systems (part of the DP system) should be separate per. DP system redundancy group. A failure in one SW cooling system (including seachest) should in no case be transferred to another DP system redundancy group.

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

11.2 DP documentation

DP documentation should be carried onboard reflecting the vessel design and DP operations in accordance with IMCA M 103 and IMCA M 109.

11.3 DP capability

The DP capability should be assessed and documented for intact condition and post worst single failure condition as defined by the DP FMEA for ballast draught and fully loaded draught. This normally implies failure of each of the redundancy groups.

The assessment should refer to DNV-ST-0111 Level 2-site. For benchmarking purposes, the assessment should be performed with the accompanying web-based DP Capability Assessment tool provided by DNV. The limiting significant wave height should as a minimum be Hs = 5.5 m at heading ±15 degrees with the following environmental parameters:

- The environmental direction increment should be 5 degrees
- The sea current speed should be 0.5 m/s
- The waves, wind and sea current should be collinear (from the same direction).

The DP capability results should be displayed as wave envelopes showing the limiting significant wave height as a function of heading for intact condition and the combined worst single failure.

The environmental load coefficients should be user defined and vessel specific. The wind and current load coefficients should be determined by wind tunnel tests or by CFD analysis, whereas the wave drift load coefficients should be determined from a 3D panel model of the hull using WAMIT, WADAM or similar. Trim should be considered for both ballast and fully loaded draught.

All other items should be in accordance with DNV-ST-0111 Level 1. The DP capability should be documented by means of a report for each draught condition as well as the corresponding web-app configuration data used for the assessments. The DP capability assessment should be reviewed by an independent competent party.

11.4 Position reference systems

The DP system should be equipped with a set of PRS and sensors compatible with the existing infrastructure used for offshore loading operations at the NCS.

Four independent PRS should be fitted, whereof minimum three should be based on different measurement principles. The locations of the PRS should be selected so that the risk of interference and shadow zones are minimized.

The OLST should be fitted with the following PRS:

- 2 x Absolute and relative GNSS (DARPS)
- 1 x Microwave long range (Artemis or XPR)
- 1 x Microwave short range (Radius)
- 1 x Hydro-acoustic system (HiPAP)

When two or more GNSS units are installed, the GNSS units should receive correction signals from at least two independent sources. Diversity can be enhanced by tracking different GNSS constellations on the GNSS systems. An inertial aiding might be integrated with the PRS systems for enhanced integrity and availability, in such a case minimum one GNSS should be integrated. Inertial aiding could be added to other PRS such as HAIN for HiPAP. The inertial measurement unit must be of navigational grade or higher.

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

The gyros should have a minimum dynamic accuracy of 0,1 degree sec/lat.

11.5 Independent position monitoring and logging system

The OLST should have an independent PMS unit fitted for real-time data acquisition, calculation, logging and displaying designed to monitor DP offshore loading/offloading.

The system 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 for the users. The system should integrate all available positioning information and calculate the best combined position for all connected systems. It should also calculate speed and course over ground.

If required, all data should be transferred to the OLT. The PMS should be powered by a separate UPS unit. During loading/offloading operation, the system should give an alarm (both audible and visual) if speed over ground is higher than a pre-set limit. 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.

11.6 Auditing, testing and acceptance

Auditing, testing and acceptance of the DP system should be in accordance with IMO MSC.1/Circ.1580.

11.6.1 DP Failure Mode

FMEA desk top study and trials should be conducted in accordance with IMCA M 166 by an independent competent party and approved by class.

The FMEA study and trials should take into consideration OCIMF Dynamic Positioning Failure Mode Effects Analysis Assurance Framework Risk-based Guidance when presenting information related to the vessel's DP redundancy concept.

A full FMEA trial should be performed with intervals not exceeding 5 years.

Annual and periodical trials should be conducted in accordance with IMCA M 190 and IMO MSC.1/Circ.1580.

FMEA observations of category 'A – Immediate Attention' should be closed out in a documented and auditable fashion prior to operations. FMEA Category 'B – Action when Reasonably Convenient' observations should be closed out as soon as practically possible in agreement with charterer(s) or field operator(s).

11.6.2 Hardware in the Loop testing

Hardware in the Loop (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

The following systems should be considered for HIL testing:

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

The HIL tests should be in accordance with DNV-ST-0373 or equivalent. The HIL test simulator can be dependent or independent of the company delivering the target system.

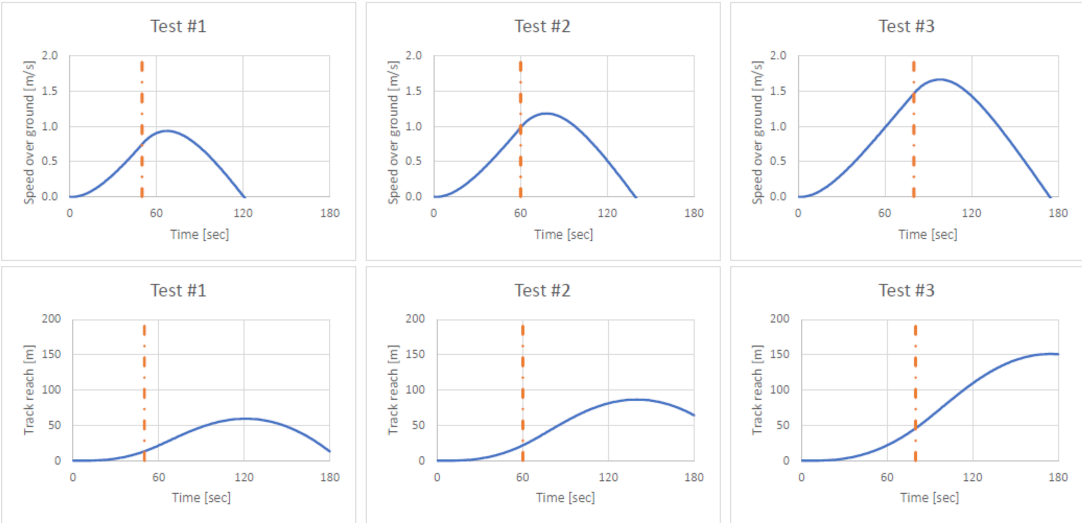
11.6.3 Emergency stopping test (DP crash stop test)

An emergency crash stop test should be performed by full ahead and full astern manoeuvres using the DP joystick with joystick gain setting High. All thrusters and propellers available to the DP system should be used in the tests. The purpose is to demonstrate the reversing of the thrust direction so that the OLST is brought to rest from various speeds. The track reach, defined as the distance the vessel travels from the starting position with the OLST dead in the water until the ahead speed again is zero, should be recorded. The ahead speed over ground and track reach shall be recorded as time series. The OLST shall be in ballasted condition during the tests.

The tests should be performed three separate times with full astern manoeuvres after 50, 60 and 80 seconds; respectively, measured from the time at which full ahead is applied. The results shall be presented on a one-page emergency stopping summary showing time intervals for full astern manoeuvres, the OLST speed and distance when full astern is applied and the track reach for each test, see example in Figure 22. The emergency stopping summary should be incorporated in the OLST DP operation manual, and it should be used during training exercises and DPO on-boarding and familiarization.

DP emergency stopping tests (DP crash stop tests) DP Shuttle Tanker RAGNA

Date: 04.10.2022
Location: Tromsøsundet



	Test #1	Test #2	Test #3	
Full astern at:	50	60	80	[s]
Speed at full astern:	0.7	1.0	1.5	[m/s]
Track reach at full astern:	13.4	21.9	46.1	[m]
Maximum speed:	0.9	1.2	1.7	[m/s]
Total track reach:	60	87	151	[m]

Shuttle Tanker dead in the water
All thrusters and propellers enabled to DP
Full ahead - DP joystick gain setting High

Full astern - DP joystick gain setting High
Shuttle Tanker brought to rest (zero speed)

Draught: 9.1[m]
Trim: 1.1 [m]

Figure 23 - Emergency stopping (DP crash stop) summary example

11.7 Incident reports, investigations, and experience transfer

The OLST owner or operator should have a DP incident reporting system in accordance with IMCA M 103. Recorded data relevant for DP operations should be made available for investigation and experience transfer.

DP undesired events and incidents should be investigated. Participation in the investigation is at the discretion of the charterer(s) or field operator(s). The OLST owner or operator should nominate a dedicated role with responsibility for DP incident 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.

The OLST owner or operator should also ensure that any incidents at any field within the 10 NMZ or any DP related incidents are reported in the OCIMF SIRE incident reporting scheme.

12 SAFETY EQUIPMENT

12.1 Free fall lifeboat

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.

Testing equipment for free-fall lifeboat release should be available onboard.

12.2 Fast Rescue Craft (FRC)

The OLSTs should be equipped with one fast going, water jet powered FRC boat with a single point davit system, located at deck level A.

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.

12.3 Emergency towing arrangements

The OLST should be arranged with a specially designed emergency towing system at the stern. The system should be arranged as follows (below is based on a typical Aframax size OLST):

- 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
- To prevent degrading the towing wire should be stored in a protected environment
- The emergency towing arrangement should be ready for use at any time
- An automatic wire brake of mechanical type to control the pay out of the towing wire should be fitted
- A permanent arrangement for safe and efficient recovery of the towing wire without the need for manual handling should be in place
- A 140 meter long, 28 mm diameter Dyneema type forerunner line with a breaking load of approximately 46 tonnes should be provided
- The emergency towing arrangement should be designed for safe testing at a frequency of minimum half a year

The forward emergency towing system should be readily available without the use of vessel's power and should not be obstructed by the BLS arrangement or other equipment.

12.4 Pneumatic Line Throwing device (PLT)

The OLST should be equipped with 2 complete PLT containing as a minimum:

- An PLT 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 PLT, both in the bow and the stern area

12.5 Messenger line cutter

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

12.6 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. Catwalk should be fitted with anti-skid gratings. If deck houses, such as VOC or gas fuel handling modules are installed, direct access from main catwalk should be provided.

The outline of the safe walkways should cover necessary workstations including (but not limited to):

- Manifolds
- Mooring arrangement
- BLS area
- Deckhouses
- Pump rooms
- Cargo sampling points

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.

In general, large grit size should be used in the anti-skid paint to maintain effect over time.

12.7 Personal protective equipment

The OLST should be supplied with personal protective equipment additional to statutory requirements.

12.7.1 Extra life jacket

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.

12.7.2 Survival suits

Additionally, to the SOLAS requirements, the OLST should be equipped with thermal insulated survival suits of appropriate sizes corresponding to the crew’s physical size. This also applies to the workstations such as the BLS area, ECR and CCR.

12.7.3 Escape hoods

Additionally, to the SOLAS requirements, the OLST should be equipped with escape/smoke hoods at each cabin.

12.7.4 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.

12.7.5 Fireman’s outfitting

Additionally, to the SOLAS requirement, 2 sets of fireman’s outfitting should be located in the bow area.
All OLST fireman's outfitting should follow the norm for clothing and protective equipment for the helideck crew stated in the NOROG Helideck Manual.

13 TESTING AND QUALIFICATIONS REQUIREMENTS

Before an OLST can be accepted for offshore loading or offloading it should undergo a comprehensive test program.

All tests should be carried out as per approved test procedures and monitored by charterer(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 charterer.

Depending on the OLST's status, testing should be performed at three stages:

- New building or a conversion: Testing at yard
- New building or a conversion: Testing inshore at charterers preferred location
- First time at loading or offloading point: Testing at field

The minimum content of these tests is described in the subsections below. Each charterer may have additional company specific requirements.

13.1 Testing at yard and maker

Area/Discipline	Non-exhaustive list of items to be tested
DP	• DP FMEA proving/verification trial, including power generation from VOC plant and power demand from consumers such as VOC plant and Blue Line mode operations (if applicable) • HIL testing of relevant equipment, if required
DP control system	• FAT • CAT
Joystick control system	• FAT • CAT
PRS	• CAT
CHS, incl. fire fighting	• Cargo Handling System proving/verification trial • Confirm double eccentric butterfly valves have been installed in fail to safe direction as per section 9.2
BLS, incl. fire fighting	• CAT • BLS & CHS FMEA proving/verification trial • BLS load test for cargo hose • Test of traction winch load at various speeds
Telemetry system	• FAT
Emergency towing system aft	• ETS proving trial
Communication systems	• FAT
Online cargo flowrate monitoring system	• FAT • Confirm equipment installed in suitable location as per maker's recommendations
VOC & VOC fuel system, if applicable	• FAT

13.2 Testing inshore

Area/Discipline	Non-exhaustive list of items to be tested
Helideck, incl. fire fighting	• Certification
DP	• Inshore DP FMEA trial, which should follow IMCA structure, including power generation from VOC plant and power demand from consumers such as VOC plant and Blue Line mode operations (if applicable) • DP Crash stop test
PRS	• Covered by Inshore DP FMEA trial

CHS, incl. fire fighting	Inshore BLS & CHS FMEA trial. Minimum tests to be carried out in both loading and offloading modes: • Loading & topping mode • Cargo tank valves & segregations • Emergency stops • ICMS failures • High & overfill alarms Recommendations should be rated by criticality defined by IMCA M 166 (A, B and C) and closed by the same criteria as DP FMEA trial recommendations.
BLS, incl. fire fighting	Inshore BLS & CHS FMEA trial. Minimum tests to be carried out in loading and offloading modes: • Interlock functions • Green line/Blue line failure • ESD, ASD, PASD • Manual emergency release from bridge & forecastle • Crude oil line sensors • HPU & accumulators • Emergency stops • BLS control system • Fire/gas detection system interfaces Recommendations should be rated by criticality defined by IMCA M 166 (A, B and C) and closed by the same criteria as DP FMEA trial recommendations
VOC & fuel system, if applicable	As part of Inshore BLS & CHS FMEA trial: • Verify that Fire, gas and safety systems for the VOC and fuel system does not interfere with Green Line/Blue Line Recommendations should be rated by criticality defined by IMCA M 166 (A, B and C) and closed by the same criteria as DP FMEA trial recommendations

13.3 Testing at field

Area/Discipline	**Non-exhaustive list of items to be tested**
DP	• DP field tests according to maker's CAT procedure
PRS	• Covered by DP field tests
BLS, incl. fire fighting	BLS field tests according to field operator and/or OLST owner procedure. Minimum tests to be carried out in relevant loading and offloading modes: • OLS drop test and drag brake calibration of traction winch (only applicable for vessels loading at OLS) • Mooring, hook-up, and disconnection test at each loading point
Telemetry system	• CAT during field test • Confirm automatic export pump stop / export valve closure
Emergency towing system aft	• Emergency towing exercise (if applicable at field location)
Communication systems	• Field test
Online cargo flowrate monitoring system	• CAT and calibration during first cargo (ref 10.4.5)
VOC & VOC fuel system, if applicable	• CAT during offshore loading

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 and offshore cargo transfer operations. This should be in accordance with field operator's requirements and based on a recognized standard such as OGUK or OCIMF.

Compliance with OGUK Tandem Loading Guidelines, Matrix 1 & 2 and/or field operator specific requirements should be demonstrated.

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 117.

14.2 BLS competence requirements

For competence and training related to BLS equipment, BLS maker recommendations for operation and maintenance should as a minimum be followed. Crew and officers attending BLS operation should have documented competence and training related to BLS equipment installed on board.

Master, Chief Officer/senior DPO 1, senior DPO 2, Chief Engineer and 2nd Engineer should complete a type specific BLS course provided by BLS maker.
Before being in charge of any BLS operation deck officers and other key personnel operating the BLS (e.g. bosun/pumpman) should attend type specific BLS course provided by maker.
Other officers and crew attending BLS operation should complete on board training related to the BLS prior to attending first operation.

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 should be responsible for the DP-watch, assisted by a junior DPO performing cargo transfer duty. Junior DPOs may be trained by the senior DPO during DP-watch.

If the junior DPO holds a DP certificate, the senior DPO and junior DPO may alternate between cargo watch and DP watch, based on approval from master. During such circumstances the senior DPO should remain immediately available on the bridge.

The master should normally not be part of the ordinary DP-watch scheme but should be present and available on the bridge at his/her discretion. The master should 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 requirement.

However, from arrival 10NMZ, during offshore operation and until departure 10NMZ, the minimum manning in the engine room should be one (1) engineer and one (1) rating.

14.5 Deck manning

The deck should always be manned with at least two persons when connected to an OLT. A continuous watch by a responsible crew member should be maintained on the bow throughout the cargo transfer operation. 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.