

 <b>PETROBRAS</b>	TECHNICAL SPECIFICATION		Nº: <b>I-ET-4880.00-9311-000-CZ1-001</b>
	CLIENT:	LOG/TM/ON	SHEET: 1 of 592
	JOB:	TP 25 – PRODUCT CARRIERS 15600 DWT	
	AREA:	PETROBRAS FLEET	IN-4880-23-001
TITLE: <b>CONTRACT SPECIFICATION</b>		LOG/PL/EGE	
			INTERNAL
 <b>MARENOVA</b>	BUILDER: N/A	CONTRACT NUMBER: 7000.0130000.25.2	
	TECHNICAL RESPONSIBLE: MARCELO DELANO	CREA NUMBER: 2006118561	KONGSBERG NUMBER: N/A

## INDEX OF REVISION

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	ORIGINAL ISSUE

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E
DATE	10/10/2025					
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ERRO NTE <b>BR</b> REFERENCIA <b>PETROBRAS</b> NAO ENCONTRADA.	TECHNICAL SPECIFICATION	I-ET-4880.00-9311-000-CZ1-001	REV.: 0
	TP 25 – PRODUCT CARRIERS 15600 DWT	SHEET:	2 of 592
	TITLE:	LOG/PL/EGE	
	<b>CONTRACT SPECIFICATION</b>		INTERNAL

1. Building specification 24-714\_1
2. Building specification 24-714\_2
3. GENEARL ARRANGEMENT



KONGSBERG

# Building specification

NVC 615 PT  
15600 TDW Product tanker



**Owner****Transpetro****Yard****Mac Laren / Ecovix****Building Specification Revision History**

<b>Version</b>	<b>Date</b>	<b>Reason for Issue</b>	<b>Sign</b>
1	17.09.2024	First issue	PEV
2	30.09.2024	Updated with more details	BEK
3	18.10.2024	Updated acc. owners clarifications	PEV
4	24.01.2025	Updated acc. to new deadweight	PEV
5	11.03.2025	Updated with misc. changes.	BEK
6	04.04.2025	Updated with misc. changes.	BEK
7	29.04.2025	Updated according to owners comments	PEV
8	20.05.2025	Updated according to owners comments	BEK
9	28.05.2025	Updated according to owners comments	PEV
10	26.08.2025	Updated according to owners comments	PEV
11	10.10.2025	Updated according to owners comments	BEK/RW

**Related Documents**

<b>Doc.No</b>	<b>Document name</b>	<b>Version</b>	<b>Date</b>
24-7141-101-001	General Arrangement	9.0	10.10.2025

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# 0 GENERAL

## Abbreviations

Table 0.1 Abbreviations

Abbreviation	Meaning
AC	Alternating Current (electricity)
ACB	Air Circuit Breaker
AFE	Active Front End
AFFF	Aqueous Film Forming Foam
AHU	Air Handling Unit
AIS	Automatic Identification System
ARPA	Automatic Radar Plotting Aid
ARS	Acid Resistant Steel
BNWAS	Bridge Navigational Watch Alarm System
BWTS	Ballast Water Treatment System
CCTV	Closed Circuit TeleVision (system)
CP	Controllable Pitch
CW	Clock Wise
CCW	Counter Clock Wise
DC	Direct Current
DE	Driving End
DIN	Deutsches Institut für Normung (German Institute for Standardization)
DN	Nominal Diameter
DOL	Direct On Line
DSC	Digital Selective Calling
DVD	Digital Versatile Disc
ECR	Engine Control Room
EEDI	Energy Efficiency Design Index
EIAPP	Engine International Air Pollution Prevention
EMC	Electro Magnetic Compatibility
EMS	Energy Management System
EOL	End Of Life
EPR	Ethylene-Propylene Rubber
ER	Engine Room
ESD	Emergency Shut Down
ESS	Energy Storage System
FAT	Factory Acceptance Test
FO	Fuel Oil
FSS	Fire Safety System (code)
FTP	Fire Test Procedures (code)
FW	Fresh Water
GNSS	Global Navigation Satellite System
GRP	Glass fibre Reinforced Plastic
HF	High Frequency
HHP	High Holding Power
HIL	Hardware In Loop

Abbreviation	Meaning
HMI	Human Machine Interface
HO	Hydraulic Oil
HP	Holland Profile
HPR	Hydro-acoustic Position Reference
HPU	Hydraulic Power Unit
HT	High Temperature
HTC	Heat Transfer Calculation
HVAC	Heating, Ventilation & Air Conditioning
IACS	International Association of Classification Societies
IAPP	International Air Pollution Prevention (certificate)
IAS	Integrated Automation System (Also known as ICMS in Transpetro Specification)
IBTS	Integrated Bilge water Treatment System
ICCP	Impressed Current Cathodic Protection
IEC	International Electrotechnical Commission
ILO	International Labour Organization
IMCA	International Marine Contractors Association
IMDG	International Maritime Dangerous Goods (code)
IMO	International Maritime Organization
I/O	Input / Output
IP	Ingress Protection
ISO	International Standards Organisation
ISPS	International Ship and Port facility Security
ISSC	International Ship Security Certificate
ITU	International Telecommunication Union
LAN	Local Area Network
LCC	Local Control Cabinet
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LFL	Low Flashpoint Liquids
LO	Lubrication Oil
LRIT	Long Range Identification and Tracking
LT	Low Temperature
MARPOL	MARitime POLLution (IMO convention)
MCB	Miniature Circuit Breaker
MCC	Motor Control Centre
MCCB	Moulded Case Circuit Breaker
MCR	Maximum Continuous Rating
MDO	Marine Diesel Oil
MED	Marine Equipment Directive
MF	Medium Frequency
MGPS	Marine Growth Prevention System
MoM	Minutes Of Meeting
MRB	Marine Radio Beacon
MSC	Maritime Safety Commission (IMO)
NDE	Non Driving End
ODM	Oil Discharge Monitoring

Abbreviation	Meaning
PA	Public Address
PABX	Private Automatic Branch eXchange
PC	Personal Computer
PC/UMS	Panama Canal / Universal Measurement System
PID	Proportional Integral Derivative (controller)
PMS	Power Management System
PPM	Parts Per Million
PS	Port Side
PTC	Positive Temperature Coefficient (thermistor)
PVC	Poly Vinyl Chloride
PWM	Pulse Width Modulation
RMS	Root Mean Square
RTD	Resistance Temperature Detector
SAT	Sea Acceptance Trial
SB	StarBoard
SCR	Selective Catalytic Reduction
SEEMP	Ship Energy Efficiency Management Plan
SFI	Skipsteknisk ForskningsInstitutt (Ship Research Institute of Norway)
SG	Steering Gear
SOLAS	Safety Of Life At Sea (IMO convention)
SPM	Shock Pulse Measurement
SSAS	Ship Security Alert System
SSB	Single Side Band
SSP	Ship Security Plan
SW	Sea Water
SWB	Switch Board
SWL	Safe Working Load
TBD	To Be Determined
TFT	Thin Film Transistor (display)
THD	Total Harmonic Distortion
UHF	Ultra High Frequency
UPS	Uninterruptible Power Supply
VDR	Voyage Data Recorder
VHF	Very High Frequency
VSAT	Very Small Aperture Terminal
VSD	Variable Speed Drive
WC	Water Closet
WB	Water Ballast
WLL	Working Load Limit
XXXX	To be solved in Basic/Detail Design phase
Y/D	Star/Delta

## Units

Table 0.2 Units

Quantity	Quantity name	Unit Symbol	Expressed in terms of SI units
Length	metre, nautical mile	m, nm	1 nm = 1852 m
Mass	kilogram, metric tonnes	kg, t	
Time	second	s	
Force, weight	Newton, tonne force, kilogram force	N, tf, kgf	
Pressure	Pascal	Pa, bar	N/m <sup>2</sup> , 10 <sup>5</sup> Pa
Hydrostatic pressure	Metre liquid column	mlc	
Energy	Joule	J	N·m
Energy	Watt hour	Wh	
Electric Current	Ampere	A	
Frequency	Hertz	Hz	s <sup>-1</sup>
Power	Watt	W	J/s
Voltage	Volt	V	J/C=W/A
Electric charge	Coulomb	C	
Electrical capacitance	Farad	F	C/V
Electric resistance, impedance, reactance	Ohm	Ω	V/A=1/S
Temperature	degree Celsius	°C	
Illuminance	lux	lx	
Area	square metre	m <sup>2</sup>	
Volume	cubic metre, litre	m <sup>3</sup> , l	
Volume	gross tonnage	GT	
Torque	Newtonmeter	Nm	
Viscosity	centiStoke	cSt	
Noise	Decibel, A-weighted decibel	dB, dB(A)	
Speed	metre/second, knot	m/s, kn	1 kn = 0,514 m/s
Rotational speed	revolutions per minute	rpm	

Table 0.3 Metric Prefix

Text	Symbol	Factor	Power
giga	G	1000000000	10 <sup>9</sup>
mega	M	1000000	10 <sup>6</sup>
kilo	k	1000	10 <sup>3</sup>
hecto	h	100	10 <sup>2</sup>
deca	da	10	10 <sup>1</sup>
(none)	(none)	1	10 <sup>0</sup>
deci	d	0.1	10 <sup>-1</sup>
centi	c	0.01	10 <sup>-2</sup>
milli	m	0.001	10 <sup>-3</sup>
micro	μ	0.000001	10 <sup>-6</sup>

## Definitions and Terms

Where the term **The Owner** is used it refers to:

Petrobras Transporte S.A. (hereinafter abbreviation),

Situated in Avenida Almirante Maximiano Fonseca, N 4361 - KM 6 BR 392 - Rio Grande - RS – Brazil

Where the term **The Yard** is used it refers to:

consórcio Mare Nova (ajustar endereço),

Situated in Ilha da Conceição, Niterói - State of Rio de Janeiro, Brasil

Where the term **The Designer** is used, it refers to:

Kongsberg Maritime AS, Ship Design

Situated in Ålesund, Norway

Where the term **The Contract** is used it refers to:

The written agreement between The Owner and The Yard.

## A General intent of specification

### Vessel philosophy

This specification, together with the General Arrangement, describes a

Tanker for Oil of Kongsberg NVC-Design type NVC 615 PT.

The vessel (hull, systems and equipment) will be designed and optimized for minimum fuel consumption and reduction of air emissions, complying with the requirements of the Energy Efficiency Design Index (EEDI) Phase 3.

The vessel will be prepared arrangement / structure wise for methanol fuel, using a engine designed for covention to methanol, according to relevant class notation .

The design and construction of the vessel and selection of equipment to be installed shall be governed by the following considerations:

- Efficient usage of structural materials
- Efficient hull form and propulsion plant
- Fuel economy at service speed and in port
- Time- and cost efficient operation in port
- Minimum cargo residue and efficient tank cleaning
- Efficient draining and cleaning of cargo lines
- Ease of maintenance and inspection
- Environmental protection
- Underwater Radiated Noise reduction
- Protection of cargo against contamination
- Crew safety
- Energy Conservation

Ergonomic assessment reports shall be issued in accordance with the AET methodology described in NR-17 and shall be prepared by a qualified and certified specialist in ergonomics. In addition, rules and resolutions applicable to control stations, provided for in the Standards, Conventions and Codes, will be duly complied with.

### Duties

The vessel to be designed for the carriage of following cargoes for both full and partial filling:

- The vessel will carry oil products such as: Marine Diesel, Diesel S10 (Petrobras product), Diesel S500 (Petrobras product), AVGAS with specific weights ranging from 0,688 to 0,880 t/m<sup>3</sup>. E Capacities and tonnage.

### Intent of specification

This specification is intended to describe the technical features of the vessel and its contents, including, but not limited to, principal dimensions, tank capacities, etc. It can be changed due to further development and to the Owner's approval.

Other items not mentioned in the Owner's technical specification, but which are mandatory by the Classification Society and/or National Authorities rules and regulations, shall be applied according to the Owner's standard and practice.

If there are any discrepancies between documents the procedures as mentioned in the Contract shall be used.

## B Arrangement, description

### Hull

The vessel is mono hull with a centre skeg.

The vessel will be constructed with double bottom and wing tanks for segregated ballast, as practical or as per General Arrangement, throughout the length of the vessel.

Cargo containment system and all steel exposed to cargo to be of normal steel. Upto 35% of the steel construction can be High Tensile Steel.

### Accommodation

The vessel shall have accommodation for a total of up to 36 persons, for crew and officers - all in single cabins - Of those 11 Crew, 10 petty officers, 6 officers, 3 senior officers. In addition 2 worker class cabin / 2 beds, 1 Pilot cabin / 2 beds and 1 Owners cabin / 2 beds.

Lifesaving equipment shall be arranged for 36 persons

Table 0.4 Cabins

Cabin Type	Quantity
State cabin (with separate sleeping room) (Senior Officers)	3
Single cabin (Officers)	6
Singel cabin (Petty Officers)	10
Singel cabin (crew)	11
Owners cabin	1 (2 beds)
Pilot cabin	1 (2 beds)
Worker class cabin	2 (2 Beds)

The accommodation shall be compliant with MLC 2006.

#### **Arrangement**

The vessel shall be arranged according to the General Arrangement.

The following compartments shall be arranged on each deck (from aft):

On Tanktop:

- Aft peak tanks
- Engine room
- Cargo area
- Forepeak tank

On 2nd. Platform Deck:

- Aft peak tanks
- Steering gear room
- Engine room
- Cargo area
- Forepeak tank

On 1st. Platform Deck:

- Aft peak tanks
- Steering gear room
- Rope store
- Aux engine room
- Engine room
- Separator room
- Cargo area
- Forepeak tank

On Main Deck:

- Hydraulic room
- Inertgas room
- Product store corrosive
- Refrigerant compr. room
- Engine workshop/store
- Engine room
- Engine change room
- Engine control room
- Central store/Eng.room loc.
- El.workshop
- Clean Agent Bottle Compart
- Hydraulic actuator room
- Foam room
- Pump room/technical room
- Methanol fuel treatment room (future)
- Cargo equipmen/deck store SB/PS

- Technical room/store
- Bosun store/rope store

On 01 Poop Deck:

- General store
- Paint store
- Store Ac/Ox
- Engine casing
- Garbage store
- Bosun Store
- Product store toxic
- Product store flameable
- Change room
- Chamber store room
- Provision store
- Laundry/Drying room
- Dirty linen room
- Clean linen room
- Meeting room
- Public toilets
- Galley
- Pantry
- Messroom
- Ship office
- Cargo control room
- Cargo tank gasfreeing vent.room
- Cargo sampl. room
- Deck store

On 02 Accommodation Deck:

- Engine casing
- HVAC room
- Auditorium
- Internet room
- Work class cabin
- Hospital
- Gymnasium
- Smoking room
- Officers living room
- Ratings living room

On 03 Accommodation Deck:

- Fire station
- Lifesaving equipment room
- Engine casing

- Emergency generator room
- Support laundry
- Crew cabins
- Petty officers cabins
- Cleaning locker

On 04 Accommodation Deck:

- Funnel
- Officers cabins
- Petty officers cabins
- Crew cabins
- Support laundry
- Cleaning locker

On 05 Accommodation Deck:

- Funnel
- Senior officers cabins
- Captains office
- Pilot cabin
- Owners cabin
- Steward cabin
- Technical room / instrument room
- El. equipment room
- Custom locker
- Cleaning locker

On 06 Bridge Deck:

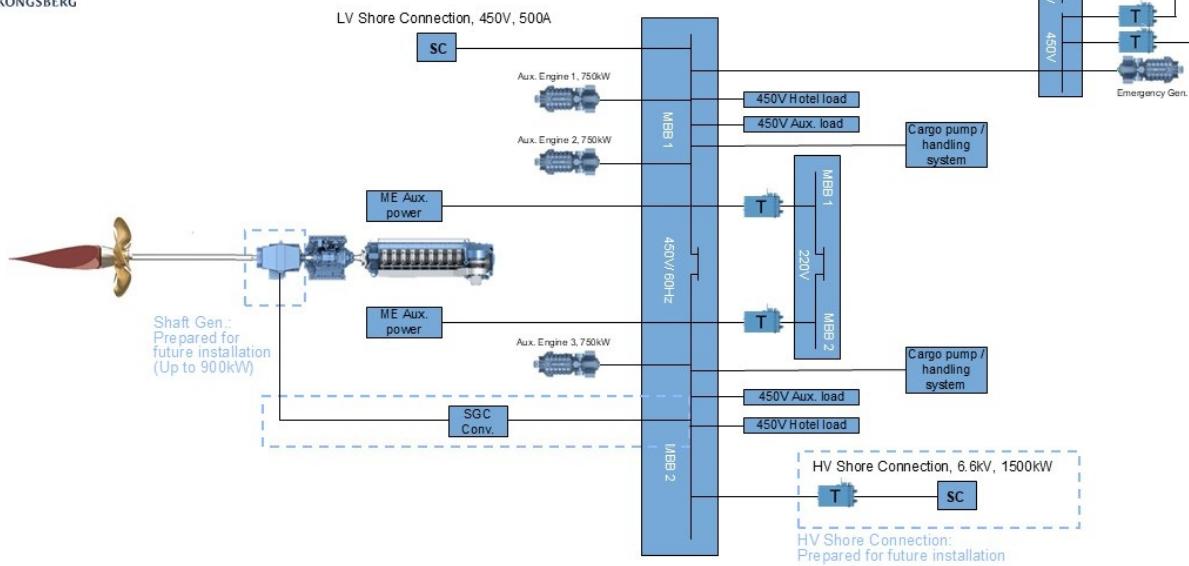
- Funnel
- Wheelhouse
- Battery store

### Main Power and Propulsion Concept

The vessel has a hybrid power system consisting of an electric power plant and a conventional main propulsion system according to [Figure 0.1](#).



## Power System Setup



WORLD CLASS – Through people, technology and dedication

KONGSBERG PROPRIETARY - See Statement of Proprietary Information

Figure 0.1

### General

Main propulsion line shall be arranged according to SFI item 63 Transmissions

By using the lever on the wheelhouse panel, or any other panel in command, an order signal will be given to the main engine governor and the electromechanical actuator for pitch control. Propeller speed and pitch will be optimized according the operational mode and load and fuel curve on the engine as relevant to achieve the best fuel economic configuration on the vessel at any time.

### Propulsion control

The propeller shall have CP with various pitch/rpm combinations embedded in its remote control system.

### Worst case failure intent

The vessel will be equipped with a single propulsion system, and as such a single component failure in the propulsion line (Main engine to Propeller) the may render the vessel without propulsion power. The two split electrical main power system shall maintain or be able to restore at least one section of the two-split main electrical system in the event of the worst single failure. (except for fire and flooding events).

## C

### Main Particulars

Table 0.5 Main Particulars

	Abbreviation	Dimension (approx.)
Length overall	L <sub>OA</sub>	150.60 m
Length between perpendiculars	LPP	146.60 m
Breadth moulded	Bm	23.40 m
Depth to freeboard deck amidships	D	11.20 m

	<b>Abbreviation</b>	<b>Dimension (approx.)</b>
Design draught amidships	Tdesign	8.20 m
Summer draught amidships	Tsummer	8.20 m
Scantling draught	Tscantling	8.40 m

## D Performance

### Endurance

The vessel shall have fuel and provision capacities for continuous operation for 34 days, at service conditions.

Cruising range to be minimum 10000 nautical miles considering conventional fuel (FO). Bunker capacity calculated for service condition.

### Environmental conditions

The ship shall be designed for the environmental conditions mentioned in the table below.

Table 0.6 Environmental conditions

	<b>Temperature</b>	Remarks
Outside air temperature	minimum -10°C	
	maximum +35°C	
Engine room temperature		Ref. <a href="#">Environmental conditions</a>
Sea water temperature	minimum +4°C	
	maximum +32°C	

For accommodation HVAC design conditions ref. [57 Ventilation, air-conditioning & heating systems](#).

### Speed and Fuel Oil consumption

Table 0.7 Speed

<b>Condition</b>	<b>Performance</b>
Continuous Service speed (at CSR and Design draught given in <a href="#">C Main Particulars</a> )	12.5 knots
Maximum Speed at trial conditions (at Design draught given in <a href="#">C Main Particulars</a> )	Approx. 13,85knots

This accounts under the following conditions (CSR Condition):

- 90% MCR on the main propulsor(s)
- 15% Sea Margin
- Even keel
- Calm weather (maximum Beaufort 2)
- Sufficient water depth (To be according to ISO-15016:2015)
- Clean hull and propellers

During the sea trial exact speed and power measurements shall be performed (Ref. SFI Item [154 Trial trips](#)).

Speed trials to be according to ISO 15016:2025.

### Fuel Oil consumption

Fuel consumption with the vessel sailing at Design/Summer draught and at continuous service power (CSR): Approx. 12,0 t/d at residual marine fuel oil category ISO-F-RMA, according to ISO 8217:2024". Including 300 kW Hotel/System load the fuel consumption will be approx. 13,41 t/d. The fuel oil consumption given above is theoretically (including manufacturer's tolerance), calculated for continuous service condition as basis for calculation of fuel tanks storage capacities and endurance.

The guaranteed fuel consumption of Main Engine(s) to be confirmed as per maker's shop test.

In addition, the design shall include dedicated storage tanks for the consumption of distillate marine fuel oil ("DMA/DMZ"-ISSO 8217) with a low sulphur content (0,1%) with a capacity equivalent to at least 4 days of the vessel's daily consumption.

#### **Energy Efficiency Design Index**

The vessel (hull, systems and equipment) will be designed and optimized for minimum fuel consumption and reduction of air emissions, complying with the requirements of the Energy Efficiency Design Index (EEDI) Phase 3, and CII- (Carbon Intensity Indicator) for the project premises.

## **E Capacities and tonnage**

Table 0.8 Capacities and tonnage

Cargo	Volume (approx figures)	Density	Remark
Cargo Tanks	16840 m3	0,88t/m3	
Slop tanks	550 m3	0,88t/m3	
Cargo Drain Tanks	70 m3	0,88 t/m3	
Methanol fuel tank ( Combined with Cargo tank no.6 SB )	1080 m3	0,88 t/m3	
Marine Gas Oil, including serv/settl. tanks [1]	100 m3	0.9 t/m3	
MDO/Heavy Fuel Oil, including serv/ settl. tanks [1]	560 m3	0.98 t/m3	
Ballast Water	8650 m3	1.025 t/m3	
Potable Fresh Water	200 m3	1.0 t/m3	
Technical Fresh Water	50 m3	1.0 t/m3	
Lubrication oil	150 m3	0.9 t/m3	
Deadweight at Summer Draught (8,20 m)	15600 mt		( in sea water with specific gravity of 1.025 )
Gross Tonnage (international, approx.)	12716		

#### **Footnotes:**

- [1] All tanks are designed for liquids with flashpoint above 60 °C, according IMO Resolution MSC.236(82) and IMO Res. A.673(16), except of Cargo/Methanol fuel tank 6 SB.

#### **The vessel to be designed for the carriage of following cargoes for both full and partial filling:**

- Petroleum products according to Class notation and technical construction..

## F Class

The vessel will be designed, built, supervised/surveyed, tested and delivered in compliance with the Laws, Classification Rules, Conventions, Regulations, Standards, Resolutions, Circulars and the other associated documents in their latest revision as mentioned below:

- In force on the date the Construction Contract is signed, or;
- If not yet in force by the date of signature of the Contract, ratified and expected to be in force by the date of delivery of the vessel, and compulsory to obtain all Class and Statutory certificates for unrestricted navigation.

The vessel will be designed, built and equipped under the survey and according to the rules and regulations of:

- Bureau Veritas (BV) (hereafter called the Classification Society), alternatively according to in DnV or ABS with equal class notations,

that are, unless otherwise agreed, valid on the date of contract and certified upon delivery to the requirements of the Classification Society notations:

(In case the class society will be changed, Table 0.9 to be adjusted accordingly)

Table 0.9 Class notations

UNRESTRICTED NAVIGATION
I
OIL TANKER
ESP
METHANOLFUEL-PREPARED (S, T, B, ME-DF, AE)
CPS(WBT)
COMF-VIB 3
COMF-NOISE 3
AUT-UMS
SYS-NEQ-1
CARGOCONTROL
LI-S3
VCS-TRANSFER
IG
SPM
CYBER SECURE
SMART (EnE2)
ETA
BWT
CLEANSHIP
SOX-x%
GREENPASSPORT
INWATERSURVEY
MON-SHAFT
ALM

The ship will fly the state flag of Brazilian and shall satisfy its latest rules and regulations for this special ship type and trade.

The Vessel shall comply with the relevant National and International rules and regulations for worldwide operation for such vessel.

Equipment onboard shall have valid certificates as applicable, ref.G Certificates.

## **G Certificates**

Compliance with applicable requirements of rules and regulations shall be documented by issue of certificates and/or statements by the relevant bodies.

The following certificates shall be obtained by the Yard and supplied to the Owner at the time of delivery of the vessel (at least, not limited to this list.) :

- *Class Certificate*
- *Cargo Ship Safety Radio Certificate + Form R + Initial Safety Radio Survey checklist*
- *Radio Station Licence*
- *Shore Based Maintenance Certificate*
- *VDR Type Approval Certificate*
- *VDR Initial installation Performance Report issued by Manufacture*
- *SSAS Type Approval certificate*
- *AIS Type Approval Certificate*
- *AIS Initial Installation report issued by Radio Surveyor on behalf of Classe Society*
- *EPIRB Type Approval Certificate*
- *EPIRB Test Report issued by Approved Service Supplier*
- *LRIT Type Approval Certificate*
- *Cargo Ship Safety Construction Certificate*
- *Cargo Ship Safety Equipment Certificate + Form "E" + Record of Safety Equipment*
- *International Load Line Certificate + Record of Conditions of Assignment*
- *Internation Oil Pollution Prevention Certificate + Form B*
- *Internation Sewage Pollution Prevention Certificate*
- *Statement of Compliance with Garbage Pollution Prevention*
- *International Air Pollution Prevention Certificate + Record*
- *NOx/ EIAPP certificates for all installed engines*
- *International Tonnage Certificate*
- *Panama Canal Universal Tonnage Measurement System (PC/UMS)*
- *International Anti Fouling System Certificate + Record*
- *Supplier Declaration for AFS tin free and AFS cybutryne free*
- *Statement of Compliance with Energy Efficiency + supplement*
- *MLC 2006 Certificate*
- *International Ballast Water Management Certificate*
- *Statement of Compliance with Honk Kong Convention + Inventory of Hazardous Materials*
- *Cargo Gear Certificates/ Records for Lifting Appliances*
- *Sanitization Certificate*
- *STATEMENT OF COMPLIANCE WITH SINGLE POINT MOORING ARRANGEMENT – "SPM"*
- *STATEMENT OF COMPLIANCE WITH SHORE POWER INSTALLATION PREPARATION (DESIGN LEVEL)*
- *TYPE APPROVAL CERTIFICATE (OIL FILTERING EQUIPMENT E OIL CONTENT METER)*

- Calibration certificate for 15 PPM alarm sensor
- Overload Test Certificate for Lifting Appliances
- Lifting Appliances wire cables certificates
- Lifting Appliances Class Certificates (Equipment certificate)
- Hydrostatic test reports/ certificates for CO<sub>2</sub> cylinders and others
- Type Approval certificate for rubber hoses intended for CO<sub>2</sub> cylinders and pilot receivers
- Type Approval Certificate for Fixed fire fighting system
- Fixed fire fighting system Initial installation report
- Commissioning/ test Report for Fixed Fire fighting Foam System.
- Foam Forming Liquid substance analysis report
- Foam Forming Liquid substance type approval certificate
- Fixed Foam System type approval certificate
- Watermist Commissioning/ Test Report
- Watermist System type approval certificate
- Lifeboat extinguishers hydrostatic test report
- Lifeboat extinguishers annual service report
- Wheeled Dry Powder extinguishers hydrostatic test report
- Wheeled Dry Powder extinguishers annual service report
- Foam form liquid substance sample analysis certificate/report
- Service report for breathing apparatus sets (incl. spares)
- Type approval certificate for breathing apparatus set
- Service report for inflatable liferafts
- Type approval certificate for Liferafts hydrostatic release
- Product certificate for Liferaft launching appliances
- Type approval certificate for Liferaft on/off load release hook
- Type approval certificate for all magnetic compass
- Deviation curve for all magnetic compass
- Calibration certificate for Wind sensor
- Type approval certificate for lifebuoys
- Type approval certificate for lifebuoys w/lights (Ex-rated)
- Type approval certificate for man overboard lifebuoys (Ex-rated)
- Hydrostatic test report for lifeboat air cylinders
- Service report for lifeboat air cylinders
- Hydrostatic test report for O<sub>2</sub> cylinders
- O<sub>2</sub> quality (purity) certificate
- Type approval certificate for Lifeboat and launching appliances
- Overload test certificate for Lifeboat launching appliances
- Wire certificates for Lifeboat winches
- Lifeboat equipment inventory list
- Type approval certificate for onload release gear
- Supplier's Commissioning report for Lifeboat and associated equipment
- Type approval certificate for Rescue boat and launching appliances
- Overload test certificate for rescue boat launching appliance
- Rescue boat equipment inventory list

- Type approval certificate for On/Off load release hook
- Mooring ropes and tails certificates
- Certificate for Towing cables and tails
- Type approval certificate for EEBD
- Hydrostatic test report for EEBD
- Service report for EEBD
- Certificate for Fire Wires
- Wire certificates for miscellaneous cranes
- Windlass class certificate
- Windlass brake test report
- Accommodation Ladder certificate
- Accommodation Ladder overload test certificate
- Gangway certificate
- Gangway overload test certificate
- Type approval certificate for Immersion Suit
- Type approval certificate for Pressure Vacuum Valves
- PV Valves test report
- Type approval certificate for O2, CH4 Gas Detectors, Tankscope meters
- Calibration certificate for O2, CH4, Gas Detectors, Tankscope meters
- ODME type approval certificate
- ODME calibration certificate
- Supplier's commissioning report for ODME
- VECS type approval certificate
- Supplier's commissioning report for VECS
- Type approval certificate for Cargo tank level gauge system
- Calibration certificate for Cargo tank level gauge system
- Supplier's commissioning service report for Cargo tank level gauge system
- Calibration certificate for sensors (pressure and temperature)
- Main/Emergency Switchboard Class certificates
- Pressure test report for cargo and fuel oil lines
- Accommodation Air quality certificate
- Potable water analysis report
- Hydrostatic test report for Deep fat frier cylinder
- Deep Fat frier type approval certificate
- Supplier's commissioning service report for deep fat frier
- MED Type approval certificates for firefighter's outfits
- Certificates for rubber mats
- UTI type approval certificate
- UTI calibration certificate
- Type Approval certificate for Gas detection system
- Calibration certificate for Gas detection system
- Supplier's commissioning service report for Gas detection system
- ECDIS type approval certificate
- Supplier's commissioning service report for ECDIS

- Construction Permit issued by Flag
- REB Preliminary Registry
- Warranty Declaration
- Inventory and Spares Declaration
- Delivery Confirmation for Design Drawings, As-Built Drawings and Manuals
- Delivery Confirmation for Design Drawings, As-Built Drawings and Manuals
- Delivery and Acceptance Declaration
- Painting Manufacturer Warranty Declaration
- Construction Certificate
- Fresh water tanks cleaning declaration
- Deadweight measurement certificate
- Asbestos Free Declaration
- Non- essential Deficiencies Declaration
- Hidrostatic Test Declaration for all Lines
- Main Engine Payment confirmation + Receipt
- Quay Trials Conclusion Declaration
- Sea Trials Conclusion Declaration
- Type Approval Certificate for Pilot Ladder
- Type Approval Certificate for Thermal Insulation
- Type Approval Certificate for Fire Doors
- Type Approval Certificate for A-60 Windows and Scuttles
- Classe Certificate for Overbord valves (side and bottom)
- Quick closing valves System certificate
- Type Approval Certificate for Air Vent Heads
- Type Approval Certificate for Pyrotechnics
- Type Approval Certificate for PA/GA System
- Type Approval Certificate for Sound Reception System
- Type Approval Certificate for Echosounder
- Type Approval Certificate for Daylight Signalling lamp
- Type Approval Certificate for Autopilot
- Type Approval Certificate for DGPS
- Type Approval Certificate for Radars
- Type Approval Certificate for Fire Hoses (ABNT)
- Type Approval Certificate for Fire Detection System
- Type Approval Certificate for MF/HF System
- Type Approval Certificate for VHF
- Type Approval Certificate for Emergency VHF (portable)
- Type Approval Certificate for NAVTEX
- Type Approval Certificate for INMARSAT-C
- Type Approval Certificate for SART
- Type Approval Certificate for FBB
- Type Approval Certificate for Unattended Machiney Space
- Type Approval Certificate for 2-Way automatic telephone system
- Type Approval Certificate for IAS

- *Type Approval Certificate for Self Powered Telephone*
- *Class Certificate for emergency fire pump*
- *Class Certificate for main fire pumps*
- *Class Certificate for ballast pumps*
- *FAT report for ballast pumps*
- *Supplier's commissioning service report for ballast pumps*
- *Type Approval Certificate for speed log*
- *Class Certificate for Emergency Diesel Generator*
- *Supplier's commissioning service report for emergency diesel generator*
- *FAT Report for Emergency Diesel Generator*
- *Type Approval Certificate for Vent Riser (including flame arrester)*
- *Class Certificate for Auxiliary Engines*
- *Supplier's commissioning report for auxiliary engines*
- *FAT report for auxiliary engines*
- *Class certificate for Thermal Oil Heater*
- *Supplier's commissioning report for Thermal Oil Heater*
- *FAT report for Thermail Oil Heater*
- *Class Certificate for Steering gear*
- *Supplier's commissioning report for steering gear*
- *FAT report for steering gear*
- *Class certificate for Main Engine*
- *Supplier's commissioning report for main engine*
- *FAT report for main engine*
- *Class certificate for shaft line system*
- *Commissioning report for shaft line system*
- *Class certificate for propeller*
- *CPP system certificate*
- *Class Certificate for Stern tube bearings (including sealing system)*
- *Class certificate for steel castings (rudder, Stern tube, horn) + rudder bearing bushing*
- *Type approval certificate for lifejackets*
- *certificate for gong*
- *Certificate for bell*
- *Type approval certificate for navigation lights*
- *Type approval certificate for Whistle*
- *Type approval certificate for Line throwing appliances*
- *Class certificate for anchor chain set*
- *Class certificate for anchors set*
- *Class certificate for chain stoppers*
- *Class certificate for starting air compressors*
- *Class certificate for Main Air Receivers*
- *Class certificate for service Air compressors*
- *Class certificate for service Air Receivers*
- *Class certificate for emergency starting system*
- *Class certificate for Incinerator*

- Type Approval certificate for Sewage Treatment System
- Class certificate for economizer
- Type approval certificate for electric breakers
- Test report for electric breakers
- Type approval certificate for electric cables
- Class certificate for Integrated Loading Computer and Trim Optimization System
- Type Approval certificate for Loading computer
- Class Certificate for Cargo Pumps
- FAT Report for Cargo Pumps
- Supplier's commissioning service report for cargo pumps
- Class Certificate for Heat Exchangers
- Class Certificate for Heat Exchangers
- Class Certificate for Main Engine heat exchanger
- Class Certificate for Fuel Oil Unit (Main/Auxiliary)
- Class Certificate for Purifiers (DO)
- Class Certificate for Purifiers (FO)
- Class Certificate for Purifiers (LO, main)
- Class Certificate for Purifiers (LO, auxiliary)
- Type Approval Certificate for Ballast Water Treatment System + USCG CERTIFICATE
- FAT Report for BWTS
- Commissioning Teste Report for BWTS according to Circ.70/Ver.1
- Type Approval Certificate for Anti Fouling System
- Class Certificate for Valves Remote Control System
- Type Approval certificate for Speed Control System
- Class Certificate for Deadman Alarm System
- Fire retardant declaration for mattresses
- Type Approval certificate for fire dampers
- Type approval certificate for Water/weather tight doors
- Class Certificate for Inert Gas System
- Supplier's commissioning service report for Inert Gas System
- Calibration certificate for O2 analizer (IGS)
- FAT Report for Inert Gas System
- Chocks and Bollards certificate (accord. International standard)
- Type Approval certificate for tank cleaning system
- Certificate for Impressed Current System
- Type Approval certificate for Emergency Towing Arrangements (aft/fwd)
- Class certificate for Emergency Towing accessories
- Class certificate for Electric motors intended for cargo pumps HPU
- FAT report for Electric motors intended for cargo pumps HPU
- Commissioning service report for Electric motors intended for cargo pumps HPU
- Class certificate for HPU auxiliary engines
- FAT Report for for HPU auxiliary engines
- Commissioning report for HPU auxiliary engines
- Class Certificate for Seawater cooling pumps

- *Class Certificate for bilge pumps*
- *Type Approval Certificate for Cargo Tanks Monitoring System*
- Declaration Concerning Compliance with U.S. Navigation Regulations

Declaration Concerning Compliance with U.S. Pollution and Sanitation Regulations

Any other certificates in addition to the ones listed above being required by the Classification Society and/or National Authorities shall be issued. If any of the above mentioned certificates are not required by the surveyors and/or any of the reports will not be issued by the survey authorities because they are not required, these documents shall not be delivered with the ship unless clearly specified.

## H Rules and regulations, tonnage regulations

The vessel shall be designed, built, equipped and certified in compliance with all relevant statutory conventions, codes and guidelines as in force on the date of keel laying, including but not limited to the following :

(For statutory documents, a Portuguese or bilingual version to be handed over.)

### a) International Maritime Organization (IMO):

1 - International Convention for the Safety of Life at Sea (SOLAS), its amendments and related Codes in its latest revision (and amendments), such as:

- LSA Code (2020 Edition and Consolidated Amendments);
- 2010 Fire Test Procedures (FTP) Code;
- 2015 Edition. Supplement. December 2019. Amendments to the International Code for Fire Safety Systems (FSS Code);

- ISM Code 2018 Edition;

- ISPS Code (2021 Edition and Consolidated Amendments);

- IGC Code (2016 Edition and Consolidated Amendments);

- IGF Code, Intact Stability Code 2008;

2 - International Convention for the Pollution Prevention of the Sea from Vessels (MARPOL), in its 2022 edition, resolutions, circulars and all amendments, referring to the annexes mentioned below:

- Annex I - Regulations for the Prevention of Oil Pollution and amendments;
- Annex IV - Regulations for the Prevention of Pollution by Sanitary Sewage and amendments;
- Annex V - Regulations for the Prevention of Pollution by Ship Garbage and amendments;
- Annex VI - Regulations for the Prevention of Air Pollution (MARPOL Protocol of 1997) and amendments;

- NOx Technical Code 2008.

3 - International Convention on Load Lines (ILLC), 1966, in its 2021 edition, resolutions, circulars and all associated amendments;

4 - Convention on the International Regulations for Preventing Collisions at Sea, 1972, and all associated amendments.

5 - International Convention on Tonnage Measurement of Vessels, 1969.

6 - Panama Canal PC/UMS Documentation of Total Volume.

7 - Specific resolutions:

- Resolution MSC.337(91) "Code of noise levels on board ships", 2012, except Sections stipulated in 1.13 (recommendatory and options);
- A.272 (VIII) - Recommendation on Safe Access to and Working in Large Tanks;
- A.330 (IX) - Amendment to the Recommendation on Safe Access to and Working in Large Tanks to include Large Water Ballast Tanks;

- Resolution A.446(XI), as amended by resolution A.497(XII)
- A.343(IX) - Recommendation of Methods of Measuring Noise Levels at Listening Posts;
- A.897 (XI) - REVISED SPECIFICATIONS FOR THE DESIGN, OPERATION AND CONTROL OF CRUDE OIL WASHING SYSTEMS (RESOLUTION A.446 (XI) AS AMENDED BY RESOLUTION A.497(XII))
- A.601(15) - Provision and Display of Maneuvering Information on Board Ships;
- MEPC.288(71) - 2017 Guidelines for ballast water exchange (G6);
  - MEPC.371(80) - AMENDMENTS TO THE 2017 GUIDELINES FOR BALLAST WATER EXCHANGE (G6) (RESOLUTION MEPC.288(71));
- 2017 Guidelines for the implementation of MARPOL ANNEX V
- Code for approval of ballast water management systems (BWMS CODE)
- A-889 (21) - Pilot Transfer Arrangements;
- A.962(23) Sec.5 on the recommendatory "IMO Guidelines on Ship Recycling" as amended by IMO Res. A.980(24). (Only concerned part to the Builder);
- A.1021(26) - Code on Alerts and Indicators, 2009;
- A.708 (17) "Navigation Bridge visibility and functions";
- A.868 (20) "Guidelines for the Control and Management of Ships Ballast Water" (Sequential Ballast Exchange Method);
- MSC/Circ.403 - GUIDELINE ON NAVIGATION VISIBILITY;
- MSC/Circ.913 - GUIDELINES FOR THE APPROVAL OF FIXED WATER-BASED LOCAL APPLICATION FIRE-FIGHTING SYSTEMS FOR USE IN CATEGORY A MACHINERY SPACES;
- MSC/Circ.568 - PILOT TRANSFER ARRANGEMENT AS AMENDED BY IMO MSC Circ.773;
- MSC/Circ. 730 (1996) RECOMMENDATION FOR VENTILATION OR INERTING OF DOUBLE HULL SPACES;
- MSC/Circ.834 - GUIDELINES FOR ENGINE ROOM LAYOUT, DESIGN AND ARRANGEMENT;
- MSC.1-Circ.982 - GUIDELINES ON ERGONOMIC CRITERIA FOR BRIDGE EQUIPMENT AND LAYOUT;
- MSC/Circ.1175 - GUIDANCE ON SHIPBOARD TOWING AND MOORING EQUIPMENT
- MSC/Circ.1053 - EXPLANATORY NOTES TO THE STANDARDS FOR SHIP MANEUVERABILITY;
- MEPC.1/Circ.906 - REVISED GUIDELINES FOR THE REDUCTION OF UNDERWATER RADIATED NOISE FROM SHIPPING TO ADDRESS ADVERSE IMPACTS ON MARINE LIFE.
- MSC.137(76) - STANDARDS FOR SHIP MANEUVERABILITY;
- MSC.192(79) - ADOPTION OF THE REVISED PERFORMANCE STANDARD FOR RADAR EQUIPMENT;
- MSC 978 - PERFORMANCE STANDARDS FOR NAVIGATIONAL EQUIPMENT (1988 EDITION);
  - MSC.494(104) - AMENDMENTS TO THE PERFORMANCE STANDARDS FOR SHIPBORNE VOYAGE DATA RECORDERS (VDRs) (RESOLUTION MSC.333(90));
  - MSC.452(99) - AMENDMENTS TO THE REVISED PERFORMANCE STANDARDS FOR INTEGRATED NAVIGATION SYSTEMS (INS) (RESOLUTION MSC.252(83));
  - MSC.530 (106) - PERFORMANCE STANDARDS FOR ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEMS (ECDIS);
- MEPC 368(79) - AMENDMENTS TO THE 2014 STANDARD SPECIFICATION FOR SHIPBOARD INCINERATORS (RESOLUTION MEPC.244(66));
- MEPC.219(63) - 2012 GUIDELINES FOR THE IMPLEMENTATION OF MARPOL ANNEX V;
- MEPC.300(72) - Code for approval of ballast water management systems (BWMS CODE)
- MEPC.378(80) 2023 GUIDELINES FOR THE CONTROL AND MANAGEMENT OF SHIPS' BIOFOULING TO MINIMIZE THE TRANSFER OF INVASIVE AQUATIC SPECIES
  - (TECHNICAL INFORMATION FOR BIOFOULING MANAGEMENT PLAN ONLY SHALL BE PROVIDED);
- MEPC. 285(70) - AMENDMENTS TO THE REVISED GUIDELINES AND SPECIFICATIONS FOR POLLUTION PREVENTION EQUIPMENT FOR MACHINERY SPACE BILGES OF SHIPS;

- MEPC.127(53) - GUIDELINES FOR BWM AND DEVELOPMENT OF BWM PLANS(G4) AS AMENDED BY RES. MEPC.306(73);
- MEPC.227(64) - GUIDELINES ON IMPLEMENTATION OF EFFLUENT STANDARDS AND PERFORMANCE TESTS FOR SEWAGE TREATMENT PLANTS AS AMENDED BY IMO RES.
- MEPC 108 (49) - REVISED GUIDELINES AND SPECIFICATIONS FOR OIL DISCHARGE MONITORING AND CONTROL SYSTEMS FOR OIL TANKERS, 2003;
- MEPC 107 (49) - REVISED GUIDELINES AND SPECIFICATIONS FOR POLLUTION PREVENTION EQUIPMENT FOR MACHINERY SPACE BILGE OF SHIPS;
- MEPC.325 (75) - INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER AND SEDIMENTS, 2004, Amendments to regulation E-1 and Appendix I (Commissioning testing of ballast water management systems)
- MEPC. 284(70) - AMENDMENTS TO THE 2012 GUIDELINES ON IMPLEMENTATION OF EFFLUENT STANDARDS AND PERFORMANCE TESTS FOR SEWAGE TREATMENT PLANTS
- MEPC.279(70) - 2016 GUIDELINES FOR APPROVAL OF BALLAST WATER MANAGEMENT SYSTEMS (G8);
  - MEPC.370(80) - AMENDMENTS TO THE GUIDELINES FOR BALLAST WATER MANAGEMENT AND DEVELOPMENT OF BALLAST WATER MANAGEMENT PLANS (G4) (RESOLUTION MEPC.127(53), AS AMENDED BY RESOLUTION MEPC.306(73))
- MEPC. 279(80) INVENTORY OF HAZARDOUS MATERIALS (The HMI shall be drawn up by the SELLER)
- MSC.353 - REVISED GUIDELINES FOR INERT GAS SYSTEM.
- MSC. 530(106) - PERFORMANCE STANDARDS FOR ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEMS (ECDIS);
- MSC.215(82) - PERFORMANCE STANDARD FOR PROTECTIVE COATINGS (PSPC) FOR DEDICATED SEAWATER BALLAST TANKS IN ALL TYPES OF SHIPS AND DOUBLE-SIDE SKIN SPACES OF BULK CARRIERS;
- MEPC.1/Circ.906 - Revised Guidelines for the Reduction of Underwater Radiated Noise from Shipping to Address Adverse Impacts on Marine Life;
  - MSC.428(98) Maritime cyber risk management in safety management systems;
  - MSC-FAL.1/Circ.3 - Guidelines on maritime cyber risk management;
  - MSC.1/Circ.1619 Guidelines on the design of mooring arrangements and the selection of appropriate mooring equipment and fittings for safe mooring;
  - MSC.1/Circ.1620 Guidelines for inspection and maintenance of grinding equipment including lines;
  - MEPC.182(59) 2009 GUIDELINES FOR THE SAMPLING OF FUEL OIL FOR DETERMINATION OF COMPLIANCE WITH THE REVISED;
  - MEPC.1-Circ.889 - 2020 Guidelines For On Board Sampling Of Fuel Oil Intended To Be Used Or Carried For Use On board;
  - MEPC.1/Circ.864/Rev.1 2019 Guidelines for on board sampling for the verification of the sulphur content of the fuel oil used on board ships.

**b) Other Conventions and Codes:**

- International Regulations for Preventing Collisions at Sea (COLREG), 1972;
- International Convention on the Control of Anti-fouling Systems on Vessels, 2001
- International Convention for the Control and Management of Vessels' Ballast Water and Sediments, 2004;
- International Convention for the Safe and Environmentally Sound Recycling of Vessels, 2009;

- International Convention on Maritime Search and Rescue (SAR), 2009
- Code on Noise Levels Onboard Ships;
- Maritime Search and Rescue (SAR) 1979;
- Code of Signals.

**c) International Labor Organization (ILO):**

- Maritime Labor Convention - MLC, 2006 ("MLC 2006");
- ILO 152.

**d) International Telecommunications Union (ITU), 1997 (Radio Regulation):**

**e) United States Coast Guard (USCG)**

- Rules and Regulations for Foreign Vessels Operating in the Navigable Waters of the USA.

**f) Rules of the Brazilian Maritime Authority - Directorate of Ports and Coasts:**

- NORMAM 201 - Embarcações Empregadas na Navegação em Mar Aberto (Vessels Used in Open Sea Navigation – document available only in Portuguese);
- NORMAM 401 - Prevenção da Poluição Ambiental causada por Embarcações e Plataformas (Prevention of Environmental Pollution from Vessels and Platforms – document available only in Portuguese);
- Circulars and Ordinances.

**g) International Electrotechnical Commission:**

- IEC TS 60034-25 - Rotating electrical machines - Part 25: AC electrical machines used in power drive systems
- IEC 60076-11 - Power transformers - Part 11: Dry-type transformers
- IEC 60079 - Explosive Atmospheres.
- IEC 60092 - Electrical Installation in Ships;
- IEC 60268-16:2011 - Objective rating of speech intelligibility by speech transmission index
- IEC 60331 - Tests for electric cables under fire conditions
- IEC 60332 - Tests on electric and optical fiber cables under fire conditions
- IEC-60533 - Electrical and electronic installations in ships - Electromagnetic compatibility (EMC) - Ships with a metallic hull
- IEC 60754 - Test on gases evolved during combustion of materials from cables
- IEC 60793 - Optical fibers
- IEC 60794 - Optical fiber cables
- IEC 60865 - Short-circuit currents - Calculation of effects.
- IEC 60909 - Short-circuit currents in three-phase a.c. systems.
- IEC 60945 - Maritime navigation and radiocommunication equipment and systems - general requirements - methods of testing and required test results
- IEC 61000-2-4 - Electromagnetic compatibility (EMC) Part 2-4: Environment - Compatibility levels for low-frequency conducted disturbances. IEC 61023 - Maritime navigation and radiocommunication equipment and systems - Marine speed and distance measuring IEC 61034 - Measurement of smoke density of cables burning under defined conditions
- IEC 61363-1 - Electrical Installations of Ships and Mobile and Fixed offshore Units - Part 1: Procedures for calculating short-circuit currents in three-phase a.c IEC 62040 - Uninterruptible power systems (UPS)
- IEC 62443 - Security for Industrial Automation and Control Systems
- IEC 62485 - Safety requirements for secondary batteries and battery installations.

- IEC 62613 - Plugs, socket-outlets and ship couplers for high-voltage shore connection (HVSC) systems
- IEC/IEEE 80005 - Utility connections in port

**i) Oil Companies International Maritime Forum (OCIMF):**

- Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases, 1st Edition, 2013 (Fixed fittings only for STBL)
- Recommendation for Equipment Employed in the Bow Mooring of Conventional Tankers at Single Point Moorings, 4th Edition, May 2007
- Recommendations for Oil and Chemical Tanker Manifolds and Associated Equipment, 2017;
- Recommendations for ship's fittings for use with tugs
- Effective Mooring, 2019
- Mooring Equipment Guidelines, 4th Edition, 2018 (Compliance with the Guidelines shall be as specified in Group 4 of the Specifications)
- Guidelines for Offshore Tanker Operations, 1st edition - 2018;
- Guidelines and Recommendations for the Safe Mooring of Large Ships at Piers and Sea Islands
- Prevention of Oil Spillages through Cargo Pump Rooms Sea Valves, 2nd Edition, 1991;
- ICS Guide to Helicopter/ship Operations, 2008 (Winching Area for Daylight Operations only, motion
- An Information Paper on Pump Room Safety, 1995;
  - Onshore Power Supply Systems\_Preliminary Design Recommendation 2023;
- International Safety Guide for Oil Tankers and Terminals (ISGOTT 2020);
- Information Paper on Pump Room Safety, September 1993 (Ch. 3 Recommendations for Equipment Fittings - New Ships, refer to Section 310)
- Vessel Inspection Questionnaires for Oil Tankers, Combination Carriers, Shuttle Tankers, Chemical Tankers, and Gas Tankers, latest revision;
- TSCF "Guidance Manual for Tanker Structures - Consolidated Edition 2022";
- "Guidelines for Ballast Tank Coatings Systems and Surface Preparation - 2014 Revised Edition".

**j) International Organization for Standardization (ISO):**

- Standards for shipbuilding, electrical and mechanical installations:
  - ISO 2923:1996 - Acoustics - Measurements of Noise on Board Vessels;
  - ISO 4406:1999 Hydraulic fluid power - Fluids - Method for Coding the Level of Contamination by Solid Particles
  - ISO 4867:1984 - Code for measurement and reporting of shipboard vibration data;
  - ISO 4868:1984 - Code for the Measurement and Reporting of Local Vibration Data of Ship Structures and Equipment
  - ISO 6954:2000 - Mechanical Vibration - Guidelines for the Measurement, Reporting and Evaluation of Vibration with Regard to Habitability on Passenger and Merchant Ships;
  - ISO 7574:2002 (Ventilation and Accommodation Conditioned Air) except for conditions of the design in the Chapter 5 - item 580;
  - ISO 8217:2024 - Specification of Marine Fuels
  - ISO 8468 - Ship's Bridge Layout and Associated Equipment.
  - ISO 8528 Reciprocating internal combustion engine driven alternating current generating sets
  - ISO 8648 - "Guidelines on Navigation Bridge Visibility and Equipment";
  - ISO 8861:1998 - Shipbuilding - Engine-Room Ventilation in Diesel-Engine Ships - Design Requirements and Basis of Calculations;
  - ISO 10816-1:1995 Mechanical Vibration - Evaluation of Machine Vibration by Measurements

- on Non-Rotating Parts - Part 1: General Guidelines;
- ISO 10816-3:2009 / 1:2017 Mechanical Vibration - Evaluation of Machine Vibration by Measurement on Non-Rotating Parts - Part 3: Industrial Machines with Nominal Power above 15 kW and Nominal Speeds Between 120 r/min and 15,000 r/min when Measured in situ;
- ISO 10816-6:1995/Amd 1:2015 Mechanical Vibration - Evaluation of Machine Vibration by Measurement on Non-Rotating Parts - Part 6: Reciprocating Machines with Power Ratings above 100 kW ;
- ISO 12944 - Corrosion Protection of Steel By Protective Paint Collection
- ISO 21984:2018 Ships and Marine Technology - Guidelines for Measurement, Evaluation and Reporting of Vibration with regard to Habitability on Specific Ships;
- ISO 20283-5:2016 - Mechanical vibration: Measurement of vibration on ships

#### **k) Brazilian Association of Technical Standards (ABNT)**

- ABNT NBR 6283 - Cálculo de níveis de iluminação em navios-Procedimento (Calculation of lighting levels on Procedure Vessels – document available only in Portuguese);
- ABNT NBR 9358 - Anodos de Liga de Zinco para Proteção Catódica (Zinc Alloy Anodes for Cathodic Protection – document available only in Portuguese);
- ABNT NBR 10387 - Anodos de Liga de Alumínio para Proteção Catódica (Aluminum Alloy Anodes for Cathodic Protection – document available only in Portuguese).
- ABNT NBR 16680 - Sistemas e revestimentos protetores de invólucros para conjuntos de manobra e controle (Protective enclosure

#### **I) PETROBRAS and TRANSPETRO**

- NI-1710 - Coding of Technical Engineering Documents;
- N-9 - Tratamento de Superfícies de Aço com Jato Abrasivo e Hidrojateamento, e demais Normas da PETROBRAS relativas a tratamento de superfícies e pintura (Treatment of Steel Surfaces with Abrasive Blasting and Hydroblasting, and other PETROBRAS Standards relating to surface treatment and painting – document available only in Portuguese);
- N-13 - Requisitos Técnicos para serviços de Pintura (Technical requirements for painting services – document available only in Portuguese);
- N-0858 - Construção, Montagem e Condicionamento de Instrumentação e Automação (Construction, Assembly and Conditioning of Instrumentation and Automation – document available only in Portuguese);
- N-1192 - Pintura de Embarcações (Painting of Ships – document available only in Portuguese);
- N-1219 - Cores (Colors – document available only in Portuguese);
- N-1503 - Cores para Pintura de Embarcações (Colors for Vessel Painting – document available only in Portuguese);
- NI-2838 - Cathodic Protection for Floating / Fixed Marine Facilities and Subsea Equipment.
- N-2900 - Gerenciamento de Alarmes (Alarm Management – document available only in Portuguese);
- N-2918 - Atmosferas Explosivas - Classificação de Áreas (Explosive Atmospheres - Classification of Areas – document available only in Portuguese);

Regulatory Norms (NR) of the Ministry of Labor, when applicable, with emphasis on:

- NR-17 - Ergonomia (Ergonomics – document available only in Portuguese);
- NR-30 - Segurança e Saúde no Trabalho Aquaviário (Safety and Health in Waterway Work – document available only in Portuguese);
- NR-32 - Segurança e Saúde no Trabalho em Serviços de Saúde (Safety and Health at Work in

- Health Services – document available only in Portuguese);
- NR-34 - Condições e meio ambiente de trabalho na indústria da construção, reparação e desmonte naval (Working conditions and environment in the shipbuilding, repair and dismantling industry – document available only in Portuguese);
  - NR-26 Código de cores (Color code – document available only in Portuguese).

#### **Ergonomics and Human Aspects norms, standards and guides**

- ASTM F1166-21 Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities
- ISO 9241, Ergonomics of human-system interaction (multiple parts)
- ISO 26800:2011, Ergonomics - General approach, principles and concepts

#### **m) Other**

- IACS Unified Interpretations, Requirements, Procedural Requirements and Recommendations;
- Society of Naval Architects and Marine Engineers - SNAME - Code for Sea Trials, 1989;
- The Tanker Structure Co-operative Forum (TSCF) - Guidelines for Ballast Tank Coating Systems and Surface Preparation, 2014;
- INTERTANKO 2021\_Bridge layout Guidelines;
- INTERTANKO Anchoring guidelines, 2019;
- Guidance on Cargo Compressor Room Entry On Board Gas Carriers, 2021;
- IMPA - International Maritime Pilot Association Guide
- ANVISA - RDC 72: Regulamento Técnico que visa à promoção da saúde nos portos de controle sanitário instalados em território nacional, e embarcações que por eles transitem (Technical Regulation aimed at promoting health in sanitary control ports installed in national territory, and vessels passing through them – document available only in Portuguese);
- ANVISA - RDC 216: Regulamento Técnico de Boas Práticas para Serviços de Alimentação (Technical Regulations on Good Practices for Food Services – document available only in Portuguese).
- ANVISA - RDC 217: Vigilância Sanitária de Embarcações, Portos de Controle Sanitário e da Prestação de Serviços de Interesse da Saúde Pública e da Produção e Circulação de Bens (Sanitary Surveillance of Vessels, Sanitary Control Ports and the Provision of Services of Interest to Public Health and the Production and Circulation of Goods – document available only in Portuguese)
- ANVISA - RDC 222/2018: Gerenciamento dos resíduos de serviços de saúde (Health service waste management – document available only in Portuguese)
- DNVGL-RP-B101 - Corrosion Protection of Floating Production and Storage Units
- DNVGL-RP-B401 - Cathodic Protection Design
- Suez Canal Navigation Rules including Tonnage Measurement
- Panama Canal Navigation Rules including Tonnage measurement
- Directive 2012/33/EU of the European Parliament and of the Council of 21 November 2012 amending Council Directive 1999/32/EC ad regards the sulphur content of marine fuels
- California Code of Regulations, title 13, section 2299.2 "Fuel and other operational requirements for ocean-going within California waters and 24 nautical miles of the California baseline."
- Regulation (EU) No 1257/2013 of the European Parliament and of the Council on vessel recycling (EU SRR);
- INMETRO PORTARIA No, 115/2022: Requisitos de Avaliação da Conformidade para Equipamentos Elétricos para Atmosferas Explosivas [ou Portaria mais recente emitida em substituição a essa] (Conformity Assessment Requirements for Electrical Equipment for Explosive Atmospheres [or most recent Ordinance issued to replace it] – document available only in Portuguese)
- Anatel Resolution 570 - Regulamento para Certificação e Homologação de Acumuladores

Chumbo-Ácido Estacionários Regulados por Válvula (Regulation for the Certification and Homologation of Valve Regulated Stationary Lead Acid Accumulators – document available only in Portuguese)

- ANSI/ISA 12.27.01 - Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids
- API RP 501 - Process Measurement
- NFPA 85 - Boiler and Combustion Systems Hazards Code - 2004 Edition.
- UL 1581 - Reference Standard for Electrical Wires, Cables, and Flexible Cords
- CENELEC CLC/TR 50427 - Assessment of inadvertent ignition of flammable atmospheres by radio-frequency radiation - Guide
- ANATEL - All applicable resolutions
- NATIONAL RESOLUTION GM/MS No. 888 - Procedimentos de controle e de vigilância da qualidade da água para consumo humano e seu padrão de potabilidade (Procedures for controlling and monitoring the quality of water for human consumption and its standard of potability – document available only in Portuguese)

\*all applicable rules cited by the rules defined above shall also be met in the project.

## I Drawings, instruction manuals, etc.

The builder shall prepare a list of certificates, to be supplied when the vessel is delivered, and submit it to the BUYER's representatives for verification. G Certificates contains a minimum, non-exhaustive list of certificates. One (1) original and two (2) hard copies shall be provided, as well as a scanned document in Databook format containing all the certificates. This Databook shall be submitted in the same way as the project documents.

The list of certificates shall include all the vessel's trading certificates, certificates for all the equipment and systems installed on board, calibration certificates for measuring instruments, overhaul/maintenance certificates for lifesaving and fire-fighting equipment, among others.

Certificates may be a Product Certificate or a Type Approval Certificate, in accordance with regulatory provisions.

For all the equipment, systems, components and materials used and supplied during the construction of the vessel, the "MD - Material Datasheet" and "SDoC - Suppliers Declaration of Compliance" forms shall be supplied along with their certificates, in accordance with the International Convention for the Safe and Environmentally Sound Recycling of Vessels, 2009 (The Hong Kong International Ship Recycling Convention, 2009).

All the Vessel's documents shall be delivered by the SELLER to the BUYER until delivery of the Vessel.

In the event that it is not possible for the SELLER to obtain any definitive trading certificates by the date of delivery of the Vessel, the corresponding provisional certificates will be provided on a temporary basis. In this case, the SELLER will be responsible for providing all the means and resources to obtain the corresponding definitive certificates and deliver them to the BUYER before the end of the Vessel Guarantee period. The same applies to the other certificates expected to be delivered.

The SELLER shall prepare an inventory of environmentally harmful materials on the vessel, indicating the quantities, location, handling and disposal of each type of material, in accordance with IMO MEPC recommendations. 279(80) INVENTORY OF HAZARDOUS MATERIALS (Ref: The "Green Passport" for Vessels), allowing the BUYER to supplement it with the harmful materials placed on board when the vessel is in service. The inventory of harmful materials shall be approved by the Classification Society.

The SELLER shall issue, as a vessel's document, a list of instruments, which shall contain instrument identification (tag), location, service or line, diagram, manufacturer, set/alarm point, model/certificate, date of last calibration.

## Delivery Plans and Manuals

The vessel's collection of "Plans and Manuals" shall be ready and approved no later than 30 (thirty) days before the vessel's scheduled delivery date and shall be delivered as follows:

2 (two) paper copy collections of the original construction plans and final manuals, organized in boxes with individual indexes, divided by discipline, with 1 (one) collection stored on a shelf in the vessel's office and 1 (one) collection stored on board, in a Locker to be defined.

3 (three) electronic collections of construction plans and final manuals, saved on a portable storage drive, the directory structure of which will be defined in advance and informed to the SELLER.

All manuals and procedures required by the Classification Rules and International Conventions/Codes shall be prepared and submitted for approval by the SELLER, even those that contain the BUYER's operational particularities. The statutory manuals and procedures shall be developed in bilingual format (Portuguese/ English), using the BUYER 's standard form (N-0381), which will be provided when requested by the SELLER.

All final/ delivery plans, documents and manuals shall also be delivered to the FTPS area in the same way as the design documents.

The documents delivered electronically shall be in searchable "PDF" format, except for the Fire Control and Lifesaving Plan, General Arrangement, Compartment Arrangements and Piping Diagrams, which shall be delivered in open "PDF" and "DWG" formats, compatible with the AUTOCAD ® program.

Copies of the software used by all equipment/systems installed on board the vessels that contain any PLCs, controllers or computers shall be provided and delivered, subject to an NDA (non-disclosure agreement), if necessary. Software for installing the applications on the controllers and computers shall also be supplied, as well as special tools and communication cables for downloading and uploading these applications.

The final construction plans and manuals shall incorporate all the design changes made during the construction of the vessel ("as built") and, where applicable, be the versions approved by the Classification Society.

Even if there has been no change to the plan approved for the series, a specific document set shall be submitted for each vessel, with its own coding by the delivery date

## Plans for Brazilian Authorities

The SELLER shall submit the bilingual plans required to obtain the Construction License in order to meet the deadlines required by the authorities.

All statutory documents in accordance with the Rules, Conventions, Codes and Regulations shall be issued in "bilingual" format.

The SELLER shall provide the BUYER, no later than 120 (one hundred and twenty) days before the delivery of each vessel, with the (bilingual) documents, for which the SELLER is responsible for, necessary for registering the vessel with the Maritime Authority.

The SELLER shall provide the BUYER, no later than 200 (two hundred) days before the delivery of each vessel, with the documents for which the SELLER is responsible for and which are necessary to obtain the Ship's Station License - LEN (GMDSS) for the vessel.

## Pictures/Posters, framed Plans and Nameplates/Signboards

The framed plans and documents required by the Rules shall be made of material that does not age due to exposure to light and shall be written in Portuguese and English. Whiteboards, for annotations with no permanent marker type pens, will be provided and fixed in the following places:

- Draft, trim and list records: on the navigation bridge;
- General notes: on the navigation bridge and in the vessel's office.

Notice boards, measuring 800 x 400mm, made of lined chipboard , with an aluminum frame, lockable, will be provided and fixed in the following locations:

- Officers' and Petty Officers' lounge;
- Ordinary crew lounge;
- Main deck corridors, PS and SB, next to the entrances to the accommodation.

One (1) notice board will be provided for the vessel's maneuvers, for use next to the accommodation ladder.

Two (2) notice boards will be provided, for use in the area of accommodation ladders, both sides,, with the following words "PROIBIDO FUMAR - NO SMOKING".

Two (2) notice boards will be provided, for use on the stern guardrails, at PS and SB, with the words " AFASTE-SE DO HÉLICE - KEEP CLEAR OF THE PROPELLER".

Two (2) notice boards will be provided for use on the fore bulwark and guardrails, at PS and SB, with the words "PROA BULBOSA - BULBOUS BOW".

One (1) notice board for Crew Shifting will be placed on Ship's Office deck.

Instruction boards, to be supplied by the BUYER, shall be framed and fixed by the SELLER on board, as defined below:

- Instructions regarding life jackets: in all corridors of the Accommodation decks, in the dining rooms and in the Ship's Office;
- Fire-fighting instructions: in all the corridors of the Accommodation decks, in the Engine Room and in the Messroom;
- Shaller List: in the Navigation Bridge, Messroom, ECR, CCR;
- Instructions on artificial breathing: Navigation Bridge, ECR, Infirmary/hospital;
- First aid instructions: Navigation Bridge and in the infirmary.
- Sea conditions board: on the Navigation Bridge;
- Box on cloud conditions: on the Navigation Bridge;
- RIPEAM board: at the Navigation Bridge;
- Whistle table: at the Navigation Bridge;
- Plate with the vessel's Call Sign (next to the GMDSS station);

One (1) ASTM A-316L stainless steel plate with at least the following information shall be fitted and fixed to each wing of the Navigation Bridge:

- Distance from Navigation Bridge to Bow;
- Distance from the Navigation Bridge to the stern;
- Distance from the Navigation Bridge to the cargo manifold;
- Distance from the Bow to the center of the Cargo Manifold;
- Distance from the Stern to the center of the Cargo Manifold;
- Height of the Navigation Bridge in relation to the baseline;
- Height of the Navigation Bridge in relation to the Normal Ballast Draught;
- Height of the Navigation Bridge in relation to the Summer draught;
- Height of Navigation Bridge in relation to full load draught;
- Height from Top of Masthead Light to Base Line;
- Height from Top of Masthead Light to Lightest ballast Draught.

On each of the side bulkheads of the Navigation Bridge, a fiberglass signboard with the vessel's name shall be provided and installed, protected and reinforced against strong winds, and clearly visible from below. The sign shall be illuminated by LED floodlights on the Navigation Bridge deck.

Two (2) stainless steel plates with the vessel's call sign engraved in black letters shall be provided and fixed on Navigation Bridge and the captain's office, next to the external communication equipment. All external signboards shall be made of ASTM A-316L stainless steel.

Machinery, equipment and accessories shall be fitted with nameplates made of ASTM A-316-L stainless steel, fixed by screws also made of the same stainless steel, with engraved characters and painted black.

Tank manholes in the Engine Room, except for those located on the double-bottom top tank, and

external fan and exhaust fan trunks, shall be fitted with nameplates made of ASTM A-316L stainless steel, fixed by screws also made of the same stainless steel, with characters engraved and painted in black, identifying the tank (name and number) and the equipment, respectively, in accordance with the final plans. The tank name shall reflect the Capacity Plan

The tank manholes located on double bottom tanks in the Engine Room, the hatches and manholes located on the exposed deck, the access holes and covers / coamings of the cargo and ballast tanks, the manholes of the chain locker mud box, the miscellaneous hatches and covers of the openings for cargo tank degassing exhausts shall be identified by means of weld seam and painted characters, going around the edge of the letter or number to be represented, indicating the name or number of the tank, in accordance with the final plans.

## J Materials

All steel and aluminium materials (if applicable) used to build this vessel shall be of marine standard with a certificate from the Classification Society. Exemptions shall be approved by the Classification Society, ref. [201 Hull materials](#).

All cast parts shall be without blisters of significance and without cracks or other defects. These parts shall not, under any circumstance, be repaired by plugging or similar without the Owner's approval.

All wooden materials shall be dry and of good quality.

Neither asbestos nor asbestos containing materials shall be used in the construction of the vessel.

Wherever galvanizing is mentioned, hot dip galvanizing is meant.

Wherever stainless steel is mentioned, AISI 316 L or similar shall be used.

Wherever Acid Resistant Steel (ARS) is mentioned, AISI 316 L or similar shall be used for welded parts, and AISI 316 L or similar for non-welded parts (like bolts etc.).

Type, size and material of equipment, machinery and fittings shall be in accordance with European Standard (EN) and/or Deutsches Institute für Normung (DIN), Norwegian Standard (NS), Yard standards and makers' standards.

## K Building method and workmanship

### Workmanship

All workmanship shall be carried out according to approved drawings and Yard practice.

All the installation instructions and recommendations from equipment and material makers shall be followed thoroughly.

### Building procedures & standards

The following procedures and workmanship standards shall be presented to the Owner for approval before the construction starts:

- Hull Ship building Process and Construction Standard (IACS REC 47 Shipbuilding and Repair Quality Standard).
- Ship Machinery Installation Standard
- Electrical Equipment and Cables Installation Standard
- Piping Practice
- Surface Preparation and Painting Standard
- Standard Procedure for Pipe Systems Cleaning

- List of Inspections and Tests for the Owner and Classification society
- Workmanship standards for all pipes, ref. 7 System for Main Engine Components and 8 Ship Common.

### **Storage, handling and protection of equipment**

The Yard shall provide proper and safe storage areas (clean, tidy, dry and against theft and physical damage) and ensure proper protection of all equipment at all times as per Makers' instructions. Electronic equipment shall be stored in an air conditioned space.

Handling/transport of all equipment shall be strictly according to the Makers' instructions.

Any damage to stored or installed equipment shall be reported to the Owner immediately.

Special care shall be taken to ensure proper protection of electric and electronic components and equipment during storage and throughout construction in order to ensure that no dust or humidity will damage or reduce lifetime of this equipment.

Records of stored and arrived equipment at the Yard's warehouse shall be reported to the Owner as per agreement.

### **Inconsistencies**

Throughout the construction period the Owner shall issue Correction Requests to the Yard whenever the Owner has detected inconsistencies between the Contract/ the Specification and vessel under construction. The Yard will precede the correction by the procedure agreed between the Owner and the Yard.

## **L Purchase routines**

The makers' list shall be a separate document and be part of the Building Contract documentation.

All substantial sub-contractors shall be approved by the Owner.

The equipment manufacturers shall be field proven (with recognized quality standards in the shipbuilding market) and defined as per some selection criteria:

- The equipment, components and their auxiliary accessories purchased shall be from the manufacturer's latest version, with characteristics equal to or greater than those specified. Equipment or components announced by the manufacturer expected to be phased out within next 10 (ten) years, considered to be at a mature stage in their life cycle by the manufacturer or in the "proof of concept" phase will not be accepted.
- The equipment shall be ordered, supplied and painted in accordance with Standard N-1503 (Colors for painting boats)
- The technical proposals ("PT's") for the equipment listed in Preliminary Document List LD-4800.00-9311-000-PTD-001, shall be forwarded to the OWNER for approval prior to the placement of orders for such equipment by the YARD with the respective manufacturers. The "PT's" shall consist of the technical specification and data sheets of the equipment and accessories, scope of supply, general arrangement with required maintenance area, installation manual, preservation procedures, clear indication of the model, list of deliverable documents, list of spare parts, required certification and list of deviations, as well as their respective delivery/ lead time.

If the equipment listed in this specification and the corresponding makers list is not relevant at the time of purchase because:

1. The equipment is not longer in production
2. The equipment is replaced by a newer generation

3. Equipment from another manufacturer is better suited for the purpose,  
the Yard shall propose another equipment maker with equal or better quality to the Owner for approval.

## M Owner Furnished Equipment

The following equipment shall be delivered by the Owner:

- Galley and Mess utensils
- Blankets and linen
- Books, charts
- Flags (including signal flags)
- Consumables (except for sea trials)
- Spare parts and other equipment above classification society requirements
- Gas welding and cutting equipment including hoses and bottles, ref. [441 Machine tools, cutting and welding equipment](#)
- Loose mooring equipment, ref. [436 Loose mooring equipment](#)
- Hand tools
- Personal protection equipment other than required by the Classification Society and National Authorities.
- Portable oxygen analyzer and gas meter;
- Portable level indicator/interface ("UTI") for cargo tanks;
- Portable gas detector and sampling tubes for vapors and gases;
- Subscription for electronic chart, exceeding 1 year, ref. [412 Satellite navigator](#)
- Medicines other than those in life boats and life rafts
- Decorations, ref. [545 Decorations](#)
- Scientific equipment if not specifically mentioned in this specification
- ...

Additionally the following systems shall be delivered by the Owner for the Yard to install and connect/ interface as stated below and according to Local Area Network solution ref. [855 Common computer systems](#).

- Spare part/ maintenance system, ref. [109 Maintenance systems, instruction material](#)
- Equipment for ISPS Gangway Control system, ref. [564 Pilot ladder, accommodation ladder, gangway and 88 Cable installation and cable support](#)
- Entertainment system (audiovisual equipment etc.), ref. [564 Pilot ladder, accommodation ladder, gangway](#)
- Equipment for VSAT installation, antenna, VSAT rack with content.
- WiFi system
- Mobile systems
- DECT system
- Telephone system
- Electronic master key locking system, ref. [512 Internal Doors](#)
- Servers and LAN system, ref. [855 Common computer systems](#)

For assistance with Owner Furnished Equipment, ref. [126 Assistance with owner's supply](#).

All other equipment necessary and according to normal ship building standard, unless expressively listed above, shall be delivered by the Yard.

## N Trim and stability

Minimum metacentre heights (GM) for fully equipped and loaded ship shall satisfy the requirements of the National Authorities. The same applies for the ship's GZ-curves for characteristic loading conditions.

The vessel will be designed so that during the voyage there is no need to move cargo or ballast for draught adjustments.

In the arrival conditions, the vessel should be approximately even keel (stern trim of no more than 30 cm). Under departure conditions, the vessel may have a stern trim of up to 1,5% of the length between perpendiculars.

A preliminary trim, stability and longitudinal strength calculation shall be submitted to the Owner for information.

After the inclination test (ref. [152 Tank capacity, inclination experiment, vibration measurements](#)) final stability calculations shall be submitted to:

- the National Authorities for approval
- the Owner for review

As soon as possible after the completion of the vessel the following final documentation shall be submitted to the Owner:

- Approved trim and stability booklet
- Damage control plans and booklets

The Trim and Intact Stability and Damage Manual will be prepared with required information to calculate the vessel's draft, stability and longitudinal forces (bending moments and shear forces), covering at least the following basic conditions:

- Light vessel\*;
  - Docking condition, with 10% consumables and ballast so that the vessel is trim-free\*;
  - Stern tube emersion (up to ship's allowable structure strength limit) \*;
  - IMO/MARPOL ballast condition;
  - Structural testing of cargo tanks (hydrostatic/chess test) \*;
- \*(For these conditions above it will not be necessary to meet the requirements of the stability criteria for this type of vessel set out in the 2008 IS Code)
- Design condition (full load), summer draft and product with a specific weight of 0,85 t/m3.
  - Normal and heavy ballast;
  - Full load for products with specific weights of 0,688/ 0,70/ 0,865 and 0,88 t/m3;
  - Cargo tanks cleaning condition (100% ballast in ballast tanks and collision tanks, and 50% ballast in port and starboard slop tanks);
  - Partial load condition with 1 (one) full segregation (for each segregation), considering all products;
  - Part load condition from 1 (one) full segregation to 4 (four) full segregations, considering all combinations between products;
  - Damage stability.

For ballast and cargo conditions, the calculation shall be made with 100% and 50% consumables on departure and 10% of consumables, equivalent to three days of fuel oil reserve in the storage tanks.

For each of the loading conditions listed above, an Addendum to the Trim and Stability Manual shall be prepared and approved, including alcohol based alternative fuels, with the following considerations:

- Volume of alcohol based fuel in the respective tanks equivalent to 50% of the total range;
- Volume of alcohol based fuel in the respective tanks equivalent to 100% of total range.

In addition to the Trim and Stability Manual, an optimum Trim table shall be prepared, approved and supplied for each loading condition between ballast and fully loaded, considering different speed ranges (between minimum and maximum operational speeds), aiming to obtain the lowest fuel oil consumption.

An optimal Trim Table to be included in the Final Stability Booklet.

The SELLER shall check and confirm that the vessel's movements/ seakeeping comply with the requirements of ISO Standard 2631 (Parts 1 and 3), for 30 min, 2h and 8h exposures, by analyzing the "RAO - Response Amplitude Operator". If necessary, the SELLER shall include in the project an active or passive system, with a control panel on the Navigation Bridge and CCR, which guarantees the range of movements within the limits defined by the aforementioned Standard.

The seakeeping criteria (slamming and green water load) shall meet the requirements defined by the classification societies. The studies carried out to define the parameters of these events shall be submitted as project documents.

Calculations of the stability during launching shall be provided.

#### **Weight control**

The Yard shall maintain Lightship weight and Centre of Gravity (CoG) control and report regularly to the Owner and Designer. Weight reports shall include weight listing sorted on SFI standard and compared to the initial weight budget.

Weight monitoring of the vessel should be performed at milestones:

1. At date when numerical cutting information is available
2. At launching. Including buoyancy measurement
3. Before delivery. Final inclining experiment

## **O Vibration and Noise Control**

### **General**

Special attention shall be paid in the design and construction to limit the vibration and noise levels within the ship to those generally accepted, and which will not result in discomfort or annoyance to the crew, ensure safe and good comfort, if relevant, to passengers, and not cause damage to the main propulsion system nor cause damage or malfunction of other shipboard machinery and equipment.

### **Vibration and Noise Limits**

On vibration, reference is made to the International Standard ISO 20283-5:2016 "Mechanical vibration -- Measurement of vibration on ships -- Part 5: Guidelines for measurement, evaluation and reporting of vibration with regard to habitability. and to the Classification Society notation listed in F Classification and Flag, in O General, in LEVEL 0 SFI Master.

On noise, reference is made to resolution MSC.337(91): "Code on noise levels on board ships". This resolution shall be met in its entirety as a part of SOLAS. Additionally specific noise limits required by the comfort notation shall be met, ref. F Classification and Flag, in O General, in LEVEL 0 SFI Master.

### **Vibration and Noise analysis**

In order to demonstrate that the specified limits to noise and vibration will be met, noise and vibration analyses shall be carried out at the project stage (consultancy services, hired by the Designer, ref. 101 Contract/specification work, general design, model testing). The analyses will be used as a basis for the construction drawings and should at least include:

- Vibration analysis of local structures (decks and bulkheads in order to avoid magnification of vibration due to resonance with main excitation sources).
- Analysis of the expected noise levels to determine the necessary noise control measures to meet the specified noise limits.

The results of the analyses shall be documented and presented at the design stage. Based upon this analysis the actual extent and quality of the floating accommodation arrangement may be adjusted, as agreed between the Owner and the Yard in order to achieve the required standards. Further, the recommended structural and arrangement modifications shall be incorporated into the design, as agreed between the Owner and the Yard as required to meet the specified vibration and noise criteria. These will in general include:

- Floating accommodation system on accommodation decks according to recommendation from the noise analysis.
- The ECR shall have a resiliently mounted raised flooring system.
- Air intake ducts, exhaust casing and air condition room, as well as room for emergency generator, shall be well sound insulated towards the accommodation.
- Resiliently mounted air intake fans
- Resiliently mounted main engines and (main) generators
- Exhaust system shall be resiliently mounted to stiff parts of the structure.
- The windows shall be double insulated with inner frames where required by the report.

### **Special considerations**

The analyses shall be extended to include analysis of the main excitation sources (propeller and main engine) and vibration analysis of the hull and sub-structures.

Vibration and noise to consider the Guidelines for the Reduction of Underwater Radiated Noise (URN)

### **Verification measurements**

Noise and Vibration evaluations shall comply with the standards below:

ISO 2923:1996 - Acoustics - Measurements of Noise on Board Vessels;

ISO 4867:1984 - Code for measurement and reporting of shipboard vibration data;

ISO 4868:1984 - Code for the Measurement and Reporting of Local Vibration Data of Ship Structures and Equipment

ISO 10816-1:1995 Mechanical Vibration - Evaluation of Machine Vibration by Measurements on Non-Rotating Parts - Part 1: General Guidelines;

ISO 10816-3:2009/ 1:2017 Mechanical Vibration - Evaluation of Machine Vibration by Measurement on Non-Rotating Parts - Part 3: Industrial Machines with Nominal Power above 15 kW and Nominal Speeds Between 120 r/min and 15,000 r/min when Measured in situ;

ISO 10816-6:1995/Amd 1:2015 Mechanical Vibration - Evaluation of Machine Vibration by Measurement on Non-Rotating Parts - Part 6: Reciprocating Machines with Power Ratings above 100 kW ;

ISO 21984:2018 Ships and Marine Technology - Guidelines for Measurement, Evaluation and Reporting of Vibration with regard to Habitability on Specific Ships;

And note, the evaluation of low-frequency ship motion which can result in motion sickness is covered by ISO 2631-1. For the evaluation of the global structural vibration of a ship, however, see ISO 20283-2.

If the vibration or noise levels exceed the requirements given in the specification, corrective measures shall be carried out by the Yard.

## P Surveyor

The Owner's representatives to be allowed to inspect the vessel, part of it and machinery at the yard at any time in the construction period.

At the request of Owner's representative the yard to arrange inspection at subcontractors premises. Inspector to have suitable office facilities at the yard and to be provided access to and assistance with telephone and pc with mail and scanner etc. in order to communicate with Owner.

Yard to assist in providing good accommodation, flats, bungalows or equivalent for inspectors and officers.

The Owner and his authorised representatives have the right to inspect the vessel, its machinery, outfit and equipment during construction. The Builder shall grant free access to the Owners representatives to the yard, the vessel and workshops for such purposes during working hours. The Builder will also obtain as far as possible access for the Owners representatives to subcontractors premises. All inspection will be carried out at the Owners own risk.

Costs involved with regard to Owners representatives inspection and stay at yard to be at the Owners expense. Cost involved with regard to owners representatives inspection of main machinery equipment at subcontractors to be at the Owners expense.

Inspector to receive copies of technical correspondence, minutes of meetings, technical matters etc. between builders and Owner. Inspector to receive items of inspections for approval. A schedule shall be provided showing major events and milestones, including test and trials. Events to be mutually agreed upon to avoid conflicts in time.

Written information of inspections and tests/trials to be submitted 24 hours beforehand.

If the inspections are to be carried out on facilities outside of the contracted yard area, yard shall give notice in reasonable time beforehand.

The Owners representatives shall observe the working rules prevailing at the Builders and subcontractors premises.

The Owner will advise the Builder as soon as possible of the inspections, tests or trials they wish to attend.

In case that the Owner's Representatives cannot attend the inspection and test due to their own cause, they are to be entrusted to the surveyors representing the Classification Society and/or authority and/or the Builder's inspector, then the result of which to be accepted by the Owner subject to a written report verifying the test results.

Where the Owners representatives discover any non compliance with the contract or specification, he shall give the Builder notice thereof in writing not later than 72 hours from discovery.

On receipt of such notice the Builder shall correct such non conformity.

In performing the supervision, the Owners representative shall ensure that the work is in accordance with the contractual documents, but without the right to stop, divert or delay the program of work in case of alleged conflicts.

The Owners representatives shall address their comments, remarks and recommendations in writing, exclusively to the Builders designated representative(s).

## **Q Delivery**

The vessel to be delivered to the Owner completely seaworthy including lubrication oil and hydraulic oil in systems ready for taking on board fuel, provisions, crew and cargo.

The entire ship to be properly cleared and cleaned, and all paint work finished to the satisfaction of the owner.

All flushing oils to be on yards account.

When the vessel has been completed, passed all tests, all the outstanding items from owner site have been solved, and has been certified as prescribed in this specification.

Documentation shall be delivered with no impeditive pending items (Design, Manuals, Class Certificates and Competent Bodies, etc).

The vessel shall be drydocked at the following stages of construction 144 Dry docking, slip docking:

- Before the Official Sea Trial;
- Before delivery.

## **R Routine by alterations**

The work to be carried out in conformity with good customary standards applied at the yard.

The yard, however, shall accede to the Owner's request with regard to materials or execution, providing that such demands are within the terms laid down in the contract and are conveyed in writing in reasonable time before the yard place their order or carry out the work.

Correction work due to non-conformity to specification/plans or to requirements of the classification society and regulatory bodies shall be carried out by the builder at prior to delivery of the vessel, unless otherwise is agreed with the owner.

The Owner may demand in writing the carrying out of minor alterations or additions over and above what is laid down in the specification.

Other work of this kind shall be carried out only after a special written agreement or according to the demands of the Owner as a result of amendments to the rules of Class or authorities.

Should the valid rules of Class or Authorities be modified after the contract has become effective, subsequent work shall be carried out in accordance with the new rules, if the owner demands that these should be followed. The yard shall to the best of their ability inform the owner of any modifications in the rules of the Class and Authorities which affect the building of the vessel, and of the consequences, financial and technical due thereto.

The yard may alter constructional details, materials, or type of equipment described in this specification, if they cannot be obtained or be technically applied, provided that in all cases these alterations are approved by the Owner, as per the Technical consultation's submission flow, and that the changes will not impair the overall efficiency of the vessel or the efficiency of the equipment. Lists of extra and credit costs are to be kept by the yard and to be agreed upon with Owner continuously during the building period.

For work of above mentioned kind, an additional charge or deduction shall be calculated according to the ordinary rates of the yard, unless otherwise agreed in writing before the work is carried out. Any alterations or additional work to be submitted in due time before design work is completed.

The agreed time of delivery shall be prolonged with such period of time as is required for the preparation and execution of such work or alteration or addition, provided delivery time is affected.

Amendments and changes to be recorded in a memorandum or a written document signed by the Owner and the Builder, and these documents will become a supplement to the Contract Specification.

The buyer to be provided with copies of all correspondence with the classification society and national authorities.

## 1 SHIP GENERAL

### 10 Specification, estimating, drawing, instruction, courses

#### Documentation

The Yard shall be in charge of the as built documentation and as built drawings according to the agreed list, the documentation shall be delivered to the Owner electronically and 2(two) paper copy collections at delivery of the vessel.

Documents to be of searchable format.

#### Vessel's Operating Manual

The Yard shall prepare and supply the vessel's operating manual, containing a functional description of the equipment and systems, design assumptions and expected operating modes, divided into sections on machinery, navigation, operation (loading, unloading, tank cleaning, inerting, etc.), deck equipment, etc., taking into account the design and technical particularities of each system and equipment for correct operation. The manual shall reference the suppliers' documents and other related design documents.

The manual shall be prepared based on the approved design documentation.

In addition to the Operating Manual mentioned in the previous paragraph, a manual/list with all the operating parameters of each equipment or system, containing the acceptable and safety limits ("set points"), shall be supplied.

All components of the manual shall be identified in accordance with the project, using unique identification (e.g. tags). Operational manual valves shall have a unique tag for identification.

### 101 Contract/specification work, general design, model testing

The Yard shall deliver all analysis and studies required by the Classification Society and National Authorities. For details, ref. Contractual Document List.

#### Special studies / manuals

Table 1.1 Special studies / manuals

Study	Comments
Hydrodynamic model testing	Model test facility
EEDI calculation / SEEMP	Designer
EMC study	Yard
Heat balance of accommodation HVAC design	HVAC supplier
Noise level prediction (ref. <a href="#">O Vibration and Noise Control</a> )	Consultant (BV), for internal use by the Designer
Vibration study (ref. <a href="#">O Vibration and Noise Control</a> )	Consultant (BV), for internal use by the Designer
Alternative Design review (if DF Methanol)	Class /Flag/Yard/Designer

The results of the analysis studies shall be presented to the Owner on request.

#### CFD Calculations

The Designer shall perform CFD aided calculations in order to optimize the vessels speed and performance as stated in [D Performance](#).

## Model Tests

The Designer shall arrange a model test program at a reputable model test facility, internationally recognized (ITTC) with a minimum ISO 9001 certification, in order to verify the vessels performance. The tests shall be in accordance with IMO EEDI requirements.

The tests shall include:

- Towing Test / two draughts (Summer Draught & Ballast Draught)
- Propulsion Test / stock propeller / two draughts
- Wake Test / two draughts (Summer Draught & Ballast Draught)
- Cavitation Test / two draughts (Summer Draught & Ballast Draught)
- Manoeuvring tests according to Resolution A.601(15)/Appendix 3

In addition, the following documents/data shall be provided:

- A model test report

The Owner is allowed to observe the tests. Eventual modifications of the hull lines after the model test shall be verified by CFD aided calculations.

Eventual modifications of the hull should be approved by Owners to decided if it's necessary or not to run a new model test.

The model test shall be witnessed by the Class Society

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## Maintenance systems, instruction material

### Equipment information/component list

Equipment information/component list for the Owner's maintenance system shall be delivered from the Yard to the Owner.

1. Preliminary information no later than latest one (1) month before the vessel's launching.
2. Final information no later than one (1) month before sea trial.

The equipment list shall contain a brief description of all equipment as follows:

- - System Name:
- Short name of the device (25 characters):
- Full name of the equipment:
- Equipment model:
- Equipment Serial Number:
- Equipment dimensions and weight:
- Technical data (plate information) of the equipment:
- Equipment manufacturer and address:
- Observations (location on board, etc.)
- All parts delivered with the different components, standard spare parts, etc.
- All additional parts ordered by the Owner until two (2) months before delivery, shall be listed.
- Other relevant information for effective maintenance, ref. I Drawings, instruction manuals, etc.

A spreadsheet template shall be provided by the Owner and populated by the Yard in order to ease the conversion of data into the maintenance system. The spreadsheet shall be aligned with the equipment list described above.

- Manufacturers' recommendations contained in manuals, drawings, diagrams, arrangements, project guides and data books relating to their respective equipment shall be followed by the

OWNER, and it is the OWNER's sole and exclusive responsibility to develop, design, approve and execute the vessel's project, incorporating all the requirements and recommendations of the equipment's manufacturers from the design phase onwards, at no additional cost to the YARD.

- The equipment manufacturers' documents, such as maintenance and operating manuals, shall be sent to the OWNER in searchable electronic format as soon as possible before the installation of the respective equipment on board and at the latest by the date of submission for approval of the commissioning and testing procedures. The equipment and systems manuals shall be complete and comprise all relevant parts such as Storage and Handling, Installation, Operation, Maintenance, Spare Parts List, Complete Part List, Data Sheet (accessories and instrumentation), Factory Test Report and Certificates. Supplier manuals shall clearly indicate the items in the scope of supply, including models, type, parts and components.

#### **Instruction material**

The Yard shall ensure that the ship's crew has the necessary instructions/ manuals on board for using the fitted equipment.

The Yard shall deliver three (3) copies of instruction manuals in English for all installed machinery and equipment. Instruction manuals shall be delivered electronically in a common readable format (e.g. PDF).

## **11 Insurance, fees, certificates, representation**

### **111 General insurance**

Ref. Contract.

### **112 Classification, statutory fees and certificates**

All fees to the Classification Society and National Authorities shall be paid by the Yard.

Any fees to external parties applicable to the construction of the vessel shall be the responsibility of the Yard.

A copy of all documentation and technical consultations exchanged between the YARD and the Classification Society shall be sent to the OWNER for information and filing, by electronic means (scanned), receiving the same treatment as other documents.

### **118 Launching & delivery representation**

Ref. Contract.

## **12 Quality assurance, general work, models**

### **121 Quality assurance, planning, work preparation**

The Vessel shall be built in accordance with a quality-plan provided by the Yard and approved by the Owner.

The Yard shall provide a detailed Progress-plan with milestones for the production and outfitting of the Vessel within 30 calendar days after signing the Building Contract. A monthly progress report shall be forwarded by the Yard.

Minutes of Meetings (MoM) shall be taken by the Yard at all important meetings between all parties. For efficient monitoring of the project, decisions, technical issues, progress and cost relevant

decisions shall be included in the MoM. Agreements and decisions mutually decided upon between formal meetings shall be included in the MoM's where it is deemed relevant from either the Yard or the Owner.

The MoM's shall be signed by both parties and shall be formally binding documents.

The vessel's design shall be developed using industry practices and tools that are already consolidated and recognized, so as to allow the design to be drawn up in a 3D model and built in accordance with detailed design method/ strategy, making it possible to predict, visualize and correct possible errors, interferences, spaces for movement, impacts, simulate the sequence of construction of the blocks, etc., as well as issuing complete parts lists by blocks or units to be defined by the shipyard according to their construction, handling and transport capacity. A block in advanced outfitting is understood to consist of the steel structure, equipment, foundations, piping and accessories, whenever applicable. At the end, an unprotected and editable electronic copy of the project shall be delivered to the OWNER by the YARD. The 3D model (and its attributes) shall be prepared in accordance with I-ET-4800.00-9311-000-PTD-017 (Digital Engineering Requirements) and its annexes.

## **122 Work management, fire guard, supervision, watch keeping**

A comprehensive and effective system of fire detection, fire protection and fire fighting shall be organized and maintained while the Vessel is under construction and outfitting. Shore water supply for fire fighting shall be provided at all times while the Vessel is in the Shipyard.

Suitable fire resistant covers shall be used to protect intricate and vulnerable items of machinery and equipment from falling sparks or other potential sources of fire.

A fire watch shall be maintained continuously during welding operations. Insulation material shall be removed within approx. 1 m of the welding.

Special restrictions against smoking shall be enforced when danger of fire or explosion exists, as well as during fuelling or handling of volatile and flammable materials.

Bare lights shall not to be used in freshly painted compartments or other spaces where a fire hazard may exist.

## **123 Clearing and cleaning**

### **Cleaning**

The vessel shall be delivered totally cleaned up.

All tanks and compartments shall be cleaned of all dirt and tonnage.

Special care shall be taken that pipe lines and machinery are clean of foreign substances before filling, that all machinery is in good running order and that all equipment and stores are properly stowed onboard. Hydraulic pipe lines shall be flushed and proved cleaned and approved by the Owner's surveyor and equipment supplier before filling of the system.

### **Provisional rigging**

Temporary access openings, which may be provided in shell, bulkheads, decks, walls etc. shall be reinstated to the satisfaction of the Classification Society. However, such accesses shall be kept to a minimum.

Eye plates or lifting plates in relation with rudder blade and propeller removal/re-installation shall remain on the hull for future use as approved by the Owner's representative.

## 126 Assistance with owner's supply

The Yard shall install the Owner furnished equipment, ref. [M Owner Furnished Equipment](#).

The Yard shall provide:

- Storage place (safe and suitable for the products stored)
- Internal transportation
- Crane/barge assistance for Owner furnished equipment.

## 127 Models, albums, photos

The Yard shall deliver One(1) model of the vessel, scale 1:100, in glass display case(s) upon completion of the first vessel in the series.

# 14 Work on ways, launching, docking

## 144 Dry docking, slip docking

The vessel shall be dry-docked within one month before delivery for:

- final inspection of:
  - sea intakes and overboard pipes
  - ventilation pipes for sea chests
  - antifouling systems
  - cathodic protection systems (ref. [278 External cathodic protection](#))
  - HPR gate valve(s)
- polishing of propellers
- removal of all brackets attached to the external shell, except for those for propeller removal

Alternatively to docking, the vessel shall be inspected by diver within one month before delivery or the paint manufacturer and the shipyard providing a painting warranty for a period of not less than 5 (five) years from the date of delivery, and are responsible for the cost of recovering the hull anti fouling paint system in the event of failure during this period or the appliance of an anti fouling painting scheme with a static period properties compatible with the vessel's idle time.

An inspection to confirm the cleanliness of the hull, propeller and sea chests is carried out by certified diving company.

Vessel performance tests (ref. [154 Trial trips](#)) shall be carried out between this dry docking or diver inspection and the delivery of the vessel.

# 15 Quality control, measurements, tests, trials

## 151 Machinery testing

### General

Inspection, tests and trials of the vessel including her hull, machinery, equipment and outfits will be carried out by the Yard or the equipment manufacturers at their work shops or on board the vessel throughout the construction period of the vessel. This will be in accordance with the Contract, the Yard and/or the Makers' standards which will comply with the rules of the Classification Society and other rules and standards given in the contract. The programme shall, at least, consisting of the following tests mentioned in this section.

In order to observe the operation and performance of all materials, components, equipment and systems, the YARD shall prepare Quay and Sea Trials Procedures, in accordance with normal practice and the characteristics of the equipment and systems, as well as the Execution Schedule for these Trials in accordance with Annex I-ET-4800.00-9311-000-PTD-018 (Technical Requirements for Construction). These documents shall be submitted to the OWNER for approval at least 45 (forty-five) days before the tests are carried out. These documents shall have been previously approved by the OWNER before the respective Tests can take place.

The Quay and Sea Trials Procedure sheets shall be prepared on the basis of a Quay and Sea Trials List in accordance with item 5.1.1.3 of the contractual Annex A, doc. no. I-ET-4800.00-9311-000-PTD-018 (Technical Requirements for Construction). This List shall be submitted to the OWNER for approval one hundred and twenty (120) days after the enforcement of the Contract.

The Deadweight verification shall be carried out for all vessels in the series. The inclining experiment, will be carried out on the first vessel of the series, and every four (04) vessels, with the vessel's readiness level as much completed/concluded as possible in accordance with the requirements of the classification society and NORMAM.

A deadweight verification shall be carried out at the time of the inclining experiment

Tests of the vessel's installations, equipment, systems and operation as a whole will comprise the following phases and shall be carried out in accordance with the contractual Annex A, doc. no. I-ET-4800.00-9311-000-PTD-018 (Technical Requirements for Construction):

- Delivery Inspection, storage and preservation in accordance with the manufacturer's recommendations;
- Visual inspection, assembly and installation (piping, equipment, structures, systems, etc.);
- Pressure and leak tests, cleaning of piping and tanks;
- Calibration of instrumentation, safety protection tests, solution of pending items;
- Equipment start-up, equipment testing, system testing and sea trials;

The Sea Trial tests will only be carried out after the OWNER and the Classification Society have completed and approved all the tests and Quay Trials as per construction schedule, based on previously approved test procedures.

### **Factory acceptance tests (FAT)**

In general Factory Acceptance Tests (FAT) shall be carried out in accordance with manufacturer's standard and in compliance with Classification Society requirements.

The full range of FAT's shall include but not be limited to the following list:

- main engines
- main generators
- main alternators
- main propulsors
- main switchboards
- winch systems
- cranes
- IAS
- Thermal Oil Heaters
- Cargo Pumps
- Ballast Pumps
- Ballast Water Treatment
- Steering Gear

- Inert gas generator
- MCB/ESB
- PMS

The Owner shall be invited to witness all Manufacturers' FAT's. A list of such trials shall be provided in the early stages of the contract. Where the Owner chooses to attend a FAT, a representative from the Yard should also attend. The Owner shall be informed of the FAT schedule at least fortyfive (45) days in advance of the expected date of the FAT and the Owner's attendance shall be confirmed to the Yard five (5) days in advance of the date of the expected test.

Information regarding a FAT and procedures, shall be submitted at least forty (40) days prior to the FAT.

All machinery shall be tested to the Owner's, Classification Society and sub-contractor's satisfaction.

#### **Torsional vibration calculation (TVC)**

Torsional vibration calculations shall be carried out by:

- the engine/generator manufacturer for the generator sets
- the propulsion manufacturer for the propulsion line
- the engine manufacturer in case of a direct driven propeller

The calculations shall be submitted to the Owner and the Classification Society for approval.

#### **Harbour acceptance test (HAT)**

List of Quay Trials and associated procedures to be submitted by the Builder for Buyer's approval.

Before the trial trip all machinery, stated to be subject to test requirements, shall be tested at dock until the preliminary adjustments have been carried out to the equipment supplier's, the Owner's, the Classification Society's and the National Authorities' satisfaction.

The main machinery shall be tested at dock before the trial trip to the extent necessary to obtain temporary service permission for the trial trip from the Classification Society and National Authorities.

The Contractor shall arrange and be responsible for the HAT.

The respective Contractors are requested to provide details in their tenders for conducting the following specific integration HAT's (Note that the full range of HAT's shall include but not be limited to the following list):

- Combined engine and generator operation tests
- Propulsion Control System
- Instruments and alarm plant
- Inclining experiment, ref. N Trim and stability
- Winches
- Cranes

The Owner shall be invited to witness all harbour trials and system commissioning tests and a list of such trials and tests shall be provided in the early stages of the contract. A representative from the Contractor shall attend all harbour trials and tests.

#### **Sea Acceptance Test (SAT)**

For SAT, ref. 154 Trial trips.

Commissioning report issued by equipment's manufacturers to be handed over to Transpetro after completion of Quay/Sea Trials as part of Delivery documentation.

## 152 Tank capacity, inclination experiment, vibration measurements

### Tank capacity

All tanks shall be calculated and sounding and ullage tables (remote and hand dipping/manual device references) shall be made for the following conditions:

- One (1) condition with trim forward
- even keel condition
- Five(5) conditions with trim aft
- Five(5) correction conditions regarding the heel to SB (Only the cargo and slop tanks ullage tables.)
- Five(5) correction conditions regarding the heel to PS (Only the cargo and slop tanks ullage tables.)
- Sounding reading intervals stepped by 1 cm.
- Ullage reading intervals stepped by 2 cm.

Sounding and ullage tables (remote and hand dipping/manual device references) shall be based on detailed as built drawings of all sounding pipes and sounding and ullage devices (drawings shall be delivered by the Yard to the Designer).

### Inclination test

When the vessel is as near completion as possible and to the National Authority and/or Classification Society surveyor's satisfaction, an inclination test shall be carried out by the Yard and witnessed by the Owner's and Designer's representatives.

## 153 Fuel & lube oil for tests and trial trips

The Supplier of the lubrication oil(s) shall be decided by the Owner in due course before delivery of the vessel. The Yard shall supply a lubrication diagram (lubrication oil schedule) for the Owner's approval.

The Yard shall supply FO, lubrication oil and grease for initial filling of the systems. The Yard shall pay the cost of the quantities of FO, lubrication oil, hydraulic oil and grease for initial fill-up of equipment as well as consumed during tests and trials. The Owner shall pay the cost of the quantities of FO, lubrication oil, hydraulic oil and grease remaining onboard in storage tanks and drums after all tests and trials are completed.

Oil samples (taken jointly by the Yard and Owner's representatives) of all hydraulic and lubrication oils shall be sent to oil suppliers laboratory for analysis. Reports from analysis shall be sent to both the Yard and Owner directly from laboratory. In case oils are found unsuitable for further service, the Yard shall restore cleanliness in the systems and storage tanks immediately and replenish affected systems fully at own cost. Thereafter the oil sample- and analysis routine shall be fully repeated. If oils are found unsuitable for further service the Owner shall not compensate the Yard for any unsuitable oil remaining onboard.

When bunkering FO during construction the Yard shall take samples on the common filling line. Samples shall be sent to a FO testing laboratory for analysis. Reports from analysis shall be sent to both the Yard and Owner directly from laboratory. In case FO is found to be off specification the Yard shall restore cleanliness in the systems and bunker tanks immediately and replenish affected systems fully at own cost. Thereafter the FO sample- and analysis routine shall be fully repeated. If off specification FO is found the Owner shall not compensate the Yard for any unsuitable FO remaining onboard.

## 154 Trial trips

When the vessel is substantially completed, the official sea trial shall be carried out by the Yard in accordance with the Classification Society's and National Authority's requirements and the Yard's practice.

A program for the technical sea trial shall be submitted to the Owner at least fortyfive (45) days before the trip.

DGPS for navigation used for trials should be type approved against IMO performance standard for speed & distance measuring equipment.

The results of the sea trials shall be sent to the Owner and the Designer.

The official sea trial shall consist of at least the test mentioned in [Table 1.2](#). The trials shall be performed at ballast draught and laden draught<sup>[1]</sup> for first vessel and laden draught for sister vessels, and for a trim no greater than 30 cm as well as other requirements of the equipment suppliers<sup>[2]</sup>, Classification Society and/or the Regulatory Bodies concerned.

Further references are made to Chapter H : ISO Standard 15016:2015

Table 1.2 Sea Trials

Test	Engine load	Remarks
<b>Speed #</b>	100% MCR 90% MCR 78.26% MCR (Contract condition) 75% MCR (EEDI condition) 65% MCR On main engine(s)	The speed at the sea trial shall be measured by the DGPS. Each speed shall be the mean of 1 consecutive run alternating in direction, 1 up and 1 down on the test course. The power of the Main Engine shall be determined using a properly calibrated and certified torquemeter. The requirements of the ITTC, ISO 19019 and ISO 15016 shall be observed. The test shall aim to verify the contractual speed requirement and EEDI.
<b>Fuel Oil consumption #</b>	100% MCR 85% MCR 78.26% MCR (Contract condition) 75% MCR (EEDI condition) 65% MCR On main engine(s)	Shall be measured during speed trials. The vessel's fuel oil consumption shall be measured during 6 (six) hours of continuous operation of the Main Engine, operating at continuous service rating (CSR), and with 1 (one) Auxiliary Engine operating at normal voyage electrical load.
<b>Maneuvers Tests</b>	According to IMO A.601(15)	As pr. the resolution IMO A.601(15), the first vessel must be maneuvered at ballast condition to, and if applicable, the sister vessels could be estimated
<b>Crash stop</b>	From 100% MCR ahead to full astern	Until ahead speed becomes zero.
<b>Turning trial</b>	100% MCR on main propeller(s)	One SB turn and one PS turn
<b>Zig-zag test</b>	100% MCR on main propeller(s)	Port and starboard to each of 10°/ 10° and 20°/ 20°test
<b>Endurance test #</b>	According Classification Society requirements	4 hours at MCR, 2 hours at CSR and 0,5 hour at 110% MCR
<b>Unmanned ER operation test #</b>	According Classification Society requirements	4 hours during endurance test
<b>Anchoring test #</b>	According Classification Society requirements	According Classification Society requirements
<b>Noise level measurements #</b>	According National Authorities	According National Authorities requirements.

Test	Engine load	Remarks
	requirements	Performed during endurance test. Noise level measurements at a minimum of 40 (forty) points in the accommodation, Engine Room and service compartments, chosen by mutual agreement between the yard and the Owner, also under ballast condition (only for the first vessel in the series, and if applicable, every fourth vessel), with the Main Engine operating at continuous service rating (CSR) Ref. SFI item <a href="#">O Vibration and Noise Control</a>
<b>Local vibration measurements #</b>	According Classification Society requirements	According Classification Society requirements. Performed during endurance test. Local vibration measurements of the structure at a minimum of 30 (thirty) points distributed in the Accommodation and in the Engine Room, selected by mutual agreement between the YARD and the Owner, and in full compliance with item 2.4.1 from the contractual Annex A (doc. no. I-ET-4880.00-9311-000-PDT-001_R0), under both design and ballast conditions, with the Main Engine operating at maximum continuous rating (MCR) (only for first vessel, and if applicable, every fourth vessel). Local vibration measurements on at least 30 (thirty) points of equipment, selected by mutual agreement between the YARD and the OWNER, and in full compliance with item 2.4.1 from the contractual Annex A (doc. no. I-ET-4880.00-9311-000-PDT-001_R0), also under ballast condition (only for first vessel, and if applicable, every fourth vessel), with the Main Engine operating at maximum continuous rating (MCR)." Ref. SFI item <a href="#">O Vibration and Noise Control</a>
<b>Linear vibrations for the hull and torsional vibrations for the shaft line</b>		As a result, part of the Sea Trial will have to be carried also at ballast condition (only for the first vessel in a series, if applicable, every fourth vessel).
<b>Joystick test #</b>		According Classification Society and Maker's requirement
<b>Compass #</b>		According National Authorities requirements
<b>Bridge equipment #</b>		Electric log (during speed trials) Radar(s) Doppler Echo Sounder Doppler Sonar Current Logger
<b>PMS test #</b>		According to Maker's test documentation
<b>Testing and demonstration of rescue equipment #</b>		According to National Authorities
<b>NOx measurement</b>		3 <sup>rd</sup> party

Sea trials to be carried out with specified fuel oil ISO8217 to be used for all trials at the discretion of the Yard.

Final list of complaints, recommendations, and alterations shall be handed over to the Yard within 24 hours from the end of the trial trip.

Full test result report for tests required by the Classification Society and Authorities shall be submitted to designer at latest by delivery of the vessel.

### **Sister Vessels**

For subsequent vessel(s), only “#” marked tests shall be carried out. Consequently, the remaining trials and tests do not have to be performed. The results achieved from the first vessel shall be provided.

Crash stop astern trial for subsequent vessel(s) may be carried out for the machinery part only.

Footnotes:

[1] The vessel's draught shall be witnessed by the Owner from a boat immediately before starting the speed runs.

[2] Propeller(s) shall be polished, if necessary.

Ref. SFI item O Vibration and Noise Control

## **156 Testing electrical plant**

The electrical plant shall be tested in all manners with regards to function and insulation conditions before delivery.

During the SAT (ref. 154 Trial trips) there shall be measurements of the line harmonics, voltage distortion for the main bus bars for all main AC voltage levels. Measurements shall be performed by main electrical system supplier or specialist. The results shall be analysed and a report shall be written.

The Owner's representative shall be informed so he/she has the opportunity to be present.

The tests shall be carried out as follows:

- All generators with switchboard equipment
- Power distribution system with sub cabinets
- Consumers in General:
  - Equipment and components function tests
  - Electric motors under normal service conditions
  - Load current and equipment temperatures to be observed
- Electrical installations:
  - Light switches
  - Light distribution
  - Plug sockets (receptacles)
- Alarm Plants
  - Warning and alarm devices
  - Tag numbering, Alarm points and settings according to I/O list (Instrumentation & automation list) and relevant system drawings
- Thermal Imaging of all major parts of the electrical distribution system (Main switchboard and distribution switchboards/patterns) and their bus-bars (with bus-bar connections) as far as practicable.
- Thermal Imaging of main electrical power cables and their connection points as far as practicable.

## 16 Guarantee/mending work

### 161 Mending work after trials

The Owner will issue a separate warranty claim for each incident. The Yard shall respond with a plan for closing each claim within two (2) weeks after receipt from the Owner and issue updated status.

#### Premises for the vessels delivery :

The following conditions shall be met:

- 1) Clean sea chests, clean heat exchangers where backflushing is applicable, all filters cleaned and new filter elements in the vessel's systems, evidence of draining of trays via scuppers, floors and decks cleaned, tanks drained (sludge, separated oil, drain, bilge, slops, fuel overflow, grey water and sewage, waste water, grease trap, sumps), painted surfaces touched up or with paint scheme recovered where required, and ballast tanks cleaned.
- 2) All quay and sea trials shall be finished, approved and with no impeditive pending items preventing the vessel from operating."

### 162 Guarantee work

Guarantee work shall be carried out according to the Contract.

## 2 HULL

### 20 Hull construction and materials

Compartments and tanks shall be formed by hull structural bulkheads and decks as shown on General Arrangement.

The vessel's entire structure will be designed using finite elements and will have a fatigue life of 30 (thirty) years. It shall be designed to carry a partial volume of product with a specific weight of 1,04 t/m<sup>3</sup> until it reaches the summer draft. A copy of the final approved finite element model and report (including the native files of the software used) shall be delivered to the BUYER.

No external structure of the hull, superstructure, access and service hatches or deck lockers shall be made of steel plates with a thickness of less than 8 mm.

The hull shall be built as an all-welded steel ship according to drawings approved by the Classification Society, Yard and Owner. As a minimum the requirements of the Classification Society notations shall be met.

Hull structural members shall be of normal strength steel (yield stress 235 N/mm<sup>2</sup>) / high strength steel (yield stress 355 N/mm<sup>2</sup>) in general, unless where the Classification Society has specific requirements.

On the vessel's hull, the use of high-tensile / special grade steel shall be limited to 35% of expected lightweight.

The areas where High Tensile steel can be applied are:

- Main deck plating and its longitudinal reinforcements.
- Bottom plating, double bottom tank top and its longitudinal reinforcements.
- Upper and lower strakes of the longitudinal bulkheads and ship's side, as well as their longitudinal stiffeners.
- Structures located in cargo tanks subjected to high stress concentrations.
- Locations where mild steel plates are required to be over than 25 mm thick.

Gratings and guardrails shall be installed at all stringers and cross-ties openings to prevent accidents.

The YARD shall prepare specific welding procedures for each type of weld to be used on board and submit them to the Classification Society for approval and copies forwarded to the OWNER for information.

The steel work shall be carried out in accordance with the construction standards and welding and non-destructive testing (NDT) inspection procedures approved by the Classification Society and the OWNER.

Construction of the vessel's hull and associated structures shall only begin after satisfactory approval by the Classification Society of the main structural drawings, confirmed by the respective approval letters.

Requirement for hull construction is to be primarily governed by document ET-4880.00-9311-000-ptd-001;

The fatigue calculations are to be delivered to Owner.

### 201 Hull materials

All steel materials (and aluminium if applicable) shall be of normal international shipbuilding and marine engineering quality.

All materials shall be tested inspected and certified as required by the Classification Society and relevant Regulatory Bodies.

Test certificates shall be delivered to the Owner where required by the Classification Society.

When galvanizing is mentioned, hot dip galvanizing shall be used, ref. [276 Galvanizing](#).

All non-steel items shall be of tested materials, and certificates shall be supplied where required by the Classification Society.

## 203 Blasting, shop-priming and cleaning of materials

### Grit blasting

All steel materials used in the building of the vessel shall be grit-blasted and cleaned according to standard SA 2.5 before priming.

### Shop priming

Immediately after the grit blasting the steel materials shall be coated with zinc primer.

The top coat system shall be compatible with the primer and approved by the paint supplier.

Where special coatings are required preparations and priming of steel materials shall be in accordance with the guide-lines of the product suppliers.

### Cleaning

Prior to applying each coat of paint, all surfaces shall be thoroughly cleaned. Cleaning materials and cleaning procedures shall be agreed with the paint supplier and in line with his recommendations.

The Owner shall be notified in due course and shall approve cleaning works before coat application.

### Owner's Surface Preparation requirement:

All structural steel shall be shotblasted to ISO 8501-1 Sa 2 ½ standard with profile (Surface roughness) between 30 and 75 µm and painted with one (1) coat of ethyl zinc silicate-based shop primer.

Blasting should not be carried out when: the relative humidity is above 85%; or the surface temperature of the steel is less than 3°C above the dew point.

The salinity limit for surfaces to be painted is 30 mg/m<sup>2</sup> of sodium chloride (milligrams per square meter).

In order to achieve a good standard of preparation for painting inside all tanks (ballast, fresh, drinking and distilled water), and empty spaces, all structural elements in the areas to be painted shall be free of grease, oil, salts, dust, all structural elements in the areas to be painted shall be free of grease, oil, grease, dust, salts, weld spatter, porosity, double lamination and biting, and all sharp edges of internal structural elements (reinforcement corners, through holes, relief holes, scallops, etc.) shall be eliminated....), allowing the paint to be applied to edges smoothed with 3 (three) passes of grinding machine (3G), in accordance with grade P2 of the ISO 8501-3 standard. All edges and weld seams shall have a stripe coat after each general coat and before the last, i.e. if the paint scheme is two coats, two stripe coats of different colors shall be applied between the first and second coats.

A Surface Preparation Standard shall be issued, in accordance with the paint manufacturer's recommendations for roughness, edge treatment, cut-outs, welding and surface preparation prior to the start of manufacture, as specified above.

The agreed standards shall be followed by the SHIPYARD as a level of internal quality in the manufacture and treatment of structures.

Erection joint welds (block and ring seams) shall only be painted after the tightness test is completed.

The treatment of the area shall meet the ISO 8501-1Sa 2.1/2 standard.

The painting schemes defined in the table below shall be applied to surfaces blasted with ISO 8501-1Sa 2 ½ grade abrasive.

After fabrication, the structural blocks shall have the damaged areas shotblasted to ISO 8501-1Sa 2 ½ and the remaining areas where the shop primer is intact and within the expiration date, shotblasted to ISO 8501-1Sa 2 over at least 70% of the area.

After construction, the erection joint weld seams and the painted areas of the tank bottoms shall be shotblasted to ISO 8501-1Sa 2 ½ and the other damaged areas treated to SSPC-SP 11. In such damaged areas treated to SSPC-SP 11 standard, a minimum roughness profile of 50 µm is required.

#### **Owner's Surface Cleaning requirement:**

The cleanliness of the steel surface and the roughness profile shall be checked at the end of surface preparation and before applying the shop primer, in accordance with the manufacturer's recommendations.

Dust removal from blasting shall be in accordance with ISO 8502-3.

No abrasive inclusions visible to the naked eye will be allowed.

All washing processes shall be carried out using clean fresh water, free from contaminants and with a pH ranging from 6.5 to 7.5.

Requirements for Painting and Corrosion Protection is to be primarily governed by document ET-4880.00-9311-000-ptd-001.

### **204 Testing of tanks, bulkheads**

The tightness of all tanks, cavities and conserved volumes shall be tested as required by the Classification Society.

No tank, or adjacent compartment, shall be coated or painted until such test is carried out and the result is approved by the Classification Society.

All openings in steel structure such as hatches, windows and outside doors etc. shall be hose tested as required by the Classification Society.

All test reports shall be available to the Owner's surveyor.

### **205 X-ray and ultrasonic testing of hull parts**

X-ray and ultrasonic testing of weld connections shall be carried out to an extent as agreed between the Yard and the Classification Society.

The tests shall not be approved before the results show a good welding technique in compliance with Classification Society requirements.

All test reports shall be made available to the Owner's surveyor.

### **207 Welding and steel construction**

Hull and superstructure shall be all welded.

Welding tables covering vessel's steel structure shall be worked out and approved by the Classification Society and the Yard.

All welding shall be carried out in accordance with Classification Society approved welding tables and to the Classification Society surveyor's approval.

Hull and superstructure shall be all welded double continuous fillet weld, intermittent welding is not accepted.

Full penetration welding shall be applied where required by the Classification Society.

## 208 Steel construction in general

### Scantlings

Scantlings of structural members and plates shall be in compliance with Classification Society requirements, unless where the Building Specification specifies scantlings exceeding these requirements.

Scantlings in some areas might be increased beyond Classification Society requirements to prevent vibrations and extensive deflection.

### Frame Spacing

The vessel shall have transversal frame spacings according [Table 2.1](#).

Table 2.1 Transverse frame spacings

Location	Frame	Distance
Stern - Bow	frame Stern - Bow	800mm

The longitudinal stiffener spacing shall in general be 700 mm.

### Quality standard

The hull structure shall be built in accordance with IACS REC 47 Shipbuilding and Repair Quality Standard.

### Material protection and Surface Preparation

Material protection and surface preparation shall be according to Yard standard and Yard supplied approved Paint Specification, ref. [27 Material protection](#), [28 Material protection, internal](#) and [203 Blasting, shop-priming and cleaning of materials](#)

### Owners requirement:

No external structure of the hull, superstructure, access and service hatches or deck lockers shall be made of steel plates with a thickness of less than 8 mm.

There will be no recess for the anchor. In the anchor stowage area, the ship's side plating shall be 50% thicker than the adjacent plating in order to protect it from anchor flukes.

The thickness of the plating on the sea chests and bilge wells shall be at least 5 mm greater than the adjacent plating.

The thickness of the ship's side and chain locker bottom plating will be at least 5 mm greater than that determined by the Classification Rules.

The structural profiles should preferably be laminated and easy to repair (e.g. "hp" profile).

Tug pushing areas of shipside at forward, mid and aft shall be strengthened with vertical stiffener according to the Yard's practice. These stiffeners shall be provided within draught range.

## 209 Watertight bulkheads with stiffening

The vessel shall be divided into watertight compartments by means of transversal- and longitudinal watertight bulkheads. The number of bulkheads, extent and positions of these shall be according to the General Arrangement, Classification Society requirements and relevant rules and regulations.

Doors in watertight bulkheads shall be arranged according to the General Arrangement, Classification Society requirements and relevant rules and regulations.

### Surface Cleaning scope prior to the surface painting:

The stiffeners of side bulkheads and bottom plating of cargo tanks shall be built externally in such a way as to facilitate cleaning (fitted within ballast tanks).

## 21 Afterbody

The aft ship shall be built with a centre skeg and hull form optimized for the main propulsion machinery.

Tug pushing areas on ship sides aft shall be reinforced according to recommended practice and strengthend with vertical stiffener according to the YARD's practice. These reinforcements shall be provided within draught range.

Head box for the rudder shall be arranged with stream lined shape to minimize resistance through water.

Special attention shall be paid to strengthening in this area to reduce transmission of noise and vibration to a minimum.

Additional stiffening shall be provided in the slamming area around the stern.

## 211 Shell plating

The shell plates in way of supporting propulsion and manoeuvring machinery, shall be increased locally with insert plates.

## 212 Eye plates

Streamlined lifting eye plates shall be arranged under the stern and on rudder to facilitate fitting and dismantle of rudder and propulsion machinery. These eye plates shall be permanently mounted.

Where eye plates are welded directly to the shell plating, without doubler plates. Local stiffeners shall be welded on the inside in-line with the eye plates.

All eye plates shall be marked with welding beads with their respective Safe Working Load (SWL).

## 214 Main deck with stiffening

Ref. [234 Main deck](#)

## 216 Stern sections

The stern shall be of square transom type above waterline, with open water stern frame shape and stern bulb below waterline, arranged for single screw and spade rudder.

A strong box type skeg shall be arranged at the centreline aft. The skeg structure shall be of sufficient strength to withstand the maximum loads that may occur whilst dry docking the vessel. Inaccessible parts of the skeg shall be conserved.

High floor frames with centre girder and web frames shall be arranged according to the Classification Society rules and regulation.

The aft end structure shall be arranged with ballast/fresh water tanks, store rooms and steering gear space.

Stern frame shall be of all welded construction. Steps of square bars shall be arranged inside the techincal fresh water tanks for inspection and also for the coating purpose.

A tank above the sterntube tank shall be arranged. The tank shall be blasted and coated same as cargo tanks. Ref. [28 Material protection, internal](#).

Stern frame shall be of open water type without solepiece. The stern shall be arranged for a balanced spade, high-lift type rudder. The propeller boss shall be of cast steel welded to the stern frame and bottom flooring.

The form of the stern frame shall be designed to give the proper clearance between the propeller and rudder.

A rudder stock trunk shall be arranged from the steering gear floor through the aft peak, with access through manhole in steering gear room.

Head box for rudder shall be arranged with stream lined shape to minimize resistance through water.

#### **Mooring deck aft**

A mooring deck aft of superstructure shall be arranged on poop deck as shown on the General Arrangement plan.

Local reinforcements for relevant deck equipment, such as mooring- and towing equipment, shall be arranged, ref. [434 Tugger winches, capstans, mooring winches with warping heads](#) [435 Fixed mooring equipment](#).

#### **Skeg structure:**

Drain plugs to be provided accordingly

### **217 Bulkheads with stiffening**

Ref. [209 Watertight bulkheads with stiffening](#).

### **218 Steering gear room**

Steering gear room(s) shall be arranged in accordance with the General Arrangement.

The room(s) shall be of sufficient size to accommodate the following type of equipment:

- Steering gear and associated equipment
- Relevant hydraulic equipment

Rigid foundations and supporting structure shall be arranged for the steering gear to minimize deflections and vibrations.

Access to-, and escape from the Steering gear room shall be arranged according to the General Arrangement and rules and regulations.

## **22 Engine area**

Fuel oil service/settling tanks and Lube oil stores tanks for main engine and auxillary generator sets shall be arranged in the engine room area as shown on General arrangement plan.

FO tanks shall be provided with openings/ hatches for removal of injured person and cleaning purposes.

Drain tanks shall be arranged in the engine room double bottom (ref. [238 Hull tanks in general](#), [70 Fuel oil systems](#), [711 Lube oil transfer & drain systems](#)).

Casings, ventilation ducts and access shall be provided from the machinery space as shown on the General Arrangement.

Sea chests in the engine room area ref. [262 Bottom plugs, sea chests, bilge wells, trunks/ casings for bottom equipment](#).

Side tanks in way of engine room shall be arranged as storage tanks for HFO, MGO, thermal oil and grey water as shown on General arrangement plan. HFO and MGO tanks shall be separated from outer shell by cofferdams.

HFO service and settling tanks and MGO service and settling tanks shall be integrated into HFO and MGO storage tanks as shown on General arrangement plan. A cofferdam shall be arranged above HFO / MGO tanks.

Two platform decks shall be arranged in the engine room as shown on General arrangement plan. Separator room and a separate room for auxiliay diesel generators to be arranged as shown on General arrangement plan.

Stores room shall be arranged as shown on General arrangement plan.

All tanks shall have accesses according to the requirements of Classification Society and National Authorities.

## **221 Shell plating**

The thickness of shell plates in way of sea chests and sea inlets shall be according to Classification Society requirements, and shall be at least 5 mm thicker than the adjacent plating.

Welding in sea chests and sea inlets areas shall be of full penetration type.

Ref. SFI item [231 Shell plating](#).

Ref. SFI item [262 Bottom plugs, sea chests, bilge wells, trunks/ casings for bottom equipment](#)

## **222 Bottom construction and keel**

Ref. [232 Bottom construction and keel](#).

## **223 Inner bottom and foundations**

### **Inner bottom**

Ref. [233 Inner bottom](#).

### **Main engine- and main generator (Option) foundations**

Foundations for main engine and main generator shall be integrated as a part of the double bottom construction, with continuous longitudinal girders with solid top flange, with strong and rigid connections in forward and aft end, and with good connections forward and aft in the deck.

The foundations shall follow the engine and generator manufacturers guidance and shall be approved by Classification Society and Owner.

### **Foundations for auxiliary and machinery equipment**

Foundations for auxiliary and machinery equipment (auxillary generator sets, compressors, pumps, separators etc.) shall be rigid and manufactured according to good shipbuilding practice, with local stiffeners and reinforcements in tank top and bulkheads.

### **Spill coamings**

Spill coamings of appropriate height shall be arranged around equipment containing oil. Capacity according National Authorities and Classification Society. Spill coamings to be 150 mm.

## **224 Decks above engine room with stiffening**

Ref. [234 Main deck](#).

## **226 Second deck, engine floors, platforms and hull tanks below main deck**

### **Platform deck 2 and 1**

Platform deck 2 and 1 shall be arranged according to the General Arrangement forming platform decks with openings in way of the main engine.

Scantlings shall be according to Classification Society requirements corresponding to the deck load, or relevant tank pressure where Deck 2 is part of a hull tank.

### Hull tanks below Main deck

Hull tanks shall be arranged according to the General Arrangement and the Tank Plan, ref. [238 Hull tanks in general](#)).

Manholes for tanks, ref. [304 Smaller hatches, emergency hatches and manholes](#).

Lifted floor and platforms in engine room, ref. [525 Loose floor plates, platforms & ladders in engine & pump rooms](#).

### Casing

Ref. [268 Casing, funnel and ducts](#)

## 23 Cargo area, midship

The cargo area is separated from machinery space aft by technical freshwater- and water ballast tanks and from the collision bulkhead forward by cofferdam as shown on the General Arrangement plan. Tug pushing areas on ship sides at midship shall be reinforced and strengthend with vertical stiffener according to the YARD's practice. These reinforcements shall be provided within draught range.

The cargo area shall be arranged with double hull throughout the vessel and designed to facilitate effective cleaning of cargo tanks.

Wing- and double bottom tanks in cargo area shall be arranged for water ballast, and shall be interconnected, as shown on the General Arrangement plan.

The cargo space is sub-divided into twelve (12) cargo tanks. Bulkheads shall be arranged as shown on the General Arrangement plan.

Two slop tanks shall be arranged aft below main deck as shown on the General Arrangement plan. Scantlings to be selected to given minimum section modulus according to Classification Society requirements.

### Deck

Design deck load in the cargo area: ref. SFI item [E Capacities and tonnage](#).

Table 2.2 Deck Chamber

Deck	Deck Chamber
Main Deck	Straight, 300mm height
Main deck, aft	NIL
Forecastle deck	NIL
Poop deck	NIL
Superstructure	NIL
Compass deck	Straight, 150mm height

Table 2.3 Sheer

Deck	Sheer
Main deck	Correspond to chamber
Forecastle deck	300mm
Other decks	NIL

### Tanks

Tanks in Cargo area shall be arranged as indicated on the General Arrangement. - See also [B Arrangement, description](#)

Measurement like reducing scallops, using rolled profiles, avoiding complex geometric configurations and ensuring that the structural configuration permits easy access for tools and to facilitate cleaning, drainage and drying of the space to be coated, to be taken for good coating performance in the water ballast tanks.

The vessel shall have 2 (two) slop tanks positioned aft of the aftmost cargo tank and in between the aftmost ballast tanks, with a minimum volume equal to 3% of the total volume of the cargo tanks, in accordance with the applicable Standards and Rules.

Table 2.4 Design criteria for cargo and slop tanks

Tanks	IMO type	Max Cargo SG [t/m <sup>3</sup> ]	Max. Cargo Temp. [°C]	Design Pressure [bar]	Full tank	Partly filled Tank (20 – 90 %)
All	Product Tanker	<u>E Capacities and tonnage</u>	50	0.2	YES	YES

## 231 Shell plating

The shell plate thickness shall be according to the minimum requirements from Classification Society unless specified otherwise in this building specification. Plate thickness may be locally increased in areas subject to vibrations and deflections.

## 232 Bottom construction and keel

### Keel

The keel shall be made of a steel plate with extension and thickness according to Classification Society requirements. The keel plate shall be carefully adapted to the vessel's geometry in the fore and aft end.

### Centre girder

A centreline girder shall be continuously welded throughout the full length of the vessel except in way of trunks.

Thickness and height of the girder shall be, as a minimum, according to the requirements of Classification Society. The centre girder shall be of a watertight construction where forming boundaries of tanks.

## 233 Inner bottom

A double bottom shall be arranged according to the General Arrangement.

The following shall apply to the double bottom construction:

- The double bottom ballast tanks and side wing tanks shall be interconnected as shown on the General Arrangement plan.
- Access to double bottom tanks shall be through the wing tanks.
- Double bottom height in cargo area shall be 1600 mm or at least B/15 in center, measured to underside of the innerbottom plating.
- Double bottom in each cargo tank shall be horizontal.
- Pump suction wells shall be recessed into the bottom of all cargo tanks, preferably aft towards either SB or PS (all to same side), as shown on the General Arrangement plan. The material of the pump suction wells shall be normal steel, and the structure of the recessed wells shall be strengthened for continuity purpose. Ref item 262 Bottom plugs, sea chests, bilge wells, trunks/ casings for bottom equipment.
- Lighting holes in the floors and girders for inspection ballast tanks shall not interfere with

structural integrity, nor be obstructed by the ballast pipes or/and hydraulic pipes of remote control valves.

- Non-watertight floors and girders shall have air- and drainage scallops of minimum 1.25 times of the suction area of the loading- and discharge pipe for the given tank at both lower and upper edge.
- Each double bottom tank shall normally have two manholes. For small tanks and small cofferdams one manhole is accepted, ref. [304 Smaller hatches, emergency hatches and manholes](#).
- Below manholes, tanks shall be provided with ladders or steps to give easy access to the tank, ref. [526 Ladders, platforms & railing in ballast & fuel tanks](#) [527 Platforms, ladders & railing in cargo tanks](#).

## 234 Main deck

The deck shall be arranged as shown on General Arrangement plan.

Main deck shall have sheer and camber according to [23 Cargo area, midship](#).

Design deck loads in the cargo area shall be according [E Capacities and tonnage](#).

The main deck shall be arranged as a continuous deck throughout the ship with camber as specified, Ref. [Table 2.2](#) and [Table 2.3](#).

Hatch coamings for cargo tank hatches, see [301 Hatches on weather decks](#)

Table 2.5 Stiffening of main deck in cargo area

Location	Type of stiffening
In way of cargo tanks	Stiffeners to be below deck plating
In way of ballast tanks	Longitudinal deck stiffeners below main deck (Inside ballast tanks)

Main deck stiffeners shall be of rolled section or flanged plate.

Drain wells for deck water to be arranged in the upper part of the aftermost wing tank, port and starboard. Capacity abt. 0,2 m<sup>3</sup> each side.

## 236 Bulkheads with stiffening

Ref. [209 Watertight bulkheads with stiffening](#).

### Transverse bulkheads

Transverse bulkheads between cargo tanks shall be of vertically corrugated construction, without stools or supporting members such as webs, stringers, brackets etc. in the cargo tanks.

All watertight bulkheads of the cargo and slop tanks shall be corrugated type. The longitudinal bulkheads between cargo and ballast tanks, and between slop and ballast tanks, shall have their reinforcements/ stiffeners located inside the ballast tanks.

Sloping deflector plates shall be arranged in the corrugations at tank top. Space below plates shall be opened to double bottom.

Cut out for access shall be arranged, and space shall be coated as ballast tank.

Division of wing ballast tanks shall be watertight webframes, ref. [238 Hull tanks in general](#)

### Longitudinal bulkheads

Three (3) continuous longitudinal bulkheads including the inner wingtank bulkheads shall be arranged throughout the cargo space.

The longitudinal bulkheads in cargo area forming wing tanks shall be of plane type with stiffeners facing out of cargo tanks.

Inner wingtank bulkheads shall be located min. 1350 mm from outer shell, measured to outer side cargotank bulkhead.

The longitudinal bulkhead in centre shall be of vertically corrugated construction, without stools, or supporting members such as webs, stringers, brackets etc. in the cargo tanks.

The vertically corrugated center line bulkhead shall be extended into double bottom and be part of the center girder system.

Sloping deflector plates shall be arranged in the corrugations at tank top, for transverse bulkheads.

Space below plates shall be opened to double bottom. Cut out for access shall be arranged. Space shall be coated as ballast tank.

## 237 Decks above Main deck with stiffening

### Walkway

A walkway and compartments shall be arranged as shown on General Arrangement plan.

The walkway shall be arranged from Poop deck to Forecastle deck, and shall have no sheer and no camber.

The use of fiberglass (GRP) in pipe rack walkways shall be adopted as far as practical and in compliance with applicable rule and regulations.

Design loads shall be as minimum according Classification Society rules and regulation.

## 238 Hull tanks in general

### General

Hull tanks shall be arranged according to the General Arrangement and the Tank Plan and shall be in compliance with relevant Classification Society notations and relevant Regulatory Bodies.

### Drain wells

Drain wells shall be arranged in every tank except in double bottom and peak tanks.

### Special considerations for hull tanks

Table 2.6 Special Considerations for Hull Tanks

Tank content	Remark
Cargo tanks/methanol fuel tanks	Tanks shall be made of normal steel and coated with appropriate coating. Cofferdams iwo. methanol tanks shall be arranged with access from open deck. Cofferdams shall be prepared for sea water filling.
MGO/HFO	No MGO/HFO tanks shall be arranged in the double bottom, ref. CLEANSHIP Class notation requirement.
Fresh Water	Cofferdams shall be arranged adjacent to tanks with content requiring such measures. Structure inside tanks, especially tanks for potable fresh water, shall be avoided as far as practical for easier inspection and cleaning.
Double bottom water ballast tanks	The water ballast double bottom tanks shall extend from side to side, separated with a longitudinal watertight bulkhead in centreline as shown on General Arrangement plan. Transverse bulkheads to correspond with the primary cargo tank bulkheads, as shown on the General Arrangement plan.
Wing water ballast tanks	The water ballast wing tanks shall extend from the double bottom tank top to main deck. Transverse wing tank bulkheads shall correspond with the double bottom tank

Tank content	Remark
	bulkhead arrangement as shown on the General Arrangement plan.

For fluid definitions, density and flash point, ref. [E Capacities and tonnage](#).

For coating requirements, ref. [28 Material protection, internal](#).

For manholes, ref. [304 Smaller hatches, emergency hatches and manholes](#).

## 24 Forebody

Foreship shall be arranged as shown on General Arrangement plan.

The collision bulkhead forward shall be arranged according to the General Arrangement plan and with a height and longitudinal position as per Classification Society requirements.

The vessel shall be built with a bulbous bow with Kongsberg 3 Wave Piercing technology as indicated on the General Arrangement

Tug pushing areas on ship sides forward shall be strengthened with vertical stiffener according to the Yard's practice. These reinforcements shall be provided within draught range.

A forecastle deck shall be arranged and provided with a suitable straight-line sheer, with no camber. Ref. [Table 2.2](#) and [Table 2.3](#).

## 241 Shell plating

The shell plating in way of anchor stowage, bolster, frog eye type, shall have locally increased thickness in excess of Classification Society requirements, and shall be minimum 50% thicker than the adjacent plating in order to protect it from anchor flukes.

Transition shall be made rounded or alternatively chamfered, and smooth to achieve better thrust performance and less noise.

## 243 Mooring deck

An mooring deck shall be arranged forward on forecastle deck as shown on the General Arrangement plan.

Local reinforcements for relevant equipment on this deck, such as anchor-, mooring- and towing equipment, shall be arranged, ref. [431 Anchors with chains and equipment](#), [433 Combined windlass/mooring winches with chain stoppers, rollers](#), [434 Tugger winches, capstans, mooring winches with warping heads](#), [435 Fixed mooring equipment](#)).

## 244 Decks below mooring deck with stiffening

Decks below mooring deck shall be arranged according to the General Arrangement.

Rope storage facilities shall be arranged in the store below the mooring deck.

For the rope hatches, ref. [304 Smaller hatches, emergency hatches and manholes](#).

## 245 Decks and stringers below main deck

Bow stringers and reinforced, horizontal stringers shall be mounted in ship sides, vertical distance shall be according to Classification Society requirements.

## 246 Bow and stem

The vessel shall be built with a bulbous bow with Kongsberg 3 Wave Piercing technology, arranged for optimum performance at design draught and high performance in heavy weather conditions.

The upper part of stem shall be a “soft nose” construction formed by well rounded steel plates.

## 247 Chain lockers

Chain lockers for anchor chain shall be arranged according to the General Arrangement.

The chain lockers shall have sufficient size, and be constructed for good self stowage of the anchor chain.

The plate thickness of the chain locker shall be at least 5 mm greater than determined by the Classification Society rules, or 12 mm whichever is greater.

The inboard end of the chain shall be attached according to Classification Society requirements, with emergency release from outside the chain lockers.

The following shall be arranged inside the chain lockers:

- Grating of hot dip galvanised perforated plates approx. 300 mm above bottom level
- Bilge pipes (well protected and arranged with mud box and suction well)
- Wooden plank covering from bottom level to approx. 2000 mm upwards
- Manholes and steps for access
- Ejectors for the chain locker mud boxes and bosun store drainage are to be installed. For the bosun store, the ejector capacity must be 10 m<sup>3</sup>/h.

### Spurling pipes

One spurling pipe shall be fitted from each chain locker to the mooring deck. The upper end shall be adapted to ensure a smooth entrance of the chain.

- Pipe diameter approx. 450 mm
- Wall thickness approx. 20 mm

A cover plate with handholds to be provided to minimize water ingress.

## 25 Deck houses & superstructures

Deckhouses, superstructures and wheelhouse shall be arranged as indicated on the General Arrangement and shall be built of steel.

All decks shall have no sheer and no camber.

Internal steel bulkheads shall be fitted around staircases, provision rooms, stores and ventilation room(s), etc. in accordance with applicable rules and regulations.

The whole structure shall be of welded construction with direct welded connections to deck plating.

Pillars below girders within deck houses to be adapted to accommodation partition bulkheads as far as practical.

The wheelhouse shall be arranged with large windows to achieve good field of vision. Framing between the windows shall be minimized.

The wheelhouse with associated arrangement may extend outside vessel full beam to allow a clear view of ship's side

## 251 Deck houses & superstructures

Outline and areas of deckhouses and superstructure shall be as indicated on the General Arrangement.

Deck heights in accommodation:

Table 2.7 Deck heights

Deck location	Approx. height (steel to steel)
Main deck - forecastle deck	3400 mm with straight sheer aftwards
Main deck - Poop deck	3100 mm
Poop deck - Deck 2	2800 mm
Deck 2 - Deck 3	2800 mm
Deck 3 - Deck 4	2800 mm
Deck 4 - Deck 5	2800 mm
Deck 5 - Bridge deck	2800 mm
Bridge deck - Wheelhouse top	3200 mm, including lifted floor

Special attention to gymnasium head clearance. Deck height in gymnasium is to be suitable for a safe use of treadmill.

Internal bulkheads in the accommodation may be of corrugated type.

Ship side and outer bulkheads in accommodation areas shall have gutters formed by flat bars, ref. [267 Gutter, bulwark, railings and cargo rails \(securing of deck cargo\), freeing ports](#).

## 252 Fan & winch houses

### Engine room ventilation duct

Engine room ventilation ducts shall be arranged aft of the superstructure, with air inlets as indicated on the General Arrangement.

Cut-outs in decks and foundations for the inlet fans shall be arranged.

Number of fans, louvres, access door/hatch and drain shall be according [574 Ventilation systems for engine rooms](#).

## 254 Bridge deck and wheelhouse

The wheelhouse shall be arranged according to the General Arrangement.

- Deck height, ref. [251 Deck houses & superstructures](#).
- Windows and external doors, ref. [514 Weathertight and Spraytight doors, 515 Side scuttles and windows with equipment](#)
- Outer bulkheads in wheelhouse shall have gutters formed by flat bars, ref. [267 Gutter, bulwark, railings and cargo rails \(securing of deck cargo\), freeing ports](#).
- Lifted floor frame made by angle profiles with a height 400 mm above Bridge deck. For floor details, ref. [522 Interior deck cover](#).

## 26 Hull outfitting

Hull and superstructure steel outfitting shall be according to normal shipbuilding standard, relevant rules and regulations, and as indicated on the General Arrangement plan.

All hull outfitting is to be welded on top of pad/doubler plates.

## 261 Hull and house markings

Vessel identification shall be clearly applied by suitable markings/signs on ship hull sides and superstructure, according to regulations and Owner's advice.

Other hull markings such as depth marks, load line marks, underwater equipment locations etc. shall be fitted according to normal standards.

In general all markings shall be made of minimum 4 mm plates and be fully welded.

#### Vessels Name and port of registry

Name in raised steel plate letters with height of 500 mm shall be welded to ship's side forward.

Name and port of registry in raised steel plate letters with height of 500 mm shall be welded to the transom.

#### Draft Marks

Metric draft marks of steel plates shall be welded on ship's side PS and SB at forward, midship and aft, and at centreline of the transom. The projected height of the marks shall be 100 mm.

#### Funnel Marks

The shipowner's Logo on funnel will be marked on both edges of the funnel by means of intermittent welding beads. The details and characteristics of the Logo will be supplied by the BUYER in accordance with Standard N-1503.

#### Warning Marks

Standard warning markings for proximity of speed log, echo-sounders and bulbous bow shall be welded on each side of vessel above the loaded waterline. Marks shall be of steel plate. All bottom equipment shall have markings.

#### Freeboard/Tonnage Marks

Freeboard and load line markings shall be welded on PS and SB side midship. Position shall be according to load line certificate and Classification Society Surveyor's satisfaction.

#### Tank Marks

Tank corners and tank number and content shall be marked by welding on shell plate. For tanks with bottom plug tank number and content shall be welded adjacent to the bottom plug.

#### IMO Marks

Vessels IMO number with letters of steel plates shall be welded foreward on the accommodation bulkhead, at the transom and in the engine room. Heights of marks to be 200 mm and 100 mm respectively.

#### Bow mark

Owner's bow emblem to be made of steel plate and welded to the bow.

#### Push tug marking

Push tug markings shall be marked by weld beads on both sides of in the aft-, mid- and foreship.

#### Frame marking

Every 10th frame shall be marked by welding of figures made of steel plates on both sides of the shipside. Figures 10 cm high

#### Marking of cargo-tank hatches

All entrance hatches and butterworth hatches to cargo tanks to be marked with tank number/name by welding runs, approx. 100 mm high.

Marking to be painted white.

#### House markings

On front of accommodation deckhouse the following to be painted with letters of ample size: **NO SMOKING**. Marking shall be arranged between windows at 5rd. and 4nd. tiers.

### **Paint marking**

Paint marking lines for waterline, etc. to be indicated on both sides with 50 mm long welding for every 1.5 meters.

The waterline marking shall have a sheer fore and aft of 0.5 % of LPP.

### **Marking of life-boats, life-rafts etc.**

Lifeboats, life preservers and other lifesaving equipment shall have the ship's name etc. painted thereon in accordance with the requirements of the regulatory bodies.

### **Overboard pipes marking**

Valves number shall be marked with welding beads in the shell.

**Domes, hatches, manholes, bottom plugs and tugboat area marks** shall be identified by capital letters and numbers 100 mm high and **20 mm wide strokes**, using weld beads around the letter or number to be represented.

## **262 Bottom plugs, sea chests, bilge wells, trunks/ casings for bottom equipment**

### **Bottom plugs**

Bottom plugs of size Ø42 mm including bottom rings for welding according to NS 2573 or Owner standard shall be provided for all tanks and compartments in the bottom. Bottom plugs shall be of approved type in accordance with Classification Society requirements.

In oil product tanks, the drain plugs shall have hexagon socket wrench type.

In water tanks, the drain plugs shall have square socket wrench type.

A total of Five (5) spare of each type plugs shall be delivered.

### **Sea chests**

Sea chests shall be arranged according to 721 Sea water cooling system.

The thickness of shell plates in way of sea chests and sea inlets shall as a minimum be according to Classification Society requirements, and shall be at least 5 mm thicker than the adjacent plating.

The following shall be provided for all sea chests:

- Full penetration welding for boundaries direct to sea
- Removable strainers, 1 hinged, shall be provided.
- Inlet strainer plates shall be of hot dip galvanized steel.
- All strainers shall be flush with the shell plating.

### **Bilge wells**

Bilge wells shall be arranged in all rooms and compartments where applicable, except in the accommodation. Access for cleaning of wells shall be provided. Size shall be minimum 150 litres.

Each bilge well should preferably be provided with covers of galvanized perforated steel plates. The thickness of the plating on bilge wells shall be at least 5 mm thicker than the adjacent plating.

### **Trunks/ casings for Bottom equipment**

Required transducer tanks, trunks and valves for mounting the under water searching equipment shall be integrated in the hull, ref. 414 Underwater searching equipment.

### **Trunks for Impressed Current Cathodic Protection (ICCP)**

Required trunks for mounting of ICCP sensors and similar equipment shall be integrated in the hull, ref. 278 External cathodic protection.

## 263 Foundations and reinforcements

### Foundations and reinforcements

Foundations for deck machinery and equipment shall be designed and built for maximum loads as given by supplier, including relevant dynamic and safety factors as required by the Classification Society. The deck shall be reinforced accordingly.

Foundations on open deck shall preferably be of closed design for easy cleaning and maintenance.

For foundations for the main switchboard, drives, converters consoles etc. special care shall be taken for easy cable entrance.

## 264 Fender and bilge keels

### Fenders

Fenders are not applicable for oil tankers.

### Bilge Keel

A bilge keel shall be fitted on each side of the vessel. Position, size and extension of the bilge keel shall be according to recommendations from the model streamline test or CFD calculations.

The Bilge keel shall normally extend 25 - 30 % of L<sub>pp</sub>.

The bilge keel are to be built of a bulb-profile without notches, and to be welded to a doubler plate on to the shell plating.

Bilge keel shall be effective and demonstrated.

## 266 Anchor pockets and hawse pipes

### Anchor pockets

Anchor shall be arranged PS and SB side as indicated on the General Arrangement.

In the anchor stowage area, the ship's shell plating shall be minimum 50% thicker than the adjacent plating in order to protect it from anchor flukes

"Frog eye" anchor arrangement to be provided, no anchor pockets.

For anchor type, ref. [431 Anchors with chains and equipment](#).

### Hawse pipe

One hawse pipe shall be fitted from each "frog eye", to the mooring deck. The upper end shall be adapted to ensure a smooth entrance of the chain.

- Pipe diameter approx. 508 mm
- Wall thickness approx. 20 mm

For washing system, ref. [813 Fire line/deck washing system](#).

## 267 Gutter, bulwark, railings and cargo rails (securing of deck cargo), freeing ports

### Gutters

Ship side and outer bulkheads in accommodation areas shall have gutters formed by flat bars. The flat bars shall be welded to the stiffeners, or the brackets for these. The flat bars shall be welded with double continuous fillet weld, intermittent welding is not accepted, ref. [251 Deck houses & superstructures](#).

### Bulwarks

On main- poop-, and forecastle deck bulwarks shall be arranged as shown on the General Arrangement plan.

### Freeing ports

Freeing ports and total area of these shall be in accordance with the International Load Line Convention.

## 268 Casing, funnel and ducts

### Casing

Casing with funnel shall be made of steel and arranged as shown on the General Arrangement plan.

Structural capacity of casing shall be specially considered for stiff support of the exhaust system and surrounding superstructure.

Special care shall be taken to insure exhaust to be taken well away from accommodation.

Special care shall be taken to reduce transmission of noise/vibrations from propeller and machinery to accommodation.

For the casing the following shall be arranged:

- Access by steel hatches and/or doors as shown on the General Arrangement plan
- Platforms by open grating on each deck level
- Openings for ventilation gratings and louvres according to [574 Ventilation systems for engine rooms](#).
- Exhaust pipe systems, ref. [742 Exhaust gas system](#).

### Ducts and trunks

Air duct(-s) with fans for ventilation of engine room shall be arranged according to the General Arrangement plan, ref. [574 Ventilation systems for engine rooms](#).

Trunks for cables and pipes shall be arranged as required. Capacity and layout of the trunks shall be carefully considered.

## 27 Material protection

### Paint Specification

A paint specification, describing all external paint systems, including preparation-, application-, and inspection procedures, shall be provided by the Yard.

The vessel's structural design shall fully comply with the Classification Rules and TSCF publications "Guidance Manual for Tanker Structures - Consolidated Edition 2022", and "Guidelines for Ballast Tank Coatings Systems and Surface Preparation - 2014 Revised Edition"

### Owner guidance for Hull corrosion protection:

#### PAINTING

The painting of the vessel's tanks (ballast, fresh water, potable drinking water and distilled water) and void spaces shall be carried out in accordance with the recommendations described in the publication of the *Tanker Structure Cooperative Forum* entitled "*Guidelines for Ballast Tank Coating Systems and Surface Preparation*" in accordance with table "*TSCF 15: Guide for minimum of 15 years - System Specification*".

## STEEL PREPARATION

All structural steel shall be shotblasted to ISO 8501-1 Sa 2 ½ standard with profile (Surface roughness) between 30 and 75 µm and painted with one (1) coat of ethyl zinc silicate-based shop primer.

Blasting should not be carried out when: the relative humidity is above 85%; or the surface temperature of the steel is less than 3°C above the dew point.

The cleanliness of the steel surface and the roughness profile shall be checked at the end of surface preparation and before applying the shop primer, in accordance with the manufacturer's recommendations.

The salinity limit for surfaces to be painted is 30 mg/m<sup>2</sup> of sodium chloride (milligrams per square meter).

## PAINTING SCHEME

The painting scheme and paint manufacturer shall be approved by the Owner.

The specification, preparation and application of the ballast tank paint system shall follow the recommendations for a 15-year system life, as defined in the SOLAS II-1 Convention and the INTERTANKO/TSCF Guide (TSCF 15: "Guide for minimum of 15 years - System Specification").

Petrobras Standards N-9, N-13, 1192, 1219, 1503 shall be considered for this purpose.

If there is a conflict between the TSCF 15 guide and one of the Petrobras reference standards, the minimum requirement indicated in the TSCF 15 guide shall be adopted.

The paint supplier shall provide a guarantee of 60 months from the date of delivery of the vessel (signing of the "Delivery and Acceptance Agreement"), assuming responsibility for the material and inspection costs of restoring the paint system of tanks (cargo, ballast, fresh, distilled and potable water) and voids, treated individually for the purpose of the guarantee, when they have paint faults that together represent an area involved in the repair greater than 2% of the area of the respective tank or void.

The paint supplier shall also provide a 60-month guarantee for the anti-fouling system, counting from the date of delivery of the vessel (signing of the "Delivery and Acceptance Agreement"), assuming responsibility for the material and inspection costs of recovering the hull's paint system when there are paint faults that together represent an area involved in the repair greater than 10% of the hull's area. The warranty conditions shall be in accordance with the manufacturer's standard conditions.

In order to achieve a good standard of preparation for painting inside all tanks (ballast, fresh, drinking and distilled water), and empty spaces, all structural elements in the areas to be painted shall be free of grease, oil, salts, dust, all structural elements in the areas to be painted shall be free of grease, oil, grease, dust, salts, weld spatter, porosity, double lamination and biting, and all sharp edges of internal structural elements (reinforcement corners, through holes, relief holes, scallops, etc.) shall be eliminated....), allowing the paint to be applied to edges smoothed with 3 (three) passes of grinding machine (3G), in accordance with grade P2 of the ISO 8501-3 standard. All edges and weld seams shall have a stripe coat after each general coat and before the last, i.e. if the paint scheme is two coats, two stripe coats of different colors shall be applied between the first and second coats.

A Surface Preparation Standard shall be issued, in accordance with the paint manufacturer's recommendations for roughness, edge treatment, cut-outs, welding and surface preparation prior to the start of manufacture, as specified above.

The agreed standards shall be followed by the Yard as a level of internal quality in the manufacture and treatment of structures.

The paint scheme shall be applied in accordance with the paint manufacturer's recommendations and other instructions for surface treatment, number of coats, film thickness (wet and dry), intervals between coats, application processes, temperature and humidity.

The parts welded by the Yard to support the scaffolding shall generally be removed, leaving only the

supports (or eyebolts) selected in agreement with the Owner.

Erection joint welds (block and ring seams) shall only be painted after the tightness test is completed.

The treatment of the area shall meet the ISO 8501-1Sa 2.1/2 standard.

Intermittent welding beads shall be made marking the water lines in normal ballast condition and at design load, executed during the assembly phase of the relevant blocks and before the internal coating is painted.

Tank boundary markings shall be made from steel plate measuring 100 x 20 x 6 mm and welded to the side, "boottop", vertical bottom and flat bottom before the internal plating is painted. All markings shall be provided during the assembly of the respective blocks according to detailed design. All the markings on the hull shall be painted with certified anti-fouling paint, in a contrasting color ("Munsell White") with the paint color of the rest of the vessel's hull.

The painting schemes defined in the table below shall be applied to surfaces blasted with ISO 8501-1Sa 2 ½ grade abrasive.

After fabrication, the structural blocks shall have the damaged areas shotblasted to ISO 8501-1Sa 2 ½ and the remaining areas where the shop primer is intact and within the expiration date, shotblasted to ISO 8501-1Sa 2 over at least 70% of the area.

After construction, the erection joint weld seams and the painted areas of the tank bottoms shall be shotblasted to ISO 8501-1Sa 2 ½ and the other damaged areas treated to SSPC-SP 11. In such damaged areas treated to SSPC-SP 11 standard, a minimum roughness profile of 50 µm is required. Dust removal from blasting shall be in accordance with ISO 8502-3.

No abrasive inclusions visible to the naked eye will be allowed.

All washing processes shall be carried out using clean fresh water, free from contaminants and with a pH ranging from 6,5 to 7,5.

Table 2.8 Location & Painting System

Location	Painting System
Live Works (Flat Bottom, Rudder, Vertical Bottom)	Up to the ballast draft waterline: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm d.f.t each (320 µm total); - Epoxy sealant (tie coat) - min. 1 coat thickness according to manufacturer's recommendations. - Anti-fouling system (Foul release), with silicone hydrogel, with or without biocides, for stays in port of up to 120 days (minimum). Guaranteed performance throughout the docking period. They shall comply with the IMO convention on anti-fouling paints without tin and cybutryne. Consider 60 months between dockings. Maximum speed loss factor of 1,5%. Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels. *
Live Works("Boottop")	Between the Ballast and Design/ Summer draft waterline: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm d.f.t each (320 µm total); - Epoxy sealant (tie coat) - min. 1 coat of 80 µm. - "Tin Free" anti-fouling system SPC ("Self Polishing Copolymer") - for stays in port of up to 40 days. Guaranteed performance throughout the docking period. They shall comply with the IMO convention on anti-fouling paints without tin and cybutryne. Consider 60 months between dockings. Maximum speed loss factor of 2,5%. CDP-type or hybrid anti-fouling paints will not be used under any circumstances. Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels. *

Dead Works (Ship's Side)	Above the draft corresponding to the waterline at the summer freeboard: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm each (320 µm total); - Finish: repaintable acrylic polyurethane, Petrobras standard N-2677 - two coats of 60 µm d.f.t. Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Main deck, accessories, deck equipment and its foundations, deck piping and supports, mooring accessories, masts, etc.	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm each (320 µm total); - Finish: repaintable acrylic polyurethane, Petrobras standard N-2677 - two coats of 60 µm d.f.t. Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
External areas of the superstructure, hatchway, deckhouses, masts and funnel, including all external decks (except the main deck), fittings, deck equipment and its foundations, pipelines, and so on decks and supports, etc.	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm each (320 µm total); - Finish: repaintable acrylic polyurethane, Petrobras standard N-2677 - two coats of 60 µm d.f.t. (120 µm total). Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Bulkheads and underdeck of internal areas of the superstructure, engine room, hatchway, deck store/ lockers and funnel.	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. One coat of 160 µm; - Finish: repaintable acrylic polyurethane, Petrobras standard N-2677 - two coats of 60 µm d.f.t. (120 µm total). Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Piping and their fittings, piping supports, interior decks and platforms, floors, equipment quarries, etc. In internal areas of the superstructure, engine room, hatchway, deck lockers and funnel.	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 150 µm each (300 µm total); - Finish: repaintable acrylic polyurethane, Petrobras standard N-2677 - two coats of 70 µm d.f.t. (140 µm total). Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Engine room tank top, including equipment's foundation, piping, accessories and supports.	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 150 µm each (300 µm total); - Finish: repaintable acrylic polyurethane, Petrobras standard N-2677 - two coats of 70 µm d.f.t. (140 µm total). Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Cargo and Slop tanks slop Total painting Note: The last coat inside the cargo tanks shall be white and have edge retention properties	Anti-corrosion system: - Painting total area; - Epoxy paint "Novolac" ", Type II, - min. 450 µm. If the scheme uses a different number of coats, the thickness of each coat shall follow the manufacturer's guidelines. In this case, the paint for the first coat shall contain additives for inspection with ultraviolet light. In the case of two coats, the colors shall be different. The paint system shall not soften or become impregnated with the product when transporting the products described in item 2.1.
Empty spaces ("voids and cofferdams")	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm each (320 µm total); Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Ballast tanks and empty spaces Total painting Note: The final coat inside ballast tanks, cargo tanks and cofferdams shall be white and should preferably have edge retention properties.	Anti-corrosion system: - Painting total area; - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm each (320 µm total); Last coat in accordance with Petrobras standard

	N-1503 - Colors for Painting Vessels.
Fresh, distilled and drinking potable water tanks Total painting	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm each (320 µm total); Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels. For the drinking water tank, the paint shall have FDA approval and a certificate of potability or similar.
Galvanized surfaces	One coat of isocyanate epoxy wash primer, or equivalent, as recommended by the paint manufacturer responsible for supplying the paint scheme + anti-corrosion paint scheme and finish specified for the area.
Fans and exhaust hoods	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 150 µm each (300 µm total); - Finish: repaintable acrylic polyurethane, Petrobras standard N-2677 - two coats of 70 µm d.f.t. (140 µm total). Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Stainless steel, CuNi, FRP pipes, etc	1st coat TASF, 2nd and 3rd coats to Petrobras Standard N-2677 of 60 µm d.f.t. (120 µm total)
Galvanized pipes	1st coat TASF, 2nd and 3rd coats to Petrobras Standard N-2677 of 60 µm d.f.t. (120 µm total)
Anchors	Petrobras Standard N-2680 160 µm
Anchor Chain (Length connections only)	Petrobras Standard N-2680 150 µm

## (\*) Note:

1. The anti-fouling paint scheme specified above shall be considered a minimum specification. If assessed by the designer, more efficient schemes can be adopted to help achieve the required EEDI;
2. The paint used to identify tank limits, draft marks, bottom plugs and any other marking shall be confirmed and have the same properties as the anti-fouling system applied to the hull.

The paint for the last coat inside ballast tanks, cargo tanks and empty spaces shall be white and should preferably have edge retention properties.

PETROBRAS N-2680 paint, when applied to tanks (cargo, ballast, fresh water, drinking water and distilled water), empty spaces, external hull (flat bottom, vertical bottom, boottop and ship's side) and gates (Engine Room and Pump Room), shall show a result greater than or equal to 12 MPa in the pull-off test, according to ABNT NBR 15877, with a failure standard of "Y" or "Z".

Paint schemes on ballast tanks shall meet the requirements of IMO PSPC-WBT standards (MSC 215 (82)).

Table A.2 - Internal Areas - Superstructure

Area	Period	Painting Treatment			Paint (Petrobras Standard)		
		Before Shop Primer	Shop Primer	After Shop Primer (See the note below)	1° Layer	2° Layer	3° Layer
Bulkhead and ceiling without isolation	Construction	As 2 1/2	zinc shop primer 15 µm	WJ-2	N-2680 160 µm	N-2677 60 µm	N-2677 60 µm
	Maintenance	SP-11	xxx	Washing 3 000 psi + SP-11	N-2680 160 µm	N-2677 70 µm	
Bulkhead and ceiling with isolation	Construction	As 2 1/2	zinc shop primer 15 µm	WJ-2	N-2680 160 µm	xxx	xxx
	Maintenance	SP-11	xxx	Washing 3 000 psi + SP-11	N-2680 160 µm	xxx	xxx
Floor without Coating	Construction	As 2 1/2	zinc shop primer 15 µm	WJ-2	N-2680 160 µm	N-2680 160 µm	anti-slip coating
	Maintenance	SP-11	xxx	Washing 3 000 psi + SP-11	N-2680 160 µm	N-2680 160 µm	anti-slip coating
Floor with Coating	Construction	As 2 1/2	zinc shop primer 15 µm	xxx	xxx	xxx	xxx
	Maintenance	SP-11	xxx	Washing 3 000 psi + SP-11	xxx	xxx	xxx
Refrigerated provision compartment	Construction	As 2 1/2	zinc shop primer 15 µm	WJ-2	N-2680 160 µm	N-2680 160 µm	xxx
	Maintenance	SP-11	xxx	Washing 3 000 psi + SP-11	N-2680 160 µm	N-2680 160 µm	xxx

NOTE: All washing and hydrojetting processes shall be carried out using clean freshwater, free from contaminants, with a pH ranging from 6.5 to 7.5.

## PAINTING MANUAL

The Yard will prepare and deliver with the on-board final plans, in a number of copies as specified, a detailed "Painting Manual" containing the following information for each compartment / location:

- Compartment name / location;
- Full description of the treatment and paint scheme applied, type of paint and its trade name, thickness (d.f.t.) per coat and colors;
- Total detailed painted area of the compartment / site ( $m^2$ ), for example:
- Main deck - plating;
- Main deck - accessories, net supports, etc;

- Main Deck - piping (per pipe);
- Flat bottom (up to the height of the bilge);
- Vertical bottom;
- Boottop;
- Ship's Side;
- External Superstructure bulkheads;
- Ballast Tanks - total per tank and, for each tank, subdivided into regions such as:

o Upper region: area from the deck to the upper surface of the first stringer;  
 o Intermediate region: area from the lower surface of the first stringer to the upper surface of the lowest stringer;  
 o Lower region: area from the lower surface of the lowest stringer to the bottom plating.

- Cargo and Slop tanks: total per tank;
- Engine Room - plating (bulkheads, decks and platforms);
- Engine Room - piping, supports and accessories.
- Bosun Store - plating (bulkheads, decks and platforms);
- etc.

This manual shall include the cargo compatibility list of the paint used in the cargo and slop tanks, containing information on all the products for which it has been tested, including the products that are not listed in item 2.1.

The document shall include all the datasheets of the products used, as well as all the product certificates required by the rules and regulations (anti-fouling, ballast and cargo tanks, etc.).

#### COATING TECHNICAL FILES

A Coating Technical File ( SOLAS XII/6.3 and MSC.1/Circ.1198) shall be prepared by the Yard in accordance with the applicable rules and regulations, containing the paint scheme, products applied and their respective data sheets and certificates, all the vessel's paint reports, list of deviations, inspection and maintenance/repair procedures during the vessel's construction and operation. This document shall be approved by the Classification Company and the Owner.

**(End of Owner guidance for Hull corrosion).**

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#### Galvanizing

Galvanising of pipes shall be carried out after all welding and treatment has been completed, with a heavy duty coating of zinc of not less than 400 g/m<sup>2</sup> (55 microns). Unless stated otherwise in this specification, the following items shall be hot dip galvanised:

- External stairs
- Pipes and flat bars in external railing
- Internal ladders in fresh water, ballast and coated cargo tanks
- External cable pipes and trays
- External gratings and walkways, unless GRP
- Flag staff and fittings
- Steel fittings on gangway
- Anchor chain (short length)
- Chain locker perforated plate
- Steel fitting refrigerated and provision store

- Small steel loose fitting on masts
- Strainers in sea chest
- Covers for bilge wells
- Perforated plates in chain lockers

For sea water systems, ref. [721 Sea water cooling system](#).

Pipe galvanizing shall be according the different pipe system descriptions, ref. [7 System for Main Engine Components, Table 7.1](#)

Galvanized equipment shall be painted with suitable primer coat if required, after which painting shall be same as surroundings except for the following:

- Galvanised steel sheet in accommodation
- Galvanised parts of air handling units
- Galvanised steel sheathing for heater insulation
- Galvanised steel sheet for exhaust pipe covering

## 278 External cathodic protection

The ship's hull shall have cathodic protection against corrosion.

### Impressed Current Cathodic Protection System

An impressed current cathodic protection system shall be provided to protect the wet surface of the hull, including the rudder and propeller, with anodes on both sides (PS and SB).

The system shall be designed in accordance with the requirements of Standards N-2838, DNV GL RP-401 and DNV GL RP-101. The sizing of the system shall take into account an average coating failure factor of 20% for the largest area of wetted surface (live work area) and a final coating failure factor (for the period between dockings) of 30%.

Grounding devices shall be fitted to the intermediate shaft and the rudder stock.

The system shall have an output interface so that the voltage and current values of the anodes, the voltage of the reference cells and the automatic/manual mode indication can be monitored on the IAS.

### Anodes

A five (5) years system for normal conditions shall be provided. Anodes of suitable type shall be used. The size, numbers and location of anodes shall be determined by calculations. The anodes shall be bolted to doubling plates on the hull. The bolts shall be of stainless steel.

Extra anodes shall be arranged during the building phase if required. Bottom inspection shall be carried out by the Yard prior to delivery of the vessel and anodes corroded more than 10% shall be replaced.

Bolted anodes shall be provided in the following locations:

- Ballast tanks;
  - Sea chests;
  - Rudder and Recess of Rudder Stock;
- The mass of anodes required shall be calculated in accordance with the requirements of Standards N-2838, DNV GL RP-401, DNV GL RP-101 and the following parameters:
- Life Cycle of anodes: 5 (five) years;
  - Percentage of time the anode is submerged:
    - Ballast tanks: 50%;
    - Recess of rudder stock and sea chests: 100%;
  - Coating efficiency factor: 80%;

- Anode efficiency factor: 85%.

Obs: Zinc anodes shall be used in the ballast tanks and zinc or aluminum in the sea chest and rudder stock recess.

Protection density must comply with the referenced standards. For sea chests and rudder stock recess, protection density shall be at least 100 mA/m<sup>2</sup>.

#### **Marine Growth Prevention System**

A Marine Growth Prevention System (MGPS) shall be installed in the sea chests, ref. [721 Sea water cooling system](#).

## **28 Material protection, internal**

For material protection internal, please see group 27. [27 Material protection](#)

## 3 EQUIPMENT FOR CARGO

Cargo handling equipment and arrangement shall fulfil the requirements for carrying oil products covered by the vessel's technical specification, Classification Society noations, rules and regulation.

### 30 Hatches

Emergency exit- and other access hatches, cargo-, provision- and stores hatches shall be fitted as indicated on the General Arrangement. Open deck hatches shall be of weathertight or watertight type as required by the Classification Society. Flush and cargo tank hatches shall be fitted as indicated on the General Arrangement. Manholes shall be arranged for access to tanks.

All hatches fitting to be SS316L.

#### 301 Hatches on weather decks

##### Hatches

Main hatches in decks shall be installed according to General Arrangement plan.

Table 3.1 Hatches on weather decks

ID / Description	Deck	Size (approx. light opening)	Position (Frame number)	Deck load	Flush/ Coaming	Hinges	Cover	Remark
Cargo tank hatches	Main deck	Ø 900 mm	See GA	-	Coaming 800 mm	Outboards / side swing	Normal steel	12 pcs. Coated as tanks inside. Guard stanchions
Slop tank hatches	Main deck	Ø 900 mm	See GA	-	Coaming 800 mm	Outboards / side swing	Normal steel	12 pcs. Coated as tanks inside. Guard stanchions
Hatch to engine workshop / Store	Poop deck SB	1750x1450 mm	10-12	-	Coaming 600 mm	Fwd.	Normal steel	Counterbalance
Hatch to engine room	Poop deck PS	3000x1900 mm	7-11	-	Coaming 600 mm	SB	Normal steel	

Hatches shall as a minimum be provided with required fire rating of the deck division they are installed.

All hatches with steel coamings shall be fitted with stainless steel roundbar on top for mating surface towards hatch seal.

All hatches mechanisms to be SS 316.

Locking device in open position shall be arranged if hatches can not be open above approximately 135°.

#### 302 Hatches on internal decks

##### Hatches

The hatches installed on internal decks are given in the table below.

Table 3.2 Hatches on internal decks

ID / Description	Deck	Size (approx. light opening)	Position (Frame number)	Deck load	Flush/ Coaming	Hinges	Cover	Remark
Hatch to lower engine room	Main deck PS	3000x1900 mm	7-11	-	Flush with steel deck	side/SB	Steel, uninsulated	Guard stanchions
Hatch to lower engine room	Main deck SB	2000x2000 mm	14-17	-	Flush with steel deck	forw.	Steel, uninsulated	Guard stanchions
Hatch to incinerator	Poop deck	800x800 mm	10-11 PS		Flush with steel deck	side/SB	Steel	Guard stanchions

Hatch cover to lower engine room shall be arranged with lifting eyes, and lifting points shall be arranged above the hatch for manual chain tackle.

Locking device in open position shall be arranged if hatches can not be open above approximately 135°.

### 304 Smaller hatches, emergency hatches and manholes

Steel hatches, with a size according to the National Authorities requirements (free opening minimum 800 x 600 mm), shall be fitted as emergency exits.

Access hatches and store hatches shall be arranged as indicated on the General Arrangement and described in [Table 3.3](#).

Hatches on open deck shall be weathertight with steel comings and steel covers, upper edge of comings shall be stainless steel round bar.

Access step(s) on the side of the hatch coaming shall be arranged.

All emergency hatches shall have a central closing device, ISPS cover and shall have counter balanced covers.

The height of comings shall be in accordance with the "International Load Line Convention".

Hatches shall as a minimum be provided with required fire rating of the deck division they are installed to.

Table 3.3 Smaller hatches and emergency hatches

ID / Description	Deck	Size (light opening)	Position (Frame number)	Indication on bridge	Flush/ Coaming	Hinges	Cover	Remark
Emergency escape from methanol fuel treatment room	Poop deck	800x600 mm	~Fr 45-46 PS		Coaming 600 mm	Fwd.	Steel	
Emergency escape from pump room	Poop deck	800x600 mm	~Fr 45-46 SB		Coaming 600 mm	Fwd.	Steel	
Emergency escape from steering gear room	Poop deck	800x600 mm	~Fr -1-0		Coaming 600 mm	SB	Steel	
Rope hatch	Poop deck	Ø 350 mm	~Fr -2 SB		Coaming 600 mm	Aft.	Steel	A rope hook shall be

ID / Description	Deck	Size (light opening)	Position (Frame number)	Indication on bridge	Flush/ Coaming	Hinges	Cover	Remark
								provided inside the rope hatch.
Rope hatch	Forecastle deck	Ø 350 mm	~Fr 98 PS/SB		Coaming 600 mm	Fwd.	Steel	A rope hook shall be provided inside the rope hatch.

### Tank cleaning hatches

Each cargo tank shall be fitted with three (3) tank-cleaning hatches for use with portable tank - cleaning machines.

Slop tanks shall have two (2) tank cleaning hatches.

These hatches shall be positioned for total coverage of cargo tanks internally, according to shadow diagram.

One of these hatches shall be arranged with sight glas, seal and steel hatch cover on top, and shall be placed above of the cargo pump suction well.

Table 3.4 Tank-cleaning hatch data

Number of units	minimum 40
Type	Circular, with hinge and three cleats (Refer to CB/T 3728-95)
Dimensions	To suit tank cleaning machine (Ø 355 mm) Height abt. 250 mm above deck according to rules
Materials	Mild steel with stainless steel rim, AISI 316 Coated internally as cargo tanks Inspection hatch to be stainless steel, AISI 316 L
Packing type	Double packings, resistant acc. to cargo list. (PTFE)

One ball valve for connecting portable closed Ullage / cargo sampling system placed in deck outside in aft part in each cargo & slop tank. One stainless steel pipe with a lot of holes, connected with ball valve and down to abt. 25 mm - 50 mm over the tank top. These pipes need to be well supported in the aft bulkhead. To prevent damages to tank bottom a welded plate of 10 mm stainless steel shall be located just below the pipe.

### Manholes

Trunk hatches for access to ballast tanks (upper edge shall be stainless steel round bar) 800 x 600 mm, height approx. 600 mm or as per rule requirements. Located as far as practical to ship side.

Watertight manholes of 600 x 600 mm for openings, with mild steel bolted cover shall be provided on all FW tanks and other tanks not mentioned above.

Each water ballast tank in cargo area to be provided with manholes according to rules and regulations. In cargo area vertical openings shall be 800 x 600 mm.

Oil-tight manholes of 600 x 400 mm for vertical openings, oval with mild steel bolted cover shall be provided on each fuel oil, gas oil and lubrication oil tanks.

To rudder trunk, each tank in engine room, aft peak tank, forepeak tank, closed cofferdams and other closed spaces, there shall be arranged manholes, 600 x 600 mm (horizontal openings), and 600 x 400 mm (vertical openings).

All vertical manhole covers to be fitted with hand grips.

Other manhole covers to be fitted with hand grips as required, type of hand grips to be approved by owner. Thickness not less than the adjacent plating.

Cover to be bolted with welded-on stainless steel bolts and stainless steel nuts.

## 31 Equipment for cargo in holds/on deck

### 316 Canvas covers

Tarpaulins of PVC covered material to be provided for the following equipment and fittings on weather deck:

- Mooring drums of deck machinery
- Control stand of deck machinery
- Wire and mooring storage reels
- Winch drums of life boat davits
- Winch drum of accommodation ladder
- Embarkation rope ladders for life rafts
- Pilot ladders
- Navigational equipment
- Searchlights
- Magnetic compass and projector compass
- Ventilation tops
- Electrical motor for pumps on deck. Cover for the complete electr. motor.
- All P/V valves for cargo and slop tanks.
- Rescue boat

Material of tarapaulins to be checked by Owner, before ordering.

## 33 Deck cranes for cargo

### General

The vessel shall be equipped with electro-hydraulic deck cranes as indicated on the General Arrangement. The cranes shall be of marine design for shipboard use in open sea.

### 331 Rotating cranes with crane pillars

#### Provision- and Rescue boat Crane

Two(2) electro-hydraulic cranes shall be installed on 2. accommodation deck, one SB and one PS. One of the cranes (SB) shall be approved for launching of Rescue boat and liferafts, and shall also serve the hatch to machinery area.

Fittings, bolts, pipes maneuvering levers etc. to be of stainless steel.

Table 3.5 Provision- Rescue boat crane data

Type	Cylinder luffing and knuckle beam slewing crane.
Capacity	2.5 t SWL/8,2 m outreach
Slewing angle	360 degree
Operation	Motion by control levers on the crane and wireless remote operation from tank deck

Power supply	<a href="#">Table 8.6</a>
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Table 3.6 Service crane data

Type	Cylinder luffing and knuckle beam slewing crane.
Capacity	8 t SWL/8,2 m outreach
Slewing angle	360 degree
Operation	Motion by control levers on the crane and wireless remote operation from tank deck
Power supply	<a href="#">Table 8.6</a>

### 334 Other cranes with equipment

#### Hoose handling crane

One (1) electro-hydraulic crane of marine type shall be installed on main deck near the after end of cargo manifold station, suitable for cargo oil hose handling and handling of the Accommodation ladders.

Fittings, bolts, pipes maneuvering levers etc. shall be of stainless steel.

Hose handling crane to be fully compliant with OCIMF specification.

Table 3.7 Hose handling crane data

Type	Cylinder luffing and knuckle beam slewing crane.
Capacity	10.0 tons at 20.0 meters outreach
Slewing angle	360 degree
Operation	Motion by control levers on the crane and wireless remote operation from tank deck
Min out-reach	4.0 m outboard of ship side in line of cargo manifold
Hoisting speed	10 m/min on full load, 20 m/min with light hook
Power supply	<a href="#">Table 8.6</a>

## 35 Loading/discharging pumps & systems for liquid cargo

#### General

The cargo handling system shall consist of submerged pumps and deck piping for each cargo tank.

The cargo pumps shall be electrically driven, each equipped with a dedicated frequency converter for individual rpm control. See [Figure 0.1](#)

Slop tank cargo pumps to be submersible with same working pressure as for main cargo tanks.

The cargo tank no.6 SB to be combined cargo tank / methanol fuel tank.

The cargo pumping system shall be designed to facilitate easy loading and cleaning operations, and to eliminate cargo pockets or collecting points within the system.

The vessel to be designed with 6 cargo segregations.

Cargo VDR monitoring system for monitoring reactive/inhibited cargo temp/press during voyages.  
Cargo monitoring system to have possibility to log data and print status after voyage.

Cargo system to be designed in co-operation with owner.

Maximum cargo tank loading temperature to be 50 deg.

Maximum noise level during full discharge not to exceed 85 db (A) on main deck at ship side.

Table 3.8 General design criteria for discharge and loading:

Pressure head at manifolds:	100 MLC
Cargo density	0.9 t/m <sup>3</sup>
Cargo viscosity	18,2 cSt at 50°C
Design discharge time	Abt. 18 hours at design criteria with 6 cargo pumps running simultaneously, incl. stripping.
Maximum discharge rate	1200 m <sup>3</sup> /h at 100 MLC., Density 0.9 t/m <sup>3</sup>
Maximum loading rate	800 m <sup>3</sup> /h per tank / total 4800 m <sup>3</sup> /h. (Not loading through pumps)
Flow speed	The maximum flow velocities in the piping will be as follows: · unloading: 5 m/s; · Loading: 5 m/s;
Segregation	<ul style="list-style-type: none"> <li>• Simultaneous discharge of six (6) grades via separate pumps and manifolds.</li> <li>• Simultaneous loading of six (6) grades over manifolds and direct drop lines to cargo tanks, using common vapour line or venting to atmosphere if allowed by terminal operator. Full segregation . SEUT type valve segregation.</li> </ul>
Cargo drop line	The cargo drop line to be DN200 and positioned oposite of cargo pumps
Cargo loading time	Simultaneous loading of up to 6 (six) products shall be carried out in a maximum of 10 (ten) hours, considering that loading is carried out exclusively by drop lines, i.e. without passing through the cargo pumps and considering products with a viscosity of 18,2 cSt at 50°C and a density of 0,85 t/m <sup>3</sup> .

### 351 Loading/discharging systems

Deepwell cargo pumps to be installed, one pump for each cargo and slop tank. Two (2) fixed pneumatic diaphragm pumps will be provided, suction from drain tanks, tank deck, manifold drip tray. One (1) portable pneumatic diaphragm pump shall be arranged that can be connected with hoses to different locations. All cargo and slop pumps are delivering to discharge crossover manifolds. Cargo pumps and slop pumps are all single suction submerged pumps.

Each deepwell cargo pump shall be arranged in the after part of each tank.

Suction shall be arranged from suction wells in starboard and port tanks.

Table 3.9 Cargo pump data

Number of units	Twelve (12) (Including the two combined methanol fuel / cargo tanks in aft part of cargo area)
Type	Deepwell, single-stage centrifugal pumps, integrated with the vessel's flue gas inerting system for purging.
Design capacity	Abt. 200 m <sup>3</sup> /h each.
Design pressure at manifold	100 M.L.C., S.G. 0,9 t/m <sup>3</sup> .
Materials, pump impeller, stack	Acid resistant stainless steel, (AISI 316L)

Drive	Stepless electric motor (Frequency regulated 1-100%)
Mounting	Vibration damping resilient mount.
Seals (O-ring)	Teflon / Viton
Shaft seal	Mechanical seal. Double teflon lip seals running on ceramic sleeve against cargo side. Seal arrangement to withstand dry running during stripping and tank washing.

Table 3.10 Slop pump data

Number of units	Two (2)
Type	Deepwell, single-stage centrifugal pumps, integrated with the vessel's flue gas inerting system for purging.
Design capacity	Abt. 100 m <sup>3</sup> /h
Design pressure head at outlet	100 M.L.C., S.G. 0,9 t/m <sup>3</sup> .
Materials, pump impeller, stack	Acid resistant stainless steel, (AISI 316L)
Drive	Stepless electric motor (Frequency regulated 1-100%)
Mounting	Vibration damping resilient mount.
Seals (O-ring)	Teflon / Viton
Shaft seal	Mechanical seal. Double teflon lip seals running on ceramic sleeve against cargo side. Seal arrangement to withstand dry running during stripping and tank washing.

The pumps shall also work satisfactorily, with reduced capacity, at higher pressures and higher viscosity.

Cargo pumps shall be fitted with stripping pipes to the deck.

Manual purging system of pump and cargo lines shall be provided. Consideration will be given for efficient stripping system of the cargo pump stack and pipes in accordance with regulations.

Cargo pumps shall have the operation controlled locally at the pump stack and remotely from cargo control station.

Emergency stop button, protected by a stainless steel box, shall be situated at both sides of the manifolds and at the cargo control station. There should also be one possibility to have one remote emergency stop button in order to be placed at the berth and also pump side in pipe trunk.

Remaining cargo in pump suction wells after completion of discharge not to exceed 75 litres.

Ability to read cargo discharge pressure from cargo control station and locally at stack.

Cargo pumps shall be fitted with stripping pipes connected to the cargo manifolds on the manifold valve discharge side.

Table 3.11 Portable cargo pump for emergency discharge

Number of units	One (1)
Type	Submerged, centrifugal
Design capacity	Abt. 100 m <sup>3</sup> /h
Design pressure head at outlet	70 M.L.C., S.G. 0,9 t/m <sup>3</sup> .
Materials, pump impeller, stack	Acid resistant stainless steel, (AISI 316L)
Drive	Hydraulic

Materials against cargo	Stainless steel (AISI 316L)
Hoses for cargo/hydraulic	Acid resistant and electrically conductive

## 352 Loading/discharging systems on deck

### General

Arrangement of cargo system to be presented to Owner for approval before commencement of work.

Suction wells designed to comply with pump manufacturers recommendations and class requirement to be fitted in each cargo tank double bottoms and main deck for slop pump's suction.

All piping and equipment in cargo systems shall be designed for 16 bar.

All nuts and bolts used in connection to the cargo piping to be stainless steel AISI 316. Spring washer to be used for flange connection.

Lines from each pair of cargo and slop pump to be led to separate cross overs for each pair of cargo and slop tank. Each cross over to be connected to two collecting manifolds.

Each cargo tank to be fitted with separate direct loading drop line by-passing the cargo pump and extending to 0.25 \* pipe diameter (mm) above tank bottom with 90 degrees end elbow.

Variable Speed Drives (VSDs) for cargo pumps shall be installed in an air-conditioned compartment.

The cargo pump intended for the tank that may be converted to carry alcohol-based alternative fuel in the future shall be suitable for pumping alcohol-based products.

Each cargo tank shall be loaded via drop lines arranged from the loading manifolds of each segregation. Drop lines shall be positioned in front of each cargo tank and discharge into the lower area of each tank, approximately 500 mm from the bottom plating. Reinforcement doubler plates with anti-abrasive paint shall be fitted on the bottom plating below each drop line. Drop line branches shall be symmetrical with respect to the vessel centerline and equipped with isolation valves installed as close as possible to the cargo line. These valves shall be provided with remote control of the continuous (partial opening) type.

Emergency ballasting of the cargo tanks (heavy ballast) shall be performed by the ballast pumps or the tank cleaning pump via a branch of the ballast line on main deck, connected to the cargo line by means of a removable spool piece. Deballasting operation shall be carried out by the cargo tank's own cargo pump through a high discharge branch, supervised and controlled by the oil discharge monitoring equipment (ODME).

The cargo pipes shall be supported on resilient Teflon packings on pipe stools with stainless steel clamps, to reduce the transmission of noise and vibration. The stainless steel clamps shall be imbedded with Teflon packing.

For piping systems on exposed decks, corrosion protection fittings shall be installed at all contact points between the piping and horizontal or vertical supports, including the fixing devices on the supports. Corrosion protection systems used shall be equivalent in performance and reliability to recognized solutions in the market (e.g. provided by Deepwater Corrosion Services).

All branches and other welded connections shall be flush inside the cargo pipe.

All cargo piping to have welded connections, with minimum flanged joints.

(Threaded joints except transmitter and sensor are not permitted.)

Removal of pumps shall not require dismantling of other pipes than those directly connected to the pumps.

Delivery lines to be arranged with expansion bends to compensate for thermal expansion in piping.

Pipe diameter to be suited to pump size ensuring good flow characteristics in accordance with pump suppliers recommendations.

Cargo pipes maximum flow rates:

- Pump discharge: 5 m/s;
- Loading: 5 m/s.

All cargo piping shall be fitted and arranged with gradient such that the residue in the line or discharging system can be reduced to a minimum (latest IMO regulations). Drain valves to be provided at low points, connected to a blowing line, ending in slop tank. Local drain valve with plug shall be arranged after each non-return valve of the cargo pump and slop pump.

Earthing of all piping shall be arranged.

The following pipe diameters are as general guidance, and will vary at certain locations:

Table 3.12 Cargo pipe dimensions

Pipes	Diameter
Discharge/loading line cargo tanks	DN 200
Discharge/loading line slop tank	DN 150
Dropline for loading	DN 200
Shore connections, Manifold	DN 250
Stripping lines to cargo pumps	DN 65
Crossover pipe	DN 250

### Cargo valves

All cargo valves to be suitable for use with a widest possible range of applicable cargoes, such as MTBE, Unleaded gasoline, Viton GF etc.

Cargo valves at cargo pump outlet and at drop line, to be of AISI 316 stainless steel, single-piece, throttle type (0-100%), butterfly type valves.

All cargo manifold valves to be steel butterfly type with hydraulic actuators. Valve control to be provided both locally and from IAS.

Folding blind flanges to be fitted on all manifold connections. The arrangement shall fully comply with OCIMF recommendations.

Each separate cross over to be separated from collector manifolds by two steel butterfly valves (on-off), fitted with hydraulic actuators.

Valve control to be provided both locally and from SSCI. In the spool piece between the two valves, there shall be a drain pipe DN 25 stainless steel and ball valve leading to the manifold drip tray (leakage control system).

Drain and purging valves to be DN25 stainless steel ball valves with cam lock quick coupling connection.

All the stainless steel ball valves shall have a lock at the handle.

All the drain valves shall be arranged with plug of stainless steel, and the quick coupling shall have cap.

## Hydraulic Control System for Cargo and Ballast Valves

An electro-hydraulic control system shall be provided for the remote operation of all cargo and ballast valves, except sea chest, drain and interconnection valves. The system shall include at least:

- One (1) compact Hydraulic Power Unit (HPU) with two pumps (one standby), oil tank, accumulators, filters with bactericidal device, local control and pump start panels.
- The Hydraulic Units shall each have a C.J.C. (C.C. Jensen) or similar off-line filtering system, and the system shall have a minimess or similar oil sampling outlet, enabling a representative quantity to be taken for analysis in accordance with the manufacturer's recommendations or best industry practice.
- The minimum volumetric capacity per minute of each pump shall be 10% of the total volume of the actuators.
- The minimum volume of the accumulator shall be 10% of the total volume of the actuators.
- The minimum volume of the hydraulic oil tank shall be 20 times the total volume of the actuators.
- Remote operation shall be possible, with the same functions as the local panel, via the IAS.
- In addition to remote control, the manifold valves shall have local hydraulic manual control.
- The opening and closing indications of the valves, as well as the hydraulic unit variables, shall be monitored by the IAS.
- The solenoid control valve sets shall be installed in the hydraulic unit compartment controlling the valves located midships aft of the vessel, and in the bosun store controlling the valves located midships forward of the vessel.
- Two (2) portable hand pumps, for emergency use, with pressure gauge, built-in oil tank and quick-connect hoses for manual emergency operation.
- Tubing material SS316L or 6Mo (NS31254) for sea spray areas. All tubing shall be installed in multi-tube arrangement with expansion loops.
- Double-acting actuators with analog position indication or flow position indicators where direct visual confirmation is not possible.
- On/off valves with feedback devices for indication of fully open and fully closed position; continuous valves on drop lines and pump discharges shall have analog indication of opening.
- All valves shall be IAS-integrated with full supervision of position, alarms for failure to open/close, and valve control interface.
- Manual emergency operation shall be possible via hand pump coupling, located nearby or in grouped boxes on deck for inaccessible valves.
- The system shall provide interlock for overboard ballast discharge based on ODME oil content signal, as per MARPOL limits.

## Cargo manifolds

The Oil Companies International Marine Forum's (OCIMF) Standard for Tanker Manifold and Associated Equipment, latest issue), to be FULLY complied with.

One crossover to be arranged for each pair of cargo and slop tanks. Crossovers to be of AISI 316L stainless steel. Total crossovers are six (6) for cargo tanks and two (2) for slop tanks.

Two (2) collecting manifolds to be arranged. All six (6) cargo and two (2) slop crossovers to be connected to two (2) collecting manifolds with 2-valve segregation.

In addition to the slop tanks, cargo tank no. 6 PS will be used for receiving oily residues and shall be equipped with the necessary and required piping arrangement.

Crossovers to be set down towards centre for drainage, with lowest point at cargo line connection.

Each cargo crossover and collecting manifold to be furnished with pressure gauges outboard of crossover valve. The pressure gauge to be of glycerine filled type with shut-off stainless steel valve.

All manifold flanges shall be sized as per the respective piping. Manifold flanges to be vertical, fixed, separate and arranged for easy use of reducers. Manifolds to be arranged to avoid spillage on disconnecting hoses.

All presentation flanges to be of ANSI type and to be "in-line".

Each cargo crossover to have connection for purging.

One 3/4 " shut-off ball valve with non-return valve shall be provided at each crossover inboard of connection valve, with snap coupling, for air/flue gas connection.

A strong saddle support to be arranged close to cargo manifold flanges.

Each loading connection at the cargo manifold shall be equipped with a pressure gauge, thermometer and sample connection. The pressure gauge and thermometer shall be installed with a protective housing. Sample connections shall be drip flange type in accordance with ISO 3170 or ASTM D-4057.

The foundation of each spill tank in the cargo manifold area shall be of flanged type, bolted to the vessel's structure.

Each loading connection shall be provided with a fold blind flange. Heated anti-pollution trays shall be arranged in accordance with OCIMF recommendations. Each tray shall be equipped with drain piping fitted with double-isolation valves and a connection for portable compressed air pump, allowing discharge to the PS slop tank. A pressure transmitter shall be provided for each cargo segregation, with indication available in the IAS. Two (2) pneumatic diaphragm pumps shall be installed in bypass arrangement on the residue line, to assist with draining trays and connections.

Vent lines connected to the manifolds shall be fitted with double-isolation valves.

#### **Drip trays, etc.**

Drip trays with stainless steel AISI 316L gratings shall be fitted beneath port and starboard manifolds. Material of angle bars for supporting the gratings to be of stainless steel, and Teflon packing to be used between the grating and supporting angle bars. Material of drip trays shall be of mild steel and coated same as cargo tanks. Size and volume of trays shall as far as practical be according to OCIMF regulations. Upper edge around drip tray under cargo manifold to be round bar AISI 316

Drain tanks under drip try should be made in the same size, length and breath as drip try.

Drip trays and drain tanks to be connected with drain lines to the membrane pump and further to slop tanks.

The drain lines to be fitted with stop valves. Drain lines to be of stainless steel, AISI 316 L.

Drip tray with stainless steel grating, AISI 316L, also to be arranged on 01-poop deck forward of accommodation. Drain to drain wells on main deck below to be arranged.

Each drip tray shall be provided with a 150 mm drain with manual valve connected to the closest aft cargo tank through a U-shaped seal.

The foundation of each spill tank (drain tank) fitted for drip trays shall be of flanged type, bolted to the vessel's structure.

A gate with rubber packing at bottom to be arranged outside, in front of accommodation.,

### **Oil discharge monitoring system**

Arrangement for using one of the slop tanks below main deck as primary slop tank and the other one as secondary slop tank, including slop tank equipment and piping arrangement according to MARPOL to be provided.

In addition to the slop tanks, cargo tank No. 6 PS will be designated for the reception of oil and water residue, and it must be equipped with the necessary piping for this purpose.

Monitoring points in each cargo discharge line to be fitted.

One oil discharging monitoring and control unit shall be provided in deckhouse / cargo control station in accordance with the requirement of MARPOL 73/78 Annex I.

The system comprises for the following main components:

- Oil content monitor
- Flow meter system
- Central control unit
- Sampling system
- Discharge control system
- Signal from speed log

Output information of the system shall be as follows:

- Instantaneous rate of discharge of oily water
- Total quantity of discharge of oily water
- Time and date
- Oil content (PPM)

A system for easy testing (bucket testing) of the ODME equipment should be provided and function agreed with owner.

The overboard discharge of oily water from slop tank shall be automatically stopped and dumped back to the secondary slop tank upon high oil content. The value of oil content shall be monitored. Equipment such as suction pump, sampling tube, flow meter, sensing unit, control system, monitoring device and recorders shall be provided in accordance with manufacturer's standard and to meet the rule requirement.

Ref. also section 381.

### **Underwater discharge**

An underwater discharge to be arranged as a seachest, in accordance with MARPOL 73/78 Annex II.

### **Cargo equipment stowage**

Supports/racks for cargo equipment stowage shall be arranged on platform above cargo manifold.

Arrangement for stowage of reducers with wooden bottom, impressed timber to be provided.

### **Cargo hoses, blank flanges and spool pieces**

18 m chemical hose with couplings to be delivered by the Owner.

18 m hose for oil with couplings to be delivered by the Owner

Blank flanges of stainless steel material, AISI 316 L., for all cargo crossovers, arranged with lifting handles to be provided.

Reducers of AISI 316L for cargo manifolds to be in accordance with OCIMF recommendations. Dimensions to be agreed with the Owner. The total number of principal and reserve reducers for both cargo and vapour shall be defined by the Owner in compliance with vessel category B and shall fully comply with OCIMF recommendations. Reducers to be stowed in a dedicated rack.

The following assorted spool pieces for cargo cross-overs to be supplied. Dimensions to be agreed with the owner:

- 3 off adapters ANSI - DIN shall be supplied.
- 8 off reducers according to Owners instructions.

## 356 Separate stripping systems

### Stripping system

A separate stripping system shall be arranged, with stripping lines from each cargo pump to the cargo crossover at the manifold valve discharge side.

Blowing/stripping of cargo pumps and cargo/slop lines shall be arranged using compressed air, with drain lines connected to the slop tanks.

Each cargo pump shall be equipped with a quick air connection for clearing remaining product from the outlet line after draining.

### Super drain pipe

Each cargo pump to be arranged with a fixed super drain pipe, abt. 30 mm, arranged inside deck trunk, from pump to top of deck trunk vacuum tank of 400 litres located on top of deck trunk at cargo manifolds. Each tank to be fitted with a fixed pipe and valve (close to each tank hatch with sight glass) between the pipe and the vacuum tank. The pipes, valves and quick connections to be stainless steel. A drain pipe and valve of stainless steel to be arranged from the vacuum tank to the slop tank. Top of vacuum tank to have shape as an oil drum. It should also be possible to make suction from fore and aft of pipe-trunk to vacuum tank.

## 36 Heating systems for cargo (Slop tks)

Table 3.13 Heat Exchanger

Heat exchanger	
No. of units	Two (2)
Primary side	Thermal oil, 6.5 bar
Secondary side	Water/glycol mixture
Type	Shell and tube
Total capacity	To be capable to supply 150% of cargo heating Requirement (75% on each)

Table 3.14 Circulating pumps

Circulating pumps	
No. of units	Two (2), common to circuit.
Capacity each	At least 100% of required flow at full heating capacity

Table 3.15 Expansion tank

Expansion tank	
No. of units	One (1)

Table 3.16 Storage tank for glycol

<b>Storage tank for glycol</b>	
No. of units	One (1)
Capacity	abt. 1m3

## 37 Gas/ventilation systems for cargo holds/tanks

Table 3.17 Design criteria for ventilation and vapour return system

<b>System</b>	<b>Capacity</b>
Ventline for each tank (Venting system)	Cargo loading of 800 m3/h.
Vapour return system collector lines and crossovers	Total cargo loading of 4800 m3/h.

### 372 Closed ventilation/return vapour systems for cargo holds

#### Cargo tanks

Cargo tank venting system to be arranged for closed loading and discharge according to USCG.

To ensure a controlled ventilation, each cargo and slop tank to be fitted with a gas freeing / venting line from tank hatch, fitted with gravity type pressure / vacuum valve and high velocity nozzle with discharges at required level above deck.

All tank vent-lines to be connected by one butterfly valve and one blind flange to one (1) separate gas return/vapour ashore lines on each side with crossovers (2 off) in manifold area and flange for land connection fore and aft of cargo manifold. Fourteen hoses 1.5 meter with quick couplings (3/4" camlock) at each end.

Cargo tank venting pipes to be fitted with ball valve with 3/4" cam lock coupling for flue gass hose mounted at ventilation riser, also as connection for portable pressure gauge, and for cleaning.

All vent pipes to be sloped to tank for drainage.

#### Return vapour system

The return vapour system shall include:

- Double-blocked drain and sample withdrawal line for the O<sub>2</sub> analyzer at each vapor outlet.
- Connection piece with lifting eye, and a blind flange with hinge and handle for each vapor outlet.
- Set of flanged reduction pieces for each vapor outlet, each equipped with lifting eye and blind flange on the smaller diameter side.
- VECS system monitoring panel installed in the Cargo Control Room (CCR), with visual and audible alarms.

#### Gas-dangerous areas

Coffer dams and enclosed structures above main deck in cargo area are all to be mechanically ventilated by permanent fans. Exhaust air to be expelled through vents according to class rules and supplier's recommendations.

### 374 Ventilation/gas freeing systems for cargo tanks

#### Portable gas-freeing fans

Portable gas-freeing fans: Four (4) portable reversible exhaust fans, made of aluminum, and powered by seawater, will be delivered. These fans will be equipped with flexible hoses connected to seawater

outlets on the main deck and spiral, flexible, retractable exhaust ducts designed to reach 1 meter above the bottom of the tanks. The total capacity of all fans must enable degassing of all cargo and slop tanks within a maximum of 10 hours.

These fans shall be supplied from the **general services** seawater branch described in Section 813 Fire line/deck washing system.

## 376 Inert gas systems

The inerting system will basically consist of injecting flue gas from inert gas generator, properly treated to achieve a maximum oxygen content of 5%, into the cargo, slop and ballast tanks.

### Inert Gas generator

One (1) Inert Gas Generator, burning Dual Fuel (DF). The capacity of the system shall be 125% of the actual maximum flow of the Cargo Pumps, as required by the rules and regulations (approx. 3 400 m<sup>3</sup>/h).

The IGS to include

- 1 (one) inert gas generator with built-in cooling system, burning diesel oil, with a gas washing and cleaning system (scrubber) to prevent contamination of the cargo by ash or humidity;
- 2 (two) diesel oil supply pumps, one as backup;
- 2 (two) electric centrifugal ventilation fans, each with a capacity of 100% of the system's total flow;
- 1 (one) Deck seal, hydraulic (wet type);
- 2 (two) seawater Pumps for the Deck Seal, each with 100% capacity;
- 2 (two) seawater pumps for cooling and washing gases, each with a capacity of 100%;
- 1 (one) pressure and vacuum switch;
- 2 (two) sets of oxygen analyzers and sensors;
- 1 (one) liquid separator;
- 1 (one) set of pipes, valves, fittings and inflation nozzles.

### Material and construction requirements

- The scrubber shall be internally lined with fiberglass or other suitable corrosion resistant material.
- The drain piping from the scrubber and the sealing tank shall be lined with polyethylene.
- The sealing tank shall be internally lined with corrosion resistant material.

It should also be possible to operate from a mimic on the alarm and monitoring system.

IGS PLANT should be connected with one (1) mainline supplying starboard and port cargo tanks. From the main line one separate line to each cargo tank with a valve equipped with means of locking by the use of chains and padlocks. All padlocks shall be operable by a single master key. In addition, a blind flange shall be fitted downstream of the valve to allow complete mechanical isolation. The injection piping in the tanks shall be positioned on the centerline of the vessel, aft of each tank (the ventilation posts will be installed forward of each tank in order to avoid dragging cargo vapor during loading). Injection nozzles in the tanks shall be connected to the deck penetration pieces by means of flanges bolted with ASTM A-316L stainless steel stud bolts, washers and nuts.

Three (3) connections for receiving inert gas from an external source shall be provided: one (1) aft, one (1) amidships, and one (1) forward on the main deck.

### Inert Gas Control System

- The inert gas control system for cargo tanks shall include at least:

- Valve opening controls
- Fan and pump start/stop controls
- Inert gas pressure control
- Safety protection devices
- Thermomagnetic on-line O<sub>2</sub> content analyzer
- Gas detour function due to high O<sub>2</sub> content
- Control panels:
  - The main control panel shall be installed in the Cargo Control Room (CCR)
  - Remote control panels with the same functions as the main panel shall be located in the inert gas compartment and the Engine Control Room (ECR)
  - A panel with required functions shall be installed on the navigation bridge
- The control system shall provide signals for remote monitoring and operation to the IAS via an open industrial communication protocol, according to the IAS point list agreed between the Owner and the Yard during design.
- If available from the manufacturer, the system shall include hardware and software for remote access via internet to the on-board system's operating data, parameters, and alarms.

### 375 High velocity pressure/vacuum valves

Table 3.18 High velocity pressure/vacuum valve

No of sets	One (1) for each cargo and slop tank, total fourteen (14)	
Type	Class approved type (also for IIB cargoes)	
Setting press	+ 0.14 kg/cm <sup>2</sup> - 0.035 kg/cm <sup>2</sup>	
Venting velocity	Min 30 m/sec	
Material	Housing : Stainless steel Wire net : Stainless steel Other internal parts : Stainless steel	
Location	Close to each tank, on side of deck trunk	
Spare	One (1) Spare P/V valve	

P/V valves to be fitted with gas freeing cover.

Platform and vertical ladder shall be arranged for maintenance of the P/V valves.

#### Vacuum breaker unit

The Vacuum Breaker Unit (VBU) shall be installed on the main deck. The VBU will serve as a secondary protection against overpressure and vacuum, activating at 0.18 kg/cm<sup>2</sup> G for positive pressure and 0.07 kg/cm<sup>2</sup> G for negative pressure, in case the primary P/V valves fail to operate.

### 378 Vapour return system

**Vapour Emission Control System (VECS)** shall be arranged in accordance with MARPOL Annex VI/3/15 and USCG regulations 46 CFR Part 39. The system shall consist of vapour return lines with valves and portable connections to cargo tank vent lines, and shall be provided as follows:

- Two (2) common vapour return lines shall be arranged from fore to aft on each side, with crossovers (2 off) in manifold area. Crossovers to be fitted with butterfly valves and blind flanges at both sides.
- Each vapour return line to have capacity of maximum loading rate, 4800 m<sup>3</sup>/h.

- Vapour return lines also to be used for inerting of cargo tanks if inert gas is received from shore when discharging.
- The presentation flanges at the cargo manifolds shall follow the requirement of OCIMF.

## 38 Auxiliary systems and equipment for cargo

### General

This section provides an overview of auxiliary systems and equipment supporting cargo and ballast operations on board the vessel.

Detailed technical, functional, and equipment requirements for the Cargo Control System, including automation, monitoring, remote operation, alarm systems, measurement, and system integration, are specified in section [381 Cargo control systems](#).

Auxiliary requirements and equipment not included in the Cargo Control System are described in the following subsections.

### Davit for port. cargo pump and tank cleaning machines

One (1) combined davit for portable tank washing machines and portable cargo pump with air-powered winch to be supplied.

### Equipment Stowage

Shelves for stowage of cargo / tank washing equipment shall be located in deck stores forward.

### Overboard Discharges from cargo area

- Overboard Discharge Oil Content Monitoring System

Approved Oil Discharge Monitoring Equipment (ODME) and control system to be fitted in compliance with **MARPOL Annex I**. ODME system to meet MEPC.240 (65) with regards to biofuel blends.

- Underwater discharge

An overboard discharge line shall be arranged from the cargo piping system to a remotely controlled discharge valve on the ship's side, in compliance with **MARPOL Annex I and II**. This line shall be used exclusively for slop or emergency deballasting operations and shall be monitored and controlled by the Oil Discharge Monitoring Equipment (ODME). The arrangement shall ensure full compliance with discharge regulations and include all required isolation valves and flexible hose connections.

Special care shall be given to the overboard slop discharge lines to avoid intake of effluent into sea water systems of the engine room.

## 381 Cargo control systems

Cargo and ballast operations are carried out from the Cargo Control Room (CCR) located on 01 Poop Deck, using a computerised cargo control system.

Loading computer to be integrated with trim optimization system.

The CCR shall be equipped with a loading and operational computer, two terminals, and two display units, minimum 26 inch.

Start and stop of cargo and slop pumps, pump speed control, inlet and outlet pressure monitoring, shall be remote-controlled from the cargo control station.

Remote operated cargo and ballast valves shall be operated from cargo control station.

The control system for cargo and ballast pumps shall also include:

- Hydraulic unit protection devices;

- Automatic reduction and stopping of pumps due to low pressure or low level in the cargo tanks, as recommended by the supplier;
- Power supply and control panels for the electric motors of the cargo and ballast pumps equipped with VSDs;
- System control and operation panels.

All valve actuators are hydraulic, and the full hydraulic control system specification is provided in Section 352 Loading/discharging systems on deck under “Hydraulic Control System for Cargo and Ballast Valves”.

Emergency stop buttons for cargo pumps shall be installed in the following locations

- in the CCR
- near the loading manifolds, on both sides
- in the ECR
- on the control panel of the hydraulic units (if present) of the cargo pumps
- in the VSD compartment (if fitted) of the cargo pumps.

Remote operation and supervision of the critical variables of the hydraulic units and cargo and ballast pumps shall be carried out through the IAS, including the following features, among others:

- Monitoring of all hydraulic system variables, if present (\*)
- Monitoring of the main electrical variables of the starting panels of the hydraulic unit motors (if present) or of the starting panels of the electric motors that drive the pumps (if present): opening status of circuit breakers/contactors, electrical current of the motor, instantaneous active power of the motor, temperatures of the electric motors, alarms, etc.
- Start/stop commands for system equipment
- Adjustments of pump speeds, system operating pressures, etc.
- Emergency stop of cargo pumps
- Monitoring system alarms and events

(\*) In addition to the usual hydraulic system variables (pressures, flow rates, temperatures, equipment operating status, etc.), the control system shall provide the IAS with the instantaneous power measurement (in kW) of each cargo pump.

If the system uses VSDs, all the parameters and measurements of the VSDs shall be available on HMIs mounted on the front doors of the electrical panels of each VSD and on a digital communication channel in open industrial network protocol for monitoring by the IAS.

If available as an option from the manufacturer, the control system shall have hardware and software resources for remote access via the internet to the on-board system's operating data, parameters and alarms.

### **High-level alarm/overflow control**

Each cargo and slop tank shall be arranged with two (2) independent level alarm sensors:

- one high-level alarm sensor at 95% of tank volume
- one high-high level alarm sensor at 98% of tank volume.

All HFO storage tanks and FO overflow tank shall be arranged with one (1) independent level alarm sensor at 95% of tank volume. Level switch type.

These alarm sensors are to be independent of the level gauging device, and both sensors are to trigger visual and audible alarms installed in the Cargo Control Room (CCR) and on the main deck.

The high and high-high level alarm control panel shall be installed in the CCR.

## Cargo and Slop Tank Measurement System

- Each cargo and slop tank shall be equipped with:
  - A radar wave (microwave) level measurement system, with antenna at the top of each tank and pressure transducer for the tank's internal atmosphere.
  - Radar in slop tanks shall be able to measure oil-water interface.
  - Three (3) temperature sensors, positioned at different levels of each tank. These sensors shall trigger visual and audible high and low temperature alarms at preset temperature levels, with readout and alarms at the cargo control station.
- The measurement system shall also include:
  - Three (3) portable radio monitoring units for use on deck.
  - Two (2) UTI closed gauging devices for manual probing and sampling, with calibration certificates.
  - A low level alarm with cargo pump stop function.
- All measurements and alarms shall be supervised by the IAS, with data available in synoptic diagrams of the vessel's tanks and interconnected to the loading computer and trim optimization system.
- Communication between the measurement system and IAS shall be via open industrial communication protocol.
- If available from the manufacturer, the system shall have hardware and software resources for remote access via internet to the on-board system's operating data, parameters, and alarms.

## Pump pressure alarm

One pressure transmitter to be fitted in each close to discharge valve. Read out of pressure in cargo control station.

There shall be two (2) operational computers with the following:

- 2 displays
- 1 keyboard, if possible.

One Loading computer (with intact and damage stability) with:

- 1 display
- 1 keyboard
- 1 colour printer in A4.

## Cargo monitoring system, control and operating equipment for cargo system

Table 3.19 The following equipment shall be provided and operated from cargo control room via the operational computers.

Mimic diagrams for:	Cargo loading/discharging system Cargo vapour system Cargo heating system Cargo washing system Fire system Water ballast system, including ballast water treatment. IGS system Gas freeing system
Remote cargo pump control.	
Remote control of ballast pumps, slop pump and tank cleaning pump, including start/stop, r.p.m. and delivery.	

Remote control of all valves in cargo and W.B. systems, with indicators for valve position included on the mimic diagram.	
Remote ullage measurement of all cargo and slop tanks.	
High and high-high level alarms in all cargo and slop tanks.	
Temperature monitoring of all cargo tanks and slop tanks.	
Remote level gauging of all ballast tanks, G.O. tanks, technical and potable F.W. tanks.	
Pump pressure	
Loading and discharge rate indication.	
Vapour space- / Inert gas monitoring with read-out and alarm for cargo tanks	
Loading instrument software programs to include:	Cargo discharge rate for each cargo tank Trim, draft, dwt, sheer forces and bending moments. Deadweight calculation. Stability program including intact and damage stability performed by direct calculations. Instructions.
Indicating diagram, with indication of:	Auxiliary engines generators electrical load

### Manual Ullage System

Local cargo tank ullaging to be through an "MMC or similar Vapour-Lock" system. The system to be arranged with two triple gauging tapes and one sample tape.

Cargo and slop tanks to be calibrated to ullage reference point for each 10 mm ullage difference with usual corrections for density and trims from -2,0 m to 0,5 m.

### Oil discharge monitor and control system

Approved Oil Discharge Monitoring Equipment (ODME) and control system to be fitted in compliance with MARPOL Annex 1.

### Portable tank level gauge and closed cargo sampling system

Two (2) portable gas safe (Hermetic or MMC), tank level gauging device which also serves as oil/water interface detector, with temperature interface and ullage gauge to be provided.

Two (2) portable, gas safe (Hermetic or MMC), cargo sampling device shall be provided for cargo and slop tanks. Sampling device capacity shall be minimum 400 ml.

For the above devices, one (1) ball valve with cap, and top part designed to support the above mentioned devices, shall be fitted on a 100 mm high stud pipe, located above cargo deck, for each cargo tank. Full depth sounding pipe in each cargo and slop tank, the pipe inside tank to be arranged with penetration holes, for cleaning purposes..

One (1) stores room to be arranged for stowage of cargo samples bottles and equipment in deck house on main deck.

### Portable vapour and gas detectors

Two (2) portable vapour detector sets, class approved type, to be provided by the buyer according to rules, with battery, battery charger, suitcase.

Portable vapour detectors shall be able to measure the following:

- Low hydrocarbon gas-content 0 to 100%
- Flammable vapours

- Toxic vapours
- Oxygen content

### Fixed gas sampling system

A fixed gas sampling system shall be installed with sampling lines from all cargo tanks, ballast tanks, aft peak tank, cofferdams, inert gas room, and HVAC unit. The system shall be capable of sequential sampling from each location and provide gas concentration measurements to a central unit located in the Cargo Control Room (CCR). The fixed gas detection system shall activate alarms when the measured values exceed the preset safety limits. Sampling points shall be designed with closed-type connections to avoid gas release.

## 382 Tank cleaning systems and equipment

A tank cleaning system shall be provided for cleaning of cargo and slop tanks.

The system shall operate using **cold sea water**, in compliance with applicable regulations and IMO Resolutions A.446(XI), A.497(XII), A.897(21).

The system shall be capable of simultaneous cleaning of two (2) largest pairs of cargo tanks using fixed cleaning machines. The cleaning system shall include:

- One (1) cleaning pump located on Main Deck, with flow capacity sufficient for simultaneous operation of cleaning machines in the two (2) largest cargo tank pairs.
- Two (2) fixed, programmable cleaning machines with one nozzle in each cargo tank.
- One (1) fixed cleaning machine of the same type in each slop tank.
- Four (4) portable, programmable cleaning machines with two (2) nozzles each.
- One (1) chemical tank for cleaning water.
- Shadow diagrams approved by the Classification Society for machine arrangement and coverage.

If shadow diagrams indicate insufficient coverage, additional fixed cleaning machines shall be provided.

Pump capacity calculations shall be submitted during design stage.

All fixed cleaning machines shall be of the same model and manufacturer.

### System Operation and Configuration

Cleaning shall be performed using cold sea water in a closed or semi-open loop. The system shall allow operation as follows:

- The cleaning pump shall draw from the ballast system and either:
  - fill the clean slop tank (Starboard), or
  - supply the tank cleaning machines directly.
- The cargo pump from the clean slop tank (Starboard) may also feed the tank cleaning machines.

A double-block valve arrangement shall be provided to connect the discharge line of the clean slop tank to the cleaning line, enabling closed-loop cleaning.

The cargo pump of the tank being cleaned shall return the oil/water mixture to the dirty slop tank (Port) via the waste line.

After separation, the water shall be transferred to the clean slop tank (Starboard) and then discharged overboard through the ODME system.

The waste line shall:

- include connections to both PS and SB,
- allow discharge to shore or overboard via ODME,
- be connected to the cargo system and trays through a double-block valve arrangement.

A Wilden-type air-driven pump shall be installed on a bypass of the waste line for drainage purposes.

### Fresh Water Sweetening

The system shall enable final freshwater rinsing of cargo and slop tanks for salt removal (sweetening). To support this, the system shall include:

- Means to deliver fresh water to the cleaning line,
- Arrangement to receive fresh water from other vessel systems and from cargo manifolds (Port and Starboard),
- Design-provided tank(s) with sufficient volume for the required freshwater, including definition of required capacity.

### Connections and Materials

Each cargo and slop tank shall be served by:

- Piping branches for fixed cleaning machines with AISI 316L stainless steel valves and spectacle blind flanges,
- Branches for portable machines with:
  - AISI 316L stainless steel valves,
  - spectacle blinds with bolts, nuts, washers,
  - bronze threaded hose connections.

Tank cleaning piping shall be sloped and arranged with drainage points at low spots.

Two (2) shut-off valves shall be fitted between the cleaning pump and machines.

### Operational Reference

The tank cleaning procedure shall comply with the operational requirements defined in Petrobras standard N-2673, considering the type of cargo handled.

### Reference Data – Typical Parameters for Tank Cleaning Equipment

The following tables contain indicative values based on typical supplier data for fixed and portable tank cleaning machines.

These values are for reference only and do not constitute binding performance criteria.

Final selection and documentation, including shadow diagrams and capacity verification, shall be provided by the system supplier and approved during the design phase.

Table 3.20 Fixed tank cleaning machines

No of sets	At least two (2) in each cargo tank and two(2) in each slop tank, according to shadow diagram.
Type	Programmable, single nozzle or
Material	Stainless steel AISI 316L double nozzle, single/multi stage type.
Nozzle diameter	9 mm
Capacity each	17 m <sup>3</sup> /h
Pressure	8 - 10 bar
Hose	40A x 10m 2 sets

Table 3.21 Portable tank cleaning machine

No of sets	Two(2)
Material	Stainless steel AISI 316L
Nozzle diameter	8 mm
Capacity each	14 m <sup>3</sup> /h
Pressure	10 bar
Hose	40A x 10m 2 sets

### 383 Hose handling system

One (1) electro-hydraulic hose handling crane shall be provided, installed on the centerline of the vessel to serve both port and starboard manifolds.

The crane shall have a lifting capacity of 10 tons SWL and be operated by remote control (radio or umbilical), certified for use in Zone 1 hazardous areas.

Crane outreach and speed shall comply with OCIMF recommendations.

A reinforced eyebolt and dynamometer (load cell) shall be installed on deck for load testing during operations.

For detailed crane specifications, see Section [334 Other cranes with equipment](#)

## 4 SHIP EQUIPMENT

### 40 Manoeuvring machinery and equipment

General layout and access arrangements shall ensure safe maintenance and inspection of the rudder and steering gear components.

Means shall be provided to prevent unauthorised access to the rudder recess area from inside the hull.

#### 401 Rudder, rudder stock and bearings

The vessel shall be equipped with one (1) suspended, semi-balanced rudder with a wing profile. The rudder shall be of fully welded construction and designed in accordance with Classification Society requirements.

##### Rudder

Manufacturer	Kongsberg Maritime
Type	CMP 3600x5900, Promas with twisted leading edge.
Dimension (l x h)	3900 x 5600 mm
Rudder angle	2 x 44°
Rudder stock length	6020 mm, estimated
Rudder trunk type	With SG foundation

The rudder shall be equipped with:

- Dismountable connection between rudder blade and rudder stock, it shall be possible to dismount the rudder without dismounting of steering gear. (There are two watertight recesses with screwed-on sheet metal covers (stainless steel stud bolts and nuts) to access the nuts securing the rudder stock and rudder pin).
- Rudder is internally protected against corrosion with VCpl-powder.
- Stainless steel drain plugs on top and bottom of rudder blade and flap
- Cathodic corrosion protection for 5 years interval.

##### Additional requirements:

- One (1) forged steel rudder stock, with AISI 316 stainless steel sleeve in the guide bearing area.
- One (1) forged steel rudder pin (pintle), with AISI 316 stainless steel sleeve in the bearing area.
- One (1) rudder carrier bearing incorporating a stuffing box.
- Bushings for rudder pin and guide bearing to be synthetic, Thordon SXL, lubrication-free.
- Rudder stock to be equipped with grounding braid.
- Two (2) watertight access recesses (with stainless steel studs and nuts) to access rudder stock and pintle nuts.
- Lifting eyes shall be fitted for rudder and propeller.
- A flat steel bar coaming shall be welded around the foundation area of the steering gear unit.
- Deck area in the steering gear compartment to be finished with non-slip surface in accordance with yard standards.
- Bulkhead, deck and ceiling in the compartment to be painted.

#### 403 Steering gear, rudder indicator and emergency steering plant

The vessel shall be equipped with One (1) steering gear.

**Steering gear**

Manufacturer	Kongsberg Maritime
Type	SR743 FCP, rotary vane
Drive	Electrical/Hydraulic motor and frequency controlled drive
Effective torque on actuator	650 kNm
Rudder angle, electrical	2 x 42°
Supply voltage/frequency	Ref. <a href="#">Table 8.6</a>

**Additional equipment:**

- Sleeve for hydraulic coupling
- Expansion tank
- Start/stop and control system
- Rudder angle indicator system
- Spare parts and special tools

**Steering Gear System Configuration**

The steering gear system shall be designed in accordance with Classification Society requirements.

It shall consist of two (2) identical hydraulic units (100% capacity each), where one unit serves as backup.

Each unit shall be capable of turning the rudder from 35° to one side to 30° to the other in maximum 28 seconds, with the vessel loaded at summer draught and main engine operating at MCR.

Hydraulic actuators shall be of rotary vane type.

**Lubrication and Operation**

- Rudder carrier bearing shall be lubricated with system hydraulic oil (no grease required).
- Emergency operation shall be possible locally by manual control acting directly on solenoid valves.

**Control and Monitoring**

- Steering gear alarms shall be provided locally, on the navigation bridge, in the engine control room (ECR), and logged in the Integrated Control and Monitoring System (IAS).
- The steering gear shall be integrated with the vessel's remote control system, ref. [793 Remote control of main propulsion and engine telegraph](#).

**Hydraulic Oil Storage and Sampling**

- A reserve hydraulic oil tank shall be installed with fill connection on the exposed deck, including a valve and blind flange, clearly identified.
- The transfer line from storage tank to service tank shall include:
  - One (1) filter rated at 10 µm / β100,
  - Local saturation indicator,
  - Sampling connection (minimess or equivalent) in accordance with best practice or supplier recommendation.

**Other Requirements**

- Means shall be provided to prevent unauthorised access to the rudder recess in the hull.
- All installation and configuration shall comply with the steering gear manufacturer's specifications and Classification Society requirements.

## 41 Navigation and searching equipment

### 411 Radar plants/electronic charting

#### Radar

The following radars shall be installed:

One (1) S-band (10 cm) ARPA/ATA radar

- TFT LCD 23" (Minimum) Colour display, minimum 340 mm effective display diameter
- 30 kW transmitter, 12-14' antenna according to manufacturers' standard.
- Performance monitor and Radar inter-switch
- The Radar display shall be capable to display selected parts of Electronic Navigational Charts (S57 format).
- Installed forward at Workstation for traffic surveillance/navigation/manoeuvring.
- Flat color display (LCD)
- 340 mm plan position indicator (PPI)
- Dedicated UPS
- Transceivers for installation on the navigation bridge bulkhead

One (1) X-band (3 cm) ARPA/ATA radar

- TFT LCD 23" Colour display, minimum 340 mm effective display diameter
- 25 kW transmitter, 6-9' antenna according to manufacturers' standard.
- Performance monitor and Radar inter-switch
- The Radar display shall be capable to display selected parts of Electronic Navigational Charts (S57 format).
- Installed forward at Workstation for Navigation support.
- Flat color display (LCD)
- 340 mm plan position indicator (PPI)
- Dedicated UPS
- Transceivers for installation on the navigation bridge bulkhead

Both radars shall have interfaces for:

- Gyro compass
- ECDIS
- AIS
- DGPS

#### ECDIS

Electronic Chart Systems (ECDIS) shall be provided as main chart system.

- TFT LCD 23" (Minimum) Colour display
- Track ball and keyboard (may be integrated in one unit)
- CD-rom for downloading of chart database
- Equipped for online downloading of chart updates
- The system is to be compatible with Electronic Navigational Charts of latest S57 edition 3.1 (or latest standard) and raster charts and corrections from major Hydro-graphic offices for worldwide coverage.
- Interface to DGPS, radar, echo sounder, gyro or magnetic compass, speed log, AIS and

Autopilot.

- System to have one (1) display at workstation for traffic surveillance and manoeuvring and one (1) display at workstation for route planning.
- Two (2) slave ECDIS displays at bridge wing consoles in wheelhouse. One connection to be provided to ECR, one connection to be provided in duty mess.

A chart radar may replace the back up ECDIS if approved by the National Authorities.

#### **Conning system**

One (1) Conning and Information System to be installed.

Signal fram DSGPS, gyro compass, speed log, anemometer, main engine & propeller data etc.

- Mass flow meters
- Fuel efficiency monitoring system installed on the bridge and use the information from the vessels navigation sensors, mass flow meters, engine data and emission sensors. TFT / LCD display, 26 inches diag.

See also [791 Manoeuvre desks, main consoles, instruments](#)

### **412 Satellite navigator**

#### **Satellite navigation systems**

A satellite navigation system with Differential Global Positioning System (DGPS) to be fitted. The system to be capable of providing direct reading of the following:

- Longitude
- Latitude
- GMT
- Distance and course of arrivals
- Waypoints

The DGPS system consisting of:

- 2 (two) DGPS receivers, with built-in differential correction receiver in accordance with the IALA(International Association of Marine Aids to Navigation and Lighthouse Authorities) standard, with automatic signal selection and distribution unit. One of the receivers shall be capable of speed-independent accuracy and heading.

### **413 Gyro plants, automatic steering, compass**

#### **Gyro plant**

2 (two) gyrocompasses, with no moving parts, with control unit and signal distribution; the control unit shall have an alarm device for the difference between the available signals.

5 (five) repeater units:

- 1 (one) on the navigation bridge forward bulkhead (with prismatic marking device)
- 1 (one) on the steering column
- 2 (two) on the navigation bridge wings
- 1 (one) in the steering gear compartment

Each digital gyro-repeater to be equipped with Rate of Turn indicator and off-course alarm, except digital gyro repeater in SG room. All repeaters to be fitted with dimmer, except digital gyro repeater in SG room.

The gyro should be capable to head up in one hour and arranged with interface to radars. Maximum error on course indication, 1 degree.

Interfaces for other systems requiring directional / rate information.

The gyro-compass to be operated on power supply directly from the emergency switchboard. Main power supply 220V, AC 60Hz, 24VDC back up

### **Autopilot**

One (1) adaptive autopilot system, connected to gyro, with dual control of electric type for follow-up (FU) & non-follow-up (NFU), to be provided. The autopilot to be equipped with dual mode operation (manoeuvring / normal sailing). The autopilot to perform track steering acc. to rules and regulations.

The autopilot system to be operated on power supply directly from the emergency switchboard.

Transmitter for autopilot to be installed according to class.

System to have the following standards:

- Rudder steering system and autopilot - comprising the steering column with helm, remote control on the navigation bridge wings, controls and interfaces with the steering gear unit; the autopilot shall be self-adaptive and redundant, with a main control unit on the steering column and another on the navigation console; the steering wheel control (FU), the emergency control (NFU) and the rudder feedback unit shall also be redundant (dual). In addition to the alarms required by rule, the rudder control shall have an alarm for follow-up failure (FU)
- Rudder angle transmitters, with an accuracy of better than 1%, with dedicated indicators on the navigation bridge ceiling (three-sided panoramic), steering gear compartment and navigation bridge wings (system independent of the steering system)

### **Course Control system**

The heading control system defines an optimal route using the vessel's heading between the current position and the final destination, calculating the influence of external environmental factors (current, wave, wind) to implement the best control of the steering system, allowing the vessel to always navigate the most efficient route compared to traditional heading control systems.

### **Speed Control system**

Speed control system: The Speed Control System ensures a constant absolute speed of the vessel by automatically changing the propulsion order when environmental influences such as wind, current and waves change the vessel's speed during navigation

Satellite Speed Log complying with IEC 61023 for marine speed and distance measuring equipment (SDME - Speed and Distance Measuring Device), capable of measuring transverse bow and stern speed and longitudinal speed, and measuring and recording the distance sailed. The system shall include an illuminated display for operation

### **Course Recorder**

Course recorder to be provided at chart table.

### **Magnetic Compass**

Two (2) magnetic compasses, one of which shall be installed in a binnacle ar the compass deck, with periscope, lighting and heading transmitter for interconnection with the gyro control unit.

The second compass shall be a spare, identical to the first, in suitable packaging for storage.

## ROT Transmitters

Rate of turn (ROT) transmitters, with an accuracy of better than 1%, with dedicated indicators on navigation bridge ceiling and wings of the navigation bridge. The indicators shall have a different appearance from the rudder angle indicator, in order to avoid misreading.

## 414 Underwater searching equipment

### General

Main units shall be installed forward at Workstation for traffic surveillance/navigation/manoeuvring, ref. 791 Manoeuvre desks, main consoles, instruments.

Depth information shall be available at:

- Workstation for Navigation support

### Navigational echo sounder

One (1) echo sounder system meeting IMO's performance standards to be installed in wheelhouse, consisting of:

- One (1) main indicator with graphic recorder and adjustable depth alarm at navigation / route-planning station.
- One (1) digital depth repeater on wheelhouse front wall
- Two (2) repeaters on Bridge wings
- Power source according to supplier.

Transducers fitted in void spaces in double bottom as follows:

- Below the bow
- In double bottom below engine room

System to be arranged with interface to the navigation system.

Echo sounder, with graphic (LCD) and digital display, interconnected to the Integrated Bridge System, transducers on the bow and stern and shallow water alarm, with display on the navigation bridge and wing consoles.

### Speed log

One (1) Doppler type IMO approved speed log to be installed, including speed through water as well as speed over the ground, consisting of the following:

- One (1) Main unit with speed and distance indicator, fitted at chart table.
- One (1) digital speed indicator (scale 0.1 knot), in wheelhouse ceiling.
- One (1) digital speed repeater indicator in engine control room
- One (1) Transducer 262 Bottom plugs, sea chests, bilge wells, trunks/ casings for bottom equipment
- One (1) Hull fitting complete, inclusive gate valve.
- Power source according to supplier

Bottom speed log with lateral speed measurement, operating in "bottom tracking" and "water tracking", with special valve for replacing the transducer while the vessel is afloat, and monitoring and operating HMI on the navigation bridge

Speed signal on NMEA format to radars, satellite navigator, gyro, ODME system and other relevant users to be provided

## 415 Clinometers, trim indicators, load indicators and loading computing system

### Clinometers

Clinometers shall be installed at the following locations:

- One (1) Wheelhouse
- One (1) Engine Control Room

### Trimindicator

One (1) integrated loading computer and trim optimization system shall be installed in the Cargo Control Room, consisting of one (1) approved and certified independent computer, interconnected to the measurement system of cargo, ballast and consumables tanks and draft, capable of performing bending moment, shear forces, intact and damaged stability calculations, as well as the definition of optimum navigation trim, with off-line mode (simulation - manual data input) and on-line mode (supervision - automatic data input), with automatic correction for vessel trim and list. The level measurements of the fuel oil storage tanks and cargo tanks shall be automatically corrected according to the temperature of the product.

One (1) repeater panel with optimum trim indication shall be installed at the navigation bridge control station.

The loading computer software shall comply with IP/API calculation procedures and nomenclature/principles, with classification society and IACS requirements.

A copy of the software for the integrated load computer and trim optimizer system shall be supplied by the Yard to the Owner together with the Computational Fluid Dynamics study and optimal trim table used to make the system.

The cargo, slop and ballast tank level measurement system, independent cargo and slop tank level alarm system, draught measurement system, consumable tank level measurement system and load computer shall be supplied by the same manufacturer/integrator and be considered as a single package.

An inclinometer shall be installed in the CCR and integrated into the loading computer for use in automatic data corrections.

### Trim and list sensor

For trim and list sensors, [381 Cargo control systems](#)

## 416 Video surveillance

A Closed Circuit TV (CCTV) certified for marine application shall be installed. The system shall minumum cover the following areas/equipment:

- Control and distribution matrix with 03 (three) control panels, located on the navigation bridge, CCR and ECR;
- 3 (three) mobile IP cameras with remote "pan", "tilt" and "zoom" control:
  - 2 (two) on the navigationbridge wings (port/starboard) for viewing the side area, accommodation/ embarkation ladders and cargo manifold;
  - 1 (one) for an overview of the engine room (top view of the Main Engine and Auxiliary Engines);
- 7 (seven) fixed IP cameras with zoom control:
  - 2 (two) for the bow mooring area ( Port/starboard);

- 2 (two) for the stern mooring area ( Port/starboard);
- 1 (one) in the purifier compartment;
- 1 (one) in the inert gas generator compartment;
- 1 (one) for the thermal oil heater;
- 1 (one) fixed IP camera with "zoom" control in the cargo pump system hydraulic unit compartment (if any);
- 9 (nine) 17" LED video monitors, located 3 (three) in the navigation bridge, 3 (three) in the ECR and 3 (three) in the CCR;
- Computer and software capable of image recording, image alteration detection and other security function

The CCTV system shall consist of a standard package from one manufacturer, with components tested and supplied together.

Compositions of components from different manufacturers for the development of a specific application system will not be accepted. The video controllers shall distribute independent images to each monitor.

The cameras in the CCTV system shall have the following minimum characteristics:

- ONVIF compatibility;
- Continuous 360° rotation horizontally and from 0° to 90° vertically (PTZ cameras);
- Ethernet connection: RJ-45 100 Base-TX;
- Video compression formats: H.265, H.264 and MJPEG;
- Frame rate: 25 fps @ 1920x1080 pixel (full HD);
- Automatic night vision;
- Minimum lighting required: 0,03 lux (F1.6, AGC ON) in color and black and white;
- 25x optical zoom;
- Automatic iris;
- 120 db WDR;
- Operation at room temperature: 0°C to +55°C;
- Humidity operation: 0% a +90%;
- 316L stainless steel, aluminum or fiberglass-reinforced plastic housing;

Equipment intended for outdoor installation shall have: IP-66 degree of protection, infrared illumination with a range of at least 50 m.

Equipment intended for indoor installation shall have: IP-44 degree of protection. The installation of cameras in a hazardous area should be avoided.

The CCTV system will be optimized for vessels with a high vibration rate. All cameras shall be supported using vibration dampers, suitable for the technical characteristics (frequency, amplitude, acceleration, etc.) of the maximum vibration expected. IP cameras shall be installed with surge protectors to protect them from induced currents at communication or power cables caused by electrical discharges. Such devices shall have a high discharge current capacity, low residual voltage and fast response time.

The CCTV system shall monitor and record images from all cameras (for 30 days). The cameras shall be monitored and controlled independently via control panels. All cameras shall be associated with the same management and storage platform (hardware and software).

The CCTV system platform shall allow logical segregation for the different users, according to the groups and privileges defined by the Owner. For example, the operators in a zone will only be able to control the cameras deployed in that area, but the Captain to his satisfaction, is to be able to watch and control all the cameras.

The CCTV system platform shall allow remote access via Ethernet-IP to watch images in real time and recordings.

Final arrangement shall be agreed with the Owner/Client.

## **417 Clocks, facsimile recorders, miscellaneous nautical equipment**

### **General**

Following equipment shall be delivered and installed according to regulations in force.

### **Clocks / Chronometers**

Separate wall-mounted clocks to be installed as follows:

- One (1) GMDSS Console
- One (1) Navigation Bridge roof console
- One (1) CCR
- One (1) ECR
- Three (3) Day rooms
- One (1) Gymnasium
- One (1) Auditorium
- One (1) Galley
- One (1) Mess room
- One (1) Ship office
- Collective and individual rooms

One (1) approved chronometer with GMT indication to be fitted in chart table.

### **Environmental instruments**

- One (1) Aneroid barometer
- Two (2) Thermometers
- One (1) Weather system interface to IAS
- One (1) Wind speed/direction indication sensor to be fitted in signal mast on top of wheelhouse with no moving parts.
- One (1) Wind speed and direction indication instrument to be provided with read-out in wheelhouse and interfaced with ECDIS.

### **Miscellaneous Nautical Equipment**

The following equipment also to be supplied and fitted:

- 3 (three) prismatic binoculars, two 7 x 50 mm and the other 15 x 80 nightvision, packed in a wooden case. The 15x80 binocular shall have bases for placement on the wings, enabling 360° rotation
- 1 (one) portable, hand-operated horn
- 1 (one) bell with a sound level of not less than 110 dB at a distance of 1 meter, made of corrosion-resistant material and designed to provide a clear timbre. The diameter of the bell mouth shall not be less than 300 mm

- 1 (one) gong with certificate - whose sound level is not less than 110 dB at a distance of 1 meter, made of corrosion-resistant material
- 1 (one) sextant, packed in a wooden box
- 1 (one) chronograph, 60-second scale, 1/5 s division
- 2 (two) stopwatches with gimbals
- 2 (two) seawater thermometers
- 2 (two) psychrometers
- 2 (two) 90 mm diameter magnifying glasses
- 2 (two) parallel transparent acrylic rulers
- 2 (two) 170 mm dividers for navigation
- 1 (one) 360 mm transparent acrylic navigational square
- 1 (one) protractor
- 1 (one) letter brush
- 4 (four) weights for cards
- 2 (two) prismatic alidade for the gyroscopic compass repeaters located on the wings of the navigation bridge
- 2 (two) maximum and minimum thermometers, scale in degrees Celsius
- 2 (two) clinometers with maximum balance records
- 1 (one) set of daytime signaling markings, consisting of
- 3 (three) ball marks
- 1 (one) cylinder type mark
- 1 (one) diamond mark
- 1 (one) cone mark
- 1 (one) green anchor buoy
- 1 (one) red anchor buoy

Otherwise all according to authorities and Owner's requirements and best practice for a vessel of this type and size.

Approved certificates to be delivered as relevant.

#### **Sound and Signal Reception System**

One (1) Digital Sound and signal reception system to be installed as per class requirement for vessels with closed bridge wings.

The Sound and signal reception system shall enable the navigator when standing inside the enclosed bridge space to listen to environmental sound signals from other ships and fog signals that are audible outside on open deck. The system shall monitor frequencies between 70 and 700 Hz.

Other minor equipment as required by applicable regulations.

#### **Chart table equipment**

- One (1) Parallel ruler
- One (1) Divider

#### **Clocks**

One (1) Master clock system.

Master and slave electronic clock system, with repeaters in the GMDSS console, navigation bridge roof console, CCR, ECR, collective and individual rooms, offices, training room, messrooms, gymnasium and galley.

## Distributor Hubs

Individual distributor hubs shall be provided for DGPS signals and gyro compasses with at least 6 spare outputs each.

## 418 Radar, signal, observation and antenna masts

The vessel shall have masts in positions indicated on the General Arrangement.

### Masts general

Masts shall be provided as shown on the General Arrangement plan.

Necessary blocks and fittings shall be fitted on the masts.

Hand rails, guard rails, ladders / steps and platforms shall be fitted in way of blocks, lights and other fittings.

Supports and stays on masts shall be specially considered and care shall be taken to avoid vibrations.

Sliding bars or wire ropes (provided by the builder) shall be used together with safety belts/harness/sliders (provided by the owner).

Equipment with components installed on the main mast or compass deck shall have devices to protect against voltage surges induced by atmospheric discharges in the communication and power cables of external components, as well as grounding standards for non-energized conductive parts.

### Radar mast

Both radar antennas shall be mounted on easily accessible platforms above top of wheelhouse and so located to minimise blind sectors. Crossbars, posts and fittings for navigation- and signal-lights, and other equipment, antennas etc., shall be arranged.

Mast shall be constructed with strength and stays, to avoid abnormal vibrations.

Sliding bars or wire ropes (provided by the builder) shall be used together with safety belts/harness/sliders (provided by the owner).

### Foremast

One (1) foremast shall be arranged on forecastle deck, and fabricated of steel plate or pipes.

Sliding bars or wire ropes (provided by the builder) shall be used together with safety belts/harness/sliders (provided by the owner).

To be self supported type in order to reduce the blind sectors.

### Radio Antennas (GMDSS) / DGPS Antennas

The antennas shall be located in correct position and distance from other equipment on top of wheelhouse.

### NOTE!

**Final positions of equipment will be detailed in the Antenna arrangement and Navigation- and Signal lights drawing during basic design engineering.**

## 419 Integrated navigation systems

### Voyage Data Recorder

One (1) Voyage Data Recorder (VDR) shall be provided to record the vessel's parameters. Type according to IMO Reg.20, SOLAS Ch.V

Main Power supply 220VAC, 60Hz.

The system to comprise the following:

- 1 Data acquisition unit
- 1 Crash survivable data storage module
- 1 Data interface unit Analogue / Digital
- Play-back function for PC, with removable data storage device for abt. 30 days

Computer and software shall be suitable for viewing data on-line, copying and transmission of data via satellite communication system. The software required for remote offline playback shall be supplied. The system shall be able to copy the recorded data to a portable memory device. The system shall be equipped with two capsules, one of which shall be fixed and the other float-free. One capsule shall be fitted with a beacon that transmits the position after an event.

#### **Automatic Identification System (AIS)**

One (1) Automatic Identification System (AIS) to be installed. Type in accordance with IMO Reg. 19 of SOLAS Ch.V.

Main Power supply 230VAC, 60Hz

- One (1) AIS transponder
- One (1) AIS processor

System shall be equipped with a dedicated HMI, pilot plug and a dedicated and identified 24 V socket

#### **Long Range Identification and Tracking system (LRIT)**

To be installed according to regulations and integrated in the INMARSAT-C.

#### **Bridge Navigational Watch Alarm System**

One (1) Bridge Navigational Watch Alarm System

The system is an integral part of the Bridge operator stations

Watch / responsibility panel, signal device etc.:

This include:

- One (1) Bridge Alarm Panel
- Four (4) Reset buttons
- Nine (9) Alarm Buzzers for public spaces and navigator cabins
- Two (2) Motion detectors
- One (1) Buzzer in wheelhouse

#### **Training**

The integrated bridge system shall be equipped with software (simulator) for crew training, to be installed on a personal computer (Computer Based Training).

## **42 Communication equipment**

#### **GMDSS installation**

A radio installation according to GMDSS Sea areas to A3 shall be provided.

Ref. SFI item [421 Radio plant, GMDSS](#).

System maintenance shall be based on duplication of equipment and shore based maintenance.

GMDSS maintenance contract.

A distress message control system shall be provided in order to be able to monitor and mute audible distress signals received by the GMDSS equipment. The control panel shall be located at the same location as the central alarm system or the system may be an integrated part of the central alarm system.

Antenna arrangement to be carefully planned in cooperation with supplier of radio and antenna equipment. VHF installation to be able to listen to 3 separate channels simultaneously.

Note: All telecommunications equipment must be approved by ANATEL. The approval certificate issued by ANATEL must be presented.

## 421 Radio plant, GMDSS

Table 4.1 GMDSS Sea areas A3

Quantity	Equipment A1, A2 and A3	Comment	Location
1	MF/HF SSB 150W Simplex radio <ul style="list-style-type: none"> <li>• MF/HF DSC terminal</li> <li>• MF/HF DSC Watch receiver</li> </ul>	Redundant power supply (24 Vdc and 220 Vac).	In GMDSS Console
1	Simplex VHF <ul style="list-style-type: none"> <li>• VHF-DSC En-/ decoder</li> <li>• VHF-DSC Watch- receiver (multi-watch)</li> </ul>	2 (two) VHF radio telephone systems (part of the GMDSS), USA and international maritime mobile channeling, redundant power supply (24 Vdc and 220 Vac).	Main unit shall be installed in forward wheelhouse. Slave units shall be installed in the CCR and in the ship's office
1	Simplex VHF <ul style="list-style-type: none"> <li>• VHF-DSC En-/ decoder</li> <li>• VHF-DSC Watch- receiver (multi-watch)</li> </ul>	Duplication of equipment. One (1) remote/slave control units with redundant power supply (24 Vdc and 220 Vac)	Main unit shall be installed in GMDSS Console. Slave unit shall be installed in the CCR
1	Inmarsat C from recognized GMDSS satellite provider <ul style="list-style-type: none"> <li>• Terminal unit,</li> <li>• Printer,</li> <li>• Keyboard</li> <li>• EGC receiver</li> </ul>	Redundant power supply (24 Vdc and 220 Vac).	In GMDSS Console
1	Inmarsat C from recognized GMDSS satellite provider <ul style="list-style-type: none"> <li>• Terminal unit,</li> <li>• Printer,</li> <li>• Keyboard</li> <li>• EGC receiver</li> </ul>	Duplication of equipment with redundant power supply (24 Vdc and 220 Vac)	In GMDSS Console
1	SSAS	Shall be implemented in satellite system(s) as required. Ref SFI <a href="#">423 Data transmission plants, satellite communication, in Building specification, in 24-7153 - UT 7420 - PSV</a>	
1	LRIT	Shall be implemented in satellite system(s) as required. Ref SFI <a href="#">423 Data transmission plants, satellite communication, in Building specification, in 24-7153 - UT 7420 - PSV</a>	
1	Navtex receiver		In GMDSS Console
1	EPIRB-AIS , COSPAS/ SARSAT <ul style="list-style-type: none"> <li>• 406 MHz.</li> </ul>	Complete with heated free-float bracket	Adequate place on wheelhouse top

Quantity	Equipment A1, A2 and A3	Comment	Location
1	EPIRB-AIS , COSPAS/ SARSAT <ul style="list-style-type: none"> <li>• 406 MHz.</li> </ul>	May be omitted if the EPIRB above is: <ol style="list-style-type: none"> <li>1. Equipped with remote activation from the position from which the ship is normally navigated</li> <li>2. Can be manually activated</li> <li>3. Can be easily retrieved by one person and brought onboard lifeboat/ life raft without putting the person at risk.</li> </ol>	Close to the position from which the ship is normally navigated.
2	Radar transponders <ul style="list-style-type: none"> <li>• 9 GHz</li> </ul>	For life- raft/ boat.	By exit(s) from wheelhouse
3	Portable waterproof VHF radios Each with: <ul style="list-style-type: none"> <li>• Dual slot charger</li> <li>• Spare battery</li> </ul>	For life- raft/ boat.	In "Radio station" in wheelhouse. Accordance with the requirement for tankers to be delivered. Additional six (6) rechargeable batteries shall be delivered.
1	Meteorological facsimile		

## 422 Lifeboat transmitters with equipment, Emergency beacon

See [421 Radio plant, GMDSS](#).

## 423 Data transmission plants, satellite communication

### Satellite Communication

The on-board data network shall be connected to the broadband satellite communication system (supplied by the Owner), in accordance with I-ET-4800.00-9990-000-PTD-002.

See also SFI item [425 Calling/command/crew call telephone plants](#)

## 424 VHF telephones

The following equipment shall be delivered and fitted (in addition to the table in SFI item [421 Radio plant, GMDSS](#)):

Fixed VHF:

- One (1) VHF radio sets, 32 channels, fixed installed in the Wheelhouse.
- One (1) VHF radio set, 32 channels, fixed installed in the ECR.

Portable VHF stations:

- Two (2) Portable Ex- type VHF with
  - One (1) multi charger (Location to be agreed with owner)
- Three (3) Portable VHF stations, all with hands free helmet connection, and all shall be intrinsically safe (Gas proof IIC) and waterproof (IP65) (also to be connectible to Fireman's helmet). With four (2) multi chargers on the bridge (1), and ECR (1).
  - One charger for each shall be provided.
- Three (3) headset for use in noisy areas.

An VHF radiant antenna system shall be installed in order to get coverage in the whole vessel also including outside area.

If number of fire parties listed on the ships muster list is higher than number of VHF radios with connection to fireman's helmet listed above, the number of VHF radios shall be increased accordingly.

## **425 Calling/command/crew call telephone plants**

The vessel to be equipped with an automatic exchange telephone system, sound-powered telephone system and a command- and calling/talk-back systems with certificates, as described below:

### **Automatic telephone system**

An automatic exchange telephone system, operating on 220V AC 1-phase current main supply, and 24V DC battery supply in case of power failure, with capacity for three (3) simultaneous users and extension lines to the telephones listed below:

- One (1) Bridge console
- One (1) Radio station
- One (1) Wing console PS
- One (1) Wing console SB
- One (1) Office (on bridge)
- Two (2) Captains cabin
- Two (2) Chief engineer cabin
- One (1) Chief engineer office
- One (1) Captain office
- Twentyeight (28) Officers/crew cabins
- Three (3) Dayrooms
- One (1) Auditorium
- One (1) Galley
- One (1) Dry Provision
- One (1) Gymnasium
- One (1) Hospital
- One (1) Messroom
- One (1) Ship Office
- One (1) Cargo Control room
- One (1) Meeting room
- One (1) Engine Control room (ECR)

Heavy duty type which shall be suitable for the surrounding noise and a separate microphone:

- One (1) CO2 room
- One (1) Forecastle deck mooring area
- One (1) Poop deck mooring area
- One (1) Emergency generator room
- One (1) Foam room / station
- One (1) Steering gear room
- One (1) Engine room
- One (1) Aux. Engine room

Telephone in ECR to be connected to the light signal columns in engine room areas in addition to normal acoustic signals.

The system to be connected to the public address system.

Automatic telephone system to be interfaced with the Iridium system and VSAT.

### **Command - , Call / Talkback Intercom and Public Address System**

A talk-back intercom system, combined as Command, Call and Public Address system complying with authorities requirements for alarm systems, to be fitted.

The system to be connected to the automatic telephone system.

Talk-back control stations to be installed in navigation bridge, cargo control station, steering gear room, wing consoles, forecastle deck (mooring area), stern mooring area, midship main deck, pump room and engine control room.

Additional Alarms / Public Address speakers to be arranged as follows:

- In corridors and in public rooms on all decks
- All cabins
- On wheelhouse roof
- Manifolds / Bunker stations
- Steering gear room, with head set
- Wheelhouse
- Engine control room, with ear-phones
- CPP station, with head set
- Stern mooring area, with head set
- Main deck area, with head set
- Otherwise throughout the ship according to authorities requirements

Public address system shall have the following noise levels:

- Interior spaces including sleeping positions and cabin bathrooms: 75 dB(A) and at least 20 dB (A) above the speech interference level
- Exterior spaces: 80 dB(A) and at least 15 dB(A) above the speech interference level.

Loudspeakers for PA function shall be mounted in public areas such as corridors, mess/dayroom, etc. as well as outside decks and engine areas as required by Classification Society and National Authorities. The PA system shall be interfaced to the telephone system for augmentation of PA and alarmdistributon.

Public Address speakers - wide coverage, with separation of areas (minimum 4 (four), including cabins, collective rooms, control rooms, engine room, main deck, bow and stern; system equipped with multimedia function with USB input and bluetooth connection; the speakers shall have volume control with "by-pass" and the system shall be interconnected to the PABX system. The sound broadcasting system shall include General Alarm functions, in accordance with the classification society's rules and the Owner's master table. The system shall include buttons configured to automatically trigger the sequence of alarm pulses for general alarm, abandon alarm and emergency station alarm. The system shall receive an alarm from the internal alarm system (alarm column).

One (1) load-speaking command system with talk back for orders from bridge / bridge wings to mooring stations aft and forward, lifeboat / rescue boat locations with attention demand.

### **Sound powered telephone**

Sound-powered telephones or safety automatic telephone system approved according to relevant rules, to be provided between wheelhouse and the following locations:

- One (1) Captain's cabin with buzzer in bed room.

- One (1) Chief eng. cabin with buzzer in bed room.
- One (1) Ships Office
- One (1) Fire stations
- One (1) Cargo Control room (CCR)
- One (1) Cargo pump room
- One (1) Engine control room (ECR)
- One (1) Steering gear room
- One (1) Engine room
- One (1) Main Engine local control station
- One (1) Next to CPP Hydr. unit
- One (1) Cargo pump VSD room
- Two (2) Cargo manifold (Both sides)
- One (1) Inert Gas Generator compartment
- One (1) Emergency manoeuvring stand in engine room, with sub-receiver in ECR.
- One (1) Emergency generator room

The sound-powered units in the engine room, steering gear room & emergency generator room to be provided with headsets.

## **427 Light and signal equipment, lanterns, whistle**

### **General**

One (1) Navigational Lanterns system, included control panel and navigation lights shall be installed according to the authorities' requirements.

### **Lantern Controllers**

All navigation lights to be controlled from indicator panels of graphic type, located in wheelhouse. Each navigation light to be controlled and protected by double pole switch and fused on each conductor.

Visual and aural indicator to be fitted.

Following navigation and signal light controls to be arranged:

- One (1) controller for navigation lights
- One (1) controller for signal lights

Navigation lights to have power supply as follows:

- Normal operation : 220VAC
- Stand-by navigation lights : 24V DC, charged from emergency switchboard

### **Navigation and signal lights**

Navigation and signal lights to be arranged according to class and authorities requirements.

### **Signal light control panel(s)**

The following signal light control panel shall be arranged:

- Steering light according to Panama requirements shall be installed.

### **Morse signal lights (also used as whistle light)**

The following morse signal light to be provided:

- One (1) morse signal light (white) (Aldis) on radar mast, synchronized with air whistle and arranged with an operating handle/switch in wheelhouse main control console (two pieces) and at each bridge wing.

### Searchlights

- Two (2) remote operated search lights, LEDtype, to be installed under bridge wings, one each side, capacity abt. 2000W each. The searchlights shall be installed on a removable base.

All searchlights to be separately controlled.

### Illumination for plaques

2 (two) illuminated plaques with the vessel's name, installed on the edge of the compass deck. The lights to be powered from Emergency switchboard.

### Day signal equipment

The following day signals shall be supplied:

- Required number and types of "Shapes" to enable the vessel to show all relevant combinations according to COLREG requirements.
- One (1) Day light signalling lamp complete with:
  - Battery with charger
  - Transformer for the charger, supply from emergency system
  - Two (2) socket outlets installed on the bridge

### Air whistle

- 2 (two) electric whistles (foremast and radar mast), with manual and automatic activation, whistle-Morse light synchronization, and push buttons for activation on the forward bulkhead of the bridge and on the wings
- One (1) whistle control system with time controller, operated on 220VAC / 1 ph, to be provided in the wheelhouse.
- One (1) push button to be provided in the wheelhouse and one (1) on each bridge wing.
- A second electromagnet for emergency voltage shall be provided, and controlled from
  - the bridge console, only for air whistle for emergency use.
  - The whistle to be interfaced to the General alarm system

The Morse signal light to be commonly used as whistle light.

Compressed air pipe of stainless steel tubes quality on open deck and shall be laid easy accessible as far as possible, not exposed to frost (Insulated where necessary) and without water pockets. Drain(s) shall be arranged if necessary.

## 43 Anchoring, mooring and towing equipment

### Equipment number

Equipment number approx. 2031.

The anchoring and mooring equipment shall be selected and designed in accordance with the recommendations of the OCIMF MEG 4th Edition, Classification Society Rules, IACS Recommendations and shall be submitted to the BUYER for verification and approval.

Anchor and mooring winches shall be of low pressure type.

The surface of the braking drum of the windlasses and mooring winches shall be made of stainless steel (ASTM A-316L).

Winches and windlasses shall have an electro-hydraulic drive and if they are fitted with independent Hydraulic Power Units, their tanks shall have a filtration system with an automatic filter unit, working off-line, with its own circulation pump, suitable for marine applications, with a fine mesh filter and coalescing element for water separation. (CJC - C.C.Jensen or equivalent).

Mooring winches and windlasses shall be designed, manufactured, installed and tested in accordance with the requirements of SOLAS II-1/3-8, OCIMF/MEG 4th edition, and Circular MSC.1/1619 - Guidelines on the design of mooring arrangements and the selection of appropriate mooring equipment and fittings for safe mooring".

Test Kit required for traction and braking tests of all drums shall be provided (typically: lugs, slings, hydraulic cylinder, pump and load cell - depending on the arrangement).

**The following equipment shall be provided for emergency towing:**

Reference also to Table 4.2

**In the bow:**

- 2 (two) bow chain stoppers to receive properly positioned chafing chains, with capacity defined in accordance with the rules and recommendations;
- 2 (two) closed chocks as per OCIMF MEG 4th rules. Edition, at least measuring 600 x 450mm;
- 2 (two) rollers aligned with the windlass drum;
- 2 (two) chafing chain with a diameter of 76mm and a length of 8m; Chafing chain complete set to be provided and properly stowed.
- 1 (one) set comprising a 15-ton winch for picking up and storing cable during operations on monobuoys ("SPM Pick-up winch") and closed chocks. This winch shall be straight aligned with the ETA chocks;

**At the stern ("SPM/ Pull-back" and "ETA - emergency towing"):**

- 1 (one) reinforced closed chock with a capacity of 200 t;
- 1 (one) bollard/ stopper with a capacity defined by the rules and recommendations, associated with a remote quick release system;
- 1 (one) nylon rope with a diameter of 40 mm and a length of 100 m;
- 1 (one) messenger cable with a diameter of 16 mm and a length of 20 m;
- 1 (one) marker buoy with flashing light;
- 1 (one) steel cable with a diameter of 80 mm and a length of 90 m.

This equipment shall follow the definitions in the OCIMF/ MEG 4th publication. Edition and OCIMF/ Recommendations for ship's fittings for use with tugs".

Generally : To be according to OCIMF MEG 4th, MSC.1/Circ.1619 and MSC.1/Circ.1620.

#### **431 Anchors with chains and equipment**

Three (3) SPEK or High Holding Power anchors shall be provided. The spare anchor should be stowed on the main deck, preferably in the area within the cargo hose handling crane range.

Anchor chain set is to be grade 3. 1 (one) spare chain length shall be provided with kenter link. There shall be hangers/hooks for stowage of spare links in the Bosun Store.

The anchor chain lengths will be joined by kenter links enabling any length to be inverted during

drydocking. All chain lengths are to be duly identified.

The anchor in their stowed position shall rest against the ship's side on 03 points. No anchor pocket foreseen. (ref. SFI 266 Anchor pockets and hawse pipes).

#### Anchors and anchor chain

Anchor type	SPEK-type (alternatively High-Hold anchor - weight reduced with 25%)
Anchor weight	6000 kg
Chain diameter	60 mm
Chain length (total of 2 chains)	577,5m
Chain Material	Steel grade Q3

### 433 Combined windlass/mooring winches with chain stoppers, rollers

Two (2) combined anchor windlass/mooring winches shall be installed on the Forecastle deck.

#### Combined windlass/mooring winch

Manufacturer	Kongsberg Maritime
Type	MW 120 L / CU 60 K3
Cable lifters	1
Chain diameter	60 mm
Nominal pull	17,4 t at 9 m/min
Maximum pull (Anchor break-out)	26,1 t
Brake holding load	127 t
Declutchable	Yes
Warping head(s)	1
Warping head dimensions	dia. 450 x 490mm length
Mooring drum(s)	2 (split drums)
Drum (dia. x length)	dia. 420/1300 x 530+390 mm wide
Storage capacity	220 m of 48 mm rope
Nominal pull	13 t at 0 - 18 m/min
Maximum pull	20,5t
Brake holding load	34 t
Declutchable	Yes
Driving unit	Electro hydraulic - low pressure
Speed control	Two speed ranges - Zero to maximum speed
Tension control	No
Type of starter	Star/Delta with overload protection in marine type IP54
Power supply	Ref. <u>Table 8.6</u>
IP class	IP54
Controls	Local
Emergency stop	Yes

#### Chain Stopper

Two (2) roller type Chain stoppers with lashing hook suitable for 60 mm dia. grade 3 chain cable shall be installed, one each side, adjusted or made adjustable for maximum tightening of anchors.

#### Local Control Stand:

Two (2) Single control stands, with one speed/rotation direction control lever, one emergency stop.

## 434 Tugger winches, capstans, mooring winches with warping heads

### Mooring winch fwd on Forecastle Deck

One (1) mooring winch fwd shall be installed on the Forecastle deck.

With two split mooring drums and one warping end.

#### Mooring winch

Manufacturer	Kongsberg Maritime
Type	MW 156 L (2 m/d+1w/e)
Warping head(s)	1
Warping head dimensions	Ø560 mm
Mooring drum(s)	2
Drum (dia. x length)	dia. 560/1400 x 500+390 mm wide
Nominal pull	15 t at 0-15 m/min
Brake holding load	34 t
Declutchable	Yes
Warping head	1
Nominal pull	approx. 13 t at approx. 0-15 m/min
Warping head dimensions	approx. Dia. 560mm
Driving unit	Electro hydraulic - low pressure
Speed control	Two speed ranges - Zero to maximum speed
Tension control	No
Type of starter	Star/Delta with overload protection in marine type IP54
Power supply	Ref. <a href="#">Table 8.6</a>
IP class	IP54
Controls	Local
Emergency stop	Yes

### Bow Chain Stopper for SPM

Two (2) roller type Chain stoppers with lashing hook, suitable for chain dimensions and quality acc. to rules, shall be installed, one each side on bow according to General Arrangement.

### Local Control Stand:

One (1) Single control stand, to be ergonomically located, with one speed/rotation direction control lever, one emergency stop.

### Mooring winch fwd On Main Deck and Mooring winches aft

One (1) mooring winch fwd shall be installed on the Forecastle deck, and three (3) mooring winches shall be installed on the Poop deck aft as indicated on the General Arrangement.

Each with two split mooring drums and one warping end.

#### Mooring winch

Manufacturer	Kongsberg Maritime
Type	MW 120 L (2 m/d+1w/e)
Warping head(s)	1
Warping head dimensions	Ø450 mm

Mooring drum(s)	2
Drum (dia. x length)	dia. 420/1300 x 530+390 mm wide
Storage capacity	220 m of 48 mm rope
Nominal pull	13t at 0-18 m/min
Brake holding load	34 t
Declutchable	Yes
Warping head	1
Nominal pull	approx. 13t at approx. 0-18 m/min
Warping head dimensions	dia. 450 x 490 mm length
Driving unit	Electro hydraulic - low pressure
Speed control	Two speed ranges - Zero to maximum speed
Tension control	No
Type of starter	Star/Delta with overload protection in marine type IP54
Power supply	Ref. <a href="#">Table 8.6</a>
IP class	IP54
Controls	Local
Emergency stop	Yes

#### Local Control Stand:

Four (4) Single control stands, with one speed/rotation direction control lever, one emergency stop.

#### Drums for safety wires

2 (two) safety fire wires, made of galvanized steel, with a diameter, capacity and length defined by the lashing calculations defined by the SDBL OCIMF MEG 4th rules. Edition, Class and IACS, stored in their own drums, with compressed air collection motors, on the main deck, one forward and one aft.

### 435 Fixed mooring equipment

Bollards, chocks, and (roller) fairleads shall be fitted as indicated on the Mooring Arrangement and approved by the Owner.

Fixed mooring equipment shall be according to the calculated Equipment number of the ship, if not specified otherwise.

Bollards and fairleads shall be locally reinforced. The SWL shall be welded to the top of all bollards and fairleads.

Table 4.2 Fixed mooring equipment

Deck	Item	Quantity	Purpose	SWL	Standard/ Type
Mooring Fwd.	Bollard	6	Mooring		NS2584
Mooring Fwd.	Chock	20	Mooring		NS2587
Mooring Fwd.	Chock	3	Emergency towing		NS2589
Mooring Fwd.	Towing bracket	2	Emergency towing		SPM stopper, 200 tons, Ø76 mm
Mooring Fwd.	Rollers	2	Mooring		NS2585

Deck	Item	Quantity	Purpose	SWL	Standard/ Type
Mooring midship	Bollard	4	Mooring		NS2584
Mooring midship	Chock	4	Mooring		NS2688
Mooring Aft.	Bollard	4	Mooring		NS2584
Mooring Aft.	Bollard	1	Emergency towing		NS2584
Mooring Aft.	Chock	16	Mooring		NS2587
Mooring Aft.	Chock	1	Emergency towing		NS2589

\*The bollard can be loaded with 2 ropes with MBL not exceeding the values in the tables.

Alternatively 1 rope with 180° circumference.

## 436 Loose mooring equipment

Loose mooring equipment according to Classification Society requirements shall be delivered by the Yard.

Loose mooring equipment beyond the Classification Society rules shall be delivered by the Owner, ref. M Owner Furnished Equipment.

### CABLES/ ROPES

The following ropes shall be provided:

- 12 (twelve) nylon mooring ropes, each 220 m long, of braided construction (double braid), with a diameter and capacity defined by the mooring calculations (SDBL OCIMF MEG 4th Edition, Class and IACS). The mooring lines shall be properly mounted on the winch drums. Each mooring rope shall be supplied by the manufacturer with two braided eye splices, made from the cable's own material, with a length of approximately 1.80m;
- 2 (two) spare nylon ropes for mooring, stowed in the bosun store and in the steering gear compartment;
- 4 (four) nylon towing ropes for tugboat maneuvering, each 100 m long, to be stowed in an appropriate place inside the bosun store and steering gear compartment, with a diameter and capacity defined by the mooring calculations set out in the SDBL OCIMF MEG 4th rules. Edition, Class and IACS;
- 2 (two) safety fire wires, made of galvanized steel, with a diameter, capacity and length defined by the lashing calculations defined by the SDBL OCIMF MEG 4th rules. Edition, Class and IACS, stored in their own drums, with compressed air collection motors, on the main deck, one forward and one aft, according to the aforementioned document.

The following equipment shall be provided for emergency towing:

In the bow:

- 2 (two) bow chain stoppers to receive properly positioned chafing chains, with capacity defined in accordance with the rules and recommendations;
- 2 (two) closed chocks as per OCIMF MEG 4th rules. Edition, at least measuring 600 x 450mm;
- 2 (two) rollers aligned with the windlass drum;
- 2 (two) chafing chain with a diameter of 76mm and a length of 8m;

- 1 (one) set comprising a 15-ton winch for picking up and storing cable during operations on monobuoys ("SPM Pick-up winch") and closed chocks. This winch shall be straight aligned with the ETA chocks;

At the stern ("SPM/ Pull-back" and "ETA - emergency towing"):

- 1 (one) reinforced closed chock with a capacity of 200 t;
- 1 (one) bollard/ stopper with a capacity defined by the rules and recommendations, associated with a remote quick release system;
- 1 (one) nylon rope with a diameter of 40 mm and a length of 100 m;
- 1 (one) messenger cable with a diameter of 16 mm and a length of 20 m;
- 1 (one) marker buoy with flashing light;
- 1 (one) steel cable with a diameter of 80 mm and a length of 90 m.

This equipment shall follow the definitions in the OCIMF/ MEG 4th publication. Edition and OCIMF/ Recommmendations for ship's fittings for use with tugs".

## 438 Hydraulic oil system for winches

### [LP hydraulic oil system for winches](#)

In general, the arrangement of hydraulic pipe systems winches shall be in accordance with the Kongsberg equipment supplier's recommendation.

The systems shall include:

- Pump(s)
- Level regulated expansion system(s)
- Valves
- Filters
- Starter cabinets
- Oil cooler(s) and thermostatic valve(s) shall be included where required.

Low pressure hydraulic oil supply tank, stores tank and drop tank, ref. [SFI 71 Lube oil systems](#)

Hydraulic oil transfer pump, ref. [SFI 71 Lube oil systems](#).

Low pressure hydraulic pipes general:

- Shall be of seamless steel quality.
- Dimension DN50 and above shall be flanged with o-ring flange MFAS or similar.
- Dimension DN40 and below shall be of precision steel tubes with compression ring fittings (bit type) make Ermeto or similar.
- On open deck, precision steel tubes to be of stainless steel quality.
- LP hydraulic pipes on open decks shall have galvanized pipe clamps.
- Deck- and bulkhead connections by flanges, shall be of approved standard by the LP hydraulic equipment supplier.
- First time filling of hydraulic oil systems shall be carried out and paid for by the Yard.

Cleaning and internal surface treatment of the pipes shall be in accordance with the recommendations from winch equipment supplier.

### [Remote Control](#)

Remote start/ stop and running indication of HPU for windlass and tugger winches from wheelhouse forward/IAS shall be arranged, ref. [792 Alarm and monitoring system](#).

## 44 Repair, maintenance and cleaning equipment & arrangements

### 441 Machine tools, cutting and welding equipment

The work benches, lockers, tools and equipment that shall be delivered and installed in the different workshops are mentioned below.

#### Workshop /Engineers tools

- · 1 mechanical lathe with 1,5 m tip spacing and 250 mm tip height;
- 1 drilling machine, max. 30 mm in diameter;
- 1 grinder, double head, 255 mm wheel diameter;
- 1 gas welding set;
- 1 electric welding machine, alternating current, 300 A;
- 1 test bench for Main Engine injectors;
- 1 test bench for the Auxiliary Engines injectors;
- 1 machine for grinding Main Engine discharge valves;
- 1 tube bending machine;
- 1 hydraulic press;
- 1 bench vice, type Morsa nº 6;
- 1 bench vise, walrus type No. 7;
- 1 worktop with wooden top;
- 1 steel cabinet for storing tools;
- 1 steel cabinet for storing instruments;
- 1 shelf with bins for small items;
- 1 shelf for storing tubes, bars, and so on;
- 1 ASTM A-304 stainless steel tank with cold water tap.

Protective curtains shall be installed in the welding areas.

There shall be fresh water and compressed air points in the workshop room.

#### Workshop /Electrician tools

- The electrical workshop shall be equipped with the following items:
  - . 1 wooden workbench with lathe;
  - . 1 steel cabinet for storing tools;
  - . 1 steel cabinet with 4 (four) drawers;
  - . 1 cabinet for storing materials;
  - . 1 insulated rubber mat placed in front of the wooden bench;
  - . 1 electrical testing panel;
  - . 1 set of shelves.

The electrical testing panel shall have the following characteristics:

- . 450V emergency power supply, 3 phases, with 20 A circuit breaker;
- . 220V emergency power supply, 3 phases, with 10 A circuit breaker;
- . Sockets for testing all types of lamps installed on board, including projectors and fluorescent lamps;
- . Continuity and fuse testing;
- . Power output terminals, with protection against accidental contact, sockets, universal type with grounding pin, and disconnect switches for the 450V and 220V circuits.

#### Cutting equipment

Four (4) Oxygen bottles and two (2) Acetylene bottles shall be arranged in separate stores.

The Oxygen /Acetylene lockers shall be equipped with local reducing outlet station(s).

The outlet station(s) shall include a cabinet with twin valve unit, Oxy/Ace regulators, flashback arrestors, hose stems and stretch relief bracket for the welding hoses. One (1) welding and cutting equipment-set with two (2) x 30 m approved hose for oxygen and acetylene shall be supplied.

- One (1) outlet station in engine room workshop
- One (1) outlet in deck workshop

#### **Welding equipment**

One (1) Welding transformer for stick electrode and for TIG welding shall be located in the engine workshop. Welding current range approx. 5-400 A. One (1) socket for welding cable shall be located in engine workshop and one (1) in the deck workshop. Two (2) x 30 m welding cable shall be delivered.

Gas welding and cutting equipment including hoses and bottles shall be delivered by the Owner, ref. M Owner Furnished Equipment.

#### **Gas protection Equipment**

Gas detector(s) (oxygen, flammable gases or vapours, hydrogen sulphide and carbon monoxide) according to SOLAS requirement for Atmosphere testing of enclosed spaces shall be available (ref. SOLAS XI-1-7).

### **442 Engine- and hand tools**

Propulsion machinery, auxiliary engines and separators hand tools shall be delivered according to the manufacturer's standard delivery, including special tools for removal of pistons.

All tools shall be located on tool boards, in shelves and in drawers/lockers arranged in the engine room workshop.

The Yard will supply the following items from the machinery inventory:

- 1 (one) internal measuring compass, 325 mm;
- 1 (one) external micrometer from 0 to 25 mm;
- 1 (one) dial indicator;
- 1 (one) magnetic base;
- 1 (one) caliper, 300 mm;
- 1 (one) manual tachometer;
- 1 (one) metric clearance gauge, with 13 sheets of 150 mm, range from 0,05 mm to 1 mm;
- 1 (one) metric thread pitch gauge, with 18 sheets, range from 0,4 mm to 7 mm;
- 1 (one) copper tube cutter, capacity 3,17 mm to 25,4 mm;
- 1 (one) portable electric drilling machine 220 Vac, steel capacity up to 13 mm;
- 1 (one) set of 2 mm to 38 mm screw-machine drill bits;
- 1 (one) 2 kg sledge hammer;
- 1 (one) set of 200 mm files (1 flat, 1 triangular, 1 round);
- 1 (one) set of 5 double spline wrenches, from 6 mm to 41 mm;
- 1 (one) pipe wrench, 250 mm;
- 1 (one) pipe wrench, 450 mm;
- 1 (one) manual grease pump, with side lever, 400 g capacity;
- 2 (two) oilers with pressure pumps, rigid nozzle, 170 g of capacity;
- 1 (one) gasket puller, length 273 mm, diameter 6 mm;
- 1 (one) gasket puller, length 158 mm, diameter 4,7 mm;
- 2 (two) pulley pullers of different sizes;
- 2 (two) tape measure for sounding tanks, 30 m foil tape, with plumb bob, graduated in the metric system;
- 1 Pneumatic Oil transfer pump for drum of 200 L;
- 1 set of hydraulic bolt cutters;

- 2 (two) air-powered impact wrenches ½";
- 2 (two) air-powered impact wrenches ¾";
- 2 (two) battery-operated impact wrenches ½";
- 1 (one) Aviation snip straight;
- 1 (one) Offset Right-Cutting Snip;
- 1 (one) Off Left-Cutting Snip;;
- 1 set of professional stud bolt puller;
- 1 (one) professional millimeter taps and die set ;
- 1 (one) professional inch UNC and UNF taps and die sets for diameters only <3/4";
- 3 sets of drill bits for steel from 1 to 13mm (for chuck);
- 1 set of rotary files

#### **444 Cleaning equipment, garbage chutes**

##### **High Pressure washer(s)**

One (1) HP washer (approx. 200 bar - 25 l/min) with hot and cold water supply shall be delivered and installed in the deck General Store.

Capacity, temperature, arrangement, hose connections, etc. shall be in accordance with NOFO 2021.

Steam outlet with lance shall be in accordance with NOFO 2021.

Capacity shall be sufficient for use of two (2) lances simultaneously.

- Hoses:
  - Two (2) x 20 m
  - One (1) x 10 m hose
- Lances:
  - One (1) "long"
  - One (1) "tank" gun

Further, quick coupling type hose connection including closing valve shall be located:

- One (1) in Steering gear room
- One (1) on mooring deck forward
- One (1) on Wheelhouse top
- Three (3) Aft of superstructure
- Two (2) in Engine room
- Five (5) on external deck

Pipe system shall be of precision steel tubes of AISI316L stainless steel quality.

A possibility to isolate and drain parts of the system exposed to frost shall be arranged.

#### **445 Garbage disposal plants, incinerators**

##### **Incinerator**

One (1) garbage and oil sludge incinerator of the type approved by the IMO/Marpol Convention Annex VI shall be provided and installed in the Engine Room. Provision shall be made for the use of fuel oil (HFO/LFO and/or DO) for the incinerator. A monorail shall be provided for moving the garbage.

The incinerator shall allow continuous burning and feeding of solids and waste produced by the purifiers, waste from the separated bilge oil tank, drain tank and sanitary holding tank.

It shall be possible to feed solids while the incinerator is running.

It shall be able to burn sludge with up to 50% water content, without using diesel oil. The system

configuration shall have automation for autonomous operation and the sizing of the tanks shall follow the standards recommended by the manufacturer.

The incinerator's emergency stop shall be installed in the ECR.

The nominal capacity should be around 300.000 kcal/h to burn the expected amount of oily waste produced per day by the vessel over a 10-hour period, and it shall have a hatch to feed solid waste and a premixing tank (conditioner or service tank) as recommended by the manufacturer.

The incinerator shall comply with the ISO 14000 emissions standard.

#### Incinerator capacities

Calorific capacity	300.000 kcal/h (420 kW)
Sludge capacity	50 l/h
Solid waste capacity	50 kg/h

The incinerator shall be complete including:

- Control panel
- Flue gas fan and flue gas damper
- Exhaust gas spark arrestor
- System for automatic burning sludge and manual feeding of garbage while burning sludge
- Device for feeding waste during operation
- Sludge /mixing tank system with electric heater (approx. 500 l)
- Necessary valves, level gauges and switches, thermostats
- Emergency stop switch shall be installed outside the Incinerator room
- IMO resolution MEPC 244(66) as amended.

#### Garbage room

The capacity of the garbage room shall be according to Classification Society requirements and/or ISO 21070. The following equipment shall be installed in the garbage room:

- One (1) Garbage compactor
- Sorting bins
- Storage containers
- Minimum one (1) scupper with connection to the grey water system
- Hatch to incinerator

The hospital and any other relevant areas of the vessel shall be provided with means to comply with ANVISA RDC 222/2018 for health care waste management.

## 446

### Outfitting in store rooms and workshops

#### Store rooms

Store rooms shall be arranged according to the General Arrangement.

Separate store room for paint and chemicals shall be arranged with ventilation and fire fighting according to the Classification Society and National Authorities requirements (ref. [579 Ventilation/AC systems for various compartments](#) and [81 Fire and lifeboat alarm, fire fighting and wash down systems](#)).

Shelves and other outfitting in the rooms shall be arranged according to agreement between the Yard and the Owner.

## Workshops

Workshops shall be arranged according to the General Arrangement and equipped as listed in [441 Machine tools, cutting and welding equipment](#).

### **447 Clamps/foundations for spare parts**

Lockers and shelves for smaller spare parts shall be delivered and fitted by the Yard.

Heavier spare parts shall be stored in special clamps or foundations at suitable places in the engine room or a store room.

Clamps and foundations shall be fitted by the Yard.

All major spare parts shall be supplied with corrosion protection.

### **448 Name plates/marking on machinery, equipment, pipes, cables**

#### **Machinery equipment**

Machinery equipment shall have markings and signs according to Owners Standard N-1503 . For Language ref. [I Drawings, instruction manuals, etc..](#)

#### **Pipes and armatures**

Marking to be according to Owners Standard N-1503

#### **Electric cables and equipment**

Marking to be according to Owners Standard N-1503

## **45 Lifting and transport equipment for machinery components**

### **452 Travelling cranes and lifting gear in engine rooms**

#### **Engine Room and Auxiliary Engine Room**

An overhead travelling crane with the capacity to lift the heaviest component of the main engine, shall be provided.

Monorails - Monorails with trolleys and hoists shall be installed to move parts on the following equipment/locations:

- 1 (one) over each auxiliary diesel generator set, with a capacity of 500 kg;
- 1 (one) in the workshop, with a capacity of 500 Kg.

Monorails with trolleys for moving parts shall be installed over the following equipment/locations:

- 1 (one) over fuel oil and lubricating oil purifiers with a capacity of 200 kg for transporting the rotors to the cleaning table;
- excluded
- 1 (one) over each hydraulic unit of the cargo system, with a capacity compatible with the heaviest part of the set;
- 1 (one) in the spare parts locker with a capacity of 500 Kg.

Two (2) 200 kg and two (2) 500 kg hoists shall also be supplied apart.

Eyebolts over equipment served by cranes or monorails shall be installed for equipment weighing 60 kg or more.

### **454 Travelling cranes and lifting gear outside engine rooms**

In general, lifting eyes shall be arranged above all equipment heavier than 60 kg for demounting and maintenance.

Lifting eyes used during the building period for mounting of components may be kept if practical, according to agreement with Owner.

### Engine workshop

Traveling beam and one (1) electric driven travelling chain tackle with 500 kg approved by Owner shall be provided.

### Miscellaneous Lifting Equipment outside Engine Room

The following miscellaneous lifting equipment shall be provided complete with winches with pneumatic motors fitted with filters and lubricators, air hoses, cables, chain hoists, etc., or alternatively with hoists and/or jibs:

Table 4.3 Miscellaneous lifting equipment outside engine room

Equipment	Quantity	Purpose	Minimum capacity	Drive
a) Tripod portable	2 (two)	Removal of gravel and mud from cargo, slop, fuel oil storage and ballast tanks	0,2 t	Air motor
b) Bosun store davit	1 (one)	Removal of parts from Bosun Store	0,5 t	Air motor
c) Cargo manifold	1 (one)	Handling of cargo reducers and others	0,5 t	Chain Hoist

## 5 EQUIPMENT FOR CREW AND PASSENGERS

### 50 Lifesaving equipment

The vessel shall have safety equipment according to SOLAS and the National Authorities for the total number of crew and passengers onboard as described in B Arrangement, description.

The survival and rescue boat crafts and their launching devices will be supplied in compliance with the latest IMO/MSC, SOLAS and LSA requirements resolutions and recommendations, and will be certified in accordance with the EU Marine Equipment Directive (MED) - 2014/90/EU.

All lifesaving & FiFi equipment are to be duly certified as per EU-MED requirements - Ref. ET-4880.00-9311-000-ptd-001.

Equipment mentioned under SFI Main Group 50 shall have certificates with a 12 months period of validity from the vessel's delivery date.

#### 501 Lifeboats/Rescue boats with equipment

##### Lifeboats/Rescue boats with equipment

Lifeboat and SOLAS Rescue boat shall be fitted as indicated on the General Arrangement plan, and shall be built and equipped according to Class and National Authorities requirements.

A socket for the lifeboat battery charger shall be provided.

##### Rescue boat

One (1) SOLAS Rescue boat shall be fitted as indicated on the General Arrangement.

##### Rescue boat

Hull	GRP
Davit type	Provision crane to be used for launching of Rescue boat, ref SFI <u>331 Rotating cranes with crane pillars</u>
Size included davit (LxBxH):	Maker's standard
Capacity:	6 persons
Speed:	Capable of maintaining a speed of 20 knots while carrying full capacity
Propulsion:	Inboard motor with water jet propulsion

##### Life boat

One (1) totally enclosed fire-resistant free fall, SOLAS approved, life boat shall be fitted according to the General Arrangement.

##### Life boat

Hull	GRP
Davit type	Freefall launch arrangement of approved type to be arranged at the stern, maintenance platform with handrails on each side of the davit
Size included davit (LxBxH):	Maker's standard
Capacity:	36 persons
Speed:	Not less than 6 knots in smooth water
Propulsion:	Inboard motor with propeller

##### Notes:

- All piping for davits and cranes shall be of stainless steel.
- The manoeuvring panels for the provision crane shall be arranged for optimal view of ship side.

- Rescue boat - arrangement for fuelling, ref. SFI item 701 Fuel oil transfer & drain systems.

## 502 Life rafts with equipment

### Life rafts

Life rafts with approved launching system shall be fitted as indicated on the General Arrangement Plan, and shall be built and equipped according to National Authorities requirements.

The life raft capacity on each side of the vessel shall be as required by the National Authorities for the total number of persons as described in B Arrangement, description.

The life rafts shall be stowed in GRP-containers, and the containers shall be fixed in solid cradles.

Provision crane shall be used for launching of liferafts, ref. SFI 331 Rotating cranes with crane pillars.

## 503 Lifesaving, safety and emergency equipment

### Lifebuoys

Fourteen (14) lifebuoys will be provided, located in accessible positions on the exposed decks, marked with the vessel's name and port of registry, distributed as follows: Seven (7) buoys with buoyant lifelines of at least 30 m in length; Five (5) buoys with self-igniting lights; Two (2) buoys with (electric battery) self-igniting light and self-activating smoke signal located at both navigation bridge wings.

### Life jackets/Immersion Suits

Life jackets will be provided in accordance with SOLAS Convention Chapter III, CLASS I, for the entire capacity of the vessel including possible passengers, with a capacity of 55 to 110 kg and at least Six (6) with a capacity of over 110 kg. Each crew member will have a life jacket stowed in their cabin. Three (3) life jackets will be supplied and installed in the engine control room, Three (3) on the navigation bridge, Two (2) in the infirmary/hospital, Eighth (8) for the shaller stations and Two (2) in the cargo control room and Two (2) on the forward liferaft. All lifejackets will be marked with the vessel's name and port of registry and will have a selfignition light and whistle. In addition, Six (6) life jackets for children will be provided.

Immersion suits will be provided for the entire capacity of the vessel. Each crew member will have an immersion suit in cabin, including the workers' cabin. In addition, Two (2) immersion suits will be supplied/installed near the forward liferaft, Two (2) at the stern, Two (2) on the navigation bridge and Two (2) in the Engine Control Room. The immersion suits that are part of the survival and rescue craft's equipment are not included in this figure.

Emergency Escape masks (EEBD) will be provided, certified and positioned as required by the rules and regulations and according to approved Fire Control and Lifesaving Plan. Emergency Escape masks (EEBD) will be maintenance free type.

### Distress Signals

One (1) set of pyrotechnic devices stowed on the Navigation Bridge will be provided, consisting of at least: Twelve (12) rockets parachutes and red lights; Eighteen (18) hand-held flares, Six (6) with a green star, Six (6) with a red star and Six (6) with a white star.

### Line Throwing Apparatus

One (1) pneumatic line throwing appliance will be supplied, equipped with the following items: Four (4) 230 m long lines; Four (4) projectiles; Two (2) air cylinders of 1,45 liters x 30 MPa (305,81 kgf/cm<sup>2</sup>).

## 504 Hospital/treatment facilities and medical equipment

The hospital/treatment room shall be arranged and equipped according to Classification Society, National Authorities requirements, and RDC 72 of The Brazilian Health Regulatory Agency (ANVISA).

The hospital shall be conveniently separated from other rooms, have a physical space that provides adequate care for the patient and the entrance shall be arranged to permit a stretcher to easily pass through (> 1000 mm).

A separate bathroom with sink, toilet and shower shall be arranged, for the exclusive use of hospital occupants, ref. [583 Bathtubs, showers, WC, washbasins](#).

The room shall be arranged for wet treatment by a shower reaching treatment bench, arranged on wet space flooring with sufficient drains.

Cabinets shall be provided for storing medicines and medical-surgical materials, as well as all the necessary furniture. Medicines and medical equipment shall be stored in a lockable cabinet in the hospital, under the responsibility of the medic. First aid cabinets shall be arranged in the galley and the ECR.

A hospital alarm shall be installed, ref. [792 Alarm and monitoring system](#).

Table 5.1 Hospital equipment

Equipment	Quantity	Remarks
Examination couch	1	Three parts with shoulder support and adjustable heights
Medical cabinet	1	Including refrigerator, poison locker etc.
Examination lamp	1	Approved type
Stretchers	1	Ambulance type
Instrument table	1	Moveable type
Bookshelf	1	
Desk with drawers	1	
Wardrobe locker	1	
Three (3) Beds with bedside Table	3	One (1) call button will be installed at the head of the beds, which will activate the bells installed in the corridor next to the medical assistant's cabin and in the corridor next to the messroom
Office chair	1	
Soft chair	1	
Individual sanitary unit	1	Equipped with shower

For radio communication to shore, ref. [42 Communication equipment](#).

For waste management, ref. to requirement in [445 Garbage disposal plants, incinerators](#).

## 505 Loose firefighting apparatuses and equipment, firemen's outfit

### Fire extinguishers

**PORTABLE FIRE FIGHTING EQUIPMENT** The quantities and location of fire extinguishers shall comply with the rules and regulations. Firefighter's outfit set (protection clothing, self-contained breathing apparatus, axe, guide cable, safety flashlight, etc.) shall be stored in fixed boxes on the bulkheads, each with a complete set.

Protective clothing shall be certified in accordance with directive EN 469, level 2 (X2, Y2, Z2). A VHF radio certified as intrinsically safe shall be provided for each rescue/firefighting team (four).

The extinguishers shall be suspended on hooks and fixed with clamps.

All loose fire extinguishers shall be of cartridge charged type.

In rooms with electric installation, extinguishers shall be of the CO<sub>2</sub> type.

### Fire axes

Fire axes shall be delivered and suspended on bulkheads in accommodation and corridors according to requirements.

### Fireman's outfit

The following fireman outfits and breathing equipment shall be provided:

- Required Complete fireman's outfits shall be supplied and stowed according to National Authority requirements and Classification Society requirements.
- Minimum One (1) Breathing air compressor, 300 bar, shall be supplied for filling of air bottles. The compressor shall have electrical supply also via the emergency generator switchboard. The compressor shall be arranged for refill of Emergency Escape Breathing Device (EEBD) sets on board. For each pair of breathing apparatus there shall be provided one water fog applicator stored adjacent to such apparatus.

A single designer, hereinafter referred to as the Fire Station (ECI) Integrator, who is a renowned designer of fire detection and firefighting systems, shall be responsible for designing the integration of the Fire Station's systems. The architecture of ECI's systems shall be submitted to the Owner for approval. The layout of the ECI compartment shall accommodate complete fire-fighting sets (fire brigade) and spare cylinders of breathing air and portable extinguishers.

### FIRE FIGHTING STATION ("ECI")

The Fire Station (ECI) shall be located in a compartment near the entrance to the Engine Room, on the main deck of the Accommodation. The installation and equipment of the Fire Station shall be arranged in an integrated manner, including but not limited to the following systems, controls, and indicators:

- Central control panel of the fire detection and alarm system with repeaters in the Navigation bridge, ECR and CCR;
- Release and alarm panel for fixed clean agent fire-fighting system (novec, inergen or similar) for the various compartments,
- Starting, stopping and supervising of the emergency fire pump and the general services, bilge and fire pumps in the Engine Room;
- Control panel for the foam system with start and stop of the bilge, fire and general services water pump and Foam Forming Liquid pump;
- Shutdown of the fans and exhaust fans in the accommodation with repeaters in the Navigation bridge, ECR and CCR;
- Shutdown of the fans and oil pumps in the Engine Room;
- Remote start panel for ventilation and exhaust dampers in compartments protected by clean agents (novec, inergen or similar);
- Gas detection system panel of ballast tanks and cofferdam;
- Activation of fixed fire-fighting systems (clean agents, foam, water, etc.);
- Remote actuation for quick-closing valves;
- Manual compressor and air bottle for breathing apparatus.
- Automatic telephone;
- Remote closing of fire doors;
- General Alarm Push Button;
- Fire alarm push button.
- Fire detection system;
- Remote closing of dampers and doors;

- Remote closing of oil tank valves;
- Emergency stops;
- Gas detection in ballast tanks and cofferdams;
- Clean agent flooding system (novec, inergen or similar).

## 51 Insulation, partition bulkheads, ceiling, doors, side scuttles, windows

### 511 Insulation, partition bulkheads, ceiling and wall panels

All accommodation shall be arranged so that deck area and free deck heights shall be in accordance with common practice for this type of ship and to fulfil the Classification Society's, National Authorities' and Marine Labour Code 2006 rules and regulations.

All works shall be carried out according to common practice and Yard standards.

Access to concealed pipes, cables etc. shall be arranged where necessary by means of hinged inspection doors. Removable sections/hatches in walls and ceilings may be accepted where doors prove to be difficult.

Dead space behind lining may be utilized for space and storage where not limited by building principles and noise reduction requirements.

The Yard shall send colour proposal and material samples to the Owner for consideration and approval.

Accommodation drawings shall be worked out and approved by the Owner and National Authorities before the work starts.

#### **Walls/bulkheads**

The panelling system shall be chosen according to noise reduction requirements. The lining system shall be easy to install and meet the following criteria:

##### **Quality:**

- Pre-arranged connecting pieces for modular system
- Accurate and rapid installation

##### **Flexibility:**

- Possibility for modular system in 100 mm or 50 mm

##### **Fire:**

- According to minimum Classification Society rules and according to the method of construction

##### **Sound reduction:**

Sound reduction shall as a minimum satisfy IMO Noise Code indexes.

Where noise reduction is required, lining shall not be penetrated for electrical cables or equipment.

#### **Ceiling**

The ceiling system shall be chosen according to noise reduction requirement. The ceiling system shall be easy to install and meet the following criteria:

##### **Quality:**

- Accurate and rapid installation

##### **Flexibility:**

- Possibility dismounting for easy access.

**Fire:**

- According to minimum Classification Society rules and according to the method of construction

**Sound reduction:**

- For noise reduction, execution and workmanship shall be as to minimize noise transfer between compartments.

Table 5.2 Linings &amp; ceilings

Compartments	Lining	Facing/materials	Ceiling	Facing/materials
Cabins	Standard panels 25 mm Double walls between cabins and between cabins and public spaces, with air gap/or insulation per noise reduction measures	Galvanised steel sheets coated with a halogen-free decorative finish on one or both sides	Standard type 25-50mm	Galvanised steel sheets coated with a halogen-free decorative finish
Corridors, stairs, recreation, mess rooms, offices, gymnasium	Standard panels 25 mm	Galvanised steel sheets coated with a halogen-free decorative finish on one or both sides	Standard type 25-50mm (perforated finish in public spaces)	Galvanised steel sheets coated with a halogen-free decorative finish
Wheelhouse	Standard panels 25 mm	Galvanised steel sheets coated with a halogen-free decorative finish on one or both sides	Standard type 25-50mm (perforated finish)	Galvanised steel sheets coated with a halogen-free decorative finish (dark, non-reflex)
Galley, pantry	Wet-room panels 25/50 mm	Stainless steel sheets coated with a halogen-free decorative finish on one or both sides	Standard type 25-50mm	Stainless steel sheets coated with a halogen-free decorative finish
Provision rooms	Polyurethane panels 50-100 mm	Stainless steel sheets	Polyurethane panels 50-100 mm	Stainless steel sheets
Laundry	Wet-room panels 25/50 mm	Galvanised steel sheets coated with a halogen-free decorative finish on one or both sides	Standard type 25-50mm	Galvanised steel sheets coated with a halogen-free decorative finish
Stairs	Standard panels 25 mm	Galvanised steel sheets coated with a halogen-free decorative finish on one or both sides	Standard type 25-50mm	Galvanised steel sheets coated with a halogen-free decorative finish
ECR	Standard panels 25 mm	Galvanised steel sheets coated with a halogen-free decorative finish on one or both sides	Standard type 25-50mm	Galvanised steel sheets coated with a halogen-free decorative finish
HVAC room	Sheet metal lining	Painted	Sheet metal lining	Painted
Stores inside Accommodation	Standard panels 25 mm	Galvanised steel sheets coated with a halogen-free decorative finish on one or both sides	Standard type 25-50mm	Galvanised steel sheets coated with a halogen-free decorative finish
Stores outside Accommodation	Sheet metal lining	Painted	Sheet metal lining	Painted
Workshops	Sheet metal lining	Painted	Sheet metal lining	Painted
Compartments on WH top	Sheet metal lining	Painted	Sheet metal lining	Painted
Instrument room	Sheet metal lining	Painted	Sheet metal lining	Painted

Compartments	Lining	Facing/materials	Ceiling	Facing/materials
Wardrobes	Wet-room panels 25/50 mm	Galvanised steel sheets coated with a halogen-free decorative finish on one or both sides	Standard type 25-50mm	Galvanised steel sheets coated with a halogen-free decorative finish

Plywood used in accommodation, control stations and service spaces shall be of approved type with regards to low flame spread and smoke toxicity.

For details regarding insulation, ref. [517 Insulation](#).

For details regarding ceiling, ref. [518 Ceiling](#).

For Provision rooms, ref. [555 Insulation, lining & battening in provision rooms, doors & ports](#).

The thin steel cladding (sheet metal lining) may be exchanged with perforated steel sheet (with acoustic foil or glass tissue, in case covering mineral wool), or glass cloth as a final surface, especially on the deckhead, where approved by Owner if not contradicting with durability and easy cleaning requirements. Spaces with high noise resources (e.g. HVAC room, Workshop, Engine room) shall be specially considered.

## 512 Internal Doors

### General

A master key locking system shall be provided for external and internal doors and hatches in accordance with common practice. The locking system shall be approved by the Owner's representative. The locks on the compartment doors will have a general master key and group master key system.

### Fire class doors

#### B-class doors

Interior doors shall meet the following requirements:

- Incombustible (B15) and to the standard of the adjacent bulkheads.
- Frames shall be of steel.
- Doors shall be fitted with stainless steel thresholds.
- All doors shall have gaskets for noise reduction.
- All cabin doors shall be equipped with noise traps in the ventilation openings.
- Kick out panels shall be installed if required.
- Doors for cabins and mess room shall have minimum light opening according to the authorities requirements.
- Interior sill in wet-rooms shall be constructed to avoid water to enter into dry compartments.

#### A-class doors

Fire doors shall meet the following requirements:

- All doors shall have as a minimum the same fire rating as the bulkhead where it is fitted.
- Door leaf: Minimum 1,5 mm primed/painted mild steel or stainless steel surface. Door leaf core shall be of mineral wool, or of ceramic fibre. Reinforced plates for hinges, door closer and panic opening devices shall be welded on inside of the door leaf.
- Door frame: 3 mm painted mild steel or stainless steel surface. Welded door frame as standard. Bolted frames as option if approved certificate. Adjustable gasket for gas-tightness and sound

reduction.

- Hinges: The hinges shall be welded to the surface of the door frame and inside the door leaf. The hinges shall be provided with washers between the top and bottom parts to reduce friction.
- Doors to rooms with risk of hazardous or toxic zones shall be of gas tight type.
- Fire doors shall close automatically when fire alarm is activated, if normally open. In addition remote release in central control station and locally shall be installed. For indication panel mounted in the wheelhouse, ref. <broken cross-reference>.

#### **Provision room doors**

Provision room doors shall meet the following requirements:

- Refrigerated/Cooler provision room doors shall have stainless steel fittings.
- Door frames for freezer room shall have heating cables with thermostatic control.
- Emergency opening devices shall be in accordance with requirements.

### **514 Weathertight and Spraytight doors**

Exterior doors shall be according to the Classification Society and National Authorities requirements. The doors from accommodation and wheelhouse to open deck shall be fitted with portholes or windows. All external doors shall be of steel (or GRP if allowed by the Classification Society and National Authorities) and have central closing appliances.

The entrance doors to the accommodation and control rooms shall have anti-piracy locking devices that can be easily opened from the inside (emergency).

Light opening shall be approx. 730 mm. All moveable parts/hinges shall be protected by cover plate, and all moveable parts, hinges and securing locks shall have lubrication nipples.

Weather tight minimum standard according to ISO 6042:2015 Weathertight single-leaf steel doors.

Weather tight steel doors for workshop and similar rooms on open deck shall have light opening approx. 700 mm.

Spray tight doors shall be built and certified according to relevant international standards

Spray tight doors for minor compartments shall have light opening of minimum 600 mm and sill height minimum 250 mm.

All external doors shall be arranged with framing of ARS.

Doors shall have hinges on the forward side as far as practical.

### **515 Side scuttles and windows with equipment**

Side scuttles and windows shall be arranged as indicated on the General Arrangement.

The wheelhouse shall be arranged with large, heated windows to give a good field of vision (ref. Table 5.4). Framing between wheelhouse windows shall be minimized.

Side scuttles shall be in accordance with International standard ISO 1751.

Standard windows shall be in accordance with International standard ISO 3903.

Inner windows where required for noise reduction shall be installed resiliently mounted in lining walls, without any direct rigid connection to the ship structure or the windows coamings. Any support of the window box shall be fixed to the inner lining or to the floating floors. Inner windows shall be openable for accessing openable windows, hinged deadlights and for cleaning and maintenance of windows.

For noise requirements, ref. [O Vibration and Noise Control](#).

The number of windows and dimensions in the tables below may vary according to the final arrangement.

Table 5.3 Side scuttles and windows

Area	Side scuttles		Standard Windows Standard 600x800 mm	Special Windows		Marine Glazing	
	Fixed	Openable		Qty.	Size LXH	Qty.	Size
Main Deck in ECR/ SWBD				1	1000x600		
01-POOP Deck			18				
02-ACC. Deck			11				
03-ACC. Deck			20				
04-ACC. Deck			16				
05-ACC. Deck			15	4	1000x1500		

Table 5.4 Wheelhouse windows

Location	Qty.	Electric heated	Defrosting air	Wipers with heating (de-icing device)	Sun protection	Flushing
Forward	17	17	17	17	17	17
Bridge wing each	6	6	6	6	6	6
Aft	14	4	14	4	14	4

Window wipers shall be installed according to Classification Society requirements and ISO 17899. Window wipers shall be positioned below the windows, where applicable, for safe access during maintenance.

For flushing of fixed windows in the wheelhouse, spray nozzles with connection to the compressed air system and hot water hydrophore system shall be installed. A mixing valve for hot and cold water shall be arranged. Solenoid valves shall be used for air and water. Nozzle pipes shall be mounted inside bulkhead with branches to each fixed window.

Water supply for window flushing for all windows, shall be arranged in three (3) loops forward, one(1) loop each bridge wing and one (1) aft. Each loop shall have a separate solenoid valve for water supply and air blowing.

A common control system for window wipers, window flushing and wiper heating shall be supplied. Wipers shall be equipped with speed control for continuous and intermittent action. Control panel(s) for each primary workstation shall be installed. The control panel in each primary workstation shall be able to control wipers relevant for that particular workstation.

Heated wheelhouse windows according to Classification Society requirements and ISO 3434 and 8863 as relevant shall be installed. Window heating shall be controlled by switches, at least one switch for each group of windows (ref. window flushing above and [791 Manoeuvre desks, main consoles, instruments](#)).

## 517 Insulation

### Thermal Insulation

General Type: Mineral wool, density: approx. 32 kg/m<sup>3</sup>

Alternative: Mineral or glass wool, lightweight type, density: approx. 18 - 26 kg/m<sup>3</sup>

All outer deck-heads, walls and bulkheads of steel, as well as ship sides shall be insulated towards all accommodation. Insulation shall be calculated according to environmental temperatures in D Performance, however as a minimum 150 mm thick mineral wool between stiffeners and 50 mm thick mineral wool around stiffeners shall be used.

The hot surfaces of all machinery, equipment, tanks and pipes operating at temperatures normally above 60° C shall be thermally insulated, as well as the flanges, valves and fittings of these piping. The ends of the thermal insulation of pipes near flanges, valves, fittings and supports shall be finished in such a way as to allow the bolts to be removed and the piping to be moved on their supports, in accordance with the Yard's practice to be approved by the Owner. Galvanized steel plates with a thickness of 0,4 mm shall be used for thermal insulation of tanks, machines, equipment and exhaust gas discharge of the thermal oil heater, main engine and auxiliary engines. The flanges, valves and fittings of insulated piping shall be thermally insulated with a mattress made of lined insulating material. The fuel oil settling tanks, fuel oil service tank, fuel oil storage tanks, purifier sludge tanks and Hot Water Tank and other heated tanks in the Engine Room, whose working temperature exceeds 60° C (except the side, bulkheads bordering tanks, double bottom tank top) and bulkheads below the double bottom tank top will be insulated with blankets or plates of insulating material, in accordance with the Yard's practice. The following regions shall also be isolated: Bulkheads and upper deck (if exposed to the sun) of the Emergency Diesel Generator compartment; Bulkheads and upper deck (if exposed to the sun) of the clean firefighting agent bottle compartment; Bulkheads and upper deck of the Steering Gear Compartment. The thermal insulation will be designed to achieve a maximum temperature on its external surface of around 60°C, considering the temperature of the air in contact with this surface to be 45°C. The hot water piping for human consumption shall be insulated so that the minimum temperature of the return water is 51°C. The thermal insulation of the thermal oil, hot water, fuel and lube piping shall be insulated with rock wool or glass wool. The exhaust gas discharge piping shall be insulated with rock wool. The refrigerant gas piping shall be insulated with polyurethane foam (non-combustible type and certified) and covered with a single layer of raw cotton canvas fabric. The Yard shall design the thermal insulation so that there is no condensation on its external surface. All materials used as thermal insulation shall be in full compliance with the applicable rules (ref. SOLAS/FSS-FTP Code, Hong Kong Convention, 2009 / MEPC. 379(80)).

Insulation shall be fitted to the structure by means of steel studs and caps. Lining of steel bulkhead not exposed to weather or casings shall not have additional thermal insulation.

#### **Fire Insulation**

General type for bulkheads: Mineral wool, density: 90-130 kg/m<sup>3</sup>

General type under deck: Mineral wool, density: 90-130 kg/m<sup>3</sup>

General type on deck under floor covering: Mineral wool, density: 140-200 kg/m<sup>3</sup>

Fire insulation shall be installed, in compliance with the descriptions on the Type Approval certificate by the Classification Society or the National Authorities, on every horizontal or vertical divisions according to relevant rules and regulations.

#### **Noise Insulation**

General Type: Mineral wool, normal density: approx. 60 - 80 kg/m<sup>3</sup>.

Special attention shall be paid to sound insulation of rooms in the accommodation bordering the following compartments:

- Casing
- Air Condition room

- Laundry
- Galley
- Mess & Day rooms/lounges
- Emergency Generator room

In addition special attention shall be paid to sound reduction:

- between cabins
- between cabins and corridors
- between cabins and offices
- between cabins and public spaces

#### **Floating Floor and dampening layers on deck**

Floating floor based on mineral wool, visco-elastic layers and steel plates shall be applied as required for necessary sound reduction and vibration dampening. Constraining layer in wet-rooms may be exchanged with concrete compound. Installation details shall follow certificates, where fire rated floors are required.

## **518 Ceiling**

All deck heads or ceilings facing open air shall be insulated with mineral wool. Thickness and density of insulation shall be according to requirements.

All insulation shall have a suitable protective cover.

Ceiling heights shall be as given in the relevant rules and regulation, but as a minimum the heights as stated in MLC 2006.

Supports for the ceilings shall be resilient mounted to the deck beams.

## **52 Internal deck covering, stairs, ladders, railing**

### **521 Underlay composition for interior deck cover**

#### **Underlay Composition for Interior Deck Cover**

For description of the floating floor systems, ref. [517 Insulation](#).

If accommodation is located above machinery spaces of category A, a floating floor of A-60 class shall be provided.

### **522 Interior deck cover**

Rubberized coating over the underlay composition shall be applied in:

- all cabins
- infirmary
- offices
- public areas (Mess room, lounges, auditorium, gymnasium, meeting room and similar compartments)
- control areas (Bridge, ECR and CCR)
- accommodation corridors and staircases

Non-skid ceramic tiles shall be applied in:

- Wet rooms
- Galley and Pantry

- Store rooms in accommodation
- Garbage compartment

Flooring shall be of approved material and construction and have a non-slip, moisture proof and easy to clean surface.

Floors in refrigerated provision stores and freezer shall be provided with a suitable anti-slip surface.

The floor in the ECR and Cargo control room shall be covered with non-slip rubber tiles of Classification Society approved type certified against the generation and spread of fire/smoke and with electrical insulation properties.

Raised floors shall be applied in wheelhouse and ECR. If necessary raised floor shall also be applied in Cargo Control room and offices.

All coating and colours shall be approved by the Owner.

All rooms where no coating is specified shall be painted as specified in the painting manual.

Yard and Owner shall be responsible for selecting materials in compliance with regulatory requirements and with necessary certification, for relevant compartments.

## **523 Internal gratings and rubber mats**

If the deck is made of conducting material the passageways in front of and behind main and emergency switchboards shall be covered by mats or gratings of oil resistant insulating material.

Mats or tiles of oil resistant insulating material shall be installed in the ECR.

## **524 Stairs, ladders, railings and handrails in accommodation**

Stairways and corridors used as means of escape shall be arranged with the required clear passage width per escape requirements as a minimum. Clear width shall be measured between handrails or between handrail and bulkhead.

Handrails in internal stairs and corridors shall be in accordance with the FSS-code or National Authority requirements.

All internal staircases shall be built in steel. The steps shall be covered with rubberized coating with noses of non-skid material. Handrails shall be mounted on both sides of every staircase and on one side (or 2 sides, depending on corridor width) in corridors and inside the wheelhouse.

## **525 Loose floor plates, platforms & ladders in engine & pump rooms**

Floor Plates or galvanized steel grating shall be provided where necessary in engine rooms, workshops, stores rooms etc. in order to provide easy and safe access to all working positions:

- Main passage/escape routes: 5 mm chequered steel plates or galvanized steel grating
- Elsewhere: 6 mm chequered aluminium plates or galvanized steel grating

Small flush hatches for access to piping and valves below, shall be arranged where necessary.

The plates shall be fastened onto angle steel profiles by countersunk stainless steel screws, or clamps where galvanized steel grating.

Inclined ladders (stairs) of steel with steps of galvanized steel grating shall be arranged.

Handrails in the engine room shall be of circular steel bars or pipes of suitable dimension, demountable where required.

All inclined ladders and stairways fitted with open treads in machinery spaces being part of or providing access to escape routes, but not located within a protected enclosure, shall be made of steel and they shall be fitted with steel shields attached to their undersides such as to provide escaping personnel protection against heat and flames from beneath.

## **526 Ladders, platforms & railing in ballast & fuel tanks**

Vertical ladders and intermediate platforms shall be mounted in all voids and tanks where required for safe access.

Internal ladders in coated tanks shall be galvanized and bolted with stainless steel bolts.

Vertical ladders in methanol tanks shall be of Acid Resistant Steel (ARS), AISI 316 L.

## **527 Platforms, ladders & railing in cargo tanks**

Vertical ladders and intermediate platforms shall be mounted in all tanks where required for safe access.

Internal ladders in coated tanks shall be galvanized and bolted with stainless steel bolts.

Vertical ladders in methanol tanks shall be of Acid Resistant Steel (ARS), AISI 316 L.

## **529 Emergency exits**

Stairways and corridors used as means of escape shall be arranged with the required clear passage width per escape requirements from FSS-code/National Authorities as a minimum, measured between handrails or between handrail and bulkhead. Hand rails in internal stairs and corridors shall be in accordance with the FSS-code/National Authorities requirements.

For emergency hatches, ref. [304 Smaller hatches, emergency hatches and manholes](#).

## **53 External deck cover, stairs and ladders**

### **531 External deck covering**

External deck covering shall not be provided. All exposed parts of steel deck shall be painted.

### **533 Handrails, railing, rail gates**

Railings shall be arranged around the deck perimeters and superstructure as indicated on the General Arrangement.

The railing shall be made of hot dip galvanized steel pipe with stanchions of hot dip galvanized steel flat bars., ref. [276 Galvanizing](#). Stanchions shall be galvanized before mounting.

Stanchion flat bars shall be arranged on every 2<sup>nd</sup> frame. Every 2<sup>nd</sup> stanchion shall be equipped with a sloping bracket from the lowest row to the deck.

Handrails in the Accommodation shall be in accordance with requirements in the Fire Safety System code, and ref. [524 Stairs, ladders, railings and handrails in accommodation](#)

### **534 External platforms, stairs, ladders & grating with equipment**

External ladders, platforms, stairs ladders and gratings shall be arranged as indicated on the General Arrangement.

External stairs shall be built of HP-profiles or standard side profiles with prefabricated, non skid steps.

All ladders and adders shall be hot dip galvanized steel and equipped with hot dip galvanized railings.

## 54 Furniture, inventory, entertainment equipment

### General

Furniture will be installed as indicated on the General Arrangement and in line with requirements from MLC and the National Authorities.

Furniture shall be made up as per European standard.

All beds to be arranged in longitudinal direction with head area facing forward.

Furniture and fittings shall be of durable marine construction and quality and shall match with the decorative arrangement of the intended space. In general fixed furniture shall be made of laminated plywood construction, edged with hardwood lists.

All items shall be strengthened with reinforcing panels, channels, angles etc. where necessary to ensure proper rigidity. Where required, furniture shall be fitted with a durable and effective securing device to prevent movement.

Hat and coat hooks shall be fitted in cabins, public spaces and toilets.

Builders suggested colour scheme for furniture, drapes and deck coverings shall be subject to Owner's approval.

For lighting and power supply to minor electrical equipment (receptacles), ref. [892 Electrical installations in accommodation](#).

### 541 Furniture for crew

#### General

Accommodation throughout shall be provided with furniture according to the rules and regulations. Unless otherwise specified, main material for bunks, drawers, desks, wardrobes similar furniture, shall be of plywood with laminated surfaces.

Drawer fronts and profiles shall be of solid wood, such as beech or similar. Tables and work desks shall have plastic laminate surface, equipped with fiddle guard and placed on fixed sockets throughout accommodation. All work desks shall be equipped with reading lamps. Outlets for power and network shall be provided above all work desks (ref. [broken cross-reference](#)).

Upholstery throughout the vessel shall be flame retardant. Decorative loose pillows with leather skin of high quality shall be supplied for sofas. Type and colour of furniture shall be approved by the Owner.

The accommodation shall be provided with hooks, handle and straps according to common practice. Wardrobe lockers shall have hooks, handles and hangers. Drawers shall be secured against wobbling.

Paper and trash bins shall be provided for each cabin, office and day room.

Precautions shall be made in order to avoid mounting of sound emitting alarm devices on bulkheads dividing adjacent cabins.

#### Crew cabins

Crew cabins shall be provided with the furniture complying with minimum requirements as listed below.

Table 5.5 Minimum requirements for cabin furniture MLC 2006

Minimum inside dimension for bunks      2000 x 800 mm

Minimum dimension for wardrobe      475 litres (600x500x1900 mm)

Minimum volume for drawers      0,056 m<sup>3</sup>

#### **Captain, Chief engineer and Chief officer cabins sleeping area:**

- One (1) Double lockable wardrobe approx. 900 x 600 mm
- One (1) simple closet
- One (1) queen-size bed with four drawers
- Two (2) bedside tables
- One (1) chair with armrest
- Two (2) bulkhead hangers
- One (1) smart 43" 4K LED TV
- One (1) 5.1 channel home theater, Bluetooth
- One (1) Fully equipped WC/shower, ref. 583 Bathtubs, showers, WC, washbasins.

#### **Officer class cabins:**

- One (1) Three-seater Sofa with armrests
- One (1) chair with armrests
- One (1) computer desk
- One (1) bulkhead desk with one drawer
- One (1) Double lockable wardrobe approx. 900 x 600 mm
- One (1) Book shelf
- One (1) double bed with two drawers
- One (1) bedside table
- Two (2) bulkhead hangers
- One (1) 43" smart LED screen TV
- One (1) domestic refrigerator. 100 liter capacity
- One (1) Fully equipped WC/shower, ref. 583 Bathtubs, showers, WC, washbasins.

#### **Petty Officer class cabins deck 04 and Petty officer class cabins deck 03 (cadets):**

- One (1) Three-seater Sofa without armrests
- One (1) chair with armrests
- One (1) simple bulkhead desk
- One (1) Book shelf
- One (1) widows bed with two drawers
- One (1) bedside table
- One (1) single size closet (> 500 l)
- Two (2) bulkhead hangers
- One (1) 32" smart LED screen TV
- One (1) domestic refrigerator. 46 liter capacity
- One (1) Fully equipped WC/shower, ref. 583 Bathtubs, showers, WC, washbasins.

#### **Petty Officer class cabins deck 03 (bosun/health assistant):**

- One (1) Three-seater Sofa without armrests
- One (1) chair with armrests
- One (1) desk with a drawer
- One (1) Book shelf

- One (1) single bed with two drawers
- One (1) bedside table
- Two (2) single size closet (> 500 l)
- Two (2) bulkhead hangers
- One (1) 32" smart LED screen TV
- One (1) domestic refrigerator. 46 liter capacity
- One (1) Fully equipped WC/shower, ref. 583 Bathtubs, showers, WC, washbasins.

**Rating class cabins:**

- One (1) Three-seater Sofa without armrests
- One (1) chair with armrests
- One (1) simple bulkhead desk
- One (1) Book shelf
- One (1) widows bed with two drawers
- One (1) bedside table
- One (1) single size closet (> 500 l)
- Two (2) bulkhead hangers
- One (1) 32" smart LED screen TV
- One (1) domestic refrigerator. 46 liter capacity
- One (1) Fully equipped WC/shower, ref. 583 Bathtubs, showers, WC, washbasins.

**Official class cabins (Owners and Pilot cabin):**

- One (1) Three-seater Sofa with armrests
- One (1) chair with armrests
- One (1) computer desk
- One (1) desk with a drawer
- Two (2) Single beds with two drawers
- Two (2) bedside tables
- Two (2) double-sized closets
- Four (4) bulkhead hangers
- One (1) Fully equipped WC/shower, ref. 583 Bathtubs, showers, WC, washbasins.

**Workers class cabins:**

- Two (2) Bunk beds
- Three (3) Industrial double steel closets
- Six (6) bulkhead hangers

**Captain's Officer's, Chief Officer's and Chief Engineer's Lounge/ Sitting Room**

- One (1) Three-seater Sofa with armrests
- Two (2) chair with armrests
- One (1) ergonomic office chair
- One (1) coffee table
- One (1) Wall shelf
- One (1) Filing cabinet
- One (1) microcomputer desk
- Two (2) Corner Tables

- Six (6) bulkhead hangers
- One (1) Drawer cabinet
- One (1) domestic refrigerator, capacity 100 liters

### **Living rooms**

Public areas shall be arranged as shown on the General Arrangement. Chairs and sofas shall be delivered according to list below:

One day room/lounge may be arranged as a smoking area. If such area is prepared, a separate exhaust fan shall be arranged, ref. 579 Ventilation/AC systems for various compartments.

Sofas and chairs in day rooms shall have upholstery of foam plastic and covered with imitation leather. Chairs in mess room shall have upholstery of imitation leather.

Final dimension of furnitures shall be as shown on the accommodation drawings.

The tables shall be of laminated plywood and equipped with hard wood or vinyl edging.

### **Mess**

The mess shall be arranged for approx. 30 persons and be equipped with:

- Five (5) dining tables with 6 (six) seats
- Thirty (30) chairs with arms
- One (1) utensil cupboard
- Twelve (12) bulkhead hangers
- One (1) water bottle holder with cooling
- Two (2) drawer cupboards
- One (1) hot self-service counter
- One (1) cold self-service counter
- Two (2) support benches
- One (1) ice machine (without manual contact)
- One (1) Rack for dish washing baskets for used cutlery, ref. 552 Equipment and outfitting in galley.
- Serving equipment, ref. 553 Crew mess and dayrooms equipment.

### **Officers living room**

- Two (2) three-seater sofas with armrests
- Two (2) armchairs
- Two (2) corner tables
- One (1) coffee table
- Two (2) games tables
- Eight (8) chairs with armrests
- Six (6) bulkhead hangers
- One (1) 55-inch 4K smart TV
- One (1) 5.1 channel home theater, Bluetooth
- One (1) bluetooth speaker
- Clothing hooks

### **Rating living room**

- Two (2) three-seater sofas with armrests

- Two (2) corner tables
- One (1) coffee table
- Two (2) games tables
- Eight (8) chairs without armrests
- Six (6) bulkhead hangers
- One (1) 55-inch 4K smart TV
- One (1) 5.1 channel home theater, Bluetooth
- One (1) bluetooth speaker
- Clothing hooks

### **Smoking room**

- Two (2) three-seater sofas with armrests
- Two (2) corner tables
- One (1) coffee table
- Four (4) bulkhead hangers

### **Auditorium**

- Twenty (20) chairs with armrests in modules
- One (1) 55-inch 4K smart TV
- One (1) 5.1 channel home theater, Bluetooth
- One (1) ceiling projection device
- One (1) whiteboard for projection and notes
- One (1) network point
- One (1) raised table on a platform

### **Gymnasium**

- One (1) bodybuilding machine (multi-exercise)
- One (1) treadmill for running
- One (1) exercise bike
- One (1) mirror across the width of the bulkhead
- One (1) smart 43" 4K LED TV
- One (1) Bluetooth stereo
- One (1) water bottle holder with cooling
- Clothing hooks

Gymnasium equipment shall be according to recognised fitness standard brands.

### **Captain's office**

- One (1) L-shaped table for a microcomputer with a drawer
- One (1) ergonomic rotating office chair
- Two (2) armless chairs
- One (1) filing cabinet with drawers
- One (1) cupboard with shelf:
- Four (4) bulkhead hangers
- One (1) clavicle (keybox)
- One (1) network connection point

**Internet room**

- Three (3) microcomputer tables with rotating chairs
- Two (2) armless chairs
- One (1) printer table

**Meeting room**

- One (1) meeting table for 10 people
- Ten (10) chairs with armrests
- One (1) tall cupboard with shelves and doors
- One (1) magnetic whiteboard for notes
- One (1) SMART TV LED 55"
- One (1) videoconferencing device
- One (1) network connection point

**Changing room with toilet at the access to the Engine Room**

- Two (2) washbasins
- Two (2) mirrors
- One (1) dispenser for liquid soap
- Two (2) paper towel dispensers
- One (1) waste garbage can with lid and pedal
- Two (2) safety handles
- One (1) shower and plastic curtain
- Six (6) bulkhead hangers
- One (1) industrial steel closet with individual doors for 18 crew members
- One (1) wooden bench with 4 (four) seats
- One (1) washbasin
- One (1) paper towel dispenser
- One (1) waste garbage can with lid and pedal
- One (1) simple mirror
- One (1) toilet
- One (1) toilet paper holder
- One (1) dispenser for liquid soap
- One (1) paper towel dispenser
- One (1) waste garbage can with lid and pedal

**Changing room at the entrance to the accommodation on the 01 Poop deck**

- Two (2) washbasins
- Two (2) mirrors
- One (1) dispenser for liquid soap
- Two (2) paper towel dispensers
- One (1) waste garbage can with lid and pedal
- Two (2) safety handles
- One (1) shower and plastic curtain
- Six (6) bulkhead hangers
- One (1) industrial steel closet with individual doors for 18 crew members

- One (1) wooden bench with 4 (four) seats

#### **Public toilets**

- One (1) washbasins
- One (1) single mirror
- One (1) toilet
- One (1) toilet paper holder
- One (1) dispenser for liquid soap
- One (1) paper towel dispenser
- One (1) waste garbage can with lid and pedal
- One (1) safety handles

#### **Cargo Control Room combined with Vessel's Office and Engine Room Supervision**

- Integrated control system comprising 3 (three) workstations with mouse, keyboard and 26" LED monitor.
- One (1) console for installing workstations and other CCR equipment
- One (1) standard microcomputer for the stress calculator function
- Three (3) microcomputer tables with a drawer.
- Five (5) ergonomic swivel office chairs
- Two (2) VHF control units (system I and II)
- Two (2) automatic telephones (independent)
- One (1) self-powered phone
- One (1) control unit with microphone and 1 (one) loudspeaker for the sound diffusion system
- One (1) clinometer
- One (1) watch
- One (1) draft indicator with interface to the integrated load and ballast control system
- One (1) portable self-contained breathing apparatus
- Three (3) filing cabinets with drawers
- One (1) cupboard/shelf
- One (1) printer table
- Eight (8) bulkhead hangers
- One (1) clavicle (keybox)

#### **Firefighting Station ("ECI") / Firefighting equipment storage room**

- Fire-fighting system equipment
- 2 (two) layers of wooden shelves with protective bars
- Space for storing spare portable fire extinguishers in quantity as defined by SOLAS
- **Below main deck**

For switchboard/control room/ECR for machinery, ref. 542 Wheelhouse, Navigation/Radio room, Office furniture/equipment.

## **542 Wheelhouse, Navigation/Radio room, Office furniture/equipment**

#### **Wheelhouse**

The wheelhouse shall have shape and size as shown on the General Arrangement.

Concerning floors, walls, bulkheads and ceilings, the insulation and lining, ref. 51 Insulation, partition bulkheads, ceiling, doors, side scuttles, windows.

Crossbars between windows shall have lining.

In the wheelhouse work stations shall be arranged, ref. 791 Manoeuvre desks, main consoles, instruments.

Additional work station(s):

- Office area

Pilot Chairs:

- Two (2) chairs on rails for the pilots.

Additional equipment/ furniture:

- One (1) 100l refrigerator
- One (1) three-seater sofa
- One (1) domestic electric coffee machine
- One (1) desk with chair
- An ergonomic office chair
- Four (4) Single chairs
- One (1) clavicle (keybox)
- One (1) whiteboard
- Book shelf arrangement according to Owner's recommendation
- Binocular boxes (forward and aft)
- Flag locker/ cabinet

Electric cabinets and signal light controllers shall be fitted in a suitable place. The arrangement should be carried out as practical and surveyable as possible and according to the Yard's practice.

### **Navigation room and radio space**

The Navigation and radio space shall be arranged as part of the wheelhouse. The navigation space shall be equipped according to common practice and provided with a planning station consisting of a combined writing and chart table with a breadth of at least 1.30 m.

The table shall have minimum one lockable drawer.

Over the chart table a suitable chart lamp shall be fitted.

A curtain shall be installed around the radio/chart "room", if required by the National Authorities. The curtain(s) should be stored in a position that does not reduce the required field of vision from workstations.

### **Engine Control Room (ECR)**

The design of the ECR room shall provide space for the future installation of an additional column in the MSB to interconnect the main 450V bus with a future onshore power supply system (cold ironing), maintaining good conditions and space for circulation in the ECR, operation and maintenance of the installed equipment.

The room shall be thermal insulated as required.

The ECR area shall be equipped with:

450V Main switchboard

220V Main switchboard

Frequency system for cargo handling

ECR Desk

A desk with a chair.

An ergonomic office chair

1 (one) domestic refrigerator with a capacity of 100 liters (approx.)

1 (one) domestic electric coffee machine

2 (two) single chairs

2 (two) lockable cupboards for special equipment and electronics.

1 (one) Clavicle.

1 (one) Whiteboard.

1 (one) drinking fountain with support for a 20-liter water bottle with cooling

#### **Cargo Control Room combined with Vessel's Office and Engine Room Supervision**

CCR shall be thermal insulated as required.

The CCR shall be equipped with:

- Integrated control system comprising 3 (three) workstations with mouse
- Keyboard and 26" LED monitor.
- 1 (one) console for installing workstations and other CCR equipment.
- 1 (one) standard microcomputer for the stress calculator function.
- 3 (three) microcomputer tables with a drawer.
- 5 (five) ergonomic swivel office chairs.
- 2 (two) VHF control units (system I and II).
- 2 (two) automatic telephones (independent).
- 1 (one) self-powered phone.
- 1 (one) control unit with microphone and 1 (one) loudspeaker for the sound diffusion system.
- 1 (one) clinometer.
- 1 (one) watch.
- 1 (one) draft indicator with interface to the integrated load and ballast control system.
- 1 (one) portable self-contained breathing apparatus.
- 3 (three) filing cabinets with drawers.
- 1 (one) cupboard/shelf.
- 1 (one) printer table.
- 8 (eight) bulkhead hangers.

#### **543 Linen and mattresses**

Spring mattresses with a fire proof cover shall be delivered for all beds.

Pillows, bedcovers and linen shall be delivered by the Owner, ref. M Owner Furnished Equipment.

#### **544 Curtains with equipment**

All windows and port holes, except in wheelhouse and galley, shall be provided with curtains. All windows in cabins shall have sun proof blinds in addition to curtains.

Curtains shall be arranged for beds in cabins for more than one person according to rules and regulations. The curtains shall be flame retardant.

All windows in wheelhouse, mess and day room shall have sun shielding shades, ref. [515 Side scuttles and windows with equipment](#).

Colour, textures and patterns shall be approved by the Owner.

## **545 Decorations**

Decorative flower or plant arrangements, statues or other objects of art such as paintings etc. shall be supplied by the Owner, ref. [M Owner Furnished Equipment](#). The Yard shall assist in mounting the pictures and decorations, ref. [126 Assistance with owner's supply](#).

## **546 Hobby, sports & entertainment equipment**

### **Entertainment equipment**

Above the superstructure on highest deck a satellite antenna system for TV and radio shall be installed.

Internal TV (satellite) reception and distribution system with DVD - including stabilized Ku-band reception antenna, "tracing" system and signal distribution in cabins and collective rooms.

The signals shall be distributed via a central unit, ref. [855 Common computer systems](#). The system shall include:

- 1,2 meter parabolic antenna (marine gyro stabilized), The antenna shall be mounted ensuring continuously signal reception, as far as possible.
- Distribution throughout the vessel through an IPTV gateway
- Three (3) transponder interfaces prepared for Conditional Access Multicam cards. The system shall to provide a user-friendly and cost-effective integrated solution with the following functions:
  - Satellite TV
  - Satellite Radio
  - Info channel

Cabins in 05-Acc. Deck and lounges to have installed 55" Televisions connected to the Satellite TV system.

## **55 Galley, messes, provision room and laundry arrangement and equipment**

### **551 Galley machinery**

The capacity of the galley equipment shall be suitable to serve 36 persons.

Galley equipment shall be arranged for efficient service-logistics and high hygienic standards. The equipment shall be made of stainless steel where required.

The arrangement of equipment and selection of materials and finish details shall comply with relevant applicable public health regulations, and shall be provided with details for marine use (like storm rails).

The following equipment shall be fitted in the galley:

- One (1) four-plate electric stove with oven attache (approx. 20 KW)
- One (1) stainless steel galley hood with grease filter on the stove and fryer, in accordance with ABNT NBR 14518
- One (1) electric oven of around 8 KW with two chambers
- One (1) electric steam boiler type with 50 liter capacity
- Two (2) duplex refrigerators with capacity of 450 liters

- One (1) universal mixer with stainless steel container with a capacity of 20 liters
- One (1) water heater (float) with a capacity of 10 liters
- One (1) 8-10 liter/7,2 kW electric fryer (with fire extinguishing protection devices approved in accordance with SOLAS)
- One (1) automatic electric cold cuts slicer
- One (1) drinking fountain with support for a 20-liter water bottle with cooling
- One (1) industrial blender
- One (1) kitchen worktop cabinet with 1 stainless steel sink and garbage disposal
- One (1) food preparation table with a stainless steel top and stainless steel bowls at the bottom
- One (1) pot rack
- One (1) general purpose shelf
- One (1) industrial dishwasher
- One (1) stainless steel tank with hose for washing pans
- One (1) stainless steel worktop with 1 (one) garbage can with garbage disposal
- One (1) dish drainer (approx. 40 plates and glasses)
- One (1) cupboard for storing devices
- One (1) defrosting unit
- One (1) Can opener,

Power supply for the equipment shall be according to [Table 8.6](#).

Some of the equipment mentioned above may be placed in the Mess room in accordance with the final arrangement drawings.

## 552 Equipment and outfitting in galley

### General

The catering spaces shall be equipped with benches, drawers and wall cabinets in stainless steel, in areas indicated on the General Arrangement, dimensioned and equipped according to capacity, function and concept of the vessel. Drawers and lockers shall be arranged to common practice and as place permits.

Fire protection shall be arranged according to Classification Society and National Authorities requirements, ref. [815 Fire fighting systems with gas, in 8 Ship Common systems, in LEVEL 0 SFI Master](#).

Plug sockets for machinery shall be arranged.

Washing equipment, ref. [583 Bathtubs, showers, WC, washbasins](#).

A complete galley plan with location of equipment, benches, drawers, shelves and cabinets shall be made by the Yard and approved by the Owner before production and purchase can commence.

A complete set of utensils (e.g. pots, pans, cutlery) to prepare and serve food shall be specified by Owner and purchased by the Yard.

### Galley and mess room serving equipment

For galley and mess room serving equipment, ref. [553 Crew mess and dayrooms equipment](#).

## 553 Crew mess and dayrooms equipment

The mess and dayrooms/lounges shall be arranged as shown on the General Arrangement.

Furniture as sofas and chairs shall be of the quality mentioned in [54 Furniture, inventory, entertainment equipment](#).

Drinking water cooler in service areas and accommodation ref. [584 Drinking water coolers](#).

#### Pantry as part of Mess room

- One (1) duplex refrigerator, domestic type, with a capacity of 450 liters
- One (1) electric coffee maker, domestic type
- One (1) automatic electric toaster, in stainless steel, for 4 slices
- One (1) microwave oven with a capacity of 17 liters
- One (1) utensil cupboard
- One (1) countertop cabinet with sink, in stainless steel, with hot and cold fresh water and cupboard at the bottom.

## 554 Freezing/refrigerating systems for provisions

#### General

Refrigerating, cooling and dry provision rooms shall be arranged according to the General Arrangement and [Table 5.6](#).

Table 5.6 Provision rooms

Type	Quantity	Temperature (approx.)	Size (approx.)
Antechamber	1	+4°C	12m <sup>3</sup>
Dry provision room	1	Ref. internal conditions in <a href="#">Table 5.9</a>	52m <sup>3</sup>
Vegetable/dairy chamber	1	+2°C	16aream <sup>3</sup>
Freezer provision rooms for fish	1	-18°C	16m <sup>3</sup>
Freezer provision rooms for meat	1	-18°C	16m <sup>3</sup>

The ceiling height in the provision rooms shall be approx. 2050 mm.

#### Freezing and cooling systems for provision

A refrigerating plant for the provision rooms shall be installed and meet the following requirements:

- Fully automatic
- One(1) set of two(2) 100% capacity air-cooled compressors having the capacity to maintain the specified temperatures by operating maximum 14 hrs/day. The compressors shall be "stand-by" for each other. During "cooling down" the two units will operate simultaneously;
- Cooling/ refrigerant medium compliant with Classification Society requirements
- Cooling elements equipped with electric de-icing with drip tray underneath
- Insulated refrigerant pipes between freeze/ cool units and compressors (capped with stainless thin plates where pipes lay open in rooms)
- Local reading of temperatures outside of each room.
- Remote temperature reading of the provision rooms in the galley
- Automatic electric defrosting shall be arranged, with drain to scupper
- Heating cables in drain pipes and scuppers in the freezer room
- The refrigeration plant shall be resiliently mounted.
- "Locked in alarm" ref. [795 Automation equipment for diesel generators](#).

The freezing and cooling compartments shall be located according to GA, and in such a manner that they are not exposed to sunlight to avoid direct sun radiation.

Air curtain shall be arranged to minimize the ingress of humidity and maintain the internal temperature.

The lights in the chambers/compartments shall operate automatically, switching on when the access doors are opened and switching off when they are closed again.

Each chamber/compartment shall be cooled by means of 1 (one) evaporator made up of 1 (one) evaporation coil and 1 (one) electric fan that will recirculate the air. The materials used shall be in accordance with the manufacturer's standards.

The units shall be designed so that the refrigerant in the condensers is sub-cooled.

An electronic controller shall be provided to monitor the temperatures in the cold rooms, with local alarms and logs and an IAS fault alarm. The chambers/compartments shall have an adjustment thermostat and thermometers that shall be easy to read and calibrate, with a display installed on the outside of the anteroom.

## 555 Insulation, lining & battening in provision rooms, doors & ports

### Insulation provision rooms

Table 5.7 Insulation of provision rooms

Room	Floor	Bulkhead	Ceiling
Dry provision room	Polyurethane plates or concrete with anti-slip surface	70-75 mm prefabricated polyurethane panels (approx. U-value of 0,29 W/m <sup>2</sup> K)	70-75 mm prefabricated polyurethane panels (approx. U-value of 0,29 W/m <sup>2</sup> K)
Cooler provision room	approx. 100 mm Polyurethane plates covered with anti slip surface	100 mm prefabricated polyurethane panels (approx. U-value of 0,22 W/m <sup>2</sup> K)	100 mm prefabricated polyurethane panels (approx. U-value of 0,22 W/m <sup>2</sup> K)
Freezer provision rooms	approx. 100 mm Polyurethane plates covered with anti slip surface	100 mm prefabricated polyurethane panels (approx. U-value of 0,22 W/m <sup>2</sup> K)	100 mm prefabricated polyurethane panels (approx. U-value of 0,22 W/m <sup>2</sup> K)

Alternative solutions providing equivalent thermal resistance with mineral wool application on steel structure may be considered (see table below). All lining and ceiling shall be of stainless steel plates.

Table 5.8 Alternative insulation of provision rooms

Room	Floor	Bulkhead	Ceiling
Dry provision room	concrete with anti-slip surfaces	2 x 100 mm Mineral wool	2 x 100 mm Mineral wool
Cooler provision room	Mineral wool covered with compound and anti slip surface	2 x 100 mm Mineral wool	2 x 100 mm Mineral wool
Freezer provision rooms	Mineral wool covered with compound and anti slip surface	3 x 100 mm Mineral wool	100 + 150 mm Mineral wool

All materials applied to lining and insulation to be certified in compliance with SOLAS and Hong Kong convention/MEPC.379(80).

Hard, durable, non-absorbent deck covering, like tiles or stainless steel plate with non-skid pattern, shall be installed in provision rooms, with attention to pallet handling equipment routes. Light coloured painted steel may be an option in transportation corridors, provision passageways and dry storage areas. Provision room doors, ref. [512 Internal Doors](#).

## **556 Walls, bins, shelves, racks, grating & inventory in provision rooms**

The following shall be provided in the dry provision room:

- Shelves as indicated on the General Arrangement or as space permits. Shelves shall be of stainless steel, or of material as agreed between the Owner and Yard.

## **558 Laundry, ironing and drying equipment**

The Common laundry shall be provided with:

- One (1) electric industrial washing machine with a capacity of 30 kg
- One (1) combined washing machine and dryer
- One (1) A semi-industrial with a minimum capacity of 10 kg
- One (1) Industrial-type electric rotary dryer, with a capacity of 20 kg
- One (1) Rotary clothes press, with a roller with 1,800 mm roll
- One (1) tall steel cabinet
- One (1) ironing board
- One (1) bench for folding clothes

The Support laundry shall be provided with:

- Two (2) 10kg domestic washing machines and dryers
- One (1) cupboard for cleaning products
- One (1) two person sit bench

The Drying compartment shall be provided with:

- One (1) clothesline with hooks and nylon threads (total of 5 clotheslines for drying clothes) The parts of the clothesline in contact with the clothes will be mostly plastic or stainless steel
- One (1) electric heater

Scuppers and washbasins ref. [583 Bathtubs, showers, WC, washbasins](#)

Power supply for the equipment shall be according to [Table 8.5](#)

All the washing machines and tumble dryers shall be installed about 100 mm above floor on vibration free dampers, preferably as tower models with tumble dryer on top of washing machine.

## **56 Lifting and transport equipment**

### **563 Provision cranes and derricks**

Ref. [331 Rotating cranes with crane pillars](#).

### **564 Pilot ladder, accommodation ladder, gangway**

Two (2) accommodation ladders,

made of aluminum alloy and powered by pneumatic motors, shall be provided, and located at midship, aft of cargo manifolds.

### A gangway

made of aluminum alloy shall be provided, with a length compatible with the vessel's dimensions (at least 6 m) and 600 mm wide, with railings, guide cable and accessories, stowed on main deck within reach of the deck cranes. The stowage of the ladder on the main deck shall be of the sliding type on rails and not the folding type.

### Two (2) pilot ladders

will be provided, adequately stowed on deck, which shall meet the requirements of the Rules, Conventions, Recommendation and standards mentioned in item 2.4.1 of this specification.

Arrangements will be made on the vessel's guardrails, on both sides, to allow the use of the pilot ladder in conjunction with the accommodation ladder, in a combined manner when required, as per SOLAS Convention.

Fittings will be installed on the ship side plating to secure the ladders (accommodation and pilot) to the shell plating, as required by SOLAS.

All ladders and gangways and their respective arrangements shall comply with the ISO standards intended for this purpose and the latest revisions of the IMPA (International Maritime Pilot Association) recommendations.

Provisions to keep the Pilot Transfer Arrangement adjacent at all times to ship's hull to be provided at different positions ("sunken eyes").

## 57 Ventilation, air-conditioning & heating systems

### General

All ventilation shall be in accordance with Classification Society and National Authorities' requirements.

The air conditioning shall be by DX system for accommodation and self-contain fan-coil units were applicable elsewhere.

Air inlets and outlets (unless stated otherwise):

- Supply and exhaust air ducts shall be arranged from and to open deck.
- Air inlets and outlets shall be separated to avoid contaminated air in inlet openings.
- Inlet louvres shall be of mist eliminator/ droplet separator type.
- Outlet louvres shall be of single stage weather louvre type protecting the duct from rain and light sea spray.
- Louvres exposed to hard weather shall be of seawater resistant aluminium and arranged with efficient drainage. Closable hatches and fire dampers shall be fitted as per regulations.
- Exhaust and natural ventilation may also be ventilated through a ventilation-hood/mushroom

### Design conditions

Table 5.9 HVAC Design Conditions

Basis for calculations	Dry bulb temperature	Corresponding humidity	Remarks
Summer internal	+23°C	50%	
Summer external	+35°C	70%	
Winter internal	+20°C	50%	
Winter external	-10°C	75%	

Reference is made to the following design conditions:

- Sea Water and Fresh Water Temperatures, ref. [72 Cooling systems](#)
- Power supply, ref. [Table 8.6](#)

### Standards

The following international standards shall be used in their latest editions:

- ISO-7547 Ships and marine technology - Air-conditioning and ventilation of accommodation spaces and other enclosed compartments on board ships - Design and basis of calculations
- ISO-8861 Shipbuilding - Engine-room ventilation in diesel engined ships - Design requirements and basis of calculations
- ISO 9943 Shipbuilding – Ventilation and air-treatment of galleys and pantries with cooking appliances

All exceptions and deviation from standards and building specification shall be defined.

### Ventilation Control system(s)

One automated control system shall be delivered for the HVAC system.

One local central HVAC operator station with full control and overview of the HVAC system shall be provided (location shall be agreed with owner) and one HMI touchscreen (minimum 24") shall be installed in HVAC control cabinet door. The OS shall have user-based access control login.

The HVAC local control system shall provide automatic operation of the HVAC system as well as full manual control when needed. The automatic functions shall ensure energy efficient operation and high comfort on board without user interaction.

Further, the HVAC control system shall provide sufficient separation to follow the general redundancy philosophy for the HVAC system. Operation and control of the system shall be possible locally on the control panel(s) and starter(s).

Common- and safety critical alarms shall be interfaced with the IAS alarm system.

The ventilation control system integration level, shall include:

- Common and safety critical alarms with timestamp and running signals for the main equipment including monitoring of system status and available energy and sensor data, as well as control of the main parameters and setpoints for automatic operation.
- IAS Interface to other compartments (e.g. Fan Start/Stop/running/Failure/Remote/ indication), either as hardwired signals or on Modbus RTU communication link to ventilation control system. (Limited to 400 IAS IO-signals. Mimic in vessel IAS system)

## 571 Ventilation/AC systems for accommodation

### Location and construction of ventilation plant

All accommodation spaces shall be air-conditioned. Return air from cabins and living rooms shall be lead partly through sanitary spaces and partly through grilles at lower part of the entrance doors. Return air shall be lead back to the AHU(s) for the accommodation.

The supply and exhaust system shall be of low-velocity type of maximum 15m/s

In general, all starters for ventilation fans serving accommodation areas shall be located in the HVAC room.

Table 5.10 Ventilation overview

Space	Type of ventilation	Air changes/h	Supply fan	Exhaust fan	Remarks
Cabins	AHU	6	AHU		Exhaust partly through sanitary room and grill in cabin door back to AHU
Sanitary rooms in cabins	AHU	20	AHU (From cabin)		Separate pipes for sanitary rooms back to AHU
Public sanitary rooms	AHU	20	AHU		Separate pipes for sanitary rooms back to AHU
Hospital (Infirmary)	AHU/ Mechanical	8	AHU	1	Exhaust to open deck (Underpressure in room according to requirements)
Support laundries	AHU/ Mechanical	10	AHU/ Natural		Tumble driers shall have exhaust to open deck
Linen Laundry	AHU/ Mechanical	10	AHU/ Natural	1	Tumble driers shall have exhaust to open deck
Gymnasium	AHU	10	AHU		
Messroom, dayroom(s)	AHU	10	AHU		
Smoking room	AHU/ Mechanical	20	AHU	1	The fan shall have stepless rpm control and sufficient capacity to maintain underpressure in the room to make sure that no smoke extends into surrounding area.
Galley	Mechanical	30/40	1	1	
Engine change room	AHU	5	AHU		
Electrical workshop	AHU	6	AHU		
Central store	AHU	4	AHU		

The number of air changes for air-conditioned rooms shall be based on a HTC (heat transfer calculation)

For instrument room in accommodation block and Wheelhouse/ demisting system, see [573 Ventilation/AC systems for control rooms](#)

#### Combined air handling/refrigeration compressor unit:

Refrigeration Plant and Air Handling Unit shall be built together as one integrated unit. The Refrigeration Plant shall be direct expansion type with refrigerant for compliant to [F Class](#) to evaporate inside cooling coil of air handling unit. The evaporators shall have electronic expansion valves. The plant shall consist of 2 semi hermetic compressors of piston type each covering 100% of the total cooling demand, including compressors driven by VSD and backup temperature and/or pressure control with automatic start/stop control of compressors.. Condenser shall to be fresh water cooled (36 °C) shell-and-tube type.

The Air Handling Unit shall be constant airflow high pressure single-pipe unit containing the following sections:

- Heating section with heating coil hot water. Materials of tubes and fins to be CU/Al.see [577 Central heating systems for accommodation](#)
- Cooling section with cooling coil for direct expansion and electronic expansion valve. Materials of tubes and fins to be CU/Al. Marine type stainless steel drain pan to be included.

- Fan section with direct driven centrifugal type fan mounted on a common base frame with vibration dampers and flexible connections.
- Discharge section

The Refrigeration Plant and Air Handling Unit shall be fully automatic operated. One common control panel shall be arranged on the Unit, including starting of fan motor, control of compressor and cooling coil, control of heating coil and all necessary safety controls for the refrigeration plant.

All internal piping and electric wiring shall be factory made and tested before leaving the factory. In the event of failure of the variable speed drive (VSD), the equipment shall operate with automatic start and stop, controlled by thermostats and/or pressure switches in order to maintain the specified temperatures or another equivalent method.

The units of the central air-conditioning system shall be designed in such a way that the refrigerant in the condensers is sub-cooled.

The units will be interconnected by a duct with a manually operated damper and equipped with a fan, cooling and heating coils, a humidification section and a regulator for mixing fresh air and circulated air. A heating system shall be provided to maintain thermal comfort in the event of low temperatures. Spare refrigerant gas containers and their respective support hangers shall be provided in sufficient quantity to replace 100% of the system's gas, including the total quantity provided for the refrigeration system.

### **Galley**

The galley shall be equipped with:

- A separate supply fan(system) with 30 air-changes/hour capacity and step less speed control.
- A duct heater on the supply fan duct may be considered.
- A self contain fan coil unit, ref. [578 Central cooling systems](#)
- A separate exhaust fan with 40 air-changes/hour capacity and step less speed control
- Frequency controlled fans with remote control (start/stop) located in the galley
- Stainless steel fat filter(s) installed above the galley range
- Fire dampers fitted in ventilation ducts as per regulations

Alternativly, the Supply air /heating/cooling to Galley, can be served by a dedicated Galley AHU (Air handling Unit)

The galley exhaust ducts shall have circular section, independent of the vessel's structure with flanges and joints, and fitted with bolted manholes for cleaning.

The suction and discharge air inlets/outlets to open air shall be fitted with ASTM A-316L stainless steel screens.

The internal ventilation and exhaust end openings in lockers, stores and compartments will be fitted with ASTM A-316L stainless steel mesh.

Where the exhaust ducts from the galley pass through accommodation spaces or spaces containing combustible materials, they shall be constructed with A-class divisions. Each exhaust duct shall be fitted with:

- Grease trap readily removable for cleaning
- Fire damper located in the lower end of the duct
- Arrangements, operable from within the galley, for shutting off the exhaust fans
- Fixed means for extinguishing a fire within the duct

## 572 Ventilation systems for provision rooms

The dry provision room shall have a separate exhaust fan with speed control and a capacity of 4 air ch/h.

Refrigeration system, ref. [554 Freezing/refrigerating systems for provisions](#).

## 573 Ventilation/AC systems for control rooms

Instrument room(s) shall have room temperature control adequate for the equipment installed.

Table 5.11 Ventilation/air conditioning systems for control rooms

Space	Type of Ventilation	Air changes/h	Supply fan	Exhaust fan	Remarks
Wheelhouse	AHU	10	AHU		Fresh air from AHU for accommodation
Instrument room(s) in accommodation block	AHU	4	1 as backup		
Instrument room(s) outside accommodation block	Mechanical	4	1		
Switchboard/ Engine Control room Room	(AHU)	4	(AHU)		Pressurized floor for cooling shall be considered.

For fan coil units, ref. [578 Central cooling systems](#).

### Wheelhouse

The wheelhouse shall have two split type AC units approx. 10 kW each, aircooled working together with the aircondition AC plant.

The external units to be located on wheelhouse top.

Fresh air to the wheelhouse shall be supplied from the AHU for the accommodation.

## 574 Ventilation systems for engine rooms

The engine room(s) shall be provided with a ventilation system designed for 25 air changes per hour, taking into account the volume of the Engine Room, ECR, and the Main Engine consumption at its maximum continuous rating, in compliance with ISO 8861:1988, using the largest volume for calculations.

### Fans

Four (4) frequency controlled fans of axial type shall be arranged for air supply to the main engine room.

Fan characteristics:

- Static Pressure: minimum 500 Pa
- Efficiency: 70% ± 5%

The fans shall be fitted with:

- Automatic closing and fire damper of ASTM A-316L. (Open/closed position of the damper shall be interlocked with start/stop of the fan)
- Sound attenuator (silencer)
- Flexible connection including vibration dampers

- Fan control shall be Local and remote from the IAS
- Remote control from the IAS shall be Manual/Auto, Start/Stop and % RPM (4-20mA = 0-100%), Running feedback to the IAS.
- Emergency stop, see [811 Fire detection, fire and lifeboat alarm systems](#)
- Automatic Speed control controlled by temperature and over pressure in the Engine room by temperature sensor and differential pressure sensor connected to the frequency converter. The required temperature and differential pressure shall be set at the frequency converter.  
Automatic bypass of ER ventilation VSD in case of Automatic Speed control failure of the system.
- Two (2) fans shall be reversible

### Ducts

Necessary ducts shall be arranged to ensure satisfactory air distribution within the room and include:

- Manual operated flow regulating dampers on all duct outlets
- Noise trap and sound reduction insulation in inlet duct(s) above the fan(s)
- Hatch for easy access to the fans
- Lifting eye above fan for easy removal of electric motor
- Drain(s) for inlet duct(s)
- Distribution ducts inside the engine room of galvanized sheet metal
- Maximum air velocity in the main ducts of around 18 m/s and in the secondary branches of around 15 m/s.

### Louvres

The louvres will meet the following requirements:

- Inlet louvres of mist eliminator / droplet separator type
- To reduce the risk of exhaust gas ingress, special attention shall be paid to the location of inlet louvres.
- Outlet louvres to be of single stage weather louvre type protecting the duct from rain and light sea spray.
- Outlet louvers shall also be fitted with ASTM A-316L stainless steel screens and integrated closable dampers.

### Auxiliary engine room

The auxiliary engine room shall be equipped with:

- Minimum one (1) Air supply fan
- Fan control shall be Local and remote from the IAS
- Remote control from the IAS shall be Start/Stop and running indication

## 575 Ventilation systems for pump/cargo rooms

Table 5.12 Ventilation fans for pump/cargo rooms

Space	Air changes [ch/h]	Supply fan	Exhaust fan	Remarks
Technical/ pump room	Min. 30 ch/h		2 (Ex. proof)	According to rules

Fan control shall be local and remote from the IAS.

Remote control from the IAS shall be Start/Stop and running indication.

#### Tank de-gassing

For de-gassing of the cargo, slop and ballast tanks, fans powered by sea water, designed to degas all cargo and slop tanks in a maximum of 10 (ten) hours.

Four (4) complete sets consisting of reversible exhaust fans with flexible hoses, suitable exhaust ducts and various accessories shall be provided. The portable exhaust fans to have local Control, and shall be made of aluminum. Fed by flexible hoses connected to outlets on the seawater/fire line pipe on deck.

### 576 Ventilation/AC systems for steering compartments

Table 5.13 Ventilation fans for steering compartments

Space	Air changes / h	Supply fan	Exhaust fan	Remarks
Steering gear room	10		1	

Supply and exhaust ducts shall be arranged from and to open deck.

Vent inlets /outlets shall be protected from water ingress.

Supply Fan control shall be local and remote from the IAS.

Remote control from the IAS shall be Start/Stop and running indication.

### 577 Central heating systems for accommodation

#### General

The central heating system for the accommodation shall be common with the central heating system described in [84 Central heating systems](#).

The central heating system/ thermal oil-to-water heat exchangers, shall supply 85°C hot water to:

- Accommodation HVAC units heaters, ref. [571 Ventilation/AC systems for accommodation](#)

### 578 Central cooling systems

#### Fan Coils

Table 5.14 Fan coils

Space	No. of / type cooling unit(s)	Remarks
Wheelhouse split unit(s)	2 Splitt units w/VSD	see <a href="#">573 Ventilation/AC systems for control rooms</a>
Acc. public spaces fan coil unit(s)	Self-contain units as required w/ VSD	Depending on HTC (Heat Transfer Calculation)
ECR	2 self-contain fan coil units w/VSD	>50% capacity each, down-stream type for pressurized floor may be considered**
Steering gear room	2 self-contain units w/VSD	>50% capacity each
Technical/Instrument Room(05-Acc deck)	Min. 1 self-contain unit w/VSD	
Engine room workshop	1 Self-contain fan coil unit w/VSD	
Electric workshop	1 Self-contain fan coil unit w/VSD	
Hospital	1 self-contain fan coil unit w/VSD	
Galley	1 Self-contain fan coil unit w/VSD	

Space	No. of / type cooling unit(s)	Remarks
Garbage room	1 self contain fan coil unit w/VSD	

Self-contain fan-coil cooling units not mentioned, shall be arranged as required according to rules and /or normal practice.

For drainage/recovery of condensate water from HVAC system, see [762 Technical fresh water systems](#)

\*\*Before starting up the downstream fan coils, the space below lifted floor must be thoroughly vacuum cleaned to assure a dust free air-stream.

## 579 Ventilation/AC systems for various compartments

Table 5.15 Ventilation/AC systems for various compartments

Space	Type of Ventilation	Air changes/h	Supply fan	Exhaust fan	Remarks
Bouson store/rope store	Mechanical	5		1	
Air drying equipment room	Mechanical		1		
Separator room	Mechanical	10		1	
Engine store/ workshop	Mechanical	10		1	Suction from welding table. Self contain fan coil unit, ref. <a href="#">578 Central cooling systems</a>
Inert gas generator room	Mechanical	10		1	According to regulations
AFT Hydraulic room	Mechanical	10		1	
Refrigerant compressor room	Mechanical	10		1	
Foam room	Mechanical	10		1	
Hydraulic room	Mechanical	10		1	
Chemical room	Mechanical	25		1 (Ex-proof)	
Future (Methanol fuel treatment)	Mechanical	30		1 (Ex-proof)	(OPTION) 1 additional ex.proof fan, according to regulations, (Catastrophe ventilation)
Chemical safety equipment store	Mechanical	25		1 (Ex-proof)	
O2 store	Mechanical	25		1 (Ex-proof)	
Acetylen store	Mechanical	25		1 (Ex-proof)	
Paint stores	Mechanical	25		1 (Ex-proof)	
Garbage store	Mechanical	10		1	
Dry provision room	Mechanical	4		1	
Cargo equipment sampling room	Mechanical	6		1 (Ex-proof)	
HVAC room	Mechanical	10		1	
Fire station	Mechanical	10		1	
Lifesaving equipment room	Mechanical	6	1		
Emergency generator set room	Mechanical	20	1		Inlet and outlet louvres shall be dimensioned according to radiator fan capacity and combustion air supply to the

Space	Type of Ventilation	Air changes/h	Supply fan	Exhaust fan	Remarks
					engine. Louvers to have integrated closable damper and of mist eliminator /droplet separator type if exposed for water ingress.
Stores	Mechanical	6	1		

The ventilation fans with separate starter cabinet, shall be controlled as follows:

- Control shall be Local and remote from the IAS
- Remote control from the IAS shall be Start/Stop and running indication

Other rooms not mentioned in the list above shall be ventilated, heated and cooled according to rules and /or normal practice.

## 58 Sanitary supply and discharge systems for accommodation

### Sanitary supply system

A sanitary supply system shall be arranged supplying hot and cold water to the accommodation, deck and other spaces.

### Sanitary discharge systems

The sanitary discharge systems shall be split into a black water system of vacuum type and a grey water system of gravity drain type.

One (1) biological type Sewage treatment plant shall be installed having capacity for all persons on board.

## 581 Sanitary supply systems

### Hydrophore system

The fresh water hydrophore plant shall be arranged with suction from Three (3) FW tanks and shall supply fresh water to the WC/showers, laundry, wardrobes, galley, etc., and include a hydrophore tank with a nominal capacity of 500 liters for the hot water system.

The hydrophore pump capacity shall be calculated according to ISO 15748-2.

The hydrophore system shall operate fully automatically with one (1) pump in standby mode.

The hydrophore system shall operate with two circulation pumps (100% each), ensuring constant flow of hot water with a target temperature range of 10°C to 70°C.

The cold and hot water distribution systems shall be arranged with sectional shut-off valves at each accommodation deck level.

The system shall include one calorifier, designed to maintain hot water supply for accommodation areas

The calorifier shall have the capacity to raise water temperature from 10°C to 70°C, using thermal oil and electric resistors (as a backup heating source).

Table 5.16 Sanitary supply system components

Description	Capacity each	No's	Type / Remarks
Hydrophore pump	5 m³/h @ 5 bar	2	

Description	Capacity each	No's	Type / Remarks
Hydrophore tank	500L	1	Hot dip galvanized
UV sterilizer	5 m³/h	1	
Mineralizing filter	5 m³/h	1	
Sanitary hot water circulation pump	0.5 m³/h @ 2 bar	2	
Hot water calorifier	140kW, 2000L/h, 500L tank	1	4 x 35 kW electric heating elements

### Technical particulars for the pumps

Hydrophore system:

- Pressure holding centrifugal type
- Horizontal or vertical execution, self-priming
- Housing of Cast Iron, impeller of Brass and shaft of stainless steel
- Maximum 1800 rpm
- Electric drive – one speed

Hot water circulation system:

- Centrifugal type
- Vertical execution, self-priming
- Housing of Cast Iron, impeller of Bronze and shaft of stainless steel
- Maximum 3600 rpm
- Electric driven – one speed

### Bunkering system

The vessel shall be provided with two (2) shore connections for fresh water bunkering, one on each side, located on the main deck in the midship area, aft of and clear from the cargo manifold. Each connection shall be equipped with a valve and blind flange.

The system shall be dimensioned for 100 m³/h. The tank valves shall be remote operated from the IAS.

### Hot water system

A hot water system consisting of:

- 1 (one) fresh water heater (Calorifier) for the rooms and compartments of the Engine Room, with a hydrophore tank with a nominal capacity of 500 liters and a nominal flow rate of 2000 liters per hour, capable of raising the water temperature from 10°C to 70°C, using thermal oil and electric resistors (backup);
- 2 (two) hot water circulation pumps (100% each).

The hot water piping in the accommodation shall be thermally insulated.

### Potable water

A drinking potable water system consisting of 1 (one) electric sterilizer (ultraviolet) and 1 (one) mineralizing filter shall be provided.

The sterilizer and mineralizing filter shall be installed in the drinking water branch of the fresh water hydrophore system (cold and hot) for the supply of drinking water to the accommodation rooms, pantries, galley and infirmary taps, i.e. where there will be human consumption for drinking, food preparation and production, and personal care.

### Fresh water supply points – cold and hot water

The hydrophore system shall supply cold and/or hot fresh water to the following locations:

#### Cold and hot water:

- Rotor washing sink in the purifier compartment
- Purifiers (as per equipment manufacturer's recommendations)
- Cleaning system of the Main Engine scavenge air cooler
- Inert gas fan compartment

#### Cold water only:

- Workshop
- Thermal oil heaters (as recommended by the manufacturer)
- Location near the thermal oil heaters
- Expansion tank area
- For priming centrifugal and positive displacement pumps, where required
- Other connections as indicated by the Owner

See also [583 Bathtubs, showers, WC, washbasins](#)

### Outside taps – technical arrangement

The vessel shall be provided with external fresh water outlets for general maintenance purposes. Connections shall be fitted with shut-off valves and distributed along both sides of the vessel's superstructure, on the main deck (cargo area), extending to the bow, and one (1) additional connection at the stern.

All taps on open deck shall have closing valve inside to prevent freezing.

### References

Pipe materials, ref. [7 System for Main Engine Components](#)

FW production system, ref. [761 Fresh water production systems](#)

Technical FW system, ref. [762 Technical fresh water systems](#).

## 582

### Sanitary discharge systems

#### General

Combined sewage/ grey water holding tank(s) with capacity according to rules shall be arranged. However, minimum capacities shall be based on:

- 25 l/day/person black water
- 110 l/day/person grey water
- Holding tank capacity not less than 4 days

The tank shall be arranged with overflow, high level alarm and flushing with seawater supply from the fire system, ref. [813 Fire line/deck washing system](#).

Remote stop buttons for the sanitary sewage pump shall be provided next to the standard discharge connection on deck.

Tank ventilation, overflow and sounding for the sewage/ grey water holding tank(s), ref. [82 Air, overflow and sounding systems from tanks](#).

The sanitary sewage piping shall be independent and segregated from the waste water (grey water) piping and scuppers.

The discharge piping from the infirmary shall be independent from other piping in the rooms and shall be taken directly to the common entrance of the Sewage Treatment Unit.

The sanitary sewage discharge pump shall be connected to the Sewage Holding Tank and discharge to incinerator and sewage standard discharge connections on open deck, both side, fitted with a blind flange in compliance with the applicable regulations.

Waste water shall be able to be discharged directly by gravity into the Treatment Unit or into the sea, in accordance with regulations. If the wastewater is directed to the treatment plant, it shall enter at the initial stages of treatment, so that it passes through all the treatment stages.

The sewage pump shall have flow control to meet the requirements of Resolution MEPC.157 (55).

A table shall be prepared and submitted for approval showing the effluent discharge rate according to the vessel's draft and speed, as provided for in Resolution MEPC.157(55).

#### **Technical particulars for sewage discharge pump**

Pump:

- Centrifugal type with non-clogging impeller for black water
- Housing and impeller of cast iron, shaft of stainless steel
- Maximum 3600 rpm
- Electric driven – one speed

Table 5.17 Sewage discharge pumps and ejectors

Description	Capacity each	Quantity	Remarks
Sewage discharge pump	20 m <sup>3</sup> /h – 25 mlc	1	Auto /manual control. Shore, incinerator, overboard (controlled) discharge

#### **Black water/ vacuum system**

A sewage vacuum plant of marine quality shall be arranged for the toilets consisting of low volume fresh water flush vacuum toilets.

Sewage shall be collected by two (2) Vacuum pumps, 100% redundant with necessary control equipment for automatic operation.

Vacuum pumps to discharge directly to the sewage treatment plant with back-up for emergency discharge to a Sewage Holding Tank.

Automatic change-over of the vacuum pumps shall be provided in the event of a vacuum system failure or any pump failure.

Vacuum pipe system shall be arranged with service valves at each accommodation deck level.

Vacuum toilets shall be arranged with "rag hook" or equal arrangement to reduce risk of foreign objects clogging the pipe system.

For pipe materials, ref. 7 System for Main Engine Components.

#### **Grey water system**

Grey water drain system from sinks, wash basins, showers, laundry, etc. shall have sufficient slope to the treatment system, with back-up drain to the Sewage Holding Tank.

Vacuum tank system(s) shall be arranged for grey water pipes with insufficient slope for gravity drainage.

Galley grey water shall be led via a grease trap to the grey water system. Drain from the grease trap shall be led to sludge tank or other suitable collecting tank in accordance with Classification Society requirements.

For gutters and drains from the galley, ref. [552 Equipment and outfitting in galley](#).

Discharge piping from the infirmary shall be routed independently from other sanitary spaces and connected directly to the common inlet of the Sewage Treatment Plant

Scuppers shall be of stainless steel, type Blucher or similar, where approved.

For bathrooms scupper, ref. [583 Bathtubs, showers, WC, washbasins](#).

For drain from gutter ways in the accommodation, ref. [809 Drain system interior spaces](#).

For pipe materials, ref. [7 System for Main Engine Components](#).

### **Sewage treatment plant system**

The plant shall have capacity for capacity for all persons onboard and shall be arranged with:

- Inlet tank, bio tanks, settling tank and clean water tank
- Complete, self-contained system for treatment of the ships grey - and black water before it is discharged to prevent pollution of harbour- and coastal waters
- One (1) air blower with back-up hose connection from working air system
- Two (2) discharge pumps
- One (1) dosing pump
- Control panel
- Compact, efficient and flexible system
- Isolation valves on each tank to enable selective emptying
- Type approval according to IMO resolution MEPC.227(64) as amended

Discharge from treatment plant via built-on discharge pump(s) to:

- Overboard below ballast water line. Overboard shall be located aft of the sea inlet for FW production
- Sewage Holding Tank.

A sample cock to be provided at the overboard pipe

### **583 Bathtubs, showers, WC, washbasins**

Bathroom units shall preferably be of a prefabricated type.

Each unit in cabins and hospital shall be supplied with:

- Vacuum toilet
- Wash basin of suitable size with hot and cold water (mixing battery)
- Scupper
- Mirror
- Suitable number of clothes hooks
- Heated towel hook
- Fixture for toilet paper
- Fixture for spare toilet paper
- WC brush
- Plastic curtains

- Thermostatically controlled water supply (mixing battery)
- Handle and soap dish
- Portioned off to prevent extensive wetting of the bathroom with own scupper

Public WC's shall be supplied with:

- Vacuum toilet
- Wash basin of suitable size with hot and cold water (mixing battery)
- Scupper
- Mirror
- Suitable number of clothes hooks and towel hooks
- Fixture for toilet paper
- Fixture for spare toilet paper
- WC brush

Prefabricated bathroom units shall be fixed on top of floating floors where floating floors are required for noise reduction.

In the workers' toilets, hangers, 04 soap holders and 04 towel holders shall be provided

#### **References**

Electrical installation ref. [892 Electrical installations in accommodation](#).

Ventilation ref. [57 Ventilation, air-conditioning & heating systems](#).

The engine room shall be equipped with:

- One (1) Stainless steel sink with mixing battery.

#### **584 Drinking water coolers**

A drinking potable water system consisting of 1 (one) electric sterilizer (ultraviolet) and 1 (one) mineralizing filter shall be provided.

The sterilizer and mineralizing filter shall be installed in the drinking water branch of the fresh water hydrophore system (cold and hot) for the supply of drinking water to the accommodation rooms, pantries, galley and infirmary taps, i.e. where there will be human consumption for drinking, food preparation and production, and personal care.

Water bottle fountain (20 L) with cooling shall be provided in the following locations:

Navigation Bridge deck

Cargo Control Room

Gymnasium

Engine Control Room (ECR)

## 6 MACHINERY MAIN COMPONENTS

### General

The vessel shall have a power- and propulsion system according to [Figure 0.1](#). All machinery shall be delivered with spare parts and certificates according to the Classification Society requirements if nothing else is stated. All machinery shall be first class marine type with normal outfitting and accessories.

Spare parts and special tools shall be delivered in accordance with the manufacturers' recommendations, based on the equipment maintenance manuals, for a minimum period of 24 months, and in compliance with the requirements of IACS Recommendations 26 to 30.

The necessary foundations, supports and arrangements shall be provided to accommodate the spare parts that will be kept on board. The Supplier shall be responsible for receiving, storing, maintaining and protecting the machinery spare parts and tools until they are delivered and handed over to the Owner.

The following spare parts, equipment and special tools shall be supplied for each vessel, as required by Rules, Conventions and Codes:

- One (1) certified spare propeller shaft (if the number of vessels is less than four, one shaft for the series).
- One (1) complete set of certified CPP (Controllable Pitch Propeller) Hub for the series, to be delivered by the completion of the first vessel.
- One (1) certified spare propeller blade with screws for each vessel.
- One (1) certified anchor, stowed on the main deck, for each vessel in the series.
- Personal safety equipment, including self-contained breathing apparatus and spare units.
- Set of protective clothing, including gas and chemical-proof clothing.
- Emergency escape breathing apparatus (EEBD).
- Portable oxygen analyzer and gas meter.
- Portable level indicator/interface (UTI) for cargo tanks.
- Portable gas detector and sampling tubes for vapors and gases.
- Portable VHF communication radio certified for the specific purpose.

All quantities and certification shall comply with applicable Rules, Conventions and Codes.

The requirements for spare parts and special tools apply to all machinery and equipment on board, unless otherwise specified.

### Environmental conditions

Machinery has to fulfil Classification Society requirements and ratings according to ISO 3046/1 under the ambient reference conditions without any de-rating as mentioned in the tables below.

Table 6.1 Environmental conditions without climatic derating

Parameter	Value
Total barometric pressure	1 bar
Ambient air temperature	between 0°C and 45°C
Relative humidity	60%
Sea water temperature	32°C

All components and systems covered by the Classification Society shall be designed to operate under the following environmental conditions if not otherwise specified in the detail requirements for the machinery, component or system, but with reduced power in conditions with ambient temperature above 45°C:

Table 6.2 Environmental conditions with climatic derating

Parameter	Value
Ambient air temperature in the machinery space	between 45°C and 55°C
Relative humidity of air in the machinery space	between 60% and 96%
Sea water temperature	up to 32°C
List, rolling, trim and pitch	according to Classification Society requirements

Environmental conditions for the ship, see [Table 0.6](#).

The mounting of the equipment shall preferably be as follows:

Table 6.3 Mounting of equipment

Equipment	Mounting
Major components such as main gearbox, deck machinery, etc.	epoxy resin chocks
Components such as shaft bearings, steering gears, etc.	adjustable steel chocks
Components such as pumps, frequency converters, starters, etc.	directly onto a foundation
Main engines, auxiliary generator sets, emergency generator set, air compressors, large frequency converters, large switchboards and servo oil pumps.	resiliently (ref. <a href="#">85 Common electrical and electronic systems</a> )

## 60 Engines for propulsion

### 601 Main Dual Fuel MGO/Methanol engine for propulsion

One (1) four-stroke, single acting, medium speed, direct injection, non-reversible dual fuel engine (MDO/MGO/HFO/LSFO+Methanol), equipped with an exhaust gas turbocharger and connected via a gearbox to a CP propeller.

The main engine shall be Methanol Ready for future conversion to dual fuel operation (MDO/MGO/HFO/LSFO + Methanol).

The Main Engine or the remote control of the propulsion system shall be equipped with a system for monitoring and automatically adjusting engine performance, with the capability to provide diagnostics (Troubleshooting) and economic torque control.

One complete swing set spare parts for the main engine shall be delivered for serie's vessels, equivalent to one engine and in accordance with the manufacturer's recommendations and class society standards. The swing set shall include: complete cylinder head and internal components, injectors, suction and discharge valves, seal and snap ring set, piston set, pins and piston rings, connecting rod set and main bearings, cylinder liner set, lube and cooling water pumps (if applicable), coolers (if applicable), and crankshaft bearings.

Automatic and remote control systems for the propulsion plant are to be in accordance with manufacturer's standard, and shall be arranged for remote manual control and monitoring from the centralised engine control room.

Tank level indicators and alarms for the Main Engine Lube Oil Sump Tank, including high and low level switches and water detection alarm, are specified in Section 822 Sounding system, Table 8.1

Table 6.4 Main engine technical data

Manufacturer	:TBD
Type	:TBD
Output (MCR)	: abt. 3480-3600 kW (MCR)
Output (CSR)	: 100% of (MCR)
Speed	: 750 rpm at (MCR)
Fuel	: MDO/MGO/HFO/LSFO+Methanol
Cooling	: Fresh water
Starting	: Compressed air
Lubricating	: Dry sump
Cooling of lubrication oil, charge air and cylinder jacket	: Fresh water, with separate coolers

### Main Engine Certification and Emissions Compliance

The Main Engine to comply with IMO Tier II. Shall be factory tested and approved by the Classification Society. The manufacturer (licensor and/or licensee) is responsible for obtaining the EIAPP certificate and NOx Technical File, ensuring compliance with MARPOL Annex VI emission standards.

The main engine technical data to be finalised after confirmation of maker.

### Torsional vibrations

Torsional vibration calculations to be carried out, and main engine to be blocked to avoid continuous running within any restricted speed range.

A secondary order vibration damper shall be installed.

### Construction and material

The construction, material and fittings for main engine shall be in accordance with the engine manufacturer's standard.

### Accessories and fittings

The accessories and fittings for main engine shall in general be in accordance with the engine manufacturer's standard.

## 63 Transmissions

### Controllable Pitch propeller

One (1) Controllable pitch propeller plant for main propulsion shall be installed.

## 634 Controllable Pitch Propeller System (CPP)

Controllable Pitch Propeller System (CPP):

Manufacturer	KM
Propeller hub type	CP - Promas
Propeller power	3500 kW
Propeller diameter	5500 mm
Propeller speed	93 rpm (approx.)
Number of blades	4

Direction of rotation	Left, seen from aft (to be verified by model tests)
Propeller blade material	NiAl-Bronze
Propeller hub material	NiAl-Bronze
Propeller accuracy class	I
Stern tube bearing type	Water-lubricated composite bearing (Thordon)
Outer stern tube seal	Water-lubricated seal (e.g., Simplex or equivalent)
Inner stern tube seal	Water-lubricated seal (e.g., Simplex or equivalent)

### The CPP system shall include:

#### General Equipment

- Propeller shaft with oil shrink couplings.
- Water supply system for stern tube lubrication.
- Water-lubricated stern tube bearings.
- Mechanical seal with test/emergency valve for hull watertightness.
- Water monitoring and filtration system, including fine mesh filter with coalescing unit (e.g. CJC type) and dedicated circulation pump for off-line filtration.
- Rope cutting knives and net pick-up ring for protection of stern tube seal.

#### Monitoring and Measurement

- Shaft grounding assembly with analog (passive 4–20 mA) interface to the IAS and monitoring in the IAS. Shaft diameter in grounding area to be increased by 5 mm.
- Bearing wear sensors for stern tube and intermediate bearings, with alarm and display in the ECR, and signal to IAS.
- Shaft torsionmeter installed on intermediate shaft, with dedicated display panel in the ECR and signal to the IAS for torque, RPM and power monitoring.
- Flow meter in lubrication circuit with low flow alarm to IAS.
- Two (2) temperature sensors per stern tube bearing and one (1) for intermediate bearing, with signals to the IAS.

#### Hydrodynamic Bearings and Shaft Dimensions

- Intermediate bearing of hydrodynamic type, cooled by low-temperature distilled water. Shaft diameter in bearing area to be increased by 5 mm for a length of 20 mm beyond bearing ends.
- Stern tube shaft diameter increased by 3 mm in the aft bearing zone, for a length of 15 mm beyond the bearing ends.

#### Pitch Control System

- Oil Distribution box (OD box) for pitch control:
  - Installed on a separate OD box shaft in the shaftline/on the forward end of the gearbox.
  - The forward part of the OD box shaft incorporates the pitch feedback mechanism and has an integral flange connection.
- Pitch pumps (2 × 100%), with automatic changeover and alarm to IAS.
- Local pump and connection for manual pitch adjustment and locking in case of HPU failure.
- A minimess or equivalent oil sampling point shall be provided to allow collection of a representative sample for condition analysis, in accordance with manufacturer

recommendations or best industry practice.

- The hydraulic pitch control system shall be designed for minimum noise transmission.

### Cooling Water Supply for Bearings

- Two (2) sea water circulation pumps (100% each) with automatic changeover and alarm to IAS.
- Each pump with dedicated water conditioning filter.

### Spare Parts

- One (1) spare propeller blade, class certified, with bolts, stored on main deck within crane reach.
- One (1) spare propeller shaft for the series, stored in watertight steel box on first vessel, with access for periodic inspection.
- One (1) complete CPP system hub for the series, delivered to the Owner with the first vessel.

### Remote control system

The propulsion will have a Kongsberg control system.

Propeller speed and pitch shall be programmed to automatically follow the propeller curve for optimal performance in the speed range, ref. [793 Remote control of main propulsion and engine telegraph](#).

The CPP control system shall include:

- Remote control stations on the navigation bridge, bridge wings, and in the engine control room (ECR).
- Local control by direct actuation on solenoid valves at the OD box.
- Mode selector switch in the ECR to toggle between remote and local control.
- Two independent command loops:
  - One for standard pitch control via control lever,
  - One for emergency operation via push-button loop.
- In case of system failure, the pitch shall remain in the last commanded position ("fail-to-set"), unless otherwise agreed with the Owner and the CPP supplier.
- All system parameters, setpoints, feedback values, status, and alarms shall be transmitted to the IAS using an open industrial protocol.

## 637 Main reduction gear

Main reduction gear for propulsion shall be of single input/single output design (SISO) and single speed design with one built-in main clutch.

The clutch arrangement shall be in accordance with Classification Society requirements.

The oil temperature in the gearbox to be thermostatic controlled.

All bearings in the gearbox to be of plain bearing type.

The standby LO-pump shall be electric driven.

Table 6.5 Main reduction gear

Main reduction gear	
Manufacturer	: FLENDER
Input power	: 3600 kW (ME)
Input speed	: 750 rpm
Output speed	: abt. 93 rpmn
Offset	: Vertical

Main reduction gear	
Propeller type	: CPP
Rotation direction input shaft Engine	: CCW (seen from aft)
Rotation direction output shaft:	: CW (seen from aft)
Cooling:	: Fresh water cooler, tube type

## 64 Boilers

### General

The vessel shall be fitted with a thermal oil heating system.

The following equipment shall be supplied:

- One (1) oil-fired thermal oil heater;
- Four (4) exhaust gas heated economizers (Main and Auxiliary Engines) with by-pass for ME, all located in the engine room/casing;
- Two (2) thermal oil circulation pumps;
- Two (2) thermal oil transfer pumps;
- One (1) expansion tank;
- One (1) thermal oil cooler;
- One (1) storage tank;
- One (1) drain tank;
- Equipment and accessories for heater cleaning;
- Automatic electronic control for combustion, level and fluid pressure;
- Piping and fittings.

For details, see section [845 Thermal Oil Heating System](#).

### Operating Modes of the Thermal Oil Heating System

The thermal oil heating system, including the oil-fired thermal oil heater and exhaust gas economizers, shall be designed to operate under the following conditions, depending on the vessel's operational mode:

- Normal at sea – Mode A
- Normal at sea with ballast exchange – Mode A
- Normal at sea with inert gas topping-up – Mode C
- In-voyage cargo tank cleaning – Mode C
- Departure and arrival – Mode B
- Unloading product – Mode B
- Anchored with closed-circuit cargo tank cleaning – Mode B
- At anchor or in harbour condition – Mode B

Where:

- Mode A – Operating the Main Engine exhaust gas thermal oil heater
- Mode B – Operating the oil-fired thermal oil heater and the Auxiliary Engine exhaust gas heaters
- Mode C – Operating the oil-fired thermal oil heater and the Main Engine exhaust gas thermal oil heater

The oil-fired thermal oil heater shall be sized to cover the total heating demand of the vessel, including all equipment and tanks, in case of failure of all exhaust gas economizers (Main Engine and Auxiliary Engines).

## 646 Exhaust gas boiler

### Exhaust gas heated thermal oil boiler for main engine

One (1) exhaust gas heated economizers for thermal oil to be fitted in the casing, supplying thermal oil to the circuit in series with the oil-fired heaters.

The heater to be arranged with a dumping cooler and an internal by-pass flap for capacity regulation.

The heater to have the following data:

- Number of units : One (1)
- Type : Exhaust gas heated thermal oil boiler
- Capacity : To be suited to utilize the waste heat available from the main engine's exhaust.

The Main Engine economizer shall be designed to withstand the condition of no oil in the pipes (dry economizer) and shall have an automatic "flap" system that makes it possible to divert the flow of gases in such a way as to increase or decrease the thermal exchange and, consequently, control the temperature of the thermal oil. If the oil temperature remains high, it shall be deviated to the cooler. Alternatively, the temperature of the thermal oil can be controlled by an economizer flow control valve, as recommended by the manufacturer.

### Exhaust gas heated thermal oil boiler for aux. engines

Three (3) exhaust gas heated economizers for the auxiliary engines shall be designed in the same way as the main engine economizer, but will not have an automatic flap system to deviate the exhaust gas flow.

## 648 Thermal oil boilers

One (1) thermal oil boiler to be fitted in the engine room, supplying thermal oil to the heating circuit.

- The burner shall be a "Low NOx" type with low particulate emissions and certified in accordance with MARPOL Annex VI.
- Simultaneous operation of the oil fired heater with the economizers shall be provided.
- The oil fired heater and exhaust gas heaters (economizers) shall meet the vessel's operating conditions.
- The oil fired heater will be designed to consume HFO/LFO and/or DO. Diesel oil only for cold starting and for igniting the pilot burner.
- The oil fired heater shall be equipped with automatic combustion/thermal oil temperature controls and a cleaning system, consisting of a soot blower and relevant controls.

## 65 Main and auxiliary generator sets

### Auxiliary Generator set

Three (3) medium-speed (900 rpm) auxiliary generator sets, designed to operate on marine fuels including HFO, MDO, and MGO, shall be installed. The engines shall also be methanol-ready.

Each auxiliary generator set shall be supplied as a complete unit on a resiliently mounted, common skid and shall consist of a diesel engine coupled to an alternator.

Ref. also section [85 Common electrical and electronic systems](#)

## 652 Auxiliary generator set for electric production

Auxiliary generator set - engine specification

Supplier	TBD
Manufacturer	TBD
Type	TBD
IMO tier	II without SCR
Engine power (MCR)	TBD bkW (to comply with 750kWe)
Engine speed	900 rpm
Cooling	FW

Each generator engine shall be equipped with:

- An engine governor system of electronic speed setting type with adjustable speed drop (3-5%).
- Pneumatic starting motor
- Hot water heated stand still heating
- Heat recovery system from cooling water systems
- Control system and monitoring system interfaced to the IAS
- Engine panel for ECR including rpm meters, push buttons and lamps.
- Safety system

Auxiliary generator set - generator specification

Supplier	TBD
Type	3-phase, synchronous brush less, self-excited and self-regulated
Power	750 kW
Voltage/ frequency	Ref. <a href="#">Table 8.6</a>
Number of phases	3
Cos φ	0.8 or system manufacturers' recommendation
Speed	According to engine rpm
Rating	S1 Continuous
Ingress Protection	minimum IP44
Insulation Class/Rise temperature	H/F
Bearing(s)	Single/double ball/sleeve bearing(s)
Cable entry	MCT
Efficiency	0.97 at full load
Cooling	FW

Each generator shall be equipped with:

- Automatic Voltage Regulator (AVR) according Classification Society requirements and with voltage adjustment from the main switchboard
- Digital Excitation system (DES to be mounted in a cabinet) including Over-voltage/Excitation fault detection system according to Classification Society requirements
- Anti condensation heater
- Winding temperature sensors
- Bearing temperature sensor(s)
- Cooler leakage detector
- Hatches for emergency air cooling, if medium speed

- Provided generator > 1500kVA, Transformers for differential protection according Classification Society requirements (both for generator and switchboard)

#### **Overall system characteristics:**

The system shall be designed such that:

- The diesel generators can be started from a "dead ship"
- It shall be possible to adjust the rpm's by input from the PMS system/ Switchboard. The input signal to control the engine speed shall be approx ± 5% around nominal rpm.
- Protection and monitoring shall be as for a main propulsion engines

#### **Auxiliary engine and generator system requirements**

The auxiliary engines shall be designed to operate on marine fuels including HFO, MDO, MGO and shall be methanol-ready. If retrofit kits for methanol conversion are not yet available, the selected engines shall be supported by a confirmed future upgrade solution provided by the engine manufacturer.

Each auxiliary engine shall be factory tested and approved by the Classification Society and the Owner, using marine fuel oil as per applicable standards. A cylinder pressure monitoring system shall be provided, capable of displaying compression and peak pressure values per cylinder, either on the IAS or a dedicated panel in the ECR. An injector test kit shall be delivered with the auxiliary engine supply.

The maximum permissible continuous load on a generator, in any service condition, using any fuel in the engines and other combustion equipment (HFO/LFO, MDO/MGO or alcohol based fuels), will be 85% of the rated power. This condition shall be demonstrated in the design documentation.

#### **References:**

Fuel Oil, ref. [70 Fuel oil systems](#).

Lubrication Oil, ref. [71 Lube oil systems](#).

Cooling water, ref. [72 Cooling systems](#).

Start air, ref. [73 Compressed air systems](#).

Exhaust, ref. [74 Exhaust system and air intakes](#).

Hot water heated stand still heating, ref. [72 Cooling systems](#).

Heat recovery system from cooling water system, ref. [72 Cooling systems](#).

## **66 Other aggregates and generators for main and emergency electrical Power production**

### **Emergency generator set**

One (1) Emergency generator set shall be installed, approx. 200kWe at 1800 rpm.

The generator set shall be supplied as a complete unit on a resiliently mounted, common, skid and shall consist of a diesel engine coupled to an alternator.

The Emergency system shall be able to feed the main system for "Dead Ship Recovery".

### **665 Emergency Generator set**

Emergency generator set - engine specification

Supplier                          TBD

Manufacturer	TBD
Type	TBD
IMO tier	II without SCR
Engine power (MCR)	TBD bkW (to comply with 200kWe)
Engine speed	1800 rpm
Cooling	Air (radiator cooled)
Cooling fan	Engine driven

The generator engine shall be equipped with:

- An engine's governor system of electronic speed setting type.
- Electric starting motor
- Stand still heating
- Local control and monitoring system
- Safety system

#### Emergency generator set - generator specification

Supplier	TBD
Type	3-phase, synchronous brush less, self-excited and self-regulated
Power	200 kW
Voltage/ frequency	Ref. <u>Table 8.6</u>
Number of phases	3
Cos φ	0.8 or system manufacturers' recommendation
Speed	According to engine rpm
Rating	S1 Continuous
Ingress Protection	minimum IP23
Insulation Class/Rise temperature	Insulation Class F with temperature rise corresponding to Class B.
Bearing(s)	According to Generator set manufacturers standard
Cable entry	MCT
Efficiency	0.96 at full load
Cooling	Air

The generator shall be equipped with:

- Automatic Voltage Regulator (AVR) according Classification Society requirements
- Anti condensation heater
- Winding temperature sensors

#### Emergency generator – additional requirements

The Emergency DG control system shall be equipped with the following features, among others:

- Automatic start of the Emergency DG, due to voltage failure in the MSB ("blackout")
- Automatic shutdown of the Emergency DG after MSB voltage returns to normal
- ESB bus protection devices (short-circuit, under- and over-voltage, under- and over-frequency)
- Emergency DG protection devices (overload)
- Analog instrumentation and manual controls in ESB
- Manual controls and indications for opening and closing the ACB
- Manual Emergency DG rotation controls
- Selection of manual / automatic / test operating mode
- Blackout simulation test from the ESB

- Local Emergency DG control panel, with motor protections, local start/stop controls, emergency stop, maintenance lockout.

The Emergency DG local control panel shall be installed next to the Emergency DG.

The emergency generator shall be designed with insulation Class F and a temperature rise limited to Class B.

The generator shall run at 1800 rpm and be air-cooled in an open circuit, discharging outside the EDG compartment, with filters and protection against rodent ingress.

The cooling and lubrication systems shall be completely independent from any external supply.

The EDG shall be kept preheated by means of internal resistors installed in the cylinder jacket cooling water circuit.

Two independent starting systems shall be provided: one electric (primary) and one pneumatic or hydraulic (secondary). If two electric systems are used, the generator shall be equipped with two separate sets of batteries, chargers, and starter motors, allowing complete redundancy and interchangeability.

If batteries are used as starting source, they shall be of the AGM (Absorbent Glass Mat) type.

The generator shall be fully self-sufficient and able to operate without any external power source in both standby and running modes.

Mechanical ventilation of the compartment shall be provided and shall operate whenever the emergency generator is in standby mode.

#### **Overall system characteristics:**

The system shall be designed such that:

- The generator sets can be started from a "dead ship"

#### **References:**

Fuel Oil, ref. [70 Fuel oil systems](#).

El. start system, ref. [866 DC systems](#)

Exhaust, ref. [74 Exhaust system and air intakes](#).

Safety system, ref. [795 Automation equipment for diesel generators](#)

## 7 SYSTEM FOR MAIN ENGINE COMPONENTS

### Pipe Line Systems – General

- All pipe systems shall be according to system drawings approved by the Owner, Classification Society, and to the satisfaction of potential involved sub-contractors.
- The National Authority's approval shall be obtained on systems where required.
- The materials used in piping systems shall be certified and documented according to Classification Society requirements.
- The ANSI/ASME standard shall be followed for all the vessel's piping. If the manufacturer's standard for any equipment is different, a transition spool shall be installed only at the connection to the equipment, and the remaining complying with the ANSI/ASME standard.
- Piping shall be arranged to be as straight as possible, minimizing the number of flange connections and bends.
- Piping shall be installed with a minimum clearance of 150 mm above deck level, measured from the lowest point of the piping.
- Air vents, ullage and sounding pipes shall be tagged with stainless steel identification plates, engraved and painted black, indicating the system code and service.
- For piping systems on exposed decks, corrosion protection fittings shall be installed at all contact points between the piping and horizontal or vertical supports, including the fixing devices on the supports. Corrosion protection systems used shall be equivalent in performance and reliability to recognized solutions in the market (e.g. provided by Deepwater Corrosion Services).
- All flanged joints on exposed decks shall be protected with removable elastomeric coatings, resistant to UV radiation and marine environment.
- The arrangement of piping on the main deck shall allow free passage of cargo transport trolleys and maintenance access for deck coatings. Where such piping is unavoidable, provide removable platforms fixed with AISI 316L stainless steel bolts to allow trolley passage and deck maintenance.
- No oil or ballast piping shall pass through the Engine Room double bottom.
- The Yard shall prepare and submit for the Owner's approval the flexibility calculation reports for the exhaust gas discharge piping of the auxiliary engines, the main engine, the thermal oil heater, ballast piping and all the piping located on the exposed deck. The native electronic files of the flexibility software calculations shall also be sent to the Owner.

### Drain and Vent Provisions for Piping

All piping systems shall be arranged to allow complete draining and de-aeration before maintenance operations.

Drain and vent points shall be installed at the lowest and highest positions of piping runs respectively, in accordance with Petrobras Standard N-108, items 6 and 6.7.

### Material (Piping and armature)

Materials used in piping systems shall be suitable for the medium and service for which the system is intended.

The pipes shall meet the requirements defined in Table 7.1.

All overboard connections shall be Sch.160.

### Legend for Material Codes in Table 7.1

A – Seamless steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 40

**AC** – Welded steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 40

\* Minimum wall thickness: 9.5 mm

**B** – Seamless steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 80

**BC** – Welded steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 80

\* Minimum wall thickness: 12.7 mm

**C** – Seamless steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 80, classified

**Cu** – Copper tube

**D** – Welded steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 20

**E** – Welded steel plate

**F** – Fiberglass tube (GRP – ISO 14692, IMO L3, filament wound, Bisphenol-based)

\* Use only on the inside of compartments

**G** – Hot-dip galvanized coating

**H** – Seamless aluminum brass tube ASTM B-11, alloy C68700

**I** – Stainless steel pipe ASTM A-316L

\* All stainless steel piping shall be SS 316L, including screws, stud bolts and nuts. When the operating temperature is higher than 60°C, the Yard shall offer another material for the cases that is resistant to stress corrosion.

**J** – Seamless drawn steel tube, DIN 2391 ("Ermeto" or equivalent)

Not to be used for machinery piping systems in the Engine Room. For these systems, conventional seamless steel pipes shall be applied.

**P** – Internally polyethylene-coated pipe

\* The polyethylene coating shall be applied by rotational molding. The supplier and the application procedure shall be qualified and approved by the Owner.

Alternatively, other coatings may be proposed by the Yard provided they demonstrate equal or superior performance and are approved by the Owner in accordance with the above paragraph.

Regardless of the type of coating, the Yard shall guarantee its preservation from application to final installation and shall present a specific procedure for preserving internally coated spools.

**PVC** – Plastic pipe, for cold/hot water in superstructure

**MT** – ASTM A-316L stainless steel multi-pipe type with PVC cover (shall be limited to a maximum of 4 (four) pipes per group).

\*<sup>1</sup> The seawater pipes between the sea chest and the pump will be internally coated with polyethylene.

Table 7.1 Piping materials

System	Piping	Nominal Diameter	Material	Expansion Joint	Pipe Joint	Pressure Rating
Inert gas	Gas - Outside the Tanks	DN<250	AC	Dresser or expansion loop	Flange	ANSI 150 psi
		DN≥250	AC*			
	Gas - Inside the tanks	All	F			
Tank cleaning	Hot water	DN<250	BCG	Expansion loop	Flange	ANSI 150 psi
		DN≥250	BC*G			
Thermal oil	Heating coils	All	B		Sleeve	ANSI 300 psi
	General	DN>100	C		Flange	ANSI 150

System	Piping		Nominal Diameter	Material	Expansion Joint	Pipe Joint	Pressure Rating
			DN≤100	H			
Hydrophore	Fresh water	Cold	DN<20	BCG or PVC	Expansion loop	Flange or sleeve	ANSI 150 psi
			DN>20	ACG or PVC			
	Hot	All	All	Cu or PVC			
Ballast (inside tanks)	Sea water		All	F	Dresser or expansion loop	Flange or sleeve	ANSI 150 psi
Ballast	Sea water		DN<250	BCG		Flange	ANSI 150
			DN≥250	BC*G			
Fire and General Services	Sea water		DN≥50	BCG	Flange	ANSI 150 psi	
			DN≥50	ACG* <sup>1</sup>			
Sewage	Sewage, sludge, sanitary sewage and wastewater		DN<50	BCG	Expansion loop	Flange	ANSI 150 psi
			DN≥50	ACG			
Sea Water Cooling	Sea water		DN<50	BCG	Expansion loop	Flange	ANSI 150 psi
			DN≥50	ACP*			
Fresh Water Cooling	Fresh water		DN<50	BC	Flange	ANSI 150	
			DN≥50	AC			
Fuel Oil	P ≤ 7 kgf/cm <sup>2</sup> G	T≤60°	DN≤20	BC	Expansion loop	Flange	ANSI 150
		T>60°	DN>20	AC		Flange	ANSI 150
	7 kgf/cm <sup>2</sup> G < P < 10 kgf/cm <sup>2</sup> G		DN≤20	B		Flange	ANSI 150 psi
			DN>20	A			
	10 kgf/cm <sup>2</sup> G < P < 16 kgf/cm <sup>2</sup> G		All	C		Flange	ANSI 150 psi
Thermal oil heater discharge		All	C			Flange	ANSI 150 psi
Lubricating oil	Transfer, purification and service		DN≤20	BC	Expansion loop	Flange	ANSI 150 psi
			DN>20	AC			
	Drain and fill		DN≤20	BC		Flange	ANSI 150 psi
Air Vents and sounding		DN>20	AC		Sleeve	ANSI 150 psi	
Compressed Air	Starting air P ≥30 bar and emergency air		All	CG			
	General service air P≥9.5 bar		DN≤20	BG		Flange or sleeve	ANSI 300 psi
			DN>20	AG			
Control air P ≤ 9.5 bar		All	Cu		Compression bonding	ANSI 150 psi	
Exhaust gases	Main Engine		All	E	Bellows	Special flange or sleeve	-
	Auxiliary Engines and thermal oil heater		All	D			
Oxygen and Acetylene	Oxygen and acetylene		All	B		Sleeve	ANSI 150 psi
Sounding	Water tanks		DN≤50	BCG or F	Not applicable	Sleeve	ANSI 150 psi
			DN>50	ACG or F			
	Oil tanks		DN≤50	BC		Sleeve	ANSI 150 psi
			DN>50	AC			
Fuel oil drain	Fuel oil		DN≤20	BC	Expansion loop	Flange	ANSI 150 psi

System	Piping	Nominal Diameter	Material	Expansion Joint	Pipe Joint	Pressure Rating
		DN>20	AC			
Air Vents	Water tanks and cofferdam	DN≤50	BCG or F*	Not applicable	Sleeve	ANSI 150 psi
		DN>50	ACG or F*			
	Oil tanks	DN≤50	BC	Not applicable		ANSI 150 psi
		DN>50	AC			
Scuppers	Scuppers	DN≤20	BCG	Not applicable	Sleeve	ANSI 150 psi
		DN>20	ACG			
Hydraulic pipes	Inside Ballast tank	All	H or MT	Expansion loop	Sleeve	According to design pressure
	Inside cargo tanks, slops tanks		I* or MT		Sleeve	
	Internal compartments in the superstructure and on the main deck		B or MT		Flange	
	Steering Gear		J		Union by pressure	
	Cranes		I*		Union by pressure	-
Electrical conduits	All	All	ACG	Dresser	Flange or Sleeve	-
Fixed Fire Fighting System	P ≥ 10 kgf/cm <sup>2</sup> G	DN≤20	BG	Expansion loop	Flange or sleeve	According to the classification society's rules
		DN>20	AG			
	P < 10 kgf/cm <sup>2</sup> G	All	BCG		Sleeve	ANSI 150 psi

### Valves – General and Material Requirements

Valves with nominal diameters less than or equal to 50 mm may be of the ball, globe or gate type. Bottom drain valves of fuel oil, diesel oil and lube oil tanks with net capacity above 0.4 m<sup>3</sup> shall be self-closing.

Lug-type isolation valves shall be provided before and after equipment and for side/sea chest valves where butterfly valves are specified. Wafer-type valves shall not be used for hydrocarbon service.

Sampling valves for fuel oil shall include local drip trays and protection against splashing on hot surfaces.

In storage and settling tanks, sampling valves shall be installed to ensure representative samples.

If handwheels are not easily accessible from platforms, stem extensions shall be fitted, or a covered access platform with locking chain provided. Where impractical, a remote manual hydraulic drive shall be fitted.

### Material Codes for Valves

- **FF** - Cast Iron (ASTM A 126);
- **BF** - Cast Bronze (ASTM B 62);
- **LL** - Brass (ASTM B 124-2);
- **AF** - Cast steel (ASTM A 216-WCB);
- **AI** - Stainless steel (ASTM A 314-S.41000).

For butterfly valves, the materials shall be:

- Body - Cast Steel ASTM A 216 WCB or Cast Iron ASTM A 126;
- Disc - Stainless Steel;
- Seat - Rubber (Viton);
- Stem - Stainless steel.

Butterfly valves shall preferably be of "Lug" type.

The valves will be according to the Table 7.2:

Table 7.2 Valve Material Selection by System

System		Nominal Diameter	Material			Pressure Rating	
			Body	Disc/Seat	Stem		
Thermal Oil		All	AF	AI	AI	ANSI 300 psi	
Sewage, Ballast, Fire Fighting, General Services, Fresh and Sea Water , Fresh Water for Domestic Service		DN ≥ 50	FF	BF	LL	ANSI 150 psi	
		DN ≤ 40	BF	BF	LL	ANSI 150 psi	
Compressed Air	30 kgf/cm <sup>2</sup>	All	AF	AI	AI	ANSI 300 psi	
	P ≤ 9 kgf/cm <sup>2</sup>	DN ≥ 50	FF	BF	LL	ANSI 150 psi	
		DN ≤ 40	BF	BF	LL		
Side valves		DN ≥ 50	AF	AI	AI	ANSI 150 psi	
		DN ≤ 40	BF	BF	LL	ANSI 150 psi	
Fire hydrants		All	BF	BF	LL	ANSI 150 psi	
Lubricating oil		DN ≥ 50	FF	BF	LL	ANSI 150 psi	
		DN ≤ 40	BF	BF	LL	ANSI 150 psi	
Fuel Oil	P < 10 kgf/cm <sup>2</sup>	DN ≥ 50	FF	BF	LL	ANSI 150 psi	
	DN ≤ 40	BF	BF	LL	ANSI 150 psi		
	16 > P ≥ 10 kgf/cm <sup>2</sup>	DN ≥ 50	FF	BF	LL	ANSI 150 psi	
		DN ≤ 40	BF	BF	LL		
	P ≥ 16 kgf/cm <sup>2</sup>	All	AF	AI	AI	ANSI 300 psi	

**Note:** Stainless steel AISI 304 shall not be used for any valve components.

#### Filters – General and Installation Requirements

Filters shall be installed in accordance with equipment manufacturers' recommendations and as specified below:

- Filters shall be provided for all systems in the Engine Room.
- Shut-off valves shall be fitted before and after all equipment and filters to allow isolation and maintenance
- Filters on the suction side of pumps connected to sea chests shall always be installed upstream.
- Lube oil and fuel oil systems shall use duplex filters, with one unit automatic.  
A manual by-pass self-cleaning type with continuous "back-flushing" operated by the filtered oil shall be used.  
Contaminants shall be removed via automatic drains (e.g., Moatti-type or equivalent).
- Filters shall be installed upstream of all temperature and pressure control valves.
- Seawater system filters shall be internally lined with polyethylene.
- Lube oil pump suction filters shall have a minimum mesh size of 2 mm<sup>2</sup>.

#### Workmanship

- For Cu.Nickel (90/10) pipes, flat steel clamps with linings shall be applied.
- For steel pipes galvanized flat steel clamps or U-type steel bolt clamps shall be applied.
- In general, all pipes shall be cleaned thoroughly.
- FW cooling, Fuel Oil, Lube Oil and Hydraulic Oil pipes shall be cleaned according to the standards required by the engine/ equipment supplier.
- Where necessary, the pipe lines shall be equipped with expansion joints or shall be laid with expansion bends.
- In general, pipes passing through tanks shall be all welded.
- The pipe spool close to the tank suction well shall be flanged.
- Flexible connections shall be provided between resiliently mounted machinery and pipes.
- For oil pipes near hot surfaces, screens shall be arranged.
- Possibility to drain-off pipelines exposed to frost shall be arranged.
- Pipes passing through ECR or Instrument rooms shall be avoided/ minimized and shall be all welded. Water pipes shall be isolated for condensate.
- Loops in closed circuit systems shall have drain plugs at lower ends and air plugs at top.
- In general, electric driven pumps shall be fitted with pressure gauges on inlet and outlet side.
- Coolers for SW and FW shall be fitted with thermometers on inlet and outlet side.
- Control valves shall be sized from the flow and pressure drop requirements of the system and not from the size of the adjacent pipes.
- All pressure system shall be pressure tested according to Classification Society requirements, but as a minimum 1.5 times design pressure and minimum 4 bar. Hydraulic piping does not need to exceed the design pressure by more than 70 bar.
- Push-fit pipe work for sanitary gravity drain shall be leakage tested at max. 0,5 bar and vacuum pipes shall be tested in accordance with recommendation from the vacuum system supplier.
- All piping systems shall be arranged to prevent the accumulation of liquids or gases in pockets; where not possible, drain connections shall be provided.
- Eccentric reducers shall be used in pump suction piping to prevent air entrapment.
- Movements caused by thermal expansion and vessel structure deflection (hogging and sagging) shall be absorbed by pipe arrangements; the use of expansion joints shall be avoided unless technically unavoidable and approved by the Owner.
- Expansion joints, if used, shall be of Dresser type with Viton seals and protected inner surfaces.
- Piping shall not penetrate control rooms or electronic spaces unless unavoidable; in such cases, gastight arrangements shall be made.
- Pressure tests shall be carried out at 1.5 times the design pressure, and at minimum 4 bar where applicable.

### Engine Room Tanks – Additional Requirements

- The capacity of the tanks shall be defined during the detailed design in accordance with this Technical Requirement and the manufacturers' recommendations.
- There shall be openings in the fuel oil storage tanks for the use of portable cleaning machines and exhaust fans, as defined in item 3.1.2.1.
- The level transmitters can be bubble or electric (pressure sensor - 4/20 mA) with indication on the IAS. The sensors shall be installed in such a way that they can be removed for maintenance or replacement without the need to open the tank.
  - It shall contain a valve capable of isolating the sensor from the tank.
- All tanks will be supplied with manhole covers, fitted with handholds and seals.

- The covers of the openings and manholes inside the Engine Room, above the tank top, shall be fixed using galvanized steel stud bolts, nuts, and washers.
- The covers of the openings and manholes below the Engine Room floor shall be fixed using clamps (150 mm), stud bolts, nuts, and washers made of ASTM A-316L stainless steel.
- The covers of the openings and manholes outside the Engine Room shall be fixed using ASTM A-316L stainless steel stud bolts, nuts, and washers.
- It shall be painted under the main deck and two meters below and one meter above the top surface of the stringers.
- Sampling valves for fuel and oil tanks shall be equipped with a drip tray and splash protection, to avoid spillage on hot surfaces and ensure safe handling during operation.

### **Thermal Insulation Requirements**

- The hot surfaces of all machinery, equipment, tanks, and pipes operating at temperatures normally above 60°C shall be thermally insulated, as well as the flanges, valves, and fittings of these piping.
- The ends of the thermal insulation of pipes near flanges, valves, fittings, and supports shall be finished in such a way as to allow removal of bolts and the shifting of pipes on their supports, in accordance with the Yard's practice to be approved by the Owner.
- The ends of the thermal insulation of pipes near flanges, valves, fittings, and supports shall be finished in such a way as to allow the bolts to be removed and the piping to be moved on their supports, in accordance with the Yard's practice to be approved by the Owner.
- Galvanized steel plates with a thickness of 0.4 mm shall be used for thermal insulation of tanks, machines, equipment, and exhaust gas discharge of the thermal oil heater, main engine, and auxiliary engines.
- The flanges, valves, and fittings of insulated piping shall be thermally insulated with a mattress made of lined insulating material.
- The fuel oil settling tanks, fuel oil service tank, fuel oil storage tanks, purifier sludge tanks, and Hot Water Tank, and other heated tanks in the Engine Room, whose working temperature exceeds 60°C (except the side, bulkheads bordering tanks, double bottom tank top) and bulkheads below the double bottom tank top will be insulated with blankets or plates of insulating material, in accordance with the Yard's practice.
- The following regions shall also be isolated:
  - Bulkheads and upper deck (if exposed to the sun) of the Emergency Diesel Generator compartment.
  - Bulkheads and upper deck (if exposed to the sun) of the clean firefighting agent bottle compartment.
  - Bulkheads and upper deck of the Steering Gear Compartment.
- The thermal insulation will be designed to achieve a maximum temperature on its external surface of around 60°C, considering the temperature of the air in contact with this surface to be 45°C.
- The hot water piping for human consumption shall be insulated so that the minimum temperature of the return water is 51°C.
- The thermal insulation of the thermal oil, hot water, fuel, and lube piping shall be insulated with rock wool or glass wool. The exhaust gas discharge piping shall be insulated with rock wool.
- The refrigerant gas piping shall be insulated with polyurethane foam (non-combustible type and certified) and covered with a single layer of raw cotton canvas fabric.
- The Yard shall design the thermal insulation so that there is no condensation on its external

surface.

- All materials used as thermal insulation shall be in full compliance with the applicable rules (ref. SOLAS/FSS-FTP Code, Hong Kong Convention, 2009 / MEPC. 379(80)).

### **Marking**

All valves, valve chests, pumps, tanks, machinery, starters, armatures, etc. shall be marked with identification signs made of ASTM A-316L stainless steel. The signs shall be engraved, painted black, and fixed with screws of the same stainless steel. The text shall be in English.

### **Colour coding of pipes**

The colour coding of all piping shall be performed in accordance with Petrobras standards N-1503 and N-1219.

Additionally, flow direction and pipe content shall be marked using labels and arrows in accordance with ISO 14726.

### **Pipe penetrations through watertight bulkheads**

- Plastic pipes are not accepted as watertight penetrations.
- Steel piping is considered watertight.

## **70 Fuel oil systems**

### **General**

The ship shall be arranged with a fuel oil system based on Residual/Heavy and Light Fuel Oil (HFO/LFO) and Distillate/Marine Diesel Fuel Oil (DO).

- Main engine HFO/LFO - DO
- Aux. generator set engines HFO/LFO - DO
- Emergency generator set engine - DO
- Oil fired Thermal Oil Heaters HFO/LFO - DO

### **Service and settling tanks**

- One (1) service tank and one (1) settling/service tank in Main engine room for MGO
- Two (2) service tanks and two (2) settling tanks in Main engine room for HFO
- One (1) service tank for Emergency generator set engine

### **Transfer pumps and purifiers**

- Two (2) FO transfer pumps for service and settling tanks in Main engine room, approx. 30 m<sup>3</sup>/h each (capacity of max daily consumption/h) one for MGO and one for HFO; one of which is a backup for the other
- Two (2) heaters for the purifiers; one of which is a backup for the other
- One (1) DO pump, approx. 6 m<sup>3</sup>/h (20% of FO transfer pumps)
- Backup filling of settling tanks with purifier feed pumps.
- One (1) FO transfer pump for Emergency generator set engine service tank, capacity approx. 1 m<sup>3</sup>/h
- Two (2) centrifugal HFO/LFO - DO purifiers, without gravity discs, of the self-cleaning type, driven by an electric motor without the pinion-crown assembly to drive the drum, one being a backup for the other
- One (1) FO automatic filtration unit with self-cleaning system;

### **Bunkering system**

From the bunkering stations, a separate filling line shall be arranged with distribution to all bunker tanks via remote operated valve chest(s). The system shall be dimensioned for 100 m<sup>3</sup>/h.

Each filling line shall comply with OCIMF recommendations and include:

- Independent filling piping
- Continuous sampling device
- Valve and blind flange

Sampling devices shall be installed close to consumers and equipped with:

- Drip trays with drain and protection
- Drain point at lowest part of tray
- Removable screens to retain solids
- Tapered bottom to facilitate drainage

## 701 Fuel oil transfer & drain systems

### Fuel Oil Transfer System

Technical particulars for the fuel oil transfer pumps:

- 3-spindle screw type, with built-on safety valve
- Casing in cast iron and screws in nitrated steel
- Electric motor – one speed
- Maximum 3600 rpm
- Suitable for low sulphur and low viscosity fuels

The fuel oil system shall include:

- Two (2) HFO/LFO transfer pumps
- One (1) DO transfer pump
- All pumps arranged for backup operation
- The HFO/LFO transfer pump shall transfer the daily HFO/LFO consumption in max. 1 hour
- The DO transfer pump capacity shall be at least 20% of HFO/LFO transfer pump

For tank sounding, level switches and alarm arrangement, see [Table 8.1](#) in [822 Sounding system](#)

#### Transfer system layout:

- Pumps shall have suction from overflow tank and from bunker tanks valve chest
- Pumps to supply settling tanks (automatic) and service tanks (manual)
- Transfer pumps shall allow transfer between any tanks and recirculation to own tank
- Transfer pump for Emergency Generator set fuel oil tank shall also supply fuel to:
  - Incinerator fuel oil tank
  - Rescue boat filling station
- Remote stop push buttons for the HFO/LFO - DO transfer pumps shall be provided next to the FO (HFO/LFO - DO) connections on the main deck and on the navigation bridge.
- The Emergency Generator service tank shall be located in the generator compartment and shall have a capacity of 150% of the volume required by applicable regulations. A low-level alarm shall be set at 100% of the tank volume. The tank shall be filled via a dedicated pipeline, and the diesel oil transfer pump shall be powered by the emergency switchboard.

#### Pipe routing and installation:

- No oil or ballast piping shall be installed in the double bottom of the Engine Room

- Rescue boat filling station shall include shut-off valve, hose, and filling nozzle

### **Overflow Tanks & System**

Overflow tank shall collect overflow from:

- Settling tank to overflow tank
- Service tank to settling tank
- Emergency Generator service tank to DO storage tank (with IAS flow indication)
- DO storage tanks to overflow tank (with IAS flow indication)
- HFO/LFO storage tanks to overflow tank (with IAS flow indication)

Overflow piping shall include:

- Sight glasses
- Observation lamps

Overflow tank shall also collect:

- Discharges from safety valves of supply/bunker lines
- Drip trays and leak trays from equipment

See also: [821 Tank venting and overflow system](#).

### **Fuel Oil Service and Settling Tanks**

Tanks shall include:

- Waste tray
- Drain pot and drain
- Overflow
- Tank sounding
- High/Low level alarms
- High/Low switches for auto start/stop of transfer pumps
- Quick-acting shut-off valves for remote operation

### **Monitoring and Remote Control**

Monitored via IAS:

- Tank levels (with separate high/low alarms)
- High/low level in Emergency Generator tank
- High level in overflow tank
- Flow indication in overflow lines

Remote control via IAS:

- Automatic start/stop of pumps
- Remote manual start
- Remote valve actuation (except quick-acting/service valves)

See also: [792 Alarm and monitoring system](#) and [822 Sounding system](#).

### **Bunkering System**

- Independent filling lines per OCIMF recommendations
- Fuel oil connections on port and starboard cargo manifold
- All connections to be equipped with:

- Continuous sampling device
- Valve
- Blind flange

## 702 Fuel oil purification plants

The Fuel oil purification system shall consist of:

- Two (2) HFO/LFO feed pumps, one of which is a backup for the other;
- Two (2) heaters for the purifiers, one of which is a backup;
- Two (2) centrifugal HFO/LFO - DO purifiers, without gravity discs, of the self-cleaning type, driven by an electric motor without the pinion-crown assembly to drive the drum, one being a backup for the other;
- One (1) FO automatic filtration unit with self-cleaning system;
- Settling, service and sludge tanks;
- Piping and fittings.
- For tank sounding, level switches and alarm arrangement, see [Table 8.1 in 822 Sounding system](#)

The Fuel oil purifier(s) shall:

- Be of Automatic self-cleaning type
- Have loose supplied type electric driven supply pump
- Have capacity in accordance with recommendation from the engine supplier/ purifier supplier, approx 1,5 m<sup>3</sup>/h
- Have suction from the FO settling tank, main engine room FO service tank(s) and the FO overflow/ drain tank with clean oil delivery to the main engine room service tanks

Each fuel oil purifier (HFO/LFO - DO) shall have sufficient effective capacity (throughput = 25% of nominal capacity) to purify, in 20 (twenty) hours, a volume of oil equal to the vessel's daily consumption, with the Main Engine operating at its maximum continuous rating (MCR) and 1 (one) Auxiliary Engine operating at 100% load.

Fuel oil purifiers (HFO/LFO - DO) shall be equipped with a seal broken alarm, with automatic by-pass, high vibration alarm and other alarms and indicators recommended by the equipment manufacturer.

The feed pumps for the purifiers shall be able to operate in parallel, pumping from one or both HFO/ LFO settling tanks.

All the purifiers (except the Auxiliary Engine LO purifiers), heaters, Main Engine fuel oil supply and service pumps, thermal oil heater fuel oil burner supply pump, viscometer and flow meter shall be arranged in Separator Room

The purifier room shall have a dedicated and organized space with panels for the special tools needed for maintenance of the purifier sets, a bench for cleaning the purifier rotors, large enough to accommodate two (2) rotors and parts that are being cleaned and one (1) sink for washing the rotors, equipped with a cold water tap, compressed air and DO outlet, ultrasonic cleaning sink capable of accommodating at least the largest bowl of the largest purifier. This space should be located preferably at the end of the compartment with the best possible ventilation flow configuration for the best working conditions in the compartment.

The room shall be sized to allow easy access for maintenance of the installed heaters, valves and accessories. The compartment deck should have a raised platform provided with galvanized grating only where required for operation.

The equipment shall be equipped with coamings and a drainage system for possible oil leaks.  
 The room shall have ventilation and exhaust in diagonally opposite positions.

Sludge collecting tank shall be installed below FO and LO separators.

Sludge system, see [803 Bilge systems and oil/water separation](#).

## 703 Fuel oil consumption system

### Fuel Oil Supply Overview

Table 7.3 Fuel oil supply system

Item	Description
Main engine	Fuel oil supply from service tank. Back-up from settling/ service tank
Aux. generator set engines	Fuel oil supply from service tank. Back-up from settling/ service tank
Emergency generator set engine	Fuel oil supply from separate service tank with capacity according to SOLAS requirement
Thermal oil heater	Fuel oil supply from service tank
Incinerator	Diesel oil supply from DO service tank via dedicated pump.
Inert Gas Generator	Diesel oil supply from DO service tank via dedicated pump.

### Fuel Oil Conditioning System for Main Engine and Auxiliary Engines

One (1) compact pressurized conditioning unit serving both Main Engine and Auxiliary Engines, following the recommendations of CIMAC (The International Council on Combustion Engines), consisting of:

- Two (2) supply pumps (1 operating + 1 standby), with safety filter at inlet and automatic changeover.
- Duplex filter(s) as recommended by engine maker, including one automatic backflush filter.
- Two (2) mass flow meters ("Coriolis") for Main Engine – supply and return, interfaced with IAS.
- Two (2) mass flow meters ("Coriolis") for Auxiliary Engines – combined flow measurement for set of AE, interfaced with IAS.
- One (1) deaeration and recirculation tank.
- Two (2) circulation pumps (1 operating + 1 standby), with automatic changeover.
- Two (2) heaters (1 operating + 1 standby), with thermal oil control valve controlled by viscometer.
- One (1) viscometer with temperature or viscosity control mode.
- Other equipment for conditioning and burning 0.1% sulfur fuel oil.
- Local control panel with graphic interface and remote supervision via IAS.
- Piping arranged for continuous circulation without temperature loss. Insulation and tracing applied.
- Interconnection with diesel oil lines for cold start and shutdown recovery.

#### Main Engine

- Separate fuel oil consumption system.
- System designed according to engine manufacturer's recommendations.
- Built-on fuel oil booster pump, mechanically driven.
- One (1) electric-driven stand-by fuel oil booster pump, screw type.
- One (1) electric-driven feeder pump (if required by engine supplier).
- One (1) fuel oil heat exchanger (if required by engine supplier).

### Auxiliary Generator Set Engines

- Separate fuel oil consumption system.
- System designed according to engine manufacturer's recommendations.
- Three-way manual valves on fuel oil inlet and outlet to operate with HFO/LFO or DO.
- One (1) dedicated diesel oil pump.
- One (1) emergency start diesel oil pump (for blackout).

### Emergency Generator Set Engine

- Separate fuel oil consumption system.
- One (1) DO service tank, located inside the emergency generator compartment.
- The DO tank shall have 150% of Class capacity, with low level alarm at 100% volume.
- The tank shall be filled by a diesel oil pump powered by the Emergency Switchboard (ESB).
- One (1) sampling point with self-closing valve.

### Thermal Oil Heater

- Separate fuel oil consumption system.
- Two (2) FO firing pumps, each for 100% load.
- Two (2) FO heaters, each for 100% load.
- One (1) mass flow meter (Coriolis type) with monitoring in the IAS, equipped with a by-pass valve and filter, installed to measure the auxiliary boiler and composite boiler as a combined set.
- Automatic pressure control valves.
- Fuel conditioning equipment for 0.1% sulfur fuel oil.
- Capability to use diesel oil for cold start-ups (as approved by maker).

### Incinerator

- One (1) supply diesel oil pump.
- System designed according to equipment manufacturer's recommendations.

### Inert Gas Generator

- One (1) supply diesel oil pump.
- One (1) mass flow meter (Coriolis type) shall be installed in the diesel oil line supplying the inert gas generator.
- System designed according to equipment manufacturer's recommendations.

### General Provisions

- Fuel consumption monitoring shall be provided individually for Main Engine, Auxiliary Engines, Thermal Oil Heater, and Inert Gas Generator.
- Fuel sampling points shall be installed close to each consumer, with drip trays and protection from hot surfaces.
- Viscosity control shall be included where required by the engine/equipment supplier.

## 704 Heating coils in fuel oil tanks

Fuel oil tanks shall be fitted with thermal oil heating coils to maintain fuel viscosity and temperature. Heating coils shall be designed in accordance with the central heating system described in section [845 Thermal Oil Heating System](#).

Each fuel oil tank (storage, settling, service) shall be fitted with a minimum of two (2) independent heating coil sections.

## 705 Fuel oil sampling/stripping

No stripping system to be arranged.

One (1) portable hand pump shall be delivered and utilized for sample taking from each tank.  
Sampling pipes shall end approx. 500 mm above the tank bottom.

There shall be valves provided for taking samples of service fuel oil in accordance with IMO Resolutions MEPC.324(75), MEPC.182(59), Circular MEPC.1/Circ.864/Rev.1 and Circular MEPC.1/Circ.889. Fuel oil supply piping for all consumers installed on board (including EDG) shall be considered, taking into account the various types of fuel.

A continuous fuel oil drip sampler according to MARPOL Annex VI and MEPC.182(59) Annex 7 shall be provided.

## 71 Lube oil systems

The Lube oil systems shall include:

- Lube oil transfer systems for filling and emptying of engines, etc. The systems shall be separated to avoid mixing of different lubrication oils
- Hull integrated lube oil (LO) - and hydraulic oil (HO) storage/drain tanks for major equipment/consumers
- Free standing storage tanks for minor consumers
- One (1) Lube oil transfer pumps,
- Two (2) self-cleaning centrifugal LO purifiers for the Main Engine, one of which is a backup
- Three (3) LO purifiers, 1 (one) for each Auxiliary Engine, centrifugal, self-cleaning type
- Five (5) heaters, 1 for each purifier
- Separate Lube oil system for each engine in accordance with the engine supplier's requirements
- Separate Lube oil system shall be arranged for the main propulsion unit. The systems shall be arranged according to the recommendations of the manufacturer

## 711 Lube oil transfer & drain systems

### Transfer pumps

- Lube oil transfer pump main engine
- Lube oil transfer pump Aux. engines
- Lube oil transfer pump main propulsion system
- Hydraulic oil transfer pump LP deck winches system
- Hydraulic oil transfer pump HPU system

The transfer pump for the main engine shall be fitted with a flow-meter (manual reading).

Technical particulars for the LO/ Hydraulic oil transfer pumps:

- 3-spindle screw type, with built-on safety valve
- Casing in cast iron and screws in nitrated steel
- Electric motor – two speed.
- Maximum 3600 rpm

### Hull integrated tanks

Hull integrated lube oil (LO) - and hydraulic oil (HO) storage/drain tanks for major equipment shall be arranged.

The tanks shall be arranged for the following purposes:

- LO storage tank(s) for main engine
- LO storage tank for Aux. generator engines
- LO storage tank for main propulsion system
- HO storage tank for LP deck winches
- HO stores tank for HPU
- Sludge tank for engine room systems
- Dirty oil tank for engine room systems

Each storage tank shall have a separate filling line from deck. The tanks shall be equipped with:

- High level alarm
- Drain cock
- Waste tray (waste trays in the engine room shall be gravity drained to the sludge oil tank)
- Vent and overflow, see [821 Tank venting and overflow system](#)
- Tank sounding, level switches and alarm arrangement, see [Table 8.1](#) in [822 Sounding system](#)

### Free standing storage tanks

The free standing storage tanks shall be installed and located adequate for the following purposes:

- 1 (capacity: 250 L) tank for windlass/mooring winches hydraulic system
- 1 (capacity: 250 L) tank for Emergency generator set engine lube oil
- 1 (capacity: 450 L) tank for steering gear system

Hand pumps shall be arranged for filling from:

- Free standing storage tanks to the systems
- Hull integrated stores tanks to systems without electric driven transfer pump

Provision shall also be made for filling LO tanks using portable pumps and LO drums.

## 712 Lube oil purification plants

The lube oil purification system shall be arranged for continuous cleaning of the oil for the main engine and auxiliary engines, using centrifugal purifiers.

- Two (2) automatic self-cleaning centrifugal lube oil purifiers for the main engine, one as a backup.
- Three (3) automatic self-cleaning centrifugal lube oil purifiers for the auxiliary engines, one for each engine.
- The LO purifier plant shall include five (5) heaters, one for each purifier, supplied from the thermal oil heating system.
- Each LO purifier for the main engine shall have an effective capacity (throughput = 20% of nominal capacity) sufficient to purify, in 20 hours, a volume of oil equal to three times the total volume contained in the main engine system at a temperature of 98°C.
- Each LO purifier for the auxiliary engines shall have an effective capacity (throughput = 20% of nominal capacity) sufficient to purify, in 20 hours, a volume of oil equal to four times the oil load of one auxiliary engine at a temperature of 98°C.
- The LO purifiers shall be fitted with high vibration alarm.

- Provision shall also be made for filling the LO tanks using portable pumps and LO drums.
- The purifiers shall be without pinion-crown assembly to drive the drum.

## 713 Lube oil systems for propulsion machinery and transmissions

### Main engine (medium speed type)

The Main Engine Lubrication Oil (LO) system shall be designed in accordance with the engine manufacturer's recommendations and the applicable Classification Society rules.

The system shall include the following components:

- Two (2) LO supply pumps for the Main Engine (100% capacity each), with automatic changeover in case of pressure drop or electrical failure.
- Two (2) LO coolers, with a minimum 0.9 margin (combined minimum cooling capacity 190%).
- One (1) automatic LO filtration unit with backflushing system.
- Electronic temperature control system.
- LO tanks, piping and fittings.
- Tank sounding, level switches and alarm arrangement, see [Table 8.1 in 822 Sounding system](#)

If the Main Engine is of 4-stroke type, the above configuration may be adjusted as per the engine supplier's recommendation.

### Cylinder Lubrication

Lubrication of the Main Engine cylinder liners shall be performed by a dedicated pump mounted on the Main Engine, drawing directly from the cylinder LO tank.

### Ventilation and Piping Inclination

- All air vents shall be fitted with flame arresters.
- The air vent from the Main Engine sump tank shall have a minimum inclination of 5°.
- The Main Engine air vent piping shall terminate near the engine room exhaust fans.
- Cylinder LO piping shall be arranged with a minimum inclination of 10°.

### Filters and Sampling

- Filters in the suction lines of the LO supply pumps shall be equipped with magnetic elements, if required by the Main Engine manufacturer.
- A sampling point shall be installed between the LO supply pumps and the Main Engine.

### Intermediate Shaft Bearing

The intermediate shaft bearing shall be lubricated by hydrodynamic means.

Cooling shall be provided by the low-temperature cooling water system.

### Transmissions

A separate LO system shall be arranged for the propulsion unit.

The systems shall be arranged according to the recommendations of the manufacturer. See [63 Transmissions](#).

## 714 Lube oil systems for auxilliary engines

### Generator set engines (high speed type)

Separate LO system shall be arranged for each Aux. generator engine and should include:

- Engine built-on lubrication oil system
- A pump for emptying the sump to the dirty oil tank

- A closed circuit LO system with automatic alarms according to Classification Society requirements for unmanned machinery spaces
- Electric driven pre-lubrication pump powered by the ESB, with interval start for stand-still lubrication of the engine.
- Tank sounding, level switches and alarm arrangement, see [Table 8.1](#) in [822 Sounding system](#)

## 716 Stern tube and stern tube tank

The stern tube bearing system shall be water-lubricated and delivered as a complete integrated system by a single supplier. The system shall comply with the applicable Class requirements, including TMON (DNV), TCM (ABS), MON-SHAFT (BV), SCM (LR), without requiring the removal of the propeller shaft for a minimum period of 15 years.

The system shall include the following:

- Two (2) stern tube bearings and a mechanical seal with emergency/test valve for hull tightness.
- Sea water circulation system with two (2) pumps, each with 100% capacity, automatic changeover in case of failure, and alarm/monitoring via IAS.
- A water conditioning filter installed in the circulation line.
- Flow meter with low flow indication and alarm connected to the IAS.
- Corrosion protection in the area between the bearings.
- Bearing wear monitoring system with indication on a dedicated panel in the ECR and integrated with the IAS.
- Two (2) temperature sensors for each stern tube bearing (including one spare) and one (1) sensor for the intermediate bearing, with alarm in the IAS.
- The diameter of the propeller shaft shall be increased by 3 mm over a distance of 15 mm beyond the aft bearing.
- The diameter of the intermediate shaft shall be increased by 5 mm over a distance of 20 mm beyond the intermediate bearing.

The design and arrangement shall follow the supplier's recommendation and meet the technical requirements of the Classification Society.

## 72 Cooling systems

The cooling systems shall be based on central cooler and provide necessary cooling for the connected equipment.

The central cooler shall be based on the sea water temperature of minimum 0°C and maximum +32°C where nothing else is described.

Fresh water (FW) low temperature (LT) systems shall be based on +36°C outlet temperature from the thermostatic valves where nothing else is described.

### Materials for Cooling Systems Equipment:

- Plate-type heat exchangers (for water systems):
  - Body: Steel plate
  - Plates: Titanium (for seawater side, ASTM B-265) and Stainless steel AISI 316L (for freshwater and oil side, ASTM A-240)
- Shell & tube type heat exchangers (for oil systems, if applicable):
  - Tubes: Aluminium Brass (ASTM B-111, alloy 687)
  - Tube plates (mirrors): Muntz Metal (ASTM B-171, alloy 365)

- Shell: Steel plate or cast iron
- Covers: Cast iron or steel, internally coated with neoprene or epoxy resin
- Anodes: Mild steel
- Seawater centrifugal pumps:
  - Volute casing: Bronze (ASTM B-584)
  - Impeller: Aluminum Bronze (ASTM B-148)
  - Wear ring: Aluminum Bronze (ASTM B-148)
  - Shaft: Stainless steel (ASTM A-276)
  - Zinc sacrificial anodes, either mounted on the equipment or as external devices
- Freshwater centrifugal pumps:
  - Volute casing: Cast iron (ASTM A-48)
  - Impeller: Phosphor Bronze (ASTM B-139)
  - Wear ring: Phosphor Bronze (ASTM B-138)
  - Shaft: Stainless steel (ASTM A-276)

**Note:**

Any replacement of the materials specified above shall only be allowed if approved by the Owner, and must offer equal or superior performance.

## 721 Sea water cooling system

The sea water cooling system shall include the following components:

- Two (2) seawater pumps, each with 100% capacity, equipped with variable speed drive (VSD). These pumps will serve to cool the heat exchangers of the low-temperature central cooling system.
- Two (2) seawater circulation pumps, each with 100% capacity, dedicated to the cooling tower and scrubber of the inert gas system.
- Two (2) seawater circulation pumps, each with 100% capacity, for the hydraulic deck seal tank.
- One (1) seawater pump for operating the vessel while in harbour mode. This pump can be omitted if the primary seawater pumps can meet harbour requirements at low speed, as verified during the design phase by the thermal balance calculation.

The system shall provide automatic pump changeover in case of a pressure drop or electrical failure. Additionally, temperature control in the low-temperature central cooling system shall be managed via a PID controller with pump speed regulation, ensuring optimal operation.

### Piping and Equipment

- Two (2) low-suction sea chests and one (1) high-suction sea chest shall be provided in the engine room to supply seawater to the system.
- Backflushing shall be arranged for the seawater side of the central coolers to allow for cleaning and maintenance.
- In-line seawater filters shall be installed at the seawater inlet of each plate heat exchanger.
- Each sea chest shall be equipped with a downstream filter. Additional filters shall be provided upstream of pumps supplying sensitive equipment, where required.
- The filters installed in seawater piping shall be internally coated with polyethylene.
- The main seawater pumps shall take suction from the sea chest and discharge to the central coolers. After passing through the central coolers, the seawater shall be either discharged overboard or returned to the sea chest or the after peak tank.
- Each suction branch from the sea chest cross-over pipe to each cooling pump shall be

equipped with an isolation valve before the pump, and each pump shall be provided with an isolation valve at the discharge side.

- An emergency bilge connection shall be arranged according to class rules.
- The seawater ejector pump for the freshwater generator shall take suction from a separate sea intake and discharge to the heat exchanger and ejectors of the freshwater generator.
- Rubber-lined butterfly valves of bronze or ductile cast steel with bronze internals and EPDM packing shall be used. The pressure in the freshwater cooling system must be higher than the seawater system to prevent contamination.
- The sea inlet valves on the crossover and sea outlet valves shall be remote-operated, with outlet valves being regulating types (0%–100%).

#### **Sea chest arrangement**

- Each sea box chest shall be provided with double isolation valves.
- Connections equipped with stop and check valves shall be installed for cleaning the sea chests using compressed air.
- Sea chests shall not have bulkheads adjacent to oil tanks.
- The total free area of the gratings of each sea chest shall be at least two (2) times the sum of the cross-sectional areas of the suction valves of the respective sea chest.
- All seawater filters installed on the suction lines from sea chests shall be equipped with differential pressure gauges.
- Sea chests shall be fitted with air vents or openings in the upper area to eliminate possible air pockets.

#### **Marine Growth Prevention System (MGPS)**

One (1) marine growth prevention system shall be provided with aluminum and copper sacrificial anodes mounted on the sea chests and designed for 5 years of operation under maximum circulation flow conditions.

The control panel shall be installed in the ECR and shall provide current measurements for each anode and a system fault alarm for monitoring by the IAS.

The system shall include all sea chests (high, low, emergency fire, ballast, etc.).

## **722 Fresh water cooling systems**

#### **General**

The fresh water cooling system shall consist of a centralized closed-loop cooling system, divided into two separate circuits:

- High Temperature (HT) circuit
- Low Temperature (LT) circuit

The HT and LT circuits shall be arranged in accordance with the engine supplier's standard system design. For medium speed engines, both circuits are normally connected to one common FW cooler, and the separation between HT and LT is made by piping and thermostatic (3-way) valves integrated in the engine cooling system.

#### **HT circuit shall supply cooling to:**

- Main Engine cylinder liners
- Pre-heater for Main Engine jackets
- Fresh Water Generator
- Deaerator tank

**LT circuit shall supply cooling to:**

- Lubricating oil coolers for Main Engine and Auxiliary Engines
- Scavenge air coolers for Main Engine and Auxiliary Engines
- Auxiliary Engines cylinder liners
- Electric generators air coolers
- Main air compressors
- Dehumidifiers
- Hydraulic systems for submerged cargo, ballast and slop pumps (if applicable)

**System configuration:**

- 2 × FW pumps per circuit (100% capacity each) – one duty, one standby, with automatic change-over in case of failure
- 2 × SW-cooled plate-type heat exchangers for the LT circuit, each sized for 100% of the required cooling capacity – one duty, one standby.
- 1 × Heat exchanger for HT circuit, cooled by the LT circuit
- 1 × Expansion tank per circuit, equipped with low level alarm
- 1 × Oil-in-water detector per circuit
- 1 × Conductivity sensor per circuit
- 2 × 3-way control valves, electric with PID control – one for LT circuit, one for HT circuit (ME)
- 1 × 3-way control valve, electric with PID control – for Fresh Water Generator
- Sea water flushing connections for heat exchangers shall be arranged for docking and emergency maintenance
- Dosing points for cooling water additives shall be provided in accordance with engine makers' recommendations

**Control and integration:**

- LT circuit temperature shall be controlled by PID regulation of SW pump speed, with 3-way valve control as backup.
- Pumps shall be auto-started based on pressure sensor signals.
- Full monitoring and control shall be available from IAS, including local/remote operation, manual/auto modes, ready and running status, and standby alarms.
- All signals from sensors and controllers shall be integrated in IAS.

**Pump specifications:**

- Vertical centrifugal type
- Cast iron housing, impellers in bronze or NiAlBronze, stainless steel shaft
- Max 1800 rpm
- Pumps to be arranged as duty/standby for each circuit

**Main Engine cooling system:**

- The main engine shall have built-on, mechanically driven jacket water pumps for HT and LT circuits.
- Electric standby pumps shall be installed for both HT and LT.
- A separate hot water pre-heater unit with dedicated circulation pump shall be installed.
- A deaerator tank shall be installed in the HT circuit to remove dissolved gases before water is cooled in the LT circuit.
- The overall arrangement shall follow the engine maker's recommendations.

### Heat exchangers:

- Plate-type heat exchangers shall be used for water cooling.
- Shell and tube heat exchangers or plate-type heat exchangers shall be used for oil cooling.
- Each heat exchanger shall be provided with pressure gauges and thermometers at the inlet and outlet of all fluid sides (freshwater and seawater).
- Sea water flushing connections for heat exchangers shall be arranged for docking and emergency maintenance.
- Cleanliness factor for design: **85%**.
- SW inlet temperature design basis: **32°C**.
- FW inlet to secondary coolers: **36°C max.**
- SW outlet from primary coolers: **45°C max.**

### Drain system:

A drain system for the fresh water cooling system shall be arranged in the engine room, including:

- Drain tank
- Drain pump with local control only (approx. capacity: 5 m<sup>3</sup>/h)
- Drain lines from all parts of the FW system
- Refilling via expansion tanks

Note: The Emergency Diesel Generator (EDG) is equipped with an independent radiator-type cooling system and is not connected to the central fresh water cooling system.

## 73 Compressed air systems

The compressed air systems shall include the following subsystems:

- Starting air system,
- Working air system,
- Instrument air system.

The compressors shall be arranged with air ventilation and exhaust branches according to the manufacturers' recommendations and shall be designed for ambient temperature of 45°C.

All air compressors shall operate with synthetic lubricating oil.

Each compressor and air dehumidifier shall be equipped with a dedicated control unit for system protection and automatic air pressure control. The control units shall send group alarm signals to the IAS.

Each air receiver shall be equipped with an independent pressure transmitter for indication and alarm at IAS.

Filters installed in the compressed air systems shall be equipped with differential pressure gauges to monitor filter obstruction.

Where possible, specifications for general service and control air compressors shall be standardized to optimize maintenance and spare parts management.

Detailed requirements for each compressed air subsystem are specified in the following sections.

### 731 Starting air systems

The starting air system shall be arranged as follows:

- **Working pressure:** 30 bar.

- **Compressors:**
  - Two (2) main starting air compressors.
  - Piston type, vertical, two or three stages.
  - Electric motor driven.
  - Each compressor shall have capacity to meet the air consumption required by the Classification Society's Rules.
  - One compressor shall be supplied from Emergency Switchboard (ESB).
- **Air receivers:**
  - Two (2) main starting air receivers, equipped with automatic purging/bleeding devices.
  - One (1) emergency air receiver, if Emergency Diesel Generator (EDG) is started pneumatically, equipped with automatic purging/bleeding.
  - Each receiver shall have an independent pressure transmitter for indication and alarm in the IAS.
- **Automatic starting air valve:**
  - One (1) automatic starting air valve shall be installed for the Main Engine.
- **Pressure reducing unit:**
  - One (1) pressure reducing unit shall reduce air pressure from 30 bar to 8 bar.
  - The unit shall be fitted with filters to achieve air quality ISO 8573-1 Class 2.4.5.
  - It shall supply the General Services Air System.
  - The pressure reducing unit is intended for emergency use only, in case of failure of the General Services Air System.
- **Compressor and system control:**
  - Automatic start/stop of compressors.
  - Automatic draining at stop and unloading at start.
  - Oil and water separator.
  - Alarms for low pressure shall be installed.
  - Local and remote control from IAS.
  - Remote control functions: Auto1/Manual/Auto2 modes, Start/Stop, Ready signal (compressor available) and Running signal to IAS.
  - Automatic operation based on system pressure sensors, connected to compressor starters.
- **Additional requirements:**
  - Air compressors shall operate with synthetic lubricating oil.
  - Compressors and receivers shall be suitable for ambient temperature up to 45°C.
  - Ventilation and exhaust branches shall be arranged according to manufacturers' recommendations.
  - Filters installed in the system shall have differential pressure gauges to monitor obstruction.
- **Starting air supply consumers:**
  - Ship whistle(s), see [427 Light and signal equipment, lanterns, whistle](#)
  - Instrument air system for engines.
  - Wheelhouse window flushing system, see [515 Side scuttles and windows with equipment](#)
  - Control locker for quick closing valves.
  - Air horn for fire alarm sounders.
  - (Reduction valves shall be arranged where required.)

## 732 Working air system in engine room, etc.

The working air system shall have a working pressure of 7 bar and shall be arranged with back-up supply from the starting air system via a 30–8 bar pressure reducing valve.

The air quality shall comply with ISO 8573-1, Class 2.4.5.

Technical particulars for the working air compressor:

- Electric driven, fitted with variable speed drive (VSD)
- Screw type
- Air cooled
- Minimum capacity: 300 m<sup>3</sup>/h FAD (ISO 1217)
- Maximum 3600 rpm
- Built-on or loose supplied air dryer with a pressure dew point of +3°C

Service air receiver:

- One (1) air receiver with a capacity of approximately 5 m<sup>3</sup>, equipped with automatic purging/bleeding device.

The system shall be equipped with:

- Automatic start/stop
- Automatic draining at stop and unloading at start
- Oil and water separator
- Alarm(s) installed for low pressure

Control requirements:

- Control shall be local and remote from IAS
- Remote control from IAS shall include Auto1/Manual/Auto2, Start/Stop, Ready signal (Compressor available) and Running indication to IAS
- Automatic control of each compressor shall be performed by pressure sensors installed in the system, connected to the corresponding starter

Compressed air connections for the general services air system shall be provided, fitted with valves and quick connection couplings, at the following locations:

- Engine Room floor and platforms
- Engine Room casing
- Main deck
- Accommodation and Navigation Bridge top decks
- Workshop
- Electric Workshop
- Purifier compartment
- Steering Gear compartment
- Inert Gas System Compartment
- Main deck (bow, stern, next to the accommodation PS and SB, in the cargo manifold, etc.)
- Emergency Diesel Generator compartment
- Fixed firefighting system compartments
- Foam compartment
- Ventilation and air conditioning (HVAC) compartment

- Midship Deck Store
- Bosun Store
- Cargo and Ballast Valve Hydraulic Unit Compartment
- Others as required

Shut-off valves shall be provided for each distribution section in an organized and standardized manner.

Dedicated connections shall be provided where an air motor is to be used:

- Accommodation ladders, with valve, drain and lubricator
- Bosun Store deckhouse

In case of emergency, the General Services Air System shall be able to supply the Control and Instrumentation Air System. For this purpose, filters and valves shall be provided to raise the air quality from ISO 8573-1 Class 2.4.5 to Class 1.2.1.

The final quantity and distribution of connections shall be confirmed during the detailed design phase.

### **733 Working air system on deck**

The working air system shall be extended to provide compressed air outlets at the following locations on the main deck:

- Bow area
- Stern area
- Cargo manifold – port side
- Cargo manifold – starboard side
- Next to the accommodation (central area)

Each outlet shall be fitted with a ball valve and a quick connection coupling.

The system shall be supplied from the working air system described in [732 Working air system in engine room, etc..](#)

A total of five (5) compressed air outlets shall be provided on deck.

The exact routing shall be confirmed during the detailed design phase.

### **734 Instrument air systems**

#### **General**

The Instrument Air System shall supply clean, dry compressed air for instrumentation and control systems throughout the vessel.

#### **System configuration**

The Instrument Air System shall include the following components:

- One (1) air compressor for instrumentation and control, compact type, suitable for marine use.
  - Rotary (screw) type.
  - Electric driven, fitted with a frequency speed drive (VSD).
  - Air cooled.
  - Oil separator and redundant filters.
  - Built-in air dryer.
- The compressor shall have a variable operational range between 50% and 100% of its nominal

capacity.

- The nominal capacity shall be sized to meet the system's average consumption at 75% of the compressor's nominal capacity.
- Nominal pressure: 8 barg.
- Air quality shall comply with ISO 8573-1, Class 1.2.1 at compressor outlet.

#### Receivers and Dehumidification

- One (1) instrument air receiver, capacity approximately 5 m<sup>3</sup>, equipped with automatic purging/bleeding.
- One (1) air dehumidifier, adsorption type, with automatic regeneration, sized to serve the consumers located outside the machinery spaces.
  - Minimum dew point: -40°C.
  - Air quality at the outlet of the dehumidifier shall comply with ISO 8573-1, Class 1.1.1.

#### Piping and connections

- Piping shall be arranged with expansion loops to absorb displacements caused by thermal expansion or vessel movements.
- Connection points for pressure gauges shall be installed near the main consumers.
- Condensate trap shall be installed at the lowest point at the air outlet to the main deck.
- Shore connection points (with blind flange and valve) shall be arranged at:
  - Forward main deck,
  - Midship main deck,
  - Aft main deck.
- Shut-off valves shall be provided before the piping penetrations to decks and accommodation areas.

#### Control and monitoring

- The compressor and dehumidifier shall have independent control units for protection and automatic pressure regulation.
- Group alarm signals shall be sent to the IAS.
- Independent pressure transmitters shall be installed on air receivers for indication and alarm at the IAS.

#### Consumers

The Instrument Air System shall serve, as applicable:

- Remote tank sounding system (ref. 822 Sounding System),
- Separators,
- Remote operated valve actuators,
- Hydraulic system pressurized expansion tanks (if applicable),
- Main engine instrumentation (if required),
- Other ship systems requiring clean, dry compressed air for control and instrumentation.

## 74 Exhaust system and air intakes

The exhaust systems shall include:

- Pipes in the engine rooms and casings made of welded steel pipes, on open deck of stainless steel quality
- Pipes in the engine rooms and casings insulated with mineral wool covered with galvanized

steel lining

- Pipes /components resiliently suspended to rigid parts of the structure
- Four (4) exhaust gas economizers for Main and Aux Engines, ref. 646 Exhaust gas boiler, which shall also function as a silencer. Attenuation minimum 35 dB(A)

## 741 Air intakes for machinery

See 574 Ventilation systems for engine rooms and Environmental conditions listed in D Performance

## 742 Exhaust gas system

### General

Exhaust systems shall be arranged for all engines and thermal oil heaters.

Exhaust pipes in the engine room and casing shall be made of welded steel pipes and bends, and shall be equipped with stainless steel flanged bellows-type expansion joints where required.

All exhaust pipes shall be routed to the top of the funnel(s) and directed aft.

Penetrations in the funnel shall have rain-proof collars.

On open deck, exhaust pipes shall be of stainless steel.

Main Engine exhaust shall be routed via an exhaust gas economizer, which shall also function as a silencer.

Auxiliary Engines and Emergency Diesel Generator shall have independent exhaust lines, each equipped with a silencer integrated with a spark arrestor.

The oil-fired thermal oil heater shall have a dedicated exhaust duct discharging directly to open air.

Maximum back pressure in the Main Engine exhaust system, including economizer, shall not exceed 300 mmH<sub>2</sub>O.

Drain pots with drain piping to bilge tank via scuppers shall be provided on all exhaust lines.

NOx measurement connections shall be arranged on exhaust lines for Main Engine, Auxiliary Engines and Thermal Oil Heater, as per applicable rules and regulations.

### Sound proofing

Exhaust systems from diesel engines shall provide minimum 35 dB(A) sound attenuation.

### Suspension

Exhaust pipes and components shall be resiliently suspended to rigid parts of the structure.

Special attention shall be given to the suspension of exhaust pipes located near accommodation areas.

A design document including routing study, support calculations and detailed fixation arrangement shall be submitted for approval.

### Insulation

All exhaust pipes shall be insulated with mineral wool, covered by galvanized steel sheeting.

Minimum insulation thickness shall be:

- 50 mm for Main Engine exhaust piping
- 40 mm for Auxiliary Engines, Emergency Generator, and Thermal Oil Heater

### Spark arrestor

Spark arrestors shall be installed on:

- Diesel engine exhausts
- Thermal oil heater exhausts

## 76 Distilled and make-up water systems

The fresh water production system shall include:

- One (1) FW generator of evaporator type. Capacity minimum 15 m<sup>3</sup>/24h at 25°C sea water temperature.

The technical fresh water system shall include:

- A separate system
- One (1) Technical FW pump
- One (1) Accumulator tank
- Technical fresh water storage tank(s)
- Filling line from bunker station
- Filling line from freshwater production plant
- Distribution lines to technical fresh water consumers
- Heating coils for preheating of cargo tank cleaning water

## 761 Fresh water production systems

A distilled fresh water system consisting of:

- 1 (one) complete Fresh Water generator, 1 (one) plate-type heat exchanger (plate material: titanium), capable of using both the residual thermal energy from the Main Engine jacket cooling water and the heat from the thermal oil (indirectly), with a minimum nominal production capacity of 15 (fifteen) tons of distilled water per day, considering the Main Engine operating at continuous service rating (CSR) and seawater at 25°C;
- 1 (one) ejector pump for the Fresh Water generator;
- 1 (one) distilled fresh water extraction pump;
- 1 (one) hydrophore system with distilled water and fresh water;

The daily production capacity of the Fresh Water generator shall be confirmed when the "PT's" are issued at the design stage with the assumptions and calculation log.

External filling of fresh water tanks and distilled water tanks shall be carried out through dedicated connections, fitted with a valve and blind flange, installed and duly identified on the main deck or through the Fresh Water generator.

The distilled water tank shall have a capacity greater than the volume of the machinery cooling system and shall have an overflow line to the fresh water tanks. The tank shall also supply water to the watermist firefighting system. The connections shall be arranged in such a way that the lower part of the tank constitutes a spare volume intended for firefighting.

The fresh water tank shall have the capacity to meet the expected consumption during the vessel's cruising range, regardless of the Fresh Water Generator output.

A bottom drain piping shall be provided for each tank to enable it to be completely drained for cleaning and maintenance.

The water produced by the Fresh Water generator shall be transferred by the distilled fresh water extraction pumps mounted on the Fresh Water Generator to the distilled water storage tank and to the fresh water storage tank via a salinity meter positioned at the distillate outlet of the Fresh Water Generator. The distilled water production of the Fresh Water generator shall be measured by an ultrasonic flowmeter with digital display and communication with the IAS.

A chemical cleaning system shall be provided with no need to open the Fresh Water Generator, with easy to use, pre-installed connections in accordance with the manufacturer.

## 762 Technical fresh water systems

### General:

Provision shall be made for filling the expansion tanks of cooling systems with distilled water directly from the distilled water tank. Segregation between general fresh water and technical fresh water shall be ensured at all times.

- Pipe material similar as the sanitary supply system, see [7 System for Main Engine Components](#)
- Pump capacity 10 m<sup>3</sup>/h - 35 mlc
- Back-up from Hydrophore system to be arranged
- Accumulator tank capacity approx. 150L

### Consumers:

- HP washer
- Separators
- Expansion tanks for FW cooling systems
- Turbine washing for main engine(s) if applicable
- Hot water boiler system
- Other consumers in engine room areas, etc.

### Technical particulars for the pump(s):

- Horizontal or vertical execution, self-priming
- Housing of Cast Iron, impeller of Brass and shaft of stainless steel
- Maximum 1800 rpm
- Electric drive – one speed

### Recovery of condensate from HVAC system:

The Technical Fresh Water System shall be extended with a function for collecting condensate produced by the central air-conditioning (HVAC) system. Condensed water from HVAC units shall be drained into a dedicated collection tank, from where it will be transferred to the Technical Fresh Water System and further distributed to selected points on the main deck and in the engine room, for cleaning purposes only. The system shall include appropriate piping and valves. Cross-connection with other fresh water systems shall not be allowed.

## 79 Automation systems for machinery plant

The vessel shall be equipped with:

### Manoeuvre desks, main consoles

Manoeuvre desks and consoles according to the General Arrangement.

The bridge concept will be implemented in the wheelhouse, control consoles and desks shall be supplied for the ECR and Bridge.

Equipment stations shall be supplied for ECR and at the Bridge.

### Alarm and monitoring system

An Integrated Automation System (IAS) for monitoring and control of relevant parts of fluid systems, tank systems, methanol fuel system, power system, machinery systems, auxiliary machinery systems shall be installed.

### Remote Control systems

Propulsion control systems inclusive Steering gear control system, i.e. separate control system for each unit.

All these control systems shall be electrically independent. Operator stations for Main bridge, Helmsman and Bridge wings, monitoring stations in ECR.

### Safety systems

Independent remote control/safety systems for relevant equipment according to requirements in class rules- and regulations, and according to manufacturer's standard shall be installed. (e.g. for Engines, etc).

Emergency stop connected to the main engine safety system shall be installed in the Steering gear room (Citadel)

Hospital alarm, routed to Treatment Room and Medics cabin, and locked in alarm for cold stores shall be installed.

### Remote access

A remote access system shall be provided (including secured access to relevant control systems).

### Energy Management

An Energy Management (EM) software package shall be provided.

### Integrated Vessel Management System

An Integrated Vessel Management System shall be provided.

### Cargo Control System

An Cargo Control System shall be provided, ref. item 38 Auxiliary systems and equipment for cargo

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## Manoeuvre desks, main consoles, instruments

### General

One central control console installed in the bridge and one in the engine control room.

### Wheelhouse

Following equipment to be installed in the wheelhouse:

- Bridge control console with two (2) adjustable operator chairs on tracks
- Bridge wing consoles
- One radio desk
- One cargo monitoring console

Bridge wing control consoles to be located at the navigation bridge wings and optimised for maximal access around console for operator.

### Workstations in navigation space

The system will consist of 5 (five) multifunctional workstations that will interface the operator with the navigation systems and equipment. 4 (four) workstations will form the main navigation console, and 1 (one) will be installed at the back of the navigation bridge as a planning station. All workstations shall be able to perform the functions of "S" and "X" Radar, Chart radar, AIS, ECDIS, VDR, Autopilot and Conning Display. The interface system between the workstations and the various navigation devices will follow the manufacturer's standard. The console's central workstation should preferably be used for the "Conning station" function and shall be installed with manual steering control interfaces (Helm-FU and NFU) and Main Engine controls and alarms.

Each workstation shall be powered by a dedicated independent UPS. The IAS workstation to be installed on the navigation bridge should, if possible, be integrated into the front console. The navigation console shall have space for an additional workstation. The main console workstations shall have an LCD display that supports a PPI of 340 mm (23.1" form 4:3 factor) or 320 mm (23" form 16:10 factor).

### **Cargo monitoring console in wheel house**

Ref. section [381 Cargo control systems](#)

### **Engine control room**

Engine control room to be provided with the following consoles and equipment:

- One (1) log table integrated with engine control room console.
- One (1) self contained air cooler
- One (1) adjustable operator chair
- Two (2) separate workstations / office space with separate chairs
- Main switchboards

The above panels to be combined or divided into suitable sections depending on final detailed design.

Two (2) door to be provided for access to the control room from the engine room.

### **Engine room control console**

One (1) engine room control console to be provided in the engine control room.

The following instruments and equipment to be installed on the engine room control console:

- CPP control lever
- M/E RPM control lever
- Telegraph receiver (selector type)
- M/E emergency stop push button with cover
- M/E auto stop override button
- Main engine revolution indicator with run hour meter
- Turbo charger tachometer and vibration alarm device
- Emergency propulsion control.
- Engineer calling device
- Telephones
- Duty engineer selection switch
- Level indicators, pressure indicators
- M/E automatic shut down alarm lamps
- Writing table
- Pressure gauges
- M/E control station transfer device
- Propeller pitch indicator
- Rudder indicator
- Steering gear alarm panel
- General alarm button
- MIP indicator
- Fire alarm push button

- Fire alarm panel
- M/E start button
- M/E stop button
- M/E control mode selection device
- M/E overload indicator
- M/E load control
- Buzzer & lamp test switch
- Alarm acknowledge button
- Dead man alarm pre-warning lamp and system on/reset button
- Integrated alarm and monitoring system as per section 792 Alarm and monitoring system
- Propeller shaft revolution indicator
- Torque meter for propeller shaft.

## 792 Alarm and monitoring system

### General

The vessel shall operate with an unmanned machinery space in accordance with the requirements of the rules.

It will be possible to supervise monitor all the vessel's machinery, navigation, cargo, ballast and other mechanical, electrical or electronic equipment and systems via the Integrated Automation System (IAS).

The IAS will be able to operate all the electrical generation, propulsion, steering, machinery, compressed air, cargo and ballast systems. It will be possible to monitor the equipment and systems needed for navigation operations via the IAS.

Engine room alarm and engine officer call extension panels shall be installed in the following locations:

- Navigation Bridge (1)
- Engine Officers' Cabins (4)
- Ship's Office (1)
- Officers' Recreation Room (1)
- Pantry/Messroom (1)
- Gymnasium (1)

### Integrated Automation System

An integrated control and monitoring system (IAS) shall be installed, consisting of redundant SCADA servers, redundant workstations (ETs), process stations (EPs), remote data acquisition stations (ERs) and redundant communication networks to interconnect the SCADA servers with the process stations.

All components of the Integrated Automation System shall have type-approval certificate issued by the classification society selected to certify the vessel.

These components include: computers, PLCs, processors, data storage devices, power supplies, signal conditioners, signal converters, monitors, operating or monitoring interfaces, keyboards and electrical or electronic instruments connected to the system (sensors, transmitters, transducers, actuators, solenoids etc).

The IAS's SCADA servers shall use the latest version of the available software. The main SCADA server shall be installed in the ECR and have development and runtime license. The secondary server shall be installed in the CCR and have runtime license. The servers shall have dedicated direct communication with each other for data synchronization. The licenses shall allow the configuration of 2500 points or more. The servers shall incorporate the latest version of Historian Essentials and the Industrial Gateway Server (IGS), and allow reading and writing to MQTT brokers. The workstations will be SCADA client stations with the function of operational console. The connection between the SCADA servers and the process stations shall use an Ethernet network (control network) that is independent of the communication network between the SCADA servers and the other Workstations (supervisory network). The control network and supervisory network shall be redundant with a ring topology.

Each SCADA Server or workstation will basically consist of a microcomputer, with keyboard, mouse and monitor. The SCADA and workstation servers will be used to display alarm lists, synoptic diagrams, variables, operating parameters as the IAS's main human-machine interface. The system's main server shall have Asset Management System software to record and control the hardware and software characteristics of each IAS device.

The supervisory network shall have switches in the ECR and CCR. Switches for automation network communication shall be of the industrial type, layer 3, manageable, with network redundancy protocols, VLAN creation capacity and routing between VLANs. Each process station will basically consist of redundant process controllers (PLC), I/O and digital communication modules and will be positioned appropriately in the ECR or other climatecontrolled room. The process stations shall have redundant power supplies for the PLCs. Each remote data acquisition station will consist of communication modules and I/O modules and shall be positioned throughout the vessel in such a way as to minimize the number of cables to be used. Remote data acquisition stations with a control function shall have a redundant power supply, with a diode module, and a power failure alarm monitored by an HMI. The system shall have the software and hardware capacity to monitor the points planned for the IAS. The equipment and systems supervised and controlled by the IAS shall make available all the signals (or sensors) considered relevant to the operation of the respective equipment or system. It will be the Yard's responsibility to supply and install sensors in other equipment or systems where, due to their nature or simplicity, this criterion is not applicable, such as: various temperature sensors, pressure sensors in cargo manifolds, etc. The synoptic diagrams and the IAS database shall be submitted to the Owner for approval during the design phase. The design of the IAS shall include complete integration between the IAS and the vessel's other systems.

An Integrated Automation System (IAS) for monitoring and control of relevant parts of the machinery systems for main- and auxiliary machinery, cargo/fluid/ballast systems and tank systems shall be installed.

The IAS is a redundant microprocessor based multi user system for cargo control, tank monitoring and alarm and monitoring of the vessel's main- and auxiliary machinery. Alarms shall be initiated if abnormalities are detected.

There shall be installed SCADA servers together with the workstations. Each SCADA Server or workstation will basically consist of a microcomputer, with keyboard, mouse and monitor. The SCADA and workstation servers will be used to display alarm lists, synoptic diagrams, variables, operating parameters as the IAS main human-machine interface.

The IAS project shall include the following information, among others:

- "Tag numbers (cross-reference with other project documents) and tag list divided by systems
- Diagrams interconnecting the various systems to the IAS
- IAS databases

- Characteristics of sensors purchased directly by the Yard for connection to the IAS
- Network interface parameters, protocols and variables.

### IAS Architecture

The IAS shall be a modular, open and distributed monitoring, alarm, recording and control system. A SCADA server shall be installed in the ECR and another in the CCR.

The SCADA servers and workstations shall be distributed as follows:

- 1 (one) SCADA server in the ECR
- 1 (one) SCADA server in the CCR
- 2 (two) workstations in the ECR
- 2 (two) workstations in the CCR
- 1 (one) workstation in the navigation bridge.

The IAS shall use industrial PLCs. All PLC modules and other components used in the system shall be the manufacturer's latest model. Equipment or components announced by the manufacturer to be phased out in the future, considered to be at a mature stage in their life cycle by the manufacturer or in the "proof of concept" phase will not be accepted. The input and output modules shall have individually insulated inputs and outputs (minimum 1500 V insulation), as well as surge protection. The analog input channels shall have HART communication. The status of each input/output shall be indicated by an LED on the front of the card. In the event of a power failure, the PLC shall maintain the internal programming, the operating system and the user application program, without the need to reload the program via any physical or external facility. The memory of the PLC and communication modules shall be sufficient to run the application with a minimum installed reserve of 20%. 10% spare input and output channels of each type (4-20 mA analog input, digital input, resistance input, digital output) shall be provided in each process station and remote data acquisition station. The cards shall be of the "plug-in" type, fitted with mechanical devices to prevent erroneous insertion into the slots. It shall be possible to replace any card while the PLC is energized, without having to undo the external wiring of the cards, without interrupting the operation of the PLC and without affecting internal programming.

The IAS shall use open (non-proprietary) communication protocols and the register layout of all digital communications in the system shall be supplied to the Owner as part of the system documentation. The use of the OPC-DA protocol is prohibited. All IAS programming files, licenses and configuration passwords (PLCs, software and supervisory system) shall be supplied as part of the IAS to the Owner. An additional iFix thick client license for operation and development shall be provided to the Owner for the series of vessels. SCADA servers and workstations shall have LED monitors, mounted on consoles and with a minimum size of 23"/ 4:3 aspect ratio.

Two (2) printers shall be installed, one in the ECR and one in the CCR for printing reports and screens. The process stations shall interface with the remote stations, sensors, equipment and individual control systems and be able to operate independently ("stand-alone") in the event of a communication network failure, without loss of continuity and without compromising the operational safety of the individual control systems and supervised equipment. Communication of the monitoring and control signals between each individual control system and the IAS shall be implemented using a digital communication network, shall according to the the individual control system standard. The use of the OPC-DA protocol is prohibited. The IAS shall have the appropriate communication cards for the communication protocol used, minimizing the installation of signal conversion gateways. The architecture of the IAS, with the arrangement of workstations, consoles and panels shall be submitted to the Owner for approval. The IAS shall be powered by redundant uninterruptible power supplies (UPS), so that it is immune to a simple power failure, i.e. a failure of any UPS will not cause the system to lose power.

## Supervision- Alarm, Visualization and Logging

The IAS shall display the values of the variables of the various systems and equipment on graphical screens (synoptic diagrams) and lists, activating the individual alarm and group alarm functions and recording changes in status (events) relating to the variables.

The main variables to be monitored by the IAS are listed below. This list is not exhaustive.

During the IAS design phase, the Yard and Owner shall jointly define the input and output signals to be configured in the IAS for each piece of equipment or system on the vessel, based on the remote monitoring and control signals provided by each equipment or system to be installed. These signals shall be described in the IAS signal list, which will be subject to analysis and approval by Owner during the IAS design phase.

All the input/output signals required by Owner shall be implemented in the IAS, limited to a maximum of 1500 physical points and 1000 points by communication network:

- Main Engine and Auxiliary Engines cooling water temperatures
- Lube oil inlet pressures at the Main Engine and Auxiliary Engines
- Load, fuel index and rotation of the Main Engine and Auxiliary Engines
- Pressure and temperature of the ME scavenge air
- Fuel inlet pressure and temperature in the Main Engine and Auxiliary Engines
- Maximum and combustion pressures of the Main Engine cylinders
- Exhaust gas temperatures from Main Engine and Auxiliary Engines cylinders
- Rotation of the Main Engine and Auxiliary Engines turbines
- Inlet and outlet gas temperatures in the Main Engine and Auxiliary Engines turbine
- Gas inlet pressure to the Main Engine turbine
- Variables from the Main Engine auxiliary and control systems (hydraulics, electronic injection, axial vibration, electrical isolation of the system, lubrication system, configured parameters, etc;)
- Monitoring of all Main Engine sensors
- Main Engine vibration damping system alarms
- Indications and various alarms from the Main Engine and generators control system
- Indications and various alarms from the Emergency DG and auxiliary equipment
- Individual alarms for the stern tube lubrication system
- Temperatures of the main shaft intermediate bearing and the stern tube bearings
- Main propeller pitch
- Individual alarms from the controllable pitch propeller system (CPP)
- Individual alarms from the propulsion control system
- Individual alarms from the Main Engine protection system
- Shaft earthing device indication
- Indications and alarms from the steering gear control and hydraulic system
- Indications and alarms of the thermal oil heaters
- Low oil level in the expansion tank of the thermal oil system
- Valves opening status of engines fuel system, thermal oil heaters, fuel pumps systems and service tanks
- Production flow rate of the fresh water generator
- Current of each anode of the anti-fouling system
- Potential of the reference electrodes, voltage and current of the anodes of the impressed

- current cathodic protection system
- Level of consumables tanks
- Level, pressure and temperature of cargo tanks
- Pressure and temperature of the cargo manifold
- Pressure from the cargo vapour manifold
- Pressure and temperatures of cargo system equipment
- Control, operation and monitoring of the hydraulic system equipment of the cargo and ballast pumps (if any)
- Control, operation and monitoring of the VSDs of the cargo and ballast pumps (if any)
- Cargo pumps discharge pressure
- Level of ballast tanks and seawater storage tanks
- Opening status, control and alarms of the cargo and ballast valves
- Indications and alarms from the hydraulic valve control system
- Ballast treatment system operating variables and alarms
- Sea water temperature
- Filters high differential pressure alarm
- Vessel's draft
- Equipment operating status, indication of process variables and inert gas system alarms
- Events and alarms from electrical systems and equipment (operation, tripping, faults, low insulation, etc.)
- Operating status and fault alarm of all the vessel's UPS
- Generator operating status and electrical parameters (current, active power, reactive power, voltage, alarms)
- Indications and alarms from switchboards and power management system - PMS (low insulation, busbar blackout, circuit breaker trip, load shedding, automatic start of generators, etc.)
- Generator winding and bearing temperatures
- Ambient temperature and pressure in the engine room
- Status and alarms of generator circuit breakers and busbar interconnections (between MSB busbars, between MSB and ESB , and between MSB and shorepower panels )
- Alarms and variables of cargo and ballast pumps (tank pressure, discharge pressure, bearing temperature, etc.)
- Various system and equipment variables (control air pressure, LO pump discharge pressure, etc.)
- Salinity in the fresh water system
- Indication of equipment status (on, off, stand-by)
- Various system alarms (sea water, fresh water, potable water, fuel oil, lubricating oil, compressed air, thermal oil, etc)
- Control, operation and monitoring of VSDs for various systems (sea water, ventilation of the engine room, etc.)
- Stand-by pump start alarm
- Oil content at the outlet of the oil-water separator
- Fire detection system alarms
- Indications and alarms from fire-fighting systems
- Gas detection system alarms

- Total operating hours of equipment
- Grouped alarms for various equipment
- Instantaneous and accumulated fuel consumption ("mass flow meter") for each group of equipment
- Power delivered to the shaft ("torsimeter")
- Bilge level indication and alarm
- Indications and alarms from the navigation systems (by GPS: geographical position, reference date and time, absolute speed (SOG); speedlog: heading and relative speed (STW); ECDIS: absolute distance sailed, relative distance sailed; anemometer: wind speed and direction; by gyro compass: heading, rate of turn (ROT); echo sounder: bow and stern depths; rudder angle indication, propeller rotation, alarms from BNWAS, radars, autopilot, trim optimization system, heading optimization system and speed optimization system)
- Other items mentioned in this Technical Requirement.

When grouped alarms are used, they shall be activated when any alarm from the respective equipment/system occurs. This feature shall be requested to the equipment/system manufacturer during the equipment tender phase. If it is possible to implement the grouped alarm by connecting all the alarms in series with dry contacts, this solution can be adopted. It is forbidden to use the same "common" conductor for more than one alarm or indication. The system configuration shall comply with the requirements described in PETROBRAS standard N-2900 - Alarm Management.

The system shall differentiate between events, alerts and alarms, in accordance with the requirements of the standard. The configured alarms shall be prioritized and classified. A list of alarms and set points (according to Annex G of N-2900) shall be drawn up documenting the alarm management analysis. The system shall be capable of automatically suppressing alarms, in accordance with the requirements of the standard. Alarms classified as required by classification society rules may not be suppressed. IAS servers and workstations shall display the values of the variables of the various systems and equipment, individual alarm events and group alarms relating to the monitored variables on graphical screens (synoptic diagrams) and lists. The color code used for the mimic diagrams and graphic displays should, as far as possible, be similar to the color code used at the machinery and cargo piping documents. The color standard for indicating the operation/stoppage of equipment shall follow that laid down in the design of the electrical switchboards. Signal acquisition of the variables can be done directly, via discrete sensors and I/O modules, or indirectly, via serial communication in an open, industry-standard protocol. Indirect acquisition shall be used when the equipment to be supervised has its own individual control system. The synopsis screens shall be submitted to the Owner for approval as a project document. All graphical screens and lists viewed via the IAS shall be printable via a printer connected to the system.

#### **Control- Supervisory control over equipment and systems**

Through SCADA servers, workstations and process stations, direct commands will be made to equipment, parameter settings and control loops, such as:

- Opening and closing of cargo and ballast system valves
- Operation of the hydraulic power units of the cargo and ballast pumps (if any)
- Operation of the VSDs for the cargo and ballast pumps (if any)
- Control the rotation of the cargo and ballast pumps
- Starting and stopping various equipment, selection of "stand-by", etc.
- Control of the start, stop, connection, disconnection and operating mode of generators
- Automatic start of sewage pumps
- Automatic shutdown of FO transfer pumps

- Fault indication of the main pumps to the stand-by pumps
- It shall be possible to adjust parameters and control loops in the IAS, such as:
  - control of thermal oil pressure reducing valves
  - temperature control of fresh cooling water system
  - setpoint adjustment of the loops and PID values
- The IAS shall perform the man-machine interface of measurement and alarm systems, such as:
  - engine room tanks and overflow tanks (as per item 5.2.4) level measurement
  - Cargo and Slop tanks measurement
  - Slop tank interface measurement
  - ballast tank level measurement
  - draught measurement
- The IAS shall perform the man-machine interface of individual control systems, such as:
  - drive system for the cargo and ballast pumps
  - control system for the cargo and ballast valves

Commands executed from the IAS on an autonomous device will act through signals sent to the respective individual control system, and not directly on the device. If a "local / remote" command is switched, it will always be in the individual control system. In equipment where, due to its simplicity, an individual control system is not applicable, the control functions shall be carried out directly by the IAS. The IAS shall directly carry out all data acquisition for measuring and alarming signals that do not belong to individual control systems of autonomous equipment.

### **Diagnostic, Self-testing and remote monitoring**

The IAS shall have self-test functions and routines and shall send the system's data to the Owner's onshore server via an ethernet network segregated from the supervision network. The supervisory system shall include MQTT client drivers that enable publishing to MQTT brokers and reading publications from MQTT brokers. The software shall have functions for selecting the data to be sent and the sampling rate for publication. It shall be possible to send any input, output or internal system variables, alarms, alerts, events, operating conditions and internal diagnostics. The configuration for sending data for remote monitoring shall be included in the system's final technical documentation.

### **Training**

The IAS shall be equipped with software (simulator) for crew training, to be installed on a personal computer (CBT - Computer Based Training).

### **IAS Operational Functions**

The IAS shall offer the operator the following functions, among others:

- Alarms and events, for recognition
- Presentation of dynamic overviews
- List of the latest alarms
- List of recent events
- List of alarms by group
- List of inhibited points
- List of excluded points
- List of variables showing the instantaneous reading
- Analog point tracking charts, with trend indication
- Full system report
- Monitoring report for a point, for a predefined period, at predefined intervals

- Changing database parameters
- Inclusion and exclusion of points
- Adding, modifying and deleting synopses
- Generation of alarm points by logical functions
- Print of machine log report, including resettable and non-resettable equipment operating hours counters
- Print screens as shown
- Log of events, alarms and commands executed, displayed on screen and with the option of copying the file to electronic media
- Self-test of the system, automatic or by manual command, with fault indications
- Inhibition of individual and group points
- Control of the operational functionality of workstations via passwords
- Engineer call

The static text in Mimics as well as I/O discription shall be in Portuguese.

### **Operator stations**

One (1) Operator station shall be installed at the bridge. The operator station includes:

- Operator Station 1 aft:
  - One (1) 27" wide TFT LED colour monitors
  - One (1) PC with keyboard and pointing device
  - One (1) Colour laser printer

Two (2) Operator stations shall be installed in the IAS console in the ECR:

- Operator Station 1:
  - One (1) 27" wide TFT LED colour monitors
  - One (1) PC with keyboard and Pointing device
  - One (1) Colour laser printer
- Operator Station 2:
  - One (1) 27" wide TFT LED colour monitors
  - One (1) PC with keyboard and Pointing device

Two (2) Operator stations shall be installed in the IAS console in the Carge Control Room (CCR):

- Operator Station 1:
  - One (1) 27" wide TFT LED colour monitors
  - One (1) PC with keyboard and Pointing device
- Operator Station 2:
  - One (1) 27" wide TFT LED colour monitors
  - One (1) PC with keyboard and Pointing device

### **SCADA servers**

- One (1) SCADA server in the ECR
- One (1) SCADA server in the CCR

### **Alarm panels**

The following alarm panels shall be installed:

- One (1) Alarm panel at bridge
- One (1) Alarm panel at each Engine Officers' Cabins (4 in total)
- One (1) Alarm panel in Ship's Office
- One (1) Alarm panel in Officers' Recreation Room
- One (1) Alarm panel in Pantry/Messroom
- One (1) Alarm panel at Gymnasium

### **Control Cargo systems monitoring and control**

Ref. [381 Cargo control systems](#)

#### **Remote access**

A remote access system shall be provided (including secured access to relevant control systems).

#### **Energy Management**

An Energy Management (EM) software package shall be provided.

#### **Integrated Vessel Management System**

An Integrated Vessel Management System shall be provided.

#### **Energy Efficiency system**

SMART class notation for energy efficiency enhancement - DNV SMART (EEN), BV SMART (EnE2), ABS

SMART (INF, AEM), or any equivalent notation/scope from IACS Classification Society - is to be focused on digital

solutions designed to collect, store, process, analyze and transmit ship's data to provide enhanced condition awareness, guidance and recommendations for crew to achieve optimum vessel performance efficiency level, leading to reduced fuel consumption and harmful emissions.

Smart system functionalities may be implemented as a standalone system or through integration/interaction

with other onboard systems provided that a failure will not render the operation of either system inoperative.

#### **Internal Alarms**

Actuation pushbuttons, indication and alarm devices at signal light columns for the following internal alarms, defined in accordance with the Regulations and international practice, shall be installed in the navigation bridge, accommodation, engine room, steering gear compartment and other compartments where necessary:

- IAS alarms
- Main Engine automation alarms
- General alarm
- Fire alarm
- Fire alarm for fixed firefighting systems such as foam, clean agents, water mist, etc
- Bridge navigational watch alarm
- Presence alarm (in areas to be approved by the BUYER), with control at the navigation bridge
- Engine Room dead man alarm
- Call from the infirmary

- Calling up of engine officer in the Engine Room by the ECR

After timing out, unacknowledged alarms shall sound via independent devices or via sound broadcast.

#### **Fixed Gas Detection and Alarm System for Engine Room and Ventilation Spaces**

The fixed gas detection and alarm system is part of the Integrated Alarm System (IAS) and shall monitor the engine room and ventilation-related spaces for early detection of gas leaks or flammable vapors.

The system shall include the following main components:

- Fixed gas detectors installed in strategic locations in machinery spaces.
- Gas warning panels in the wheelhouse and engine control room.
- Automatic activation of ventilation in deck trunk spaces if gas concentration exceeds allowable limits, as measured by the gas detectors.
- Integration with IAS alarm management.

In addition, an Oil Mist Detection System shall be installed in the engine room and monitored by the IAS, with alarms displayed locally and in the CCR.

The table below summarizes the primary components of the fixed gas detection system:

Table 7.4 Fixed gas warning system

No.	Unit	Location
1	Gas detector	Monitored rooms
1	Gas warning panel	Wheelhouse (safe area)
1	Pump box	Engine room (safe area)
1	Flame trap	Engine room (safe area)

All alarms shall be connected to the IAS and visualized in the IAS and CCR panels. The system shall be designed in compliance with Class requirements for hazardous area monitoring.

### **793 Remote control of main propulsion and engine telegraph**

#### **General**

Remote control system for main engine and CPP to be provided at the engine control room and wheelhouse.

The engine control to be designed according to class requirement for unmanned engine room operation.

The Main Engine or the remote control of the propulsion system shall be equipped with a system for monitoring and automatically adjusting engine performance, with the capability to provide diagnostics (Troubleshooting) and economic torque control.

Remote control system of main engine and CPP to be divided into following modes:

1. In wheelhouse - Combined or separate control of propeller pitch and main engine speed.
2. In bridge wings - Combined or separate control of propeller pitch and main engine speed.
3. In engine control room (ECR) - Combined or separate control of propeller pitch and main engine speed.

Overload protection device to be operated in case M/E reaches the permissible value in order to reduce the pitch of CPP to the programmed value.

A control position change-over switch to be provided on the control console in engine control room.

Simple emergency manoeuvring device for main engine and CPP to be provided at the local station in accordance with manufacturer's standard.

The Main Engine control system shall be equipped with the following features, among others:

- Local manual control
- Remote control in the ECR
- Remote control in the navigation bridge (console and wings)
- Signaling devices for control transfer
- Independent telegraph system on site, in the ECR and in the navigation bridge
- Main Engine rpm and load indications, in strategic positions the Main Engine rpm and load signals shall be sent to the integrated navigation system
- A device that totals the revolutions and hours of operation of the Main Engine, with indications of these variables in the IAS
- Automatic combined control of Main Engine rpm and CPP pitch
- Acceleration program, with "by pass" of critical speeds
- Main Engine protection devices and their auxiliaries
- Analog measurement of critical variables
- Real-time Main Engine performance monitoring system (combustion pressures and shaft power).
- Communication channel in open industrial protocol for external supervision of all the variables, measurements, parameters and alarms of the main engine, auxiliary systems and control system.
- Hardware and software for remote access via the internet to data on all variables, measurements, parameters and alarms of the main engine, auxiliary systems and control system.

The CPP control system shall be equipped with the following features, among others:

- Local manual control, in the oil distribution box (engine room)
- Remote control in the navigation bridge (console and wings)
- Pitch indications, in strategic positions, among others: navigation bridgeconsole, navigation bridgeroof, wings, ECR console and near the CPP servomotor
- CPP hydraulic system protection devices
- Local control panel for the CPP's hydraulic system, with protections, local start and stop controls and more.
- Open industrial protocol communication channel for external supervision of all CPP variables, measurements, parameters and alarms.

The Main Engine and CPP control systems shall have isolated power supplies for the internal circuits of each system and insulation measuring devices with an indication of the insulation resistance of the internal circuit and a low insulation alarm. This alarm shall be made available to the vessel's integrated control and monitoring system (IAS). If the project includes the installation of an independent ME shutdown/slowdown system, this system shall also meet these requirements.

The control panel for the CPP's hydraulic system shall be installed close to the hydraulic unit.

The combined control of Main Enginerpm and CPP pitch shall act to optimize propulsion performance and minimize fuel consumption in all vessel loading conditions.

In the event of a failure in the CPP control system, the propeller pitch shall be kept in the position it was in immediately prior to the failure ("fail to set"). At the Owner discretion, another definition may be adopted for the system's behavior in the event of a failure, provided that the CPP manufacturer proves that this new philosophy is capable of guaranteeing a safer condition for the Vessel.

### **Propeller pitch**

Remote control system of propeller pitch is electro hydraulic, i.e. signal transmission from bridge/control room to propeller system is electrical which governs hydraulic valves/cylinders for the adjustment of propeller pitch.

The CPP levers on the bridge wing control stand to correspond with the movement of the bridge control stand CPP lever.

The system consists of two independent loops:

- One for normal operation by control lever.
- One for emergency operation by push button.

### **Engine rpm.**

Remote control of engine rpm. is electronic.

### **Emergency stop**

Under the following minimum conditions, the main engine to be stopped automatically with alarm:

- Low lub. oil inlet pressure
- Over speed
- High jacket coolant outlet temp.
- M/E bearing temp. high slow down.

Manual emergency stop button to be provided in the engine control room and wheelhouse. Manual emergency manoeuvring lever (including stop position) to be provided on the local control position.

### **Load reduction**

Slow down request to be arranged after the following conditions:

- Lub. oil inlet press. low (pre-alarm)
- HT Cooling FW press. Low
- LT Cooling FW temp. high
- LT Cooling FW temp. high
- Charging air temp. high
- Lub. oil inlet temp. high
- Exhaust gas temp. high
- Turbocharger exhaust gas temp. high
- Oil mist in crankcase high
- CPP servo oil press. Low
- Sleeve bearing temp. output shaft propeller side high
- Sleeve bearing temp. output shaft engine side high
- Stern tube bearing temp. high

- M/E HT Cooling FW temp. high
- M/E LO inlet temp. high
- Thermal oil system failure

Alarms to be transferred to the navigation bridge in unmanned machinery space (E0) mode.

Ref. table section [792 Alarm and monitoring system](#).

#### **Interlock of turning gear**

Interlock to be arranged for engine start when turning gear is active.

#### **Automatic overload protection**

The engine shall be equipped with an automatic overload protection.

### **794 Automation equipment for thermal oil heaters**

The control system and protection safety devices for thermal oil heaters shall be supplied together with the equipment.

The alternating power supply to the heater system shall be consistent (same source) with the supply to the peripherals (fans and pumps).

The control system for the thermal oil heaters shall be installed in the ECR (main) with a local control (auxiliary), installed near the heater, preferably on the burner floor. The heater shall be switched on fully automatically.

### **795 Automation equipment for diesel generators**

#### **PMS System**

The power generation system shall be controlled by a dedicated microprocessor-based power management system (PMS). The PMS shall be installed in the MSB and ESB with a digital humanmachine interface. The PMS shall have the following functions:

- Diesel generator control
- Bus tie breaker control
- Control of onshore power supply synchronization with generators, temporary paralleling and load transfer
- Electrical protections for generators and busbars
- Control of starting and stopping of generators
- Automatic synchronization of generators and closing of circuit breakers
- Automatic control of frequency and busbar voltage
- Selecting the start and stop sequence for generators
- Automatic start of stand-by generator, due to high load
- Automatic generator shutdown due to low load
- Automatic generator shutdown on failure (triggered by alarms on equipment process variables - temperatures/pressures), with stand-by generator start-up (with and without "blackout")
- Automatic start of the second stand-by generator when the first one fails to start
- Control of parallelism and load sharing between generators (symmetrical and asymmetrical)
- Blackout recovery functions
- Generator overload prevention function (heavy load start sequences)
- Monitoring the electrical parameters of generators and busbars

- MSB busbar protection functions (short-circuit, under- and over-voltage, under- and overfrequency)
- Generator protection functions (overload, reverse power, etc.)
- Interlocks
- Semi-automatic generator control mode with commands for starting, stopping, connecting and disconnecting generators triggered manually via the PMS human-machine interface located in the MSB and ESB, automatic synchronism, parallelism, load sharing and load transfer functions between generators
- Automatic generator control mode with generator start and stop, synchronism, parallelism, load transfer, connection and disconnection of generators on the busbar according to load demand
- Disconnection of non-essential loads by generator overload alarms (Load Shedding)
- Individual alarms for each electrical protection
- Individual alarms for configured electrical parameters (overcurrent, overload, active power, reactive power, reverse power, under-voltage, over-voltage, under-frequency, overfrequency, start fault, synchronism fault, short circuit).

The power management system (PMS) shall be able to control the temporary parallel connection between the on-board generators and an onshore power supply system to be installed in the future. The parallelism time shall be limited by the PMS.

The voltage of the on-board electrical system shall be controlled by the PMS in order to make the system's voltage level compatible with the port terminal OPS supply before the parallel connection. The load transfer between the generators and the port OPS system during connection and disconnection of the OPS system at the main bus shall be controlled by the PMS and comply with the characteristics of the speed governors of the on-board generators without causing excessive variation in voltage and frequency. The PMS shall block the connection or disconnection of OPS in situations that could cause a load step in the generators above the limits established by rule.

Non-essential loads shall be separated into priority groups to be shed at different alarm levels in the electrical system (overload and underfrequency). The list of non-essential load consumers shall be submitted to the Owner for approval. All the parameters configured in each vessel's power management system shall be recorded and incorporated into the system's technical documentation to be delivered to the Owner.

The system configuration files shall be delivered to the Owner together with the final technical documentation after commissioning. The PMS shall make available to the IAS, via a digital communication channel using open industrial protocol, at least the system's alarm signals and the signals provided for monitoring and operating the generators:

- Generator start/stop controls
- Circuit breaker connection/disconnection command
- Automatic/semi-automatic mode selection
- Generator start sequence selection
- Monitoring voltage, current, frequency, active power and reactive power of generators
- Busbar voltage and frequency monitoring
- Monitoring of circuit breaker status (open/closed)
- Monitoring of all PMS alarms

The data register layout sent via the communication protocol shall be part of the system's final technical documentation.

The system shall keep a record of events and alarms in chronological sequence in an internal memory for future verification and diagnosis of faults or anomalies in the electrical system.

If available as an option from the manufacturer, the PMS shall have hardware and software resources for remote access via the internet to the on-board system's operating data, parameters and alarms.

## **797 Automation equipment for other machinery components**

The Auxiliary Engines control system shall offer the functions of automatic equipment control, equipment protection, local operation (stop/start), emergency stop, maintenance lockout, local control of the pre-lubrication and pre-heating systems.

The Auxiliary Engines control panel shall be supplied by the engine manufacturer and can be mounted on the skid or on a support next to the Auxiliary Engines. The Auxiliary Engines manufacturer shall make the signals for remote monitoring and operation available to the IAS via an open industrial communication protocol and in accordance with the list of IAS points agreed between the Owner and the Yard during the design phase. The protection and locking sensors ("interlocks" and "trips") will be in accordance with the classification society's requirements and manufacturers' standards.

The Auxiliary Engines control system shall include the necessary hardware and software for remote access via the internet to the data of all the variables, measurements, parameters and alarms of the equipment and control system.

## **798 Instrumentation**

### **Coding, Identification and documentation**

The instruments shall have their technical information informed on data sheets. The instrument data sheets shall be collected and delivered to the BUYER, forming an Instrumentation Databook.

The instruments, including those supplied with the equipment, shall be coded in the vessel's design in accordance with the ISA standard. The vessel's system code on which the instrument is installed shall be part of each instrument's code.

The instruments shall be identified with a stainless steel plate containing tag and identification written in Portuguese.

The instruments installed in the vessel's systems shall be represented in the diagrams (P&ID) of these systems, or in specific diagrams for this purpose (instrumentation diagrams).

The instruments installed in the equipment shall be represented in instrumentation diagrams. A Vessel's Instrument List shall be issued with the main characteristics of the instruments, including: code, function, process variable, location, type, setting, working range, calibration frequency, manufacturer, equipment description, tag, set point, IAS acquisition station number, etc. All certificates of conformity with the respective national and international standards, as well as calibration certificates, shall be supplied with the instrument data sheets.

### **General**

The instruments shall use materials and enclosures that are suitable for the process they are intended for and the mounting location.

The instrument enclosures shall be compatible with the installed environment, and for outdoor areas they shall be at least IP56. When using aluminum enclosures for instruments or junction boxes, they shall be of the copper-free type, suitable for marine environments.

The scale of analog reading instruments shall be sized so that the rated value or working range of the variable is between 25 and 75% of the instrument's full-scale deflection value.

The range of the sensors/transmitters shall be dimensioned so that the rated value or working range of the variable is between 25 and 75% of the range.

Analog pointer instruments installed in reciprocating machines (e.g. diesel engine, compressor) shall be filled with glycerin to dampen the vibration of the pointer and protect the instrument's internal mechanism.

Level gauges, flow gauges and other similar gauges shall have adequate local lighting to make it easier for the operator to see them. Tubular sight glasses will not be accepted. Magnetic sight glasses are acceptable for viscous fluids that cannot be read through glass sight glasses.

Pneumatic transmitters, controllers, etc. shall be equipped with a vent filter with pressure gauge in the control air supply line.

Mass flow meters ("Coriolis" type) shall be interconnected and monitored by the IAS, for totalization and visualization in the synoptic diagrams, and also equipped with local indication/readout.

"Special" transmitters, i.e. those that require algorithms such as totalization, averaging, statistical filtering, etc. in order to be read properly, shall be monitored directly by the IAS, which will perform these functions.

Instrumentation should be simplified wherever possible by using IAS resources, such as duplicating 4~20mA analog instrument signals via galvanic isolators, rather than installing additional independent instrumentation. Sensor signals used by different control or monitoring systems shall be galvanically isolated.

All instruments in contact with flammable fluids shall have a single seal certified in accordance with IEC 60079-40 (single process seal equipment) or ANSI/ISA 12.27.01 (single seal equipment).

Instruments installed in a hazardous area shall have intrinsic safety protection (Ex-i). Intrinsic safety barriers shall be galvanically isolated.

Instruments and related measuring elements shall be installed so that they are easily accessible from decks, platforms or walkways as far as possible and are not subject to excessive vibrations.

### Pressure Instruments

Pressure gauges, pressure switches, transmitters, etc. shall be equipped with a manifold in the impulse line close to the instrument, with the number of ports appropriate to its functionality. In addition to the manifold, instruments installed more than 2 m from the impulse outlet shall be fitted with a "root valve".

Pressure switches and pressure transmitters shall be installed with manifolds suitable for connecting instruments for testing and gauging purposes, without the need to remove connections or the instrument to be tested.

The pressure transmitters shall have the following characteristics:

- Differential capacitive measuring cell or strain gauge
- Suitable for use in industrial automation
- Accuracy better than 0,1%
- Local calibration of "zero" and "span" possible
- Local indication of the process variable (PV) on a digital display.
- Configurable via HART protocol

Fuel oil instruments shall have a remote seal with a capillary in the impulse line. Tees shall be used to close and assemble the seal. The distance between the process outlet and the sealing tee shall be minimized. Double-distilled glycerin shall be used as sealing fluid. The use of the sealing or condensate pot shall be restricted to specific cases and submitted to the BUYER.

Instrument connections cannot be installed in the lower part of the pipe, due to the possibility of debris obstructing the impulse line in this condition.

Instruments installed in systems with pulsating pressure or subject to "water hammer" shall be fitted with a snubber in the impulse line.

API RP 501 shall be adopted as the installation standard.

### Temperature Instruments

Bulb-capillary thermometers, temperature switches, transmitters, etc. shall have the sensing bulb mounted in a stainless steel well with a threaded connection.

The wells for pipe-mounted sensors shall be installed perpendicular to the flow of the fluid being monitored and during the pipe manufacturing phase.

Sensors installed in systems that may experience rapid temperature variations shall have the well filled with an appropriate liquid to improve heat exchange with the instrument.

Bulb-capillary thermometers with adjustable second pointer and alarm contact shall be mounted on a suitable base with anti-vibration dampers.

API RP 501 shall be adopted as the installation standard.

### Level Instruments

Level switches shall be of the capacitive or float type with a totally watertight magnetic coupling.

The level switches shall have devices for testing their functionality, without requiring access to the electrical contacts.

Vertical mounted level switches ("displacer" type) shall be easy to dismantle, with adequate access and space for removing the instrument.

Indirect liquid column pressure level transmitters shall be installed with a valve that allows them to be removed for maintenance without having to empty the tank. API RP 501 shall be adopted as the installation standard. Top mounting switches shall be used to monitor void spaces, manholes, cofferdams and tanks located below the platform of the engine room, where access is limited, avoiding the need to enter confined spaces for maintenance.

## 8 SHIP COMMON

### Pipe line systems - general

- All pipe systems shall be according to system drawings, approved by the Owner, Classification Society and to the satisfaction of possibly involved Sub-contractors.
- National Authority's approval shall be obtained on systems where it is required.
- Thickness of all penetration pipes connected to ship's side, bottom, main deck as well as deck scuppers pipes are to be Sch.160.
- The materials used in piping systems shall be certified and documented according to Classification Society.

### Material (Piping and armature)

All requirements related to piping materials, workmanship, valves, marking and color coding shall refer to 7 System for Main Engine Components

## 80 Ballast and bilge system, drain system outside accommodation

### General

The Ballast and the Bilge systems shall be separate systems

### Ballast system

The ballast system shall consist of:

- Two (2) variable speed Ballast pumps, back-up for each other. Capacity 500 m<sup>3</sup>/h each
- Two(2) Ballast ejectors for stripping of ballast tanks and main lines to be provided. Drive water to be supplied by ballast pumps.
- Valves and pumps shall be remote operated from IAS.
- Alarms and variables of cargo and ballast pumps (tank pressure, discharge pressure, bearing temperature, etc.)
- One (1) Ballast Water Treatment Plant (BWTP) with a total capacity of 1000 m<sup>3</sup>/h, suitable for operation with two ballast pumps running simultaneously. Type approved according to requirements of IMO resolution MEPC 125(53) as amended. Separate control system with interface for monitoring (status running/stop) from the IAS.

### Bilge system

The bilge system shall consist of:

- Three (3) bilge wells in Engine Room (PS forward, SB forward and Center aft);
- Two (2) pumps for General Services, Bilge and Fire;
- One (1) sea water pump for the central cooling system
- One (1) bilge pump
- Final number and capacities shall be according to SOLAS and Classification Society requirements
- The Bilge main pumps of eccentric screw type
- Valves and pumps, locally operated
- One (1) Bilge ejector for chain lockers
- One (1) Bilge water holding tank
- One (1) Bilge water separator, centrifugal type, capacity 2,5 m<sup>3</sup>/h with 5ppm ODM system, in compliance with IMO Resolution MEPC 107(49) and certified by the USCG.

- One (1) Bilge water separator supply pump
- One (1) Bilge water settling tank with heating coils. Tank arrangement in accordance with Marpol guidance note for IBTS bilge primary tank
- One (1) Oil tank
- One (1) overflow tank
- One (1) Sludge pump
- One (1) FO/LO drain tank
- One (1) FO/LO sludge tank
- One (1) clean water drain tank (air conditioning condensate, etc.)
- One (1) Incinerator
- Piping, filters and accessories.

#### **Drain system outside accommodation**

A sufficient number of pipes and drain collectors shall be laid from the decks.

### **801 Ballast system, solid ballast**

#### **General**

- Two (2) sea chests shall be provided for the ballast system, one in each side ballast tank near the pumps. Each sea chest shall have double isolation valves.
- The ballast system shall be designed with two (2) ballast pumps operating in parallel.
- Each ballast pump shall be installed inside a separate side ballast tank (port and starboard). Each pump shall be connected to a dedicated sea chest located inside the ballast tank, next to the ballast pump. Isolation valves shall be installed near the ballast pumps to allow them to be removed for maintenance.
- The system shall be designed in such a way that any ballast pump can be connected to any ballast tank and the Fore Peak Tank.
- Ballasting and de-ballasting of the Aft Peak Tank shall be carried out by the general services and fire pumps located in the Engine Room.
- The ballast piping system shall be arranged as a ring line, with a longitudinal branch passing through the Port ballast tanks and a longitudinal branch passing through the Starboard ballast tanks. These branches will be interconnected by transverse piping equipped with shut-off valves, allowing flexible operation and transfer of ballast water between the tanks.
- A branch shall be arranged for filling the Starboard slop tank, connected to the ballast piping by means of a removable spool piece.
- The system shall allow deballasting of the ballast tanks by port and starboard through a high discharge side connection.
- All ballast piping made of steel shall be coated with polyethylene and externally painted according to the painting scheme for the region as defined in section 7 System for Main Engine Components.
- Material of penetration pieces to be according to ballast piping outside tanks.
- Piping inside the ballast tanks will be made from GRP (Glass Reinforced Plastic), ensuring resistance to corrosion and hydraulic hammering.
- Arranged for pumping from sea inlet via BWTS to tanks and from the tanks via BWTS to overboard.

- Arranged to prevent gravity filling or discharge of tanks by-passing the BWTS. The by-pass of the BWTS shall be in compliance with BWM Convention.
- Sea inlet, ref. [72 Cooling systems](#).

### Technical particulars for the Ballast water pump

- Two (2) vertical centrifugal ballast pumps, self-priming by built-on automatic air ejector, "deep well" type with electric drive.
- Each pump will have a capacity of 500 m<sup>3</sup>/h. Maximum 3600 rpm, electric driven - Variabel speed (VFD converter).
- Pump Construction and Materials:
  - Volute casing: Bronze (ASTM B-584)
  - Impeller: Aluminum Bronze (ASTM B-148)
  - Wear ring: Aluminum Bronze (ASTM B-148)
  - Shaft: Stainless Steel (ASTM A-276)
- Zinc sacrificial anodes shall be fitted, either integrated or externally mounted, for seawater service.

### Monitoring and Remote Control:

Ballast system shall be remote operated and monitored from IAS.

The following equipment to be monitored:

- Level in tanks. See [822 Sounding system](#)
- Ballast water pumps discharge line shall be arranged with pressure transmitter for remote reading.

The following equipment to be controlled and monitored:

- Valves for ballast water system as defined above. See also [792 Alarm and monitoring system](#)
- Ballast water pump control shall be Local and remote from IAS.
- Remote control from IAS shall be manual Start/ Stop, Running indication and discharge pressure to IAS.

### Ballast Water Treatment System (BWTS)

The Ballast Water Treatment Plant (BWTP) shall be approved in accordance with IMO Resolution MEPC.125(53) as amended, and comply with USCG regulations and Classification Society requirements. The system shall allow compliance with the D-2 standard under all operational modes, including stripping and fallback operation.

The Ballast Water Treatment Plant shall be sized for a total flow capacity of 1000 m<sup>3</sup>/h, suitable for operation with two ballast pumps running simultaneously.

General system description

- The treatment technology shall be electrochlorination with filtration.
- Two (2) filters shall be provided, each capable of handling 100% of the ballast pump flow rate.
- The system shall serve all ballast tanks, including the Fore Peak and Aft Peak tanks.
- The system shall allow simultaneous ballasting during cargo unloading via elevated piping.
- Certificates and documentation shall be provided as per applicable regulatory and class requirements.

Filtration and disinfection

- Filters shall be automatic backwash type.

- The system shall be suitable for operation in seawater and freshwater.
- The treatment system shall operate effectively at water temperatures down to 0°C. If required, arrangements shall be made for water heating.
- The system shall be able to treat water with salinity ≥ 0.1 PSU.
- If salinity is below system limits, the system shall use stored seawater for electrochlorination. A dedicated seawater tank shall be provided, with sufficient capacity to treat the full ballast capacity under normal operating conditions with minimum water salinity.
- The holding time of ballast water after treatment shall be in compliance with applicable IMO and USCG regulations, with requirements as defined in the Requirement Specification (if specified), and shall be confirmed and approved by the Owner.

#### Electrochlorination system components (for side-stream systems)

- Two (2) seawater booster pumps shall be provided, each with 100% capacity.
- Automatic changeover shall be arranged in case of low pressure.
- A basket-type filter shall be fitted upstream of each booster pump.
- Differential pressure sensors shall be installed and connected to IAS with alarm signal.
- A chemical cleaning system shall be provided for the electrolysis cell electrodes.
- All tools, reagents and chemicals required for 10 ballasting and 10 deballasting operations shall be supplied.
- If neutralizer is used, a neutralizer tank shall be provided with minimum capacity for 10 deballasting operations.
- Each seawater booster pump for the electrochlorination unit shall be provided with a basket-type filter upstream, with a differential pressure sensor and alarm connected to IAS.
- The Ballast Water Treatment System shall be arranged so that each ballast pump can operate with any treatment unit.

#### Monitoring, control and interface

- The system shall be fully operated from a dedicated panel in the CCR.
- The control panel shall include graphic synoptic display, alarm handling, data logging, and real-time status.
- A local control panel shall be installed near the BWTS equipment for testing and maintenance.
- The system shall be interfaced with IAS for status, alarms and running indication.
- The system shall provide remote monitoring of operational variables and alarms via a serial communication channel using an open industrial network protocol.
- If available, the control system shall support remote access to operating data and alarms via internet.
- Differential pressure across filters shall be monitored with alarms in CCR.
- Sampling devices shall be installed for each ballast tank to enable compliance checks.

#### Redundancy and fallback mode

- In case of BWTS malfunction or failure, the vessel shall implement the "Sequential Ballast Exchange Method" in accordance with stability and strength criteria.

#### Spare parts and accessories

- A complete filter maintenance kit shall be delivered, including filter elements, gaskets, and other required parts.

## Ballast Discharge Monitoring and Control (ODME)

A monitoring and control system shall be provided for any discharge of oily water mixture from cargo tanks into the sea.

The system shall comply with applicable IMO MARPOL Annex I and USCG requirements.

It shall be installed downstream of the Ballast Water Treatment System, and shall be capable of interfacing with the IAS for status and alarm forwarding.

## 803 Bilge systems and oil/water separation

### General

Technical particulars for the pumps and ejectors:

- Eccentric screw type shall have casing of cast iron, rotor of stainless steel and stator of Perbunan. A solenoid valve for priming water and a safety valve shall be provided. (Priming water shall be supplied from the technical FW system, with back-up from fire main)
- Centrifugal type shall be of vertical design, self-priming type with housing of cast iron, impeller of Ni.Al.Bronze and shaft of stainless steel.
- Pumps shall be electric driven – one speed, where nothing else is described.
- Two (2) pumps for General Services, Bilge, and Fire duties shall be installed
- Each fire pump (including emergency), bilge pump and general services pump shall be able to attend the total capacity required from foam system (see 816 Fire fighting systems with foam (Low and High Expansion)).
- Maximum rpm in accordance with recommendation from the pump supplier.
- Ejector shall have bronze housing and drive water from fire main.

### 1. Bilge System

- Three (3) bilge wells in Engine Room (PS forward, SB forward and Center aft)
- One (1) bilge pump (spindle type)
- Two (2) General Services, Bilge and Fire pumps, with filters at bilge suction branch, serving as backup to bilge pump
- One (1) sea water pump for central cooling
- One (1) bilge water holding tank
- One (1) bilge water settling tank with heating coils
- Drainage from ER decks, platforms, cofferdams, sea chest, stern tube tank and steering gear/ emergency fire pump recess is collected via scuppers and pipes
- The Aft Peak Tank shall be filled and drained by the General Services, Bilge and Fire pump.
- Emergency bilge suction performed by the largest capacity, self-priming pump, with direct suction and no filters
- The sea water cooling pump arranged for emergency bilge suction shall be power supplied by ESB. Alternatively, an equivalent arrangement shall be provided.
- Bilge pump discharges to:
  - Bilge water holding tank
  - Separated oil tank
  - PS Slop tank (via check valve and removable spool piece)
  - International discharge connections on both forward sides of accommodation (with shut-off valve and blind flange)

### 2. Oily Water Separator (OWS) System

- One (1) oily water separator (OWS), USCG certified, complying with IMO MEPC.107(49)
- Capable of separating emulsions

- Equipped with oil content meter, direction valve, integrated discharge pump
- Sample and test lines installed vertically
- One (1) OWS supply pump
- Connected to bilge water holding tank and settling tank
- Discharges water overboard via oil content meter and oil to separated oil tank
- Used to empty clean bilge water tank
- Heating system provided for bilge and separated oil tanks and connected piping
- Bilge water separator installations shall be provided with overboard sample cock, as per applicable rules.

### 3. Sludge System

A system for handling sludge oil shall be arranged.

The sludge pump shall:

- Be of single-screw (eccentric/helical) type, electric driven, two-speed
- Have suction from the FO/LO sludge tank, FO/LO drain tank, separated oil tank and oily water separator filter, with discharge to the incinerator sludge tank, oily water separator, PS slop tank and international discharge connection (IMO standard flange in bunker station).
- Have local control only
- One (1) sludge pump shall serve as a backup supply pump for the oily water separator
- One (1) incinerator shall be provided for the treatment of sludge and oily residues
- The sludge pump shall have:
  - Volute casing: Cast iron (ASTM A-48), internally coated
  - Stator: Synthetic rubber
  - Shaft and impeller: Stainless steel (ASTM A-316L)
- The sludge pump and oily water separator shall have local control only.
- The Bilge and Sludge pumps shall have remote stop push buttons located next to the international discharge connections on deck. The sludge pump shall also have a remote stop button located close to the Incinerator Sludge Tank.

### 4. Drainage and Auxiliary Functions

- One (1) Drain Inspection Tank (Clean water drain tank, e.g. A/C condensate), fitted with instruments and accessories as specified in Section 822 Sounding system, Table 8.1.
- One (1) FO/LO drain tank
- One (1) FO/LO sludge tank
- One (1) separated oil tank (not adjacent to hull boundaries)
- One (1) overflow tank
- Drain valves for bow compartments operable from exposed deck
- Eductor system for chain lockers, Bosun Store and access ducts (10 m<sup>3</sup>/h, operated by GS/Bilge/ Fire pumps)
- Filter baskets at pump inlets and easy-clean mud boxes
- Interconnection between pumps to provide redundancy
- Priming of bilge and sludge pumps by water branches from hydrophore system
- Scuppers sized and located to prevent accumulation and ensure effective drainage to bilge wells

## 5. Deck Drainage in Cargo Area

Drain scuppers without bilge wells, fitted with SPILL VALVE, shall be installed to drain deck residues accumulated at the aft cargo area to the Slop Tanks.

### 804 Drain system outside accommodation

The vessel's possible trim shall be taken into consideration for routing and installation of drain pipes.

- Sufficient number of pipes shall be laid from the respective decks.
- Convex screwed drains shall be installed on exposed decks and platforms to prevent clogging.
- Waste water piping with siphoned scuppers shall be installed to drain the decks of galley, pantries, cold store, infirmary, toilets, changing rooms, laundry rooms and storerooms. Waste water discharges shall be taken to the Sanitary Sewage Treatment Unit or to the ship's side by means of a storm valve and shut-off valve.
- Drain collectors shall be arranged on wheelhouse top and other areas with large surfaces to be drained.
- Drain pipes from the wheelhouse top shall be laid on the inside down to the bridge deck.
- Drain pipes from the superstructure shall be fitted outside bulkheads.
- Scupper drain and side penetration pipes shall be built of steel pipes, Sch.160, to ensure durability and compliance with safety standards.
- Where possible, drains from one deck shall be routed directly above the drain down to the next level.
- Top of funnel(s) shall have drain pipe directly overboard.

Freeing ports, ref. [267 Gutter, bulwark, railings and cargo rails \(securing of deck cargo\), freeing ports](#).

### 807 Drainage from technical spaces

Drain pots shall be arranged in all corners in all technical rooms and spaces and have volume of minimum 20 litre.

Drain from technical rooms shall be led independently to bilge water drain tank, drain from same room can be combined.

Drain pipes from technical spaces shall be DN80.

In engine room caution should be taken to arrange drain notches so that all water will be drained to bilge wells.

### 808 Drainage from hazardous areas/spaces

#### General

Drain from hazardous spaces shall be contained and the extent of potential spills limited.

Drip trays and coaming bars shall be provided for equipment and tanks to collect oily waste, with drain piping leading to the fuel oil and lube oil drain tank.

Fuel Preparation Room for Methanol (FPR) shall be arranged with a sill height of minimum 300 mm.

### 809 Drain system interior spaces

The vessel's possible trim shall be taken into consideration for routing and installation of drain pipes from interior spaces.

- Sufficient number of pipes shall be laid from the respective decks
- Where possible, drains from one deck shall be routed directly above the drain down to the next level

- Drainage from all gutter ways in accommodation to work with fore and aft trim
- Inspection hatches for gutter ways shall be arranged in accommodation according to Yard standard
- Insulation shall be stopped 50 mm above deck in gutter ways. Stainless steel mesh insulation stoppers shall be installed.
- Gutter bars shall be provided at accommodation decks at the lower end of insulated bulkheads.
- Internal drains from accommodation can be led to bilge wells in processing area where feasible.

## 81 Fire and lifeboat alarm, fire fighting and wash down systems

### Fire fighting and alarm systems provided on board:

- **Fire detection and alarm system** (see [811 Fire detection, fire and lifeboat alarm systems](#))
- **Gas and oil mist detection and alarm system**
  - Gas detection system for the methanol fuel supply system (FSS) and other methanol based gas detectors.
  - Oil mist detector system shall be provided at assigned locations in the Engine Room for detection of airborne oil mixtures.
  - Gas detection system for vessel (gas detection system(s) as required for methanol fuel system is to be installed in accordance with Class and regulatory body requirements)
- **Fire line system** including emergency fire pump, hydrant system, fire posts and hoses (see [813 Fire line/deck washing system](#))
- **Fixed clean agent fire fighting system** (Novec™, Inergen™ or equivalent) for engine control room, paint store, and main engine scavenge air box (see [815 Fixed clean agent fire fighting system \(Novec/Inergen\)](#))
- **Fixed high-expansion foam fire fighting system** for Engine Room, workshops, storerooms, and purifier compartment (see [816 Fire fighting systems with foam \(Low and High Expansion\)](#))
- **Fixed low-expansion foam fire fighting system** for cargo deck and trunk area (see [816 Fire fighting systems with foam \(Low and High Expansion\)](#))
- **Portable fire extinguishing systems** (see [818 Fire fighting systems with powder](#))
- **Fixed water mist fire fighting system** for local protection of main engine, auxiliaries, thermal oil heater, incinerator and purifiers (see [819 Watermist fire-fighting system for local protection high risk areas](#))
- **Fixed detection and extinguishing system** in galley hood and deep fat fryer (see below in this section)
- **Pneumatically operated remote closing system** for ventilation dampers, fire doors and quick-closing valves on fuel/lube oil tanks (see below in this section)
- **Manual or remote closing system** for emergency generator fuel service tank (see below in this section)

The vessel shall be equipped with a complete fire-fighting system designed in accordance with applicable international rules and Classification Society requirements.

The fire-fighting system shall consist of the following main subsystems:

- Fixed sea water fire-fighting system with two (2) general service/bilge/fire pumps, each with 100% capacity;
- One (1) self-priming emergency fire pump with independent sea chest and dual power supply;

- Fixed foam fire-fighting system covering engine room and cargo area;
- Fixed clean agent fire-fighting system (Novec, Inergen or equivalent) for engine control room, paint store, and other designated spaces;
- Fixed high-pressure water mist fire-fighting system for local protection of main engine, auxiliaries, thermal oil heater, incinerator and purifiers;
- Portable fire extinguisher system in accordance with Class requirements;
- Fire detection and alarm system with repeaters;
- Fixed fire detection and extinguishing system in galley hood and deep fat fryer;
- Pneumatically operated remote closing system for ventilation dampers, fire doors and quickclosing valves on fuel/lube oil tanks;
- Manual or remote closing system for emergency generator fuel service tank;
- Gas detection system for ballast tanks and enclosed spaces, with panel in Fire Station and repeaters in CCR and Bridge.

A fixed gas detection system shall be installed to monitor hydrocarbon gases (CxHy), hydrogen sulphide (H<sub>2</sub>S), and oxygen (O<sub>2</sub>) in enclosed and hazardous areas. The system shall operate by sequential scanning of sampling points located at:

- Ballast tanks (one point per tank)
- Inert gas main line
- Forward peak tank
- Cofferdams
- Paint locker
- Chemical locker
- Gas locker
- Engine room
- Air intake to accommodation area

Sampling points with sensors installed in tanks shall include a shut-off valve to protect the sensors from water ingress. The gas detection system shall be integrated with the fire detection and alarm system and with IAS for status monitoring and failure alarms.

Indications and alarms shall be displayed in the Cargo Control Room (CCR). At least 10% spare sensors and one test kit per sensor type shall be supplied. Preferably, the gas detection system shall be provided by the same supplier as the fire detection system.

All equipment and systems shall be certified in accordance with applicable international codes and regulations, including the EU Marine Equipment Directive (2014/90/EU) where applicable.

## 811

## **Fire detection, fire and lifeboat alarm systems**

### **Fire detection and alarm system**

An addressable automatic fire detection system shall be installed in accordance with regulatory body requirements.

One (1) automatic addressable fire detection system shall be installed in accordance with Classification Society and National Authority requirements. Power supply and loops shall be arranged and segregated according to the main fire zones.

The fire detection system shall have addressable detectors with multiple loops, a main control panel located in the Fire Station and repeater panels in the navigation bridge, ECR and CCR.

All control panels shall be able to silence the alarm, acknowledge alarms and indicate the location of triggered sensors.

The line diagram of the fire detection system, together with its identification texts/messages displayed on the main and repeater control panels, shall be framed and displayed in the Fire Station.

Detectors and push buttons shall be installed as follows:

- Thermovelocimetric detectors: in confined spaces and directly above equipment subject to rapid and high heat generation (galley, engine room)
- Ion detectors: in individual cabins, control stations, corridors, collective spaces, engine rooms and locker/store
- Ultraviolet (UV) detectors: Engine Room
- Alarm push buttons: general use, where recommended and indicated in the firefighting plan.

The fire alarm shall sound primarily in the main panel and repeaters, and with a time delay in the various accommodation areas, in accordance with the Fire Station Integrator standard.

The fire detection system shall also have the following features

- Command and control the closing of accommodation doors and dampers in order to automatically isolate compartments
- Switching off the ventilation in the engine room and living quarters
- Powered by 220V and with a built-in UPS
- Interconnected to the VDR
- Interconnected to gas detection systems
- With reversible contact for IAS fault alarm

Fire detectors shall be easily accessible for testing.

Computer software for set up for spare sensors shall be supplied, if needed.

General Alarm push buttons to be provided as required by rules and at all control stations.

When activated, bells and sirens shall sound continuously for fire alarm and according to regulations for general alarm.

As per Code of Alarms, General Alarm is to be 07 short blast + 01 long blast and Fire Alarm is to be consecutive 01 short + 01 long blast.

Alarms shall be of adequate sound level throughout the vessel, and alarms shall be transmitted to the PA system.

The panel for the fire detection central shall have built-in monitoring circuits intended to control that the equipment at any time is in satisfactory order and indicate faults which could prevent a fire alarm. Faults in the system shall be indicated on the central panel by means of visual and audible signals.

The Fire detection alarm plant shall:

- be prepared for an input from intercom/PA for muting of bells and sirens.
- be equipped with separate battery and battery charger, alternatively a built-in solution.
- have power supply from emergency switchboard.
- close fire doors automatically if fire doors are equipped with door holding magnets, ref. [512 Internal Doors](#). In addition local release button for each door and common manual release button on bridge on indication panel for fire doors.

## 812 Emergency shutdown system

Emergency push buttons to be provided at designated locations as requested by Class and at Owner'S convinience. Preferably Remote push buttons to be located at ECR, CCR and WH.

## 813 Fire line/deck washing system

### General Services, Bilge and Fire Pumps:

Two (2) General Services, Bilge and Fire pumps shall be provided to supply fire-fighting sea water and general services sea water to the main deck, casing, accommodation, engine room and other areas of the vessel as required by rules.

Two (2) seawater branches shall be provided on the main deck, one exclusively for firefighting and the other for general services.

The pumps shall be sized for 100% capacity each, including for feeding the foam systems, and shall be started at different rotational speeds depending on the demand of the system(s) to be served.

One of the pumps shall supply the Fresh Water Generator in the event of failure of the Fresh Water Generator ejector pump.

The general services seawater branch shall also supply:

- Bilge eductors in the bow compartments;
- Anchor chain washing system;
- Portable gas-freeing fans for tank degassing (see Section 374 Ventilation/gas freeing systems for cargo tanks).

Each fire pump (including emergency), bilge pump and general services pump shall be able to attend the total capacity required from foam system (see 816 Fire fighting systems with foam (Low and High Expansion))

Technical particulars for the Fire / General Service / Deck Washing pumps:

- Vertical centrifugal type, self-priming by built-on automatic air ejector;
- Housing and impeller of Ni.Al.Bronze or Bronze, shaft of stainless steel;
- Maximum 3600 rpm;
- Electric driven – one speed.

### Emergency Fire Pump:

One (1) centrifugal, vertical, self-priming, electric motor-driven emergency fire-fighting pump shall be supplied.

The pump shall be connected to a dedicated sea chest, located in such a way that it can supply water even when the vessel is in the lightest operational condition.

The emergency fire pump will be fed by main and emergency power supply and shall be located in a compartment aft of the Engine Room with access from the Steering Gear Compartment. The compartment shall be insulated with class A-60 insulation material on the bulkhead facing the Engine Room.

The pump shall be started locally and remotely (navigation bridge, Fire Station - "ECI" and foam compartment) without the need for any operational procedure to enable the pump to be primed, which shall be guaranteed by its self-priming system and by another independent method such as a seawater expansion tank and check valve near the sea chest or another method provided for in the design and approved by Class to keep the pump primed "ready for operation" at all times.

Main/emergency fire pumps and foam pump to have start/stop push buttons locally and at Fire Station and Wheelhouse.

### Fire Main Piping and Armatures

Connections with a valve and quick coupling connection ("Storz") for a 2½" (DN65) hose shall be provided in the following locations:

- 1 (one) at Bosun Store;
- 5 (five) on each side of the cargo area;
- 2 (two) on the Main Deck (or deckhouse), at stern;
- 2 (two) per deck, externally, on the accommodation, except navigation bridge deck;
- 1 (one) on the navigation bridge deck;
- 1 (one) in the Steering Gear Compartment;
- 2 (two) per floor and platforms in Engine Room.

Fire connection with a valve and quick coupling connection for a 2½" (DN65) hose shall comply with ABNT standards.

Movements in the fire-fighting seawater system pipes caused by thermal expansion or the vessel's structure shall be absorbed by expansion bends (loop).

From the fire main system the following lines shall be arranged:

- Distribution to fire posts
- Isolating valve for machinery space comprising fire main pumps shall be arranged readily available outside machinery space.
- Washing of anchor chain hawse pipes
- Drive water to ejector(s)
- Flushing of Sewage/Grey water hull tank. Ref. [582 Sanitary discharge systems](#)
- Supply to local water sprinkler systems for the following compartments:
  - Paint stores.

### **Fire Stations (Hydrant Boxes)**

A necessary number of fire posts shall be arranged in the engine room, in the accommodation, on deck and other places as required by the Classification Society and/or National Authorities.

Each fire post shall include:

- Fire valve including hose connection
- Number, length and diameter of fire hoses shall be in accordance with Classification Society and/or National Authorities requirements.
- All fire hoses shall be stored in separate cabinets.

### **Monitoring and Remote Control:**

The following equipment to be controlled and monitored:

- Control of Fire pump, Fire/Deck washing pump and Emergency fire pump shall be Local and remote from IAS
- Remote control from IAS shall be Auto/Manual, Start/Stop, Running indication to IAS.

## **816 Fire fighting systems with foam (Low and High Expansion)**

### **General Description**

The vessel shall be equipped with a fixed foam fire-fighting system to protect the cargo deck and cargo trunk, as well as high-risk areas in the engine room and workshops. The system shall be designed to provide both low-expansion and high-expansion foam protection, ensuring rapid fire suppression in all designated areas.

The foam system shall be interconnected with the emergency fire pump discharge to ensure uninterrupted foam supply. All components of the system shall comply with the applicable Classification Society rules and international regulations.

### Foam Generation System

The foam system shall consist of the following main components:

- One (1) Foam Forming Liquid Tank located in a dedicated foam compartment inside the accommodation on the main deck. The tank shall be equipped with a sampling cock for testing purposes.
- One (1) Foam Forming Liquid Pump, capable of supplying foam to all protected areas.
- Proportioners, control valves, and diffusers for proper foam distribution.
- Foam concentrate shall be AFFF (Aqueous Film Forming Foam) at 3% concentration.
- The sealing joints on the flanges of the foam system piping shall be made of non-combustible material.
- Expansion bends (loops) shall be used to compensate for thermal expansion and vessel structural movements.

### Low-Expansion Foam System

The low-expansion foam system shall provide protection for the cargo deck and cargo trunk areas. The system shall include:

- Foam Monitors:
  - Monitors shall be installed on the main deck above cargo tanks, arranged along the centerline of the vessel.
  - Additional monitors shall be placed on each side of the accommodation forward bulkhead.
  - Each monitor shall be fitted with a ball valve with an ASTM A-316L stainless steel seat.
  - The number and location of monitors shall ensure full coverage of the cargo deck area.
  - Isolation valves shall be installed immediately before the monitors for maintenance and removal purposes.
  - All sealing gaskets used in foam monitor connections shall be made of non-combustible material, as required.
- Foam Connections and Hoses:
  - Foam piping system shall be equipped with quick coupling connections for 2½" hoses.
  - Connections shall be distributed in such a way that all points of the deck can be reached by at least one portable nozzle.
  - Sets consisting of foam concentrate containers, foam applicators, and flexible hoses shall be provided in accordance with the applicable rules and regulations.
  - All valves, couplings, and foam hoses shall be certified in accordance with Classification Society and international standards.
  - Each fire pump (including emergency), bilge and general services pump shall be able to attend the total capacity required from foam system.

### High-Expansion Foam System

A fixed high-expansion foam system shall be installed to protect the engine room, workshops, engine room storerooms, and purifier compartment. The system shall:

- Provide independent activation for each protected area.
- Be supplied with seawater from the fire, bilge, and general services pumps, as well as the emergency fire pump.

- Ensure the entire volume of the protected areas can be filled with high-expansion foam for effective fire suppression.
- Each fire pumps (including emergency), bilge and general services pump shall be able to attend the total capacity required from foam system.

The foam system shall be fully integrated with the vessel's fire-fighting alarm and control system.

Activation and monitoring shall be available from the Fire Station (ECI) and other designated locations.

#### **References:**

[803 Bilge systems and oil/water separation](#)

[813 Fire line/deck washing system](#)

### **818 Fire fighting systems with powder**

Hand extinguishers shall be installed according to the requirements of the National Authorities. Ref. [505 Loose firefighting apparatuses and equipment, firemen's outfit](#).

### **819 Watermist fire-fighting system for local protection high risk areas**

#### **General Description**

A fixed watermist fire-fighting system shall be installed in the Engine Room for local protection of high-risk equipment, including:

- Main Engines
- Auxiliary Engines
- Thermal Oil Heater
- Incinerator
- Purifiers

The system shall be supplied with fresh (distilled) water from the technical freshwater tank. The piping connection on the tank bulkhead shall be located below other outlets to ensure minimum water level for fire-fighting. A low-level alarm shall be provided.

The distilled water tank shall have a capacity greater than the volume of the machinery cooling system and be connected via overflow to the general fresh water system. The lower part of the tank shall be reserved as spare volume for fire-fighting purposes.

The system shall operate by zone, with individual watermist nozzles and dedicated fire detectors for each protected equipment.

Activation shall occur in two stages:

- First detector: triggers alarm and starts the watermist pump
- Second detector: releases water to the relevant zone

Manual activation shall be possible locally (via call points) and from the Fire Station (ECI), including start/stop of the pump and manual actuation of the directing valves. Shut-off valves shall be arranged for testing.

The system shall be powered from the Emergency Switchboard (ESB) and fully integrated with the vessel's fire detection and alarm system. Components shall comply with Class and IMO requirements.

### **815 Fixed clean agent fire fighting system (Novec/Inergen)**

#### **General Description**

A fixed clean agent fire-fighting system (Novec™, Inergen™ or equivalent) shall be installed to protect the following spaces:

- Engine Control Room (ECR)
- Main Engine Scavenge Air Box

The system shall be fully integrated with the fire detection and alarm system. Activation shall be automatic via fire detection and manual from the Fire Station (ECI).

Clean agent cylinders shall be located in a dedicated storage compartment.

A local clean agent system shall also be installed in the galley hood and deep fat fryer, integrated with the ventilation damper system.

If required by engine maker, alternative extinguishing media may be used for the scavenge air box, subject to Class approval.

All equipment shall be certified in accordance with applicable rules.

**Note:** Paint Store shall be protected by a fixed water sprinkler system (see [813 Fire line/deck washing system](#))

## 82 Air, overflow and sounding systems from tanks

### General

Tank vent and sounding pipes shall be clearly marked with numbers of the related tanks.

### Tank venting

Tank vents or overflow shall be arranged for all tanks.

- The FO bunker tanks shall be arranged with a common vent/ overflow system with drain to the FO overflow tank
- Common tank vent/overflow system for LO & HO stores tanks in engine room area to sludge or dirty oil tank. The overflow pipe shall have an air pipe to open deck.

### Sounding systems

The vessel is equipped with tank level measurement systems using different sensor types depending on the tank function.

- Ballast tanks, sea water tanks and draught measurement use pneumatic bubble-type systems.
- Fuel oil, fresh water, lubricating oil and sewage tanks are measured using either external pressure transmitters with isolation valves or bubble-type systems.
- Cargo and slop tanks are monitored by radar-type level sensors (see Section [381 Cargo control systems](#)).

Manual sounding is provided for tanks, as listed in Section [822 Sounding system](#).

All tank level sensors are integrated with the IAS and provide readouts in the CCR and engine control room.

For detailed specifications of all sounding systems, refer to Section [822 Sounding system](#).

## 821 Tank venting and overflow system

### Tank Venting

The tank venting system shall meet the following requirements:

- Air vents shall be arranged for all tanks, sea chests, and void spaces.
- Tank vent pipes for built-in tanks shall be routed to open deck and be self-draining.
- The height of the tank vent pipe opening shall be minimum 760 mm above main deck, unless otherwise required.
- Air vents shall be directed generally towards the exposed deck.
- The fuel oil tanks located in the Engine Room may have their air vents grouped in collectors; however, diesel oil tanks and heavy oil tanks shall have independent venting systems and shall not be interconnected.
- Air vents for the Main Engine LO Sump tank, Auxiliary Engine crankcases, and Intermediate LO tanks shall be independent and not interconnected with any other system.
- Air pipes from sewage treatment plants and sewage waste water tanks shall be routed above the top of the funnel, in accordance with Class requirements.

### **Overflow System**

- An overflow system shall be arranged for the sewage waste water tanks in accordance with sanitary discharge system requirements (ref. 582 Sanitary discharge system).
- For fuel oil cargo tanks (except combined tanks), a common air/overflow pipe system shall be arranged with drainage to an overflow tank.
- Overflow pipelines shall not promote progressive filling between damaged tanks or between tanks assumed to be intact.
  - For instance, overflow from a FO cargo tank on SB side shall be routed to a common overflow pipe on PS side, and vice versa.
- The overflow line and overflow tank shall be arranged with level alarms.

## **822 Sounding system**

### **General**

As an integrated part of the IAS, one (1) Remote tank sounding system shall be installed.

The Remote tank sounding system provides tank data for the pictures on the IAS operator stations defined in 792 Alarm and monitoring system.

In tanks with remote sounding sensor(s) at the same level, the liquid density has to be set manually. In the tanks with Two (2) remote sounding sensors at different level the difference in liquid pressures between the sensors enables “auto density” calculation for these tanks. Pressure transmitters for liquids that pose explosion hazards, required measures for these pressure transmitters shall be taken (i.e. barriers and Ex certification of equipment as required).

For pressure transmitter type remote tank sensors, constant reading of the liquid pressure.

Pressure transmitters shall be connected to the IAS Sub I/O cabinets, ref. 792 Alarm and monitoring system.

For remote sounding system with pressure transmitters, outside atmospheric pressure transmitter to be included.

A summary of all tanks with Remote, Manual and Local level indicators is provided in Table 8.1.

### **Cargo and Slop Tanks Measurement System**

The cargo and slop tanks shall be monitored by a radar wave level measurement system, which is integrated with temperature measurement at three height levels in each tank and inert gas pressure measurement.

The system shall utilize microwave antennas, installed at the top of each tank, incorporating a pressure transducer for monitoring the tank's internal atmosphere and a special probe connection for additional measurement functions.

For slop tanks, the radar system shall be capable of detecting the oil-water interface level, ensuring accurate separation monitoring.

For more details regarding the cargo and slop tank measurement system and ullage equipment, see Section [381 Cargo control systems](#).

### **Independent Level Measurement System for Ballast Tanks, Consumables, and Draught Measurement**

The level of consumable tanks (fuel oil, fresh water, sewage, oily water, lubricating oil) shall be measured by either external pressure transmitters with isolation valves or a pneumatic bubble-type liquid column pressure system. The selected system shall be consistent throughout the vessel and integrated with IAS and the loading computer.

The measurement of draught and the level of ballast and sea water tanks shall be carried out using a pneumatic bubble-type system.

Draught measurement shall be taken from four (4) dedicated measuring points:

- Forward
- Aft
- Midship port side (PS)
- Midship starboard side (SB)

All sensors shall provide data to the IAS, with indication available in the CCR and engine control room.

Any tank used to store sea water shall have the measurement included in the ballast tank level measurement system.

The control panel(s) for measuring the level of ballast tanks, consumable tanks, and draught shall be installed in the CCR.

If the system uses individual pressure transmitters per tank, the sensors shall be installed outside the tanks and isolation valves shall be provided between the sensors and the tanks to facilitate maintenance.

Measurements and alarms from the level measurement systems of all ballast tanks, draught, and consumable tanks shall be supervised by the IAS and made available in synoptic diagrams of the vessel's tanks and hull (trim and list calculation). The measurements shall also be sent to the loading computer and trim optimization integrated system.

### **Closed Measurement and Sampling System for Cargo Tanks**

Two (2) UTI closed gauging measures shall be installed for manual probing and sampling of cargo tanks and interface measurement of slop tanks, with calibration certificates.

Each cargo tank shall have four (4) measurement connections:

- Three (3) with a diameter of 1"
- One (1) allowing sampling of 1 liter of product

Each slop tank shall have two (2) measurement connections:

- One (1) with a diameter of 1"
- One (1) allowing sampling of 1 liter of product

All connections shall be fitted with hermetic stainless steel valves for the following functions, performed with portable equipment:

- Ullage measurement
- 1-liter sampler
- Temperature measurement
- Measurement of O<sub>2</sub> content / H<sub>2</sub>S content / hydrocarbons in an inert atmosphere / explosimeter
- Interface detection

The portable equipment, two (2) of each type, required for these functions (Ullage System and Closed Sample) shall be provided.

System functions and interface details for closed ullage and sampling are described in Section [381](#)  
Cargo control systems.

#### Additional Requirements:

- Sounding pipes shall preferably allow sampling of tank contents. If not feasible, separate sampling pipes shall be arranged for Aft Peak Tank, Fore Peak Tank, Chain Locker, Ballast Tanks and Fuel Oil Storage Tanks.
- Sounding pipes in the Engine Room (mainly for double bottom tanks) shall be provided with a self-closing device (counterweight).
- All sounding pipes shall be fitted with galvanized striking plates at the lower end.
- Sounding pipes for oil tanks shall be equipped with test cocks.

Table 8.1 Sounding Type Summary Table

Tank Name	Qty	Remote	Manual	Local (Type)	Remarks
Heavy Fuel Oil Storage Tank	2	✓	✓	Local indicator (KDG type or similar)	high level switch
Heavy Fuel Oil Settling Tank	2	✓	✓	Local indicator (KDG type or similar)	high and low level switches. Overflow pipe with sight glass and bulb.
Fuel Oil Service Tank	2	✓	✓	Local indicator (KDG type or similar)	high and low level switches and overflow to settling tank.
Diesel Oil Storage Tank	1	✓	✓		
Diesel Oil Service Tank	1	✓	✓	Local indicator (KDG type or similar)	high and low level switch
Fuel oil / lubricating oil sludge Tank	1		✓		high level switch
Fuel oil and lubricating oil drain Tank	1		✓		high level switch
Fuel Oil Overflow Tank	1	✓	✓		high level switch
Main Engine Lube Oil Sump Tank	1	✓	✓		high and low level switch and water detection alarm
Diesel Fuel Oil for Emergency Generator	1	✓		Sight glass indicator	In the emergency generator compartment, with low level switch
Incinerator Diesel Oil (*)	1			Sight glass indicator	
Sludge for automatic fuel oil filter (*)	1				
Thermal Oil Storage Tank	1	✓	✓		

Tank Name	Qty	Remote	Manual	Local (Type)	Remarks
Drain Inspection Tank (Clean water drain tank)	1			Sight glass indicator	Side windows with lamps, oil detector and low level alarm.
Thermal Oil Drain Tank	1		✓		
Fresh Water Storage Tank	1	✓	✓		
Distilled Water Tank	1	✓	✓		
Bilge Tank	1	✓	✓		high level switch
Grey Water / Sewage Holding Tank	1		✓	Sight glass indicator	High level switch
Separated Oil Tank	1		✓		
Sludge from Purifier	1		✓		high level switch
LO sludge from ME purifiers	1		✓		high level switch
LO sludge from AE's purifiers	1		✓		high level switch
ME LO Settling	1			Sight glass indicator	high and low level switch
ME LO Drain Tank	1		✓		high level switch
CPP Hydraulic Oil Reserve Tank	1			Sight glass indicator	
ME lube oil reserve	1			Sight glass indicator	High and low level switches
AEs Lube oil Storage	1			Sight glass indicator	High and low level switches
LO Intermediate tank for AEs (*)	3			Sight glass indicator	
Parts Cleaning Oil Tank	1			Sight glass indicator	
Fresh water expansion of the high central cooling system	1			Sight glass indicator	With level switch and low level alarm.
Fresh water expansion of the low central cooling system	1			Sight glass indicator	With level switch and low level alarm.
Freshwater hydrophore	1			Sight glass indicator	With pressure switch.
Water heater tank for accommodation	1			Sight glass indicator	high and low thermostats.
Hydraulic Oil Reserve for Steering Gear	1			Sight glass indicator	
ME Cylinders LO Storage Tank (*)	1			Sight glass indicator	
ME Cylinders LO Service Tank (*)	1			Sight glass indicator	Low level switch
Lube oil for compressors	1			Sight glass indicator	
Lube oil for machinery in general	1			Sight glass indicator	
ME Air Cooler Cleaning Tank	1		✓		
Sludge from Incinerator Tank	1		✓		high level switch
Thermal Oil Heater Cleaning Tank	1		✓		
Stern Tube Cooling Water Tank (**)	1		✓		
Drain for Exhaust Gas Collection Tank	1		✓		
Kerosene	1			Sight glass indicator	
Cargo Tanks	12	Radar			
Slop Tanks	2	Radar			

(\*) - According to the system manufacturer's recommendations

(\*\*) - This tank should be provided if deemed necessary by the manufacturer of the stern tube lubrication system

**Notes:**

- Fuel storage tanks shall be equipped with temperature transmitters for monitoring by the IAS and for correcting the level measurement by the loading computer.
- All tank level measurement sensors shall be integrated with the IAS. Readouts shall be available in the CCR and the engine control room.
- Sounding pipes shall be provided where required by Class or as backup to remote systems.
- Cargo and slop tanks are monitored by radar-type gauges (see Section 381 for full description).

## 84 Central heating systems

The vessel is equipped with a thermal oil heating system as the primary heat source for various consumers. The thermal oil heating system is described in detail in [845 Thermal Oil Heating System](#).

### 845 Thermal Oil Heating System

The vessel is equipped with a thermal oil heating system as the primary source of heat for various consumers, including hot water production, HVAC, and tank heating systems. The system shall recover heat from the exhaust gas economizers of the main engine and auxiliary engines, with oil-fired thermal oil heaters serving as a backup when heat recovery is insufficient. Thermal oil shall be used to supply heat to the following systems:

#### **Hot Water System:**

- One (1) fresh water heater (calorifier), with a capacity of 500 liters and a nominal flow rate of 2000 liters per hour, capable of raising the water temperature from 10°C to 70°C, using thermal oil as the primary heating source and electric resistors as backup.
- Two (2) hot water circulation pumps, each rated at 100% capacity.
- The hot water piping in the accommodation shall be thermally insulated.

#### **Tank Heating System:**

- Heating coils for tanks shall be supplied with thermal oil through heat exchangers, ensuring the tanks' contents are maintained at required temperatures.
- Tank heating consumers include fuel oil storage, settling and service tanks, slop tanks, sludge tanks, separate oil tank, incinerator sludge tank, and any other designated tanks as required.

#### **HVAC Heating System:**

- The accommodation and wheelhouse HVAC systems shall be heated via thermal oil-to-water heat exchangers, ensuring comfortable ambient temperatures in all relevant areas.

#### **Other Heating Consumers:**

- Additional heating consumers may be connected to the thermal oil system, including main and auxiliary engine pre-heaters, if applicable.
- The system shall include heating of:
  - Fuel oil purifier heaters
  - Lube oil purifier heaters
  - Fuel oil heaters for Main and Auxiliary Engines
  - Fresh water preheater for Main Engine jackets
  - Circulating fresh water preheater for Auxiliary Engines
  - Oil/water separator
  - Fuel oil mixing and deaerator tanks
  - Fuel oil pipes
  - Scavenge air system drain tank

- Separate oil tank
- Bilge tank
- Inert gas system seal water
- Fresh water generator
- Air conditioning

#### **Control System:**

- The entire thermal oil heating system shall be integrated into the vessel's automation system, with monitoring and control capabilities to optimize heat distribution based on demand.
- Temperature shall be controlled via the IAS.
- Each consumer shall have its own independent display/by-pass assembly.
- Temperature control valves shall be supplied for the following consumers:
  - Direct-acting thermostatic type:
    - Main Engine jacket fresh water preheater,
    - Hot water tank,
    - Lube oil settling tank for the Main Engine.
  - Pneumatic type with electronic actuator:
    - Fuel oil heaters for the Main Engine,
    - Fuel oil purifier heaters,
    - Fuel oil heaters for the oil fired thermal oil heater,
    - Lube oil purifier heaters,
    - Fuel oil service and settling tanks.

#### **Heating Coil Configuration:**

- A minimum of two (2) independent heating coil sections per tank shall be provided for fuel oil storage, settling and service tanks.
- The heating coil capacity shall be dimensioned based on tank geometry and medium temperature.

#### **Design Criteria for Tank Heating Calculation**

- Outside air temperature: 2° C;
- Sea water temperature: 4° C;
- Air temperature in the Engine Room: 20° C;
- Temperature and heating time for each tank according to the following table, considering an initial temperature of 25°C:

Table 8.2 Tank heating system

Tanks	Tank temperature [°C]	Time (Hours)
Fuel oil storage	40	48
Fuel oil settling	70	8
Fuel oil service	90	8
Main Engine LO Sump Tank (@ suction)	30	8
FO/LO Drain	40	12
FO Drains/ Overflow	50	12
Sludge	40	12
Slop tanks	40	12
Freshwater expansion	45	6

Tanks	Tank temperature [°C]	Time (Hours)
ME Scavenger cooler cleaning	60	12
Separated oil	50	12

### Thermal Oil Heating System Equipment:

The following equipment shall be supplied:

- Five (5) thermal oil heaters: one oil-fired unit, four exhaust gas economizers (Main and Auxiliary Engines)
- Two (2) thermal oil circulation pumps (100% capacity each)
- One (1) expansion tank
- One (1) thermal oil cooler
- Two (2) thermal oil transfer pumps
- One (1) storage tank
- One (1) drain tank
- Equipment and accessories for heaters cleaning
- Automatic electronic control for combustion, level and fluid pressure
- Piping and fittings

The burner shall be of the "Low NOx" and low particulate emission type and certified according to Marpol Annex VI.

Simultaneous operation of the oil-fired heater with the economizers shall be provided. The oil-fired heater and exhaust gas heaters (economizers) shall meet the vessel's operating conditions. The oil-fired heater will be designed to consume fuel oil as defined in item 2.2.7 and diesel oil only for cold starting and for igniting the pilot burner.

The oil-fired heater shall be equipped with automatic combustion/thermal oil temperature controls and a cleaning system, consisting of a soot blower and relevant controls.

The Main Engine economizer shall be designed to withstand the condition of no oil in the pipes (dry economizer) and shall have an automatic "flap" system or flow control valve to regulate thermal oil temperature. The Auxiliary Engine economizers shall be designed similarly but without the flap.

Two (2) thermal oil supply connections shall be provided, one on each side of the exposed deck, in the accommodation/casing area.

The heat balance shall be approved in advance by the Owner.

The oil-fired thermal oil heater shall be sized to cover the total heating demand of the vessel, including all equipment, tanks, and systems, in the event of failure of all exhaust gas economizers (Main Engine and Auxiliary Engines).

For **Operational Modes** of the thermal oil heating system (Mode A/B/C), see section [64 Boilers](#).

#### General/ references:

Thermal oil boiler, ref. [648 Thermal oil boilers](#)

Control system, ref. [648 Thermal oil boilers](#)

Pipe material, ref. [7 System for Main Engine Components](#). Hot water pipes to be insulated.

Heating coils in fuel oil tanks, ref. [704 Heating coils in fuel oil tanks](#)

## 85 Common electrical and electronic systems

### General

The ship shall have alternating current systems as defined below, and shall be according to Figure 0.1, Classification Society and relevant IEC norms.

The Main power system shall be a redundant 3 phase 450V AC/ 60Hz system.

The ship's alternating current systems shall be insulated towards hull throughout the vessel except grounding detecting circuits, necessary circuits of electronic equipment, etc.

All AC systems shall be equipped with earth failure instrument with alarm output, and 24 V DC systems shall have an earth failure relay with alarm output to the IAS.

Each power distribution system shall be equipped with a insulation measurement and low insulation locator system, installed in the system's main distribution panel (panel fed directly by generators, transformers, UPS or batteries, for example: MSB, ESB etc.).The system shall have an electrical system insulation resistance indicator and a low insulation feeder locator with individual fixed meters for each output feeder of these distribution panels and a monitoring and alarm device

The arrangement of the electrical equipment throughout the vessel shall as far as practical provide ready and safe access to parts requiring inspection, maintenance and repair.

All electrical equipment shall be located such that, as far as practicable, they are not exposed to risk of breakdown or damage caused by water, steam, oil or excessive heat. Where unavoidable exposed to such risks, the equipment shall be suitably protected or enclosed.

The design of the electric plant including generators, motors and controllers shall be coordinated to insure that the voltage drop when starting the motor with highest inrush current shall not exceed 15% of the rated voltage.

In no case the voltage drop during start-up shall be greater than 15% at the starter panel, 20% at the motor terminals (or a more restrictive requirement demanded by the classification society) or 20% at the other panels in the electrical system

Generators reactance shall be matched with consideration given to short circuit fault level and level of voltage distortion in the network.

Calculation for line harmonics / voltage and current distortion for main bus-bar shall be worked out. The total harmonic distortion in voltage waveform shall normally not exceed 8%, nor shall any single order harmonics exceed 5%. The total harmonic distortion may however exceed the given levels provided that equipment subjected to the increased distortion levels are documented to withstand the actual levels. i.e. A declaration or guarantee from the system responsible may be an acceptable level of documentation.

All electrical equipment shall be of the latest design employing reliable components and shall be selected to provide maximum availability of spare parts and service on a worldwide basis.

All electrical equipment shall be protected from vibration under normal operating services by mounting equipment with sufficient structure and hardware, sway bracing etc. All Electric cabinets, frequency converters and sub- switchboard in all rooms aft of engine room shall be mounted with vibration dampers. All electrical equipment exposed to the weather shall be designed considering wind and salt-water spray.

All electrical and control panels shall be installed with vibration dampers on their respective supports.

The maximum permissible continuous load on a generator, in any service condition, using any fuel in the engines and other combustion equipment (HFO/LFO, MDO/MGO or alcohol based fuels), will be

85% of the rated power. This condition shall be demonstrated in the design documentation. In any service condition, it shall be possible to start any consumer without having to start an additional DG, unless the total electrical load after starting the consumer exceeds 85% of the generated power.

Table 8.3 DGs running in operation modes

Condition of service	Generators in Operation
Normal seagoing	1
Voyage with Tank cleaning	1
Departure or arrival manoeuvring	1 (*)
Offloading at terminal with ballast water treatment	2
Monobuoy offloading with ballast water treatment	2
In port (anchored) + degassing/inertization/ventilation	1
Voyage with ballast renewal	2

(\*) For operational safety reasons, two (2) DGs will operate in parallel.

The continuous powers (COP, according to ISO 8528-1) of the main generating sets and emergency generating sets shall be confirmed when the Main Electrical Load Analysis and the Emergency Electrical Load Analysis are submitted to the Owner for approval. The electrical load analysis shall show consumers grouped according to their simultaneity of operation.

All Electrical Systems shall comply with IEC 60092 Recommendations, as well as the Regulations, Standards and Conventions specified in section 2.4.1.

For the correct sizing and purchase of the equipment, at least the following electrical studies shall be carried out and the appropriate calculation reports submitted to the Owner for comments: load flow; short-circuit (according to IEC 61363-1); voltage drop due to starting of large motors (with a power greater than 55 kW); coordination of electrical system protection; harmonic distortion in the system; incident energy from electrical panels (according to IEEE Std 1584).

The studies shall be specific to the vessel's electrical system as designed, and typical schemes will not be accepted. The loading conditions considered shall reflect all the service conditions defined in section 6.7, with a specific condition for maximum short-circuit, which shall consider the service condition of maximum loading and operation of 3 DGs. The short-circuit study shall indicate the minimum and maximum short-circuit current level allowed for the connection point with the terminal's Onshore Power Supply system. For the incident energy study, the respective maximum and minimum short-circuit level service conditions for each panel shall be taken into account.

### Earthing

Generally shall all metal parts of the electrical installation, other than current carrying parts, be earthed.

Earthing may however be omitted for double-insulated equipment, bearing housings, low voltage equipment, etc. Metal enclosures which are installed directly on parts of the steel hull or steel constructions which are welded to the hull, may be earthed by means of the fixing devices, provided reliable contact is made. The connection of earth conductors to the parts that shall be earthed and to the hull shall be made by corrosion-resistant screws or clamps. The cross section of the cables shall correspond to the earth conductor. Earthing screws and clamps shall not be used for other purposes.

### Marking of electric systems

All electrical equipment shall be clearly and durably labelled with necessary information for easy identifying. All cables (in both ends), conductors and terminals shall be clearly labelled for easy reference to documentation.

The marking signs shall be of durable type and easy to read, markings shall be as follows:

- Marking at the outside of the equipment shall be engraved signs, black text on white bottom.
- Inside switchboards and similar the marking can be more simple, but shall be durable.
- All emergency signs shall have white letters on a red background.

The labels/marking system shall be approved by the Owner.

### Load Analysis

The Designer shall prepare an electrical load analysis.

The main generating sets shall be sized to meet the service conditions shown in the table below: Normal seagoing, Voyage with Tank cleaning, Departure or arrival manoeuvring, Offloading at terminal with ballast water treatment, Monobuoy offloading with ballast water treatment, In port (anchored) with degassing/inertization/ventilation, Voyage with ballast renewal.

The electrical load analysis shall include the calculation for all service conditions, considering both the scenarios for using conventional fuels (HFO/LFO and MDO/MGO) and the scenarios for using alcohol based fuels, in accordance with the conceptual design in "ready for" class notation to be developed.

### Short Circuit Analysis

The Power systems supplier shall provide short circuit and selectivity analysis each of the voltage systems defined below as required from the Classification Society and regulatory bodies.

### System setup

The Main Power system shall be arranged according to Figure 0.1 and as follows:

### Power sources, power systems and equipment voltages

#### Power sources

The ships electrical power sources shall be:

Table 8.4 Electrical Power sources

Description	Quantity	Capacity kW	Voltage VAC	Phase	Power factor	Frequency
Auxiliary generator sets, ref. <u>652 Auxiliary generator set for electric production</u>	3	750	450V	3	0,8	60Hz
Emergency generator set, ref. <u>665 Emergency Generator set</u>	1	200	450V	3	0,8	60Hz
Shore Connection Yard stay/ Dry docking, ref. <u>868 Shore connection</u>	1	300	450V	3	0,8	60Hz

#### Power systems

The ships electrical power systems shall be:

Table 8.5 Electrical power systems

Description	Quantity	Switchboard(s)/ Distribution(s)	Separation/ Busties	Main Feeds	Network type	Phase	Voltage	Frequency
Main AC power	1 (2-split)	One (1) Switchboard	One (1)	According to <u>Figure</u>	IT	3	450V	60Hz

Description	Quantity	Switchboard(s)/ Distribution(s)	Separation/ Busties	Main Feeds	Network type	Phase	Voltage	Frequency
system				0.1				
Sub AC power system	1 (2-split)	One (1) Switchboard	One (1)	Two (2) via transformers	IT	3	220V	60Hz
Sub 450V Distr. panels	N/A	N/A	N/A	Redundant feed	IT	3	450V	60Hz
Sub 450V Starters	N/A	N/A	N/A	Redundant feed	IT	3	450V	60Hz
Emergency AC power system	1 (Single)	One (1) Switchboard combined with Sub Emergency switchboard	-/ NA	One (1)	IT	3	450V	60Hz
Sub Emergency AC power system	1 (2-split)	One (1) Switchboard combined with Main Emergency switchboard	-/ NA	Two (2) via transformer	IT	3	220V	60Hz
Main DC systems	2 (independent)	Distribution panels, ref. <a href="#">866 DC systems</a>	-/ NA		IT	NA	24V	NA

### Equipment Voltages:

Equipment shall have voltages as listed below:

Table 8.6 Equipment Voltages

Voltage	System/equipment
450V/60Hz	Auxiliary generators Emergency generator Transformers 450V/220V Electrical motors in general Electrical heating fans heavy galley machinery heavy laundry machinery 250kVA Shore connection
220V/ 60Hz	Illumination receptacles Minor heaters Heating panels and heating cable Minor electrical motors (below 1 kW) Galley - and laundry equipment Remote control equipment Control Voltage Rectifiers/ battery charges Electronic equipment Communication systems.
24 V DC	Electronic equipment (Navigational, monitoring, governors etc.) Remote control Start batteries for emergency engine Start batteries for auxiliary engines

All 1-phase consumers shall be distributed as equally as possible on the 3 phases.

## 855 Common computer systems

### Local area network

An infrastructure shall be installed for broadband satellite communication systems and Ethernet data networks for computers, smart devices, routers, access points and automation

systems, in accordance with the requirements described in I-ET-4800.00-9990-000-PTD-002. The data network shall be physically segregated between the administrative computer network, the access point network and the telemetry data network. The telemetry data network shall include 3 switches to be installed in the ship's control centers (ECR, CCR and navigation bridge) interconnected in a loop.

The on-board data network shall be connected to the broadband satellite communication system (supplied by the Owner), in accordance with I-ET-4800.00-9990-000-PTD-002. The antenna supports and cable penetration pieces between the antennas and the satellite communication system transmitters shall be manufactured and installed by the Yard, in accordance with the equipment manufacturers' guidelines to be informed by the Owner during the vessel's design phase.

## 86 Electrical motors, transformers etc.

### Motors

Motors < 500 kW as far as practical shall be Class F insulation, with maximum temperature rise not exceeding class B. However, where a motor is specially designed to suit the driven machinery (e.g. galley or workshop machinery etc.) the maker's standards may be followed.

### Transformers

All required transformers shall be included and shall be of the dry, natural, air cooled or FW cooled marine type, temperature Class F.

### Clean Power plants and UPS systems

Uninterrupted Power System(s) (UPS) for equipment and systems shall be arranged according to Classification Society and equipment suppliers requirements.

### Shore connection

A shore connection 450V/60Hz- 250 kVA for Dry dock/ Yard stay shall be installed and connected to one the 450V/60Hz Main AC systems as per Figure 0.1.

## 861 Electrical motors

Motors generally shall be of the induction marine type generally having squirrel cage rotors. Each drive shall be carefully considered in conjunction with the manufacturers of the motor and the driven unit and the most suitable characteristics selected. The nominal output of a motor shall be determined by the characteristics of the associated driven unit and shall be such that it cannot be exceeded. Rating for motors shall generally be for continuous full load duty (S1), but for motors where other ratings are widely accepted other ratings may be used.

Major motors in general shall have bearings in both DE and NDE.

Electric motors shall have the following characteristics, unless otherwise specified:

- Marine use, induction, squirrel cage rotor, 450V or 220V, 60 Hz, 3 phases, power factor at least 0,8 inductive
- Minimum performance in accordance with current INMETRO regulations
- Locked rotor current of no more than 6 (six) times the rated current, for motors greater than 55 kW with direct start or compensated start (soft starter, autotransformer, star delta)
- Bearings, pre-lubricated and sealed in accordance with IEC recommendations and the specific use of the motor; if this is not possible, prior approval shall be obtained from the Owner
- Housing with lifting eye, for electric motors over 20 kg
- Fully enclosed, with external ventilation (IC411), connection box with cable glands and

- connection terminals mounted on an insulating block
- Minimum degree of protection: IP44 when located in accommodation compartments, IP55 when located in machinery spaces and similar spaces; IP56 in open areas
- Heating resistor, powered at 220V, for electric motors installed in damp or open areas, steering gear room, fire pumps, thermal oil heater fans, inert gas fans, compressors, deck equipment, and motors weighing more than 500 kg. The "Heating on" indication shall be provided by means of a relay that detects the current in the heating resistors.
- The protective paint system of the motors shall be suitable for corrosivity category C5-M in accordance with ISO 12944-2. The durability range shall meet the "H" (High) durability requirements set out in ISO 12944-5, which refers to a minimum durability time of more than 15 years.
- Grounding connector on the base, on the same side as the junction box. Motors powered by a frequency converter shall have an additional grounding connector inside the junction box. The connectors shall be identified with grounding symbols.
- RTD or PTC (2 per phase) in motors with a rated power above 150 kW or driven by frequency converters, for over-temperature protection.
- Electric motors shall be sized to meet the design point of the loads being driven, with the following oversize factors
  - a) motor with a rated power of less than 22 kW - 25% oversize;
  - b) motor with a rated power of 22 kW up to and including 55 kW - 15% oversize;
  - c) motor with rated power greater than 55 kW - 10% oversize
- The speed (rpm), duty type and starting performance of each electric motor shall meet the needs of the driven equipment, under the most critical working conditions envisaged for the operation.

Two-speed electric motors shall have independent windings for each speed. Electric motors with a power rating of less than 75 kW shall have a direct starter and electric motors with a power rating of 75 kW or more shall have a compensated starter (soft starter, autotransformer, star-delta).

In no case the voltage drop during start-up shall be greater than 15% at the starter panel, 20% at the motor terminals (or a more restrictive requirement demanded by the classification society) or 20% at the other panels in the electrical system, according to the motor start-up study.

Electric motors for large consumers, as indicated in the specific items for each system in this Technical Requirement, shall be equipped with variable speed drives (VSD). VSD-driven electric motors shall meet the requirements of IEC TS 60034-25.

VSD-driven Ex electric motors shall be certified in conjunction with the VSD, in accordance with the requirements of IEC 60079-14. The technical characteristics of the VSD used for motor certification shall be described in the certificate of conformity or in the manufacturer's technical documentation, referenced in the motor certificate.

The certification of conformity of the motor shall cover the actual operating conditions regarding the speed variation range, torque characteristics and technical characteristics of the VSD used in the type tests for the certification of the motor.

Electric motors for specific use, such as for galley, laundry and workshop equipment, shall be in accordance with the manufacturer's standard for the equipment used.

Table 8.7 Minimum ingress protection for electric motors

Equipment	IP rating
• Electric motors in stores, technical rooms etc.	IP 44
• Electric motors in Engine room	IP 55

- |  |       |
|--|-------|
| • Electric motors on open deck         | IP 56 |
| • Electric motors in accommodation     | IP 44 |
| • Electric motors in ventilation ducts | IP 44 |

Electrical motors for the following shall have automatic stand still (space) heating of adequate size:

#### Deck machinery

- Deck cranes
- Machinery mounted on open deck or in wet atmosphere
- Machinery mounted in room without insulation adjacent to open deck or to ship's side (excluding engine room)
- All Cargo pumps and HPU's
- Fi-Fi pumps
- Motors in Steering gear room
- Motors for thermal oil heaters
- Inert gas fans
- Compressors
- Motors more than 500kg

Heating element shall be monitored (i.e. with A-meter).

## 865 Transformers

#### General

All transformers to be fully compatible with the remainder of the electrical system.

Transformers for electrical power supply to lighting, small power equipment, communication, etc. to be provided as follows:

#### Main transformers - 450V / 220V

Two (2) of marine type (one set as spare) transformers to be installed near the main switchboard for regular lighting, small power equipment, internal communication equipment, navigation equipment, radio equipment, etc.

The two tran working in parallel. In case of failure in one of the transformers, the other one to automatically take over the whole load.

Table 8.8 Main transformer

Type	Drip proof natural air cooled dry type
Capacity, each	According to electrical load calculation, each with 120 % of electrical load balance calculation.
Phase	3 phase
Frequency	60 Hz
Voltage	Primary voltage 450V Secondary voltage 220V
Insulation	Class F, with a maximum temperature rise corresponding to class B.
Connection	Banks of single-phase transformers connected in delta-delta shall be used.
Protection	IP 44
Remarks	Transformers to be self ventilated

#### Emergency transformers

Two (2) (redundant) transformers shall be installed to supply the 220V distribution panel of the ESB. Each transformer shall be able to support 100% of the load of the ESB 220V panel.

Table 8.9 Emergency transformer

Type	Drip proof natural air cooled dry type
Capacity, each	According to electrical load calculation
Phase	3 phase
Frequency	60 Hz
Voltage	Primary voltage 450V Secondary voltage 220V
Insulation	Class F
Connection	Banks of single-phase transformers connected in delta-delta shall be used.
Protection	IP 44
Remarks	Transformers to be self ventilated

Banks of single-phase transformers connected in delta-delta shall be used.

The transformers shall have the following characteristics:

- Marine use, 450V / 220V, 60 Hz, with primary taps (+/- 2,5% and +/- 5%)
- Voltage Regulation: better than 2,5%
- Dry type, air-cooled, natural ventilation, continuous duty
- Class F insulation, with a maximum temperature rise corresponding to class B
- Flame-retardant, self-extinguishing insulation resin with a low content of toxic gases on combustion, in accordance with IEC 60076-11 fire behavior class F1.
- Degree of protection IP23 for the transformer and IP44 for the terminal box.
- Silver connection terminals
- Lifting and lateral movement eyes

The magnetizing current (inrush) of the transformers shall be informed in the equipment data sheet for protection settings. Facilities shall be installed for temporary earthing using earthing cables and connectors. The Electrical Load Analysis of the Transformers shall be submitted to the Owner for approval.

## 866 DC systems

### 24V Battery System

24V DC battery systems for equipment and systems shall be installed as required by Classification Society National authorities and equipment suppliers requirements.

Two (2) 24 VDC uninterruptible power supply systems shall be installed, consisting of a rectifier, charger, battery group and distribution panels, fed by the ESB, as follows:

- System 1, for GMDSS consumers, according to the GMDSS manufacturer's standard.
- System 2, for general use (ECR console, CCR console, navigation bridge chart console, MSB, ESB, navigation lights, temporary lighting, etc), with the following characteristics:
  - Certified for marine use
  - Sealed batteries (VRLA - valve-regulated lead-acid), AGM type, certified in accordance with Anatel Resolution 570, with a 20% oversize factor (over the entire life time of the batteries)

- Autonomy of 30 minutes for the installed load (including the 20% oversize factor)
- Output regulation: - 5% / + 10% (maximum)
- Modular construction, with a minimum of 3 (three) rectifier modules (the failure of a module cannot cause system failure, unless of a capacity reduction) a spare rectifier module shall be provided  
Readout instruments: batteries current and voltage, charger output current and voltage, insulation measurement of the 24 Vdc system
- Insulation fault locator capable of identifying the faulty output feeder (this system may be installed in the distribution panel fed by the rectifier)
- Alarms: 220 Vac fault, 24 Vdc fault, internal fault, low insulation in the 24 Vdc system, overcurrent, undervoltage and overvoltage
- Reversible contacts for 24 Vdc system low insulation alarm and group alarm.
- The installation of battery groups and their respective rectifiers/chargers shall follow the recommendations of the respective manufacturers.

## 867 Clean power plant and Uninterruptible Power supply systems

### Uninterruptible power supply system – UPS

UPS systems for equipment and systems shall be installed as required by Classification Society National authorities and equipment suppliers requirements.

The design philosophy shall take into account that UPS (Uninterrupted Power Supplies) will only be used for equipment powered by alternating current that suffers serious disturbance in case of a momentary power failure, or that needs to be restarted or data re-entered. Dedicated UPSs (220V/220V AC) shall be installed for the following systems and equipment, among others:

- Fire detection system (alternatively, "built-in" UPS can be installed)
- IAS workstations
- Measurement system for cargo and ballast tanks
- Integrated load computer and trim optimizer system
- Radars (display only)
- Navigation and ECDIS/ENC system workstations
- Broadband satellite communication systems
- Server, routers, access points and other data network components
- CCTV

The UPSs shall have characteristics in accordance with the standard of the Integrator responsible for the system or equipment served by the respective UPS, in addition to the following:

- Certificate of conformity with IEC 62040-3
- Certified for marine use
- Sealed batteries (VRLA - valve-regulated lead-acid), AGM type, certified in accordance with Anatel Resolution 570, with a 20% oversize factor (over the entire life time of the batteries)
- Blackout operating time: 30 (thirty) minutes at full load
- Isolated distribution
- Alarms: input power failure, internal failure, low insulation in the output
- Reversible output contact for group alarm
- Automatic bypass in the event of a fault.

## 868 Shore connection

### Shore connection

The shore power connection box shall be located in the Emergency DG compartment, with provision for weathertight cable entry through the bulkhead, with a cable tray inside and shall have the following characteristics:

- 450V, 3 phases, 60 Hz
- 500 A capacity
- Connection terminals for the external cable
- Plug-in molded case thermomagnetic circuit breakers
- Internal heating element
- Phase sequence verification device
- Ammeter
- Dual voltmeters for all phases with voltage measurement before and after the circuit breaker

### Future Shore connection

The vessel's design shall consider the future installation of a Shore connection system- (at 6,6 kV) sized to supply 100% of the electrical power of 2 DGs, meeting the requirements of IMO circular MSC.1/Circ.1675, IEC/IEEE 80005-1, IEC/IEEE 80005-2, IEC 62613-1, IEC 62613-2 and classification society standards. The design for the installation of this system shall be submitted for the issuance of a Statement of Compliance by the classification society.

The design of the future installation of the Shore connection system shall describe at preliminary design level the technical characteristics of the Shore connection system and all the interventions in the existing infrastructure and systems necessary for the installation and integration of the future system. Spaces reserved for the installation of new equipment, materials and the construction of rooms shall be clearly identified in the design documentation.

The design shall consider the future installation of connectors for the power and control cables (port terminal cables) of the port Shore connection system on both sides of the vessel (portside and starboard), in the midships region, aft of the cargo manifold , in a position that allows the onshore power cables to be lifted and moved using the vessel's cargo crane. A representative drawing of this movement shall be included in the technical design documentation.

The number of connectors for the power cables to be used for each vessel shall be calculated to meet the rated power of the system, according to the standard power per cable established in IEC/IEEE 80005-1 for onshore power cables on oil tankers. The system shall provide interlocks to prevent cables from being disconnected while energized.

The design shall take into account the future installation of supports for the port terminal cables during system operation.

The design shall take into account access control to the high-voltage equipment and remote closing of the Shore connection incoming circuit breaker on the vessel (without the presence of people in the compartment housing the high-voltage panels).

The future Shore connection system shall be equipped with automatic tripping in the event of emergencies, such as loss of hull grounding , high mechanical voltage on the connecting electrical cable, imminent failure of the cable connection, emergency stop triggers, etc .

Emergency stop buttons for the port Shore connection system shall be provided in the ECR and in the high voltage equipment compartment. The future 6,6 / 0,44 kV transformer for the OPS system shall meet the characteristics specified for the other transformers on the vessel, as per item 865 Transformers of this Building Specification.

The future Shore connection system, the vessel's PMS and the installation design shall make it possible to temporarily connect the on-board generators to the shore system in parallel.

The vessel's distribution system shall remain isolated after connection to shore power. The Shore connection system shall measure the energy received from shore and display this measurement on the receiving panel. The Shore connection system shall provide the status of circuit breakers, operational indications, measurements and alarms to the IAS.

## 87 Electrical distribution systems

### Main distribution system

The vessel shall have an electric distribution system setup and switchboards according to 85 Common electrical and electronic systems, and shall include "Power Management" and "Blackout Prevention" Systems.

### Distribution panels/ Electrical utility stations

Distribution panels shall be installed for all relevant voltage levels.

## 871 Main low voltage switchboards

### General

The vessel shall be equipped with the necessary switchboards according to Table 8.5.

The switchboards shall be designed for free standing mounting on a common base frame. Each cubicle shall consist of a framework built up of zinc plated squared tubes. The top, the sides and the rear (except wall mounted sections) shall be covered with detachable steel panels, while the front shall be fitted with hinged doors. The switchboard shall be of dead front type and have enclosure according to Classification Society requirements. Handrails of insulating material shall be provided at the front.

Remote control of main electric generators to be provided in ECR.

The circuit breakers shall be operated from outside the panel, with no need to open the compartment door, and shall have a safety lock that can be fitted with a padlock for maintenance.

Bus bars and other conductors shall be of copper. Bus-bars and other conductors with their supports shall be mechanically and thermally dimensioned and fixed such that they can withstand the forces occurring by the maximum short-circuit which can occur without detrimental effect. Flame-retardant partitions shall be provided between compartments which shall prevent spreading of arc and minimize spreading of ionised gases in case of fault.

The switchboards shall be mounted with vibration dampers (below and on top).

The main busbar should preferably be located at the top of the panel, without splices, silver plated at the contact points and equipped with disconnecting links where necessary to guarantee the vessel's operation in emergency situations.

The busbars shall be made of electrolytic copper, insulated (sheathed) and fitted with silver plated contacts/terminations.

The switchboard shall be equipped with

- Internal electrolytic copper ground bar
- Acrylic protection to prevent contact with live parts
- Door locks in the open position
- Heating resistors for panels installed in damp areas or on open decks
- Lifting eyes for panels weighing more than 20 kg
- Made from 316L stainless steel or painted carbon steel.

Certificates of compliance with the short-circuit currents indicated by the study shall be provided for each panel. In the case of a short-circuit current of less than 10 kA, certification may be waived. Electrical panels shall have an incident energy level lower than the 'CAT-2' arc rating clothing (up to 8 cal/cm<sup>2</sup>).

The panels shall be painted in accordance with the requirements of ABNT NBR 16680 for environments with a very high corrosivity category (C5-M).

The panels shall be fitted with a nameplate on the front door identifying the panel (tag) and the main electrical characteristics of the equipment, including the calculated incident energy levels and the required arc rating for clothing used on the panel.

The height of manual control devices in relation to the floor shall be limited to 1750 mm. Indications of heating element operation shall be controlled by current relays, i.e. they shall indicate the actual operation of the heating element.

Cable entrance shall generally be from below.

Space in conduit for future cabling shall be prepared.

Necessary converters/signal outputs shall be provided for the propulsion plant, etc.

All switchboards shall have available space for circuit breakers for future installation, with 2 – 3 circuit breakers for each main busbar section.

The 450V and 220V main switchboards shall be installed in the ECR.

450V and 220V emergency switchboard shall be installed in the emergency generator room.

Switchboards shall be laid out and built in accordance with Table 8.5 and Classification Society requirements.

The panels shall be painted in accordance with the requirements of ABNT NBR 16680 for environments with a very high corrosivity category (C5-M).

The panels shall be fitted with a nameplate on the front door identifying the panel (tag) and the main electrical characteristics of the equipment, including the calculated incident energy levels and the required arc rating for clothing used on the panel.

The height of manual control devices in relation to the floor shall be limited to 1750 mm.

Indications of heating element operation shall be controlled by current relays, i.e. they shall indicate the actual operation of the heating element.

The following color standard shall be adopted:

- Internal and external color: gray RAL7030
- Identification of busbars and phases:
  - AC systems: R phase - red, S phase - white, T phase - blue
  - DC systems: positive - red, negative - black
- Signaling of operating functions:
  - powered: white or colorless

- normal, circuit breaker open, stopped: green
- circuit breaker closed, working: red
- stand-by, fault, attention, reversing, preheating: yellow

The electrical panel feeders shall be fitted with a safety device to lock them for maintenance.

Switchboards, starter panels and electrical panels in general shall make available, for external use (monitoring by the IAS), all the signals considered relevant to the operation of the respective electrical equipment.

The electrical panel supplied as part of other equipment will follow the equipment manufacturer's standard, while respecting the color standard indicated in this document. All electrical and control panels shall be installed with vibration dampers on their respective supports.

The internal diagram of each electrical or control panel shall be printed, laminated and positioned firmly on a support inside the panel.

#### **450V switchboard**

The switchboard shall be dimensioned for all power sources except shore connection and Emergency Generator in Table 8.4 in continuous parallel operation.

The MSB shall consist of at least:

- 3 (three) DG input columns
- 1 (one) synchronization column
- 1 (one) bus tie breaker column
- 2 (two) group starter panels
- 2 (two) transformer feeder columns
- 2 (two) 450V distribution columns
- 1 (one) 220V distribution column

The MSB design shall consider the future installation of one (1) input column to receive power from a future onshore power supply system.

The MSB columns shall be certified against short-circuit and arc flash. They shall be made up of individual cubicles, separated by steel plates, in order to confine electrical faults.

The MSB shall be designed and sized to continuously support the operation of 3 (three) generators in parallel at 100% of their rated power.

The main busbar of the MSB shall be divided into two sections, interconnected by an extractable tie breaker (ACB).

The main busbar shall be provided with cold busbar links between every two generators and between the generators and the distribution sections.

Duplicate consumers shall be divided between the two group starters and between the two 450V distribution columns. Each 450V and 220V distribution column shall have at least three spare circuits equipped with circuit breakers.

The circuit breakers for the DGs and the bus tie breaker shall be of the same model, of withdrawable air circuit breaker (ACB) type, with features for testing in the withdrawn position and protection functions in an "intelligent" electronic module.

The MSB shall be equipped with optical arc detection sensors to trip the busbar's power circuit breakers.

The DG circuit-breakers shall be interlocked with the shore power circuit-breaker in the MSB.

The design shall consider temporally parallelism between the DGs and the Emergency DG during the transition from the emergency supply to the main supply. Consumer loads circuit breakers shall be thermomagnetic plug-in moulded case circuit breakers.

The MSB shall have a power management system (PMS) as well as analog meters for the system's electrical variables (bus voltage and frequency, generator voltage and frequency), manual controls and indications for opening and closing ACBs and manual controls for AE's rotation.

The automatic and manual controls shall be located in the MSB synchronization column, which shall be equipped with synchronizing relays (ANSI 25) to interlock the closing of the circuit breaker at unsynchronized condition.

The front and rear doors of electrical panels shall be fitted with handrails made of insulating material along the entire length of the panel. The panel shall be built in such a way as to allow safe thermographic inspections with the circuits energized at cable and busbar connections.

Shore power shall be fed to the 450V switchboard as defined in 868 Shore connection.

### Main generator panels

There shall be one generator panel for each generator.

This panel shall contain equipment for control and protection of the generator:

The control equipment installed in front of the panel shall be:

- 3 ammeters (scale min. 130% of the rated full load)
- 1 frequency meter (scale min.  $\pm 8\%$  of the nominal frequency)
- 1 voltmeter (scale min. 120% of the rated voltage)
- 1 wattmeter (scale min.  $\pm 15\% / 130\%$  of the rated full load)

One (1) voltmeter switch for connection the voltmeter between the different phases and the different phases and earth.

All meters to have red mark for normal value/upper limit.

The protection equipment installed inside the panel shall be:

- 1 Air-Circuit breaker, motor operated.
- 1 generator guard, if not built-into circuit breaker or instrument, for protection against over-current, reverse power. The limits shall be adjustable.
- 1 Differential protection unit if generators are above 1500kVA
- 1 selector switch (normal/manual operation)

In front of panel shall be mounted control equipment for the generator breaker, etc.:

- 2 push-buttons for opening/closing of breaker
- 1 signal lamp (open)
- 1 signal lamp (closed)
- 1 Signal lamp (manual operation)
- 1 switch (on/off) and indication lamp for generator heating
- 1 signal lamp indicating over current/reverse power
- 1 push button for reset of over current/reverse power
- 1 hour counter up to 99.999 hr (no reset type)
- 1 speed control.

Necessary synchronising device and lamps for manual synchronising shall be installed.

## Main bus instrument / Common equipment

- Voltage guard
- Frequency guard
- Insulation guards
- Power quality monitoring shall be included for the main busbars; 2 x 450V, and 3 x 220V. THD and single harmonics < 63. harm. for 450V bus-bars, and THD and < 21. harm. 220V busbars. Indication on IAS PMS/switchboard picture.
- Mimic diagram in front including:
  - Running indicator emergency diesel
  - Emergency switchboard supplied from emergency generator
  - Emergency switchboard supplied from main switchboard

## 220V Switchboard

The 220V switchboards downstream of Main switchboards PS/SB shall be supplied by a 3-phase transformer each. Each transformer shall be sufficient for supplying the vessels normal 220V consumption during transit mode. The switchboard shall be divided into two parts by means of a circuit breaker, the load shall be connected to the two switchboards, according to separation requirements and equalisation of load.

The two parts will normally be running in split mode. Upon failure on one of the feeder circuits the feeder breaker can be disconnected and the bus-tie breakers engaged, thus the remaining transformer can supply both 220V switchboards.

The vessel's 220V consumers shall be supplied from these switchboards, important consumers shall be supplied directly from the switchboard, consumers of minor importance in general shall be supplied via locally installed distribution panels.

Moulded Case Circuit Breakers (MCCB) shall be applied. Consumer loads circuit breakers shall be thermomagnetic plug-in moulded case circuit breakers.

## 872 Emergency switchboards

An emergency switchboard (IT), 450V, shall be installed close to the emergency generator. The switchboard will be normally supplied from the 450V main switchboard. A failure in the normal power system will start the emergency generator automatically and connect it to the emergency switchboard. The emergency switchboard will be equipped similar to the standard for the main switchboard.

The emergency system shall have the necessary facilities to feed the main switchboard for dead ship recovery.

A 220V emergency switchboard (IT) shall be provided. The switchboard shall be supplied by separate 450V/220V, 3-phase emergency transformer(s), ref. [865 Transformers](#).

Emergency light according to rules, shall be integrated in the ordinary light installation, bed lights in all cabins shall have power supply from emergency system. Additionally, emergency light to be installed in captain's cabin, master's cabin and cabins with alarm panel for UMS.

The ESB shall normally be fed by the MSB or, in an emergency, directly by the Emergency DG.

The ESB shall consist of at least:

- 1 (one) Emergency DG input column
- 1 (one) input column for MSB supply and transformer feeder

- 1 (one) 450V distribution column
- 1 (one) 220V distribution column.

Moulded Case Circuit Breakers (MCCB) shall be applied.

The ESB columns shall be short-circuit and arc flash certified.

They shall be made up of individual cubicles, separated by steel plates, in order to confine electrical faults.

Each 450V and 220V distribution column shall have at least two spare circuits equipped with circuit breakers.

The Emergency circuit breaker shall be of withdrawable "air circuit breaker" (ACB) type, with features for testing in the withdrawn position and protection functions in an "intelligent" electronic module. Consumer loads circuit breakers shall be thermomagnetic plug-in moulded case circuit breakers.

The front and rear doors of electrical panels shall be fitted with handrails made of insulating material along the entire length of the panel.

The panel shall be built in such a way as to allow safe thermographic inspections with the circuits energized at cable and busbar connections.

In addition to the consumers provided for in SOLAS, the Emergency DG shall feed:

- DGs pre-lubrication systems
- Heating resistor for the main generators
- Any equipment needed to provide the starting conditions for the DGs and Emergency DG
- Refrigerated Provision System
- Galley equipment
- UPS
- Fire detection and fire fighting systems
- Diesel oil transfer pump for the Emergency DG tank
- 1 (one) reversible fan of engine room
- 1 (one) main air compressor
- Electrical test panel
- Electrical and mechanical workshop, ECR, CCR, Navigation Bridge and infirmary sockets
- Charging sockets for lifeboat batteries
- Emergency lighting (around 30% of normal lighting and part of the deck floodlights)
- Emergency sea water pump, responsible for emergency draining of the engine room.

## 874 Starters and emergency stop system

### Group Starter panels

Group starter panels shall be made up of individual cubicles, separated by steel plates, in order to confine electrical faults.

The group starter panels shall have the following resources:

- Common busbar for grouped starters
- Manual controls for power, start, stop, "local/remote" selection (\*), "manual/automatic" selection and other necessary controls
- Indications of "powered", "running", "stand-by", "local", "remote", "manual", "automatic", "heating on", faults (individualized) and other necessary information
- Ammeter, for motors with a power rating of 10 kW or more, with marking of the rated current

- of the equipment being driven
- Safety device for attaching a padlock for maintenance.
- The local control pushbutton, with a "de-energized" lockout feature, shall be installed next to the driven equipment, whenever the respective starter panel is located more than 5 (five) meters from it. The local control buttons will have "start", "stop" commands and "running" indication when it is not possible to identify the operation of the equipment. The "stop" pushbutton shall be "fail safe", have a latch in the actuated position and be protected against accidental actuation by means of a tilting cover
- Input and output interface signals with the IAS, according to the application (running, local / remote, fault alarm, among others)

(\*) Local control means control from the field button next to the equipment, and remote control means control from the starter panel or IAS.

Starter panels for specific use, such as for galley, laundry and workshop equipment, shall be in accordance with the manufacturer's standard for the driven equipment.

All circuit-breakers shall be supplied with locking devices for blocking and signaling during maintenance work on the equipment.

Power supply circuits for electric motors driven by VSD to improve energy efficiency shall include VSD by-pass contactors or circuit breakers and a direct or compensated start operating mode depending on the motor's power. VSD shall have an input reactance to reduce the harmonic distortion at the electrical system and prevent damage to the VSD due to system voltage transients. Each group starter panel shall have at least two spare starters or 20% spare starters (whichever is greater), equipped with circuit breakers and a complete control circuit.

Copies of the respective connection diagrams for each starter panel shall be prepared, supplied and confirmed available after the installation has been completed.

### **Unlinear loads**

The amount of various unlinear loads on the various busbars to be limited according to what is required to keep within the harmonic distortion levels given in 85 Common electrical and electronic systems.

During the engineering period, preliminary THD calculations at each separate system (450V/220V) for the vessel's various normal operation modes to be worked out, and based on the system capability and known unlinear loads in the system an available rest capability for 6-pulse drives to be calculated and documented.

If the THD calculation for a busbar section gives levels that exceeds the limits given in 85 Common electrical and electronic systems, yard to supply means to reduce the harmonic distortion on the given busbar.

Means to lower the harmonic distortion:

- Replacing 6-pulse drives with higher pulse numbers
- Using pulse drives with active filters
- Replacing pulse drives with AFE drives
- Installing separate filters to reduce the THD

Transformers in the systems shall be designed to minimise harmonics back to source.

### **Emergency Stop**

Emergency stop push buttons shall be arranged in groups. Generally these shall be based on shunt trips in the main switchboard covering several fans/pumps etc. by one push-button. The push buttons shall be protected against accidental operation by cover or breakable glass.

Emergency stops shall be automatically triggered by the fixed fire-fighting systems in those areas.

Further emergency stops for sludge pump etc. shall be arranged according to Classification Society requirements.

All emergency stop locations shall be agreed by the Owner during the approval stage.

Emergency stop push buttons shall be arranged in groups previously agreed with the Owner.

## **875 Distribution panels**

### **General**

Local distribution panels (fuse lockers) shall be arranged for minor machinery, illumination and heating.

All distribution panel cabinets shall be made of aluminium or primed steel with a painted surface. The cabinets shall have hinged door(s) with catch and lock complete with key or similar. All panels shall be keyed alike. A directory frame and card shall be provided inside the doors.

Distribution panels shall have a common power supply bus and individual circuits for consumers, protected by plug-in thermomagnetic circuit breakers.

Each distribution panel shall have at least two spare circuits or 10% of the total number of circuits (whichever is greater), equipped with circuit breakers.

Cable entrance for distribution panels in machinery spaces shall generally be from below.

The degree of protection shall be IP23 in control rooms and similar spaces, IP44 in machine and similar spaces and IP56 in open areas.

### **Distribution panels for 450V**

Distribution panels 450V for galley- laundry equipment, heating fans, illumination etc.

Earth failure indication shall be provided for this cabinet.

Miniature circuit breakers (MCB) shall be used.

### **Distribution panels for 220V**

Distribution panel for 220V equipment.

Miniature circuit breakers (MCB) shall be used.

This 220V distributions shall be supplied directly from the 220V main switchboards which are supplied via transformers 450V/220V

### **Distribution panels for 24 V**

Distribution panels for electronic equipment, remote control etc.

Miniature circuit breakers (MCB) shall be used.

## **88 Cable installation and cable support**

### **General**

All power supply cables throughout the vessel shall be of minimum 1,0 kV or 250 V grade insulation and meet the voltage which they are subjected to. Minimum 1,0 kV grade cables shall be used for all

cables above 1 mm<sup>2</sup> installation and minimum 250 V grade cables shall be used for all pair cables. Special attention shall be paid during selection of cables to power supply connection to three-phase drives from pulse-controlled converters.

Cables shall not be painted.

All cables shall be installed in compliance with the rules of the Classification Society.

All cables except co-axial cables, shall in general have multicore and multistranded construction.

Cables in general shall have copper conductor and XLPE or EPR conductor insulation.

Special cables such as compensating cables, data network cables, shielded cables, coaxial cables etc. shall be used where necessary, ref. [886 Special cables](#).

General-purpose electrical cables for marine use shall be made of stranded copper, with insulation and outer jacket made of completely halogen-free materials, "flame retardant", "low smoke emission" in accordance with IEC 60332 parts 2 and 3, smoke density in accordance with IEC 61034-2, and low toxic smoke emission in accordance with IEC 60754. Cables installed in areas likely to come into contact with hydrocarbons shall have an oil-resistant sheath.

Fire-resistant cables shall comply with IEC 60331-21.

Three core power cables (single or multiple in parallel) shall be used to and from frequency converters. Multiple single core cables in parallel may be used for other high power equipment provided the cables are arranged to limit the difference in impedance between the cables for one component.

For multiple single core cables this means that cables shall be arranged with three or six cables in one bundle and configured according to normal ship building standards. The cables shall be revolved two (2) times with equal distance if over 30 m long. If over 80 m long, cables shall be revolved five (5) times with equal distance.

Instrumentation and control cables shall be kept away from power cables to avoid electromagnetic induced currents. All cables shall be installed taking into account the segregation requirements set out in IEC-60533 regarding electromagnetic interference. In addition, a minimum spacing of 300 mm between trays is required for maintenance.

Electrical cables in areas exposed to the weather shall be installed in cable trays. These shall be made of 316L stainless steel and the cables shall be armored, with a PVC outer jacket. In load handling equipment areas, covers shall be installed over cable trays.

Control and power cables between the DGs and the MSB and between the Emergency DG and the ESB, cables installed in or passing through hazardous areas classified as zone 0 or zone 1 and cables passing through areas subject to mechanical damage (cargo handling areas, permanent maintenance areas, main deck, submerged areas) shall be armored. Multicore cables shall have a galvanized steel wire mesh armor and single-core cables shall have a copper armor or other non-magnetic material protected by an anti-corrosion coating.

Flexible electrical cables for remote control pushbuttons shall have a spare pair of conductors and a minimum flexibility class of 5.

The outer cover of cables exposed to sunlight shall be protected against degradation by UV radiation and comply with UL 1581 section 1200. Equivalent certification can be submitted for evaluation to Owner.

All electrical, instrumentation, automation and communication cables connected to Ex equipment shall be circular and compact, with an extruded, non-hygroscopic jacket and filling material, and shall be subjected to restricted breathing tests in accordance with the requirements of IEC 60079-14.

The outer cover of the cables/conductors shall be:

- For grounding/equipotential cables: green and yellow
- For intrinsically safe circuit cables: light blue
- For AC or DC power cables: black
- For phase conductors in three-phase cables: black, brown and gray
- For phase conductors in two-phase cables: black and brown
- For DC cable conductors: red (positive) and black (negative)

### Cable support

Cable trays for major cable runs shall be of the Z-profile type for effective installation, and to enable cables to be installed on both sides of the cable tray.

Space for future additional cables shall be provided in major cable runs (Approx. 10%).

### EMC plan

An EMC plan for cable installation shall be provided.

The plan shall as a minimum contain:

- A philosophy for use of screened cables
- Classification of cables into different EMI generation and susceptibility levels
- Rules for separation, routing and bunching of cables.
- Description of earth and cable screen connections.

The EMC plan shall be accepted by the Owner before installation work starts.

### Fixing of single core cables

In order to guard against the effects of electro dynamic forces developing on the occurrence of a short circuit or earth fault, single core cables shall be firmly fixed, using supports of strength adequate to withstand the dynamic forces corresponding to the prospective fault current at that point of the installation. The fixing clamps of the cables should not damage the cable when the forces affect the cables during a 1 s short circuit period.

### Screened cables

All 24 V cabling shall be of the screened type (except cables from battery to main distribution). All cables outside and in the wheelhouse shall be screened type. All cables to a hazardous area (Ex) shall be screened or armoured. This is also valid for cables passing through a Hazardous area (Ex).

## 881

### Cable installation

Cable runs shall be located as far as possible away from spaces exposed to excessive heat, steam, exhaust gas and moisture.

Cabling shall be avoided in spaces exposed to drip or accumulation of water or oil vapour as far as possible.

Cables liable to be exposed to mechanical damage shall be protected by suitable means e.g. by using galvanized steel pipes, steel conduits, flexible steel pipes etc.

Cable installation on open deck shall be minimised.

For protection of vertical single cable penetration to open deck, galvanised pipe with cable gland on top shall be provided. The pipe shall have a height of 900 mm above deck with a swan neck where possible. The pipe shall be fully welded to deck.

Wiring throughout the vessel shall be carefully arranged to eliminate fire risks.

The voltage drop from the main switchboard bus-bar to any point in the installation when cables are carrying maximum current under normal service conditions shall not exceed the Classification Society rules (AC=6%, DC=10%).

The cabling throughout the vessel shall be done in such a way that various instruments/meters on the bridge, instrument room, engine room etc. do not get affected due to radio frequency interference when the radio station is in operation.

The minimum bending radius for multipole armored cables shall not exceed ten times their nominal diameter and for single-pole armored cables shall not exceed twelve times their nominal diameter. No cable splices will be accepted. When strictly necessary, the connection of two sections of cable shall be made inside panels or junction boxes, using appropriate terminals fixed to the base plate. The use of splicing connectors or similar will not be accepted.

The electrical cables shall be identified at both ends in accordance with the respective codes ("tags") of the electrical diagrams. The conductors in use shall be identified at both ends according to the codes of the terminals to which they are connected.

Electrical cable junction boxes shall be shown on the electrical diagrams and shall be visibly identified at the installation site.

Electrical cables installed on masts shall have mechanical protection up to a height of 3 m (three meters).

Independent separate earthing cable shall generally be applied for earthing of metallic enclosures. Earthing by means of the fixing devices shall be limited to special cases and is only acceptable in internal areas and provided the electric contact is made firm through metal to metal contact without paint with corrosion resistant screws, nuts and star washers.

## 882

### Cable support

Cables shall be effectively supported and secured without damaging their outer coverings.

Cable groups shall be supported on metal trays/ hangers placed clear off steel hull structure to permit painting on surrounding structures.

Cables may be installed directly on wooden walls or other non-rusting materials where frequent painting is not required.

Cable trays/ hangers shall be made of galvanized steel. On trays and flat bars, they shall be fixed with AISI 316L stainless steel clamps coated with plastic

material, so as not to damage the cables. Cable outlets in cable trays shall be protected with thermoplastic material.

The support of the trays in the exposed area shall be made of 316L stainless steel or painted galvanized steel. In branch

sections where the use of cable pipes is necessary, these shall be made from ASTM A-53 or ASTM A-106 schedule 80 welded steel pipes.

Cable pipe bodies and cable pipe fittings shall be hot-dip galvanized and painted externally. Fastening screws for conduits, trays or rails shall be 316L stainless steel.

Independent trays or conduits shall be provided on the main deck for each of the following groups of electrical cables:

- Power and lighting cables;
- Intrinsically safe system cables;

- Communication, navigation and automation system cables.

The electrical continuity of the cable trays shall be ensured with jumpers or bonding cables fixed using welded AISI 316L stainless steel bolts, lock washers and hexagonal nuts, designed exclusively for this purpose.

A total of maximum 6 single core power cables may be bunched by one clamp.

Cables exposed to weather shall be secured with stainless steel hoops and buckles.

Where cables pass through watertight bulkheads or decks, watertight stuffing glands, or boxes for multi-transit arrangement, shall be used. The multi-transits shall have additional space for future installation.

Where cables pass through non-watertight bulkheads, beams or girders, the cables shall be protected in the penetration.

Cable sealing schemes with sealing compound or MCTs installed below the worst-case waterline shall withstand the expected hydrostatic pressure column (provided with watertight certification). These sealing schemes shall be certified with a minimum hydrostatic pressure of 4 bar. Sealing compound schemes and MCTs applied in hazardous areas shall have a certificate issued by a certifying body or official laboratory attesting the compliance with the requirements of IEC 60079 and Brazilian legislation (INMETRO).

Each MCT shall have at least 20% reserve blocks. MCTs shall have type certificates approved by an IACS member classification society, for use in A-60 penetrations and do not require the use of fire retardant compounds on the blocks.

The sealants used shall be of the flexible type and shall allow the laying of new cables by easy removal and subsequent replacement of the sealant. Rigid sealing compound will not be accepted.

Coamings for cables shall be provided at places where cables pass through non-watertight decks.

In accommodation where panel work is done over hull structure, cables shall be concealed as far as practical.

Panel-work in accommodation covering cable runs, shall be easy dismountable.

Cable trays between bridge deck, instrument room and main deck shall be easy accessible for future installation.

The cables in engine room spaces, lockers, stores etc. may be exposed.

For installation of temporary electrical equipment on wheelhouse top, an easy accessible and easy dismountable multi cable penetration - tube or similar - shall be provided from the wheelhouse to open deck. The penetration shall go through the inside lining in the wheelhouse and shall be easily sealed when not in use (e.g. with screwed cap or similar in both ends). If this penetration is arranged on the wheelhouse top, a swan neck arrangement shall be applied.

Edges of cable support/ trays to be provided with protection against cable chafing/ damage.

Cable metallic bands to be provided in machinery spaces and elsewhere applicable.

## 885 Spare cables

Electrical control cables, with a minimum capacity of 20 pairs of conductors, shall be installed as a reserve for future extensions, between: navigation bridge and CCR; navigation bridge and ECR; ECR and CCR.

Types and number of spare cables to be installed between the different locations shall be agreed with the Owner, but shall be a combination of power cables (1,5 mm<sup>2</sup> and 2,5 mm<sup>2</sup> (various numbers), signal cables (twisted pair) and Cat7 network cables.

## 886 Special cables

### Ethernet (twisted pair)

Ethernet LAN cable shall support Class D performance characteristics as a minimum. This is achieved by using ISO/ IEC Category 6. The reason for this is to ensure network reliability and immunity against background noise (EMC).

### Ethernet (fibre optical)

According to standards, multimode cable plants shall maintain uniform fibertypes in each link including jumpers and patch cords. Many suppliers equipment comprises 62.5 µm patch cords internally and recommends compliance with standards by maintaining consistent core sizes within the plant.

Special electrical or fiber optic cables shall be installed in accordance with the recommendations of the manufacturers of the equipment they serve.

Fiber optic cables shall meet the requirements of IEC 60793, IEC 60794, IEC 60332-1-2, IEC 60332-1-3, IEC 60332-3-10 and IEC 60332-3-22, including the maximum operating temperature of 85°C (IEC 60793-1-52). The laying of fiber optic cables shall comply with the tensile limits and bending radius of the respective cable, according to the manufacturer's information.

### Can bus

A high level protocol, CANopen (ref. ISO11898), shall be used for administrating the bus communication and for interface to application and system software.

CANopen networks run at high data rates, and require cable specifically designed to carry high frequency signals. Low quality cable will attenuate the signals, and may render the signal unreadable for the other nodes in the network.

To ensure network reliability and immunity against background noise (EMC) a proper cable suitable for CAN-Bus communication shall be selected.

### Instrumentation

Instrumentation cables for permanently installation in ships shall comply with IEC 60092-350 and IEC 60092-376.

Instrumentation cables shall be shielded by pair or 3 core. Instrumentation and communication network cables shall have a general copper shield and outer jacket, and shall meet the requirements of IEC TS 60034-25.

All instrumentations cables should be stranded type. Attention shall be paid to cable length and calculations regarding voltage drop shall be made in order to choose a cable with suitable wire cross-section.

### Serial data transmission (RS422/485 including Modbus)

TIA-422 and TIA-485, commonly known as RS422 and RS485, are two independent standards for balanced and differential serial communication.

The standard does not give any recommendations regarding cable types or cable impedance. However, many equipment suppliers recommend to use a twisted pair shielded cable with characteristic impedance of 120 Ohm and low capacitance.

### Serial data transmission (RS-232)

TIA-232, commonly known as RS232, is a point-to point, full duplex, not galvanic isolated and unbalanced serial communication method.

The standard does not give any recommendations regarding cable types to be used for transmitting RS232 signals, so most twisted pair cables can be used. On the other hand, the transmission range will increase if a cable with lower capacitance and larger diameter is used. Shielded twisted pair cables with low capacitance is recommended.

### Coaxial (Antennas)

Flexible, coaxial single conductor cable types are recommended. The coax characteristic impedance should be  $50 \Omega$  to ensure both relatively high power handling capability and low signal loss per unit length.

In order to assure the best performance in permanent installations it is recommended to choose both cable and connectors according to equipment manufacturer's recommendations in actual application.

### Profibus

For profibus communication a special screened twisted pair cable suitable for profibusDP is required. The requirements are:

- Impedance:  $135..165 \Omega$  3-20 MHz
- Capacitance:  $<30 \text{ pF/m}$
- Resistance (line resistance):  $< 110 \Omega/\text{km}$
- Core/wire diameter:  $\geq 0,64 \text{ mm}$
- Core/wire size:  $\geq 0,32 \text{ mm}^2$

Multi core conductor, single core are not allowed.

### Low Voltage power distribution (220V AC/24 V DC)

Power cables for permanently installation in ships shall comply with IEC 60092- 353 and IEC 60092-354. Depending on application, power cables shall be either braid screened or unscreened.

Attention should be paid to cable length and calculations regarding voltage drop shall be made in order to choose a cable with suitable wire cross-section. This is especially important for 24 V power cables.

### Power cables for variable frequency drive

The power supply cables for VFD-driven motors shall be multi-core, with a copper shield concentric to the phase conductors and an outer jacket.

## Electrical installations

### General

The accommodation, workspaces and outside decks shall have sufficient lighting and emergency lighting, meeting the requirements of the National Authorities and emergency lights shall be approx. 30% of the normal lighting.

These lights shall cover requirements and areas like Floodlights on work decks, Life raft -/ Lifeboat lights, ISPS lights, Searchlights and illumination of Vessel's name and Owners logo.

Generally there shall be mounted marine type LED light fittings. Incandescent lamps may be used for decorative purposes in accommodation and where fluorescent fixtures are impractical. Downlights shall be applied throughout the accommodation to the largest possible extent.

Emergency lighting shall be arranged in workspaces and accommodation and be according to National Authorities' requirements.

Low location lighting and supplementary lighting shall be arranged for cabins and escape ways in corridors and stairways according to Class, rules and regulations. ref. F Class and H Rules and regulations, tonnage regulations

The switches used in the lighting circuits shall be bipolar. Residual current devices (RCD) shall be installed on all lighting terminal circuits.

The lighting systems (main and emergency) shall be designed to reduce the possibility of total lighting failure in any area of the vessel, always using two different circuits per area.

Illumination level (Lux) shall be according to class and authorities requirements if nothing else is specified.

The lighting systems (main and emergency) shall be designed so that there is a maximum of 15% current unbalance between phases.

The emergency lighting (powered by the ESB) will meet the minimum areas required by SOLAS and will also make up 50% of the infirmary lighting and (around) 30% of the main lighting, and shall be properly identified.

Lighting equipment and fittings powered by emergency/temporary lighting systems shall be clearly identified. In distribution panels, the luminaire circuits shall be independent of the socket circuits.

Lighting fixtures shall only use replacement materials (lamps, power modules, etc.) available on the Brazilian market. Otherwise, the Yard shall supply at least 5% of the total number of components of the respective model used in the vessel as spare.

In addition to the main lamp powered by alternating current, some of the vessel's luminaires shall also have a lamp powered by 24 Vdc. Luminaires of this type shall be provided in the following areas:

- 12 (twelve) in the engine room;
- 3 (three) in the ECR;
- 2 (two) in the staircase trunk;
- 1 (one) in the galley;
- 1 (one) in the accommodation corridor adjacent to the messroom;
- 2 (two) in the Emergency DG compartment.
- 1 (one) in the CCR;
- 1 (one) in the inert gas generator compartment;
- 1 (one) in the Engine Room Emergency Exit Trunk.

Enclosures shall have IP ratings as mentioned in Table 8.10.

To minimise THD issues on the 220V systems, special attention shall be paid to drivers for lights (HP, fluorescent and LED) throughout the vessel. Drivers (LED drivers, Electronic ballasts, uncompensated ballasts) shall be selected to minimise the impact these have on the THD on the electric power system.

The lighting in the engine room is to be provided by LED floodlights, controlled from the site. The supply hatch will be illuminated by LED floodlights, controlled from the site.

The lighting in the Main Engine top area shall be provided by LED floodlights, controlled from the site. The lighting on the Navigation Bridge shall be equipped with dimmers and controlled individually by area of operation.

Table 8.10 Minimum IP rating for electrical lighting enclosures

Equipment	minimum IP rating
Light fixtures in dry accommodation	IP 20
Light fixtures in galley, laundry, etc.	IP 44
Light fixtures in engine room, etc.	IP 54
Light fixtures in stores, garbage room, etc.	IP 44
Light fixtures on open deck	IP 66

### Service supply/ Service receptacles

Service sockets from various voltage systems, 1 and 3 ph shall be installed throughout the vessel as normal for the ship type and trade.

The maximum current of the lighting/ socket circuits shall not exceed 20 A.

Residual current devices (RCD) shall be installed on all socket terminal circuits.

Industrial sockets for general use, watertight (IP-56), two-pole, universal type with grounding pin, shall be installed in the engine room (at least four sockets per floor), engine compartments, engine storerooms, deck storerooms, bosun store, lifeboat area, rescue boat area, external area of the main deck (portside and starboard) and in a safe area to serve the hatchway, funnel, workshops, galley, pantry, laundry, near the radar mast and forward masts.

Sockets installed in hazardous areas shall be manufactured in fiberglass-reinforced plastic enclosures and have Ex-de type protection.

ESB-powered sockets shall be available on the lifeboat's launch platform (for charging its battery) and make up 50% of the sockets installed in the workshops (electrical and mechanical), the infirmary, the ECR, CCR and navigation bridge.

In addition to the general-purpose sockets, specific-purpose sockets shall be installed for each washing machine, iron, refrigerator, dishwasher, ice machine, microwave oven, coffee maker, toaster, copy machines, microcomputer, television, DVD player, stereo set, etc.

Three-pole sockets, with grounding pin, 450V / 50 A, shall be installed to supply the electric welding machine, in the electrical workshop, steering gear compartment, engine room casing and bosun store.

The sockets in the workshops shall be powered by the ESB.

The plugs and sockets shall follow the usual Brazilian market standards.

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### Electrical installations in engine room, stores, workshops, etc.

#### Installation in engine room, stores, workshop etc.

Tank level gauges and pipeline flow gauges shall be equipped with local lighting using LED lamps.

Light fittings below decks exposed for high vibrations or shock loads (e..g. cargo deck/ work deck) shall be mounted with rubber suspension.

#### Heating of compartments outside accommodation

Rooms without air supply from an air handling unit shall be equipped with Electrical heating being able to keep the inside temperature well above freezing i.e. minimum room temperature according to 57 Ventilation, air-conditioning & heating systems. If a room/ area requires more than 3 kW heating capacity the heating shall be by heating circuits from the hot water boiler system. Ref.845 Thermal Oil Heating System and 577 Central heating systems for accommodation.

## 892 Electrical installations in accommodation

### General

All lamps shall be provided with double poled switches.

Spotlights shall have step-less dimmers.

The light fittings in accomodations shall be of the recessed type with tubular LED lamps or LED lamps with E27 sockets.

Sufficient number of double poled switches shall be installed for each room and area throughout the accommodation as normal for the ship type and trade.

General-purpose, non-static, two-pole, universal sockets with a grounding pin shall be installed in the superstructure corridors (with a spacing of 15 m between sockets), cabins (2 (two) next to the bed, 4 (four) on the work table and 2 (two) on the bedside table), working and training areas, control rooms, dry storerooms and in electrical equipment compartments.

Heating of accomodation shall be of electrical type.

Power socket in accommodation to be 20A.

## 893 External light, deck light etc.

### Outside lighting

Sufficient LED lighting and LED emergency lighting shall be provided for all outside decks meeting the requirements of the National Authorities.

All outside lights shall be suitable for operation in the environmental conditions (ref. [Table 0.6](#)) of which they are exposed.

General lighting outside shall be Stainless steel or Brass light fittings (LED).

Lighting on the main deck and other external working areas, including the funnel, shall be provided by LED spotlights, controlled from the navigation bridge by a control panel or equivalent resource.

The accomodation ladders will be illuminated by LED spotlights installed on a folding base in the navigation bridge wings, controlled from the navigation bridge. Signal lights and searchlights can also be used to illuminate the accomodation ladders, provided their installation arrangement is suitable.

Lighting of the provision crane operation area at hull side area shall be provided by LED spotlights installed on a retractable base, with site socket, plug and switch.

Lighting of the hull side area used for rescue boat launching shall be provided by an LED spotlight installed on a retractable base, site controlled.

Lighting of the hull side area used for all inflatable raft launching (aft and forward) shall be provided by an LED spotlight installed on a retractable base, locally controlled and powered by ESB.

Two (2) portable bulbous bow warning lights (white) and two (2) portable propeller warning lights (red) shall be supplied.

Ten (10) portable 20 W LED luminaires shall be supplied, watertight, increased safety (Ex-e"), encapsulated (Ex-m) or non-sparking (Ex-n), with a protective grid, with 15 m of flexible cable combined with a steel guide cable.

External lights forward and on the sides of the superstructure shall be switched on in the forward bridge console. External lights astern shall be switched on in the aft bridge console.

All luminaires or spotlights installed in a hazardous area shall have Ex protection of the increased safety type Ex-e, encapsulated Ex-m or non-incendive Ex-n.

All luminaires or floodlights installed outdoors shall have an AISI 316L stainless steel or fiberglass reinforced plastic housing.

In addition to the standard fixing of each model to the vessel support, all floodlights and spotlights installed in open areas shall be fixed to the vessel's structure by AISI 316L stainless steel chains or cables.

A floodlight in each of the following deck areas shall be powered by the ESB: bow, stern, cargo manifolds (one per side).

Lighting fixtures/ luminaries to be provided with shox for vibration purposes.

## 9 ENERGY EFFICIENCY

### 9.1 General

The vessel will be designed, built and operated with a view to excellence in mitigating environmental impacts in order to minimize air emissions, discharges into the sea and underwater noise.

The vessel's design shall take into account the concept of energy efficiency and management laid down in IMO rules, regulations and recommendations, MARPOL Convention Annex VI and related documents, with a reduction in emissions to the sea, air and optimization of fuel consumption, fully complying with the Energy Efficiency Design Index (EEDI) phase 3, without compromising design characteristics such as speed, draft (summer load line), cruising range and minimum deadweight.

During the concept design, the following technologies characterized as "Category A" (MEPC.1/Circ.896 - 2021 GUIDANCE ON TREATMENT OF INNOVATIVE ENERGY EFFICIENCY TECHNOLOGIES FOR CALCULATION AND VERIFICATION OF THE ATTAINED EEDI AND EEXI), non-exhaustive, shall be considered where not already specified in parts 1 to 7 of this Technical Requirement:

- Optimized fuel consumption for the vessel's operational profile;
- Optimization of hull lines;
- Optimization of the propulsion system;
- Rudder optimization;
- Use of hydrodynamic appendages "Energy Saving Devices" (hull, rudder, propeller).

Other technologies that might be implemented in the project:

- Use of alternative fuel (minimum preparation);
- Engines designed and equipped with improvements that allow reduced fuel consumption at low loads, engine performance monitoring and automatic adjustment system, with the ability to provide troubleshooting and economic torque control;
- Variable speed drive (VSD) electric motors, not limited to cooling system pumps and fans in the engine room;
- Use of a high-performance anti-fouling system ("low friction coating");
- LED lighting;
- Trim optimization system (+optimal trim table) integrated with loading software;
- Course control system;
- Speed control system;
- Shaft power measurement system (torsionometer) with display connected to the IAS;
- Fuel consumption measurement system, using a mass flow meter (Coriolis), independent for each consumer group, integrated with the IAS and enabled for external data transfer.

In addition to the Category A technologies and others mentioned above, Category B technologies ("Air Lubrication System; Wind Assisted Propulsion System") and Category C technologies ("Waste Heat Recovery System, DC grids, photovoltaic cells") as defined in document MEPC.1/Circ.896, shall be assessed and proposed, where not already specified in parts 1 to 7 of this Technical Requirement, in compliance with the design assumptions as a means of improving the vessel's performance, energy and environmental efficiency, with a view to meeting the regulatory indicators (EEDI/ CI).

#### 9.1.1 Optimized Fuel Consumption

##### Kongsberg AutoChief Propulsion Control System

- Fuel pilot function
- Speed pilot function

The vessel have implemented functionalities in the AutoChief Propulsion Control System, like fuel- and speed pilot functions to keep fixed speed, or fixed fuel consumption.

### K-Chief PMS - Power Management System

The Kongsberg integrated K-Chief Power Management System will cover all basic functionalities for safe and efficient operation. It can be part of a total Energy Control architecture, which again contains several layers and strategies for optimal efficiency, the Energy Management System.

#### 9.1.2 Optimized Hull Lines

Hull design is based on extensive iterations by CFD on hull resistance and propulsion efficiency, for design draught without compromising ballast draught conditions.

Marin Model Basin was engaged to used their best experience data in speed prognosis.

Information from Marin studies in combination with iteration from propeller supplier, was used in further optimizations by CFD.

#### 9.1.3 Optimized Propulsion System

The vessel is equipped with an optimized propulsion system designed to maximize efficiency across the entire operating profile. A key feature of this system is the use of a large-diameter controllable pitch propeller (CPP) operating at low revolutions per minute (RPM). This configuration ensures high propeller efficiency by reducing losses due to cavitation and slip, while also enhancing thrust at lower speeds.

The large CPP is specifically engineered for efficient operation in combinator mode, where both pitch and RPM are continuously adjusted by the vessel's power management system. This enables the propulsion system to follow the optimal propeller efficiency curve throughout the speed range, ensuring minimal fuel consumption and reduced emissions during varying operational conditions.

#### 9.1.4 Rudder Optimization

##### Promas - integrated twisted rudder- propeller solution

- The Promas system integrates the propeller, hub cap, bulb, and rudder into one propulsive unit, increasing propulsive efficiency and improving manoeuvrability. This results in significant fuel savings without power losses.

The hub cap in combination with the "Costa bulb" reduce/take away the hub vortex behind the propeller. With reduced/no hub vortex, the load on the propeller are moved from the propeller tip and closer to the hub.

This gives more efficient propeller and reduce pressure pulses from propeller tip to hull, and by that reduce conditions for potential noise and vibration.

The twisted rudder recovers rotation energy from the propeller water and gives a lift in forward direction.

##### K-Steering remote-control system

- Safe and energy efficient steering.

K-Steering is the latest generation of control systems for Steering Gears. The Kongsberg K-Steering combines control system for the steering gear unit into one system for mode selection and command transfer for stable, safe and efficient steering.

## 9.2 Other technologies

The vessel is designed with a "System Integration Philosophy", which makes sure the technical interphase and technical logistics are designed to optimize vessel operation and maintenance.

## K-Chief Integrated Automation System IAS

- Seamless Integration between Kongsberg Systems
- Optimized configuration - Saving space and weight
- Shared spare parts minimize crew training and maintenance

Our K-Chief solution is the ultimate choice for shipowners and operators seeking seamless integration and enhanced operational safety when using multiple Kongsberg systems.

Our cutting-edge, redundant bus network maximizes system reliability, while interchangeable operator stations and shared spare parts minimize crew training and maintenance.

### **The vessel will be prepared for an Shaft Generator option**

The gear box will be prepared with a PTO shaft for Shaft Generator.

In addition there will be arranged an open section in switchboard for potential Shaft Generator.

The decision on providing a Shaft Generator will not be taken before the Model Test Performance is concluded.

The reason for an optional Shaft Generator is to provide further margins on EEDI Index, if margins on estimated speed are reduced after Model Test.

## 10     OPTIONS



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# Building specification

NVC 615 PT  
15600 TDW Product tanker



**Owner****Transpetro****Yard****Mac Laren /  
Ecovix****Building Specification****Revision History**

<b>Version</b>	<b>Date</b>	<b>Reason for Issue</b>	<b>Sign</b>
1	17.09.2024	First issue	PEV
2	30.09.2024	Updated with more details	BEK
3	18.10.2024	Updated acc. owners clarifications	PEV
4	24.01.2025	Updated acc. to new deadweight	PEV
5	11.03.2025	Updated with misc. changes.	BEK
6	04.04.2025	Updated with misc. changes.	BEK
7	29.04.2025	Updated according to owners comments	PEV



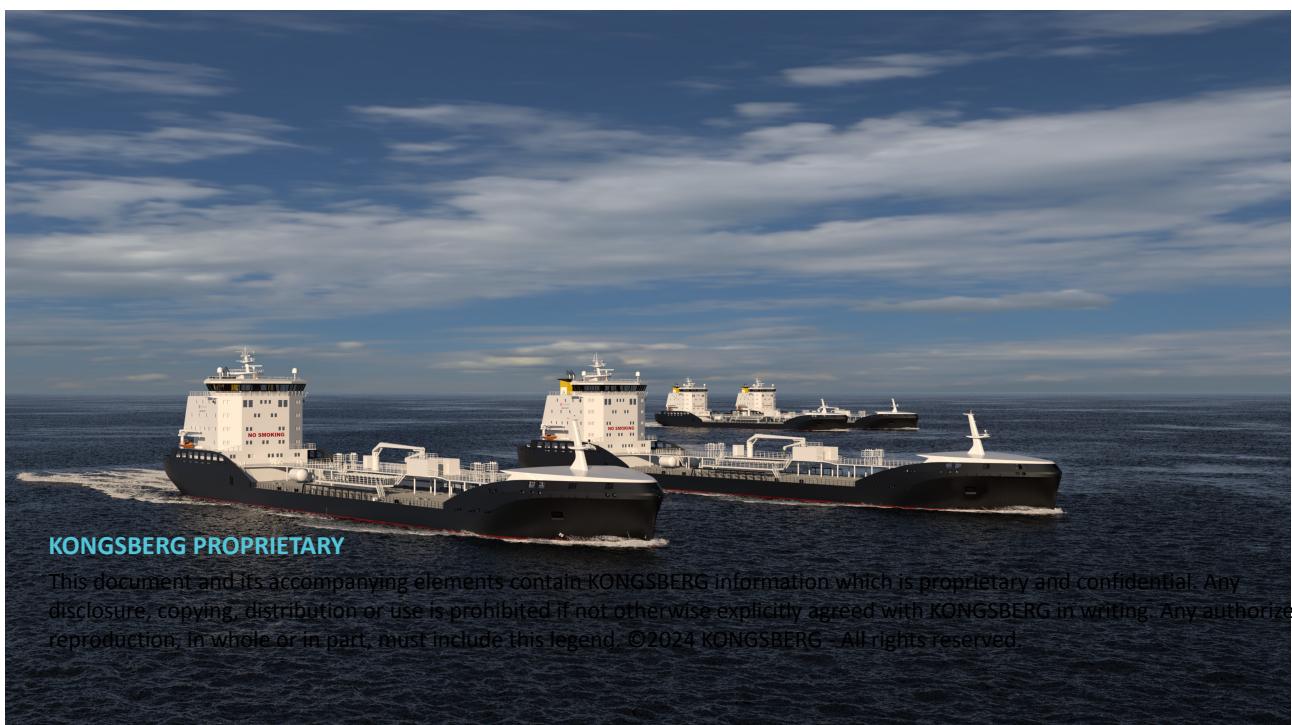
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**Building Specification  
Revision History**

8            20.05.2025    Updated according to owners comments    BEK

# Building specification

Related Documents		Document name	Version	Date	Updated according to owners comments	PEV
NVC 615 PT	10		26.08.2025			
15600 TDW Product tanker						
<b>Doc.No</b> <b>Document name</b> <b>Version</b> <b>Date</b> <b>Updated according to owners comments</b> <b>PEV</b>						
24-7141-101-001	General Arrangement	11	8.0	10.10.2025	28.05.2025	Updated according to owners comments
						BEK/RW
<b>Related Documents</b>						
Doc.No	Document name	Version	Date			
24-7141-101-001	General Arrangement	9.0	10.10.2025			



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## 0 GENERAL

### Abbreviations

Table 0.1 Abbreviations

Abbreviation	Meaning
AC	Alternating Current (electricity)
ACB	Air Circuit Breaker
AFE	Active Front End
AFFF	Aqueous Film Forming Foam
AHU	Air Handling Unit
AIS	Automatic Identification System
ARPA	Automatic Radar Plotting Aid
ARS	Acid Resistant Steel
BNWAS	Bridge Navigational Watch Alarm System
BWTS	Ballast Water Treatment System
CCTV	Closed Circuit TeleVision (system)
CP	Controllable Pitch
CW	Clock Wise
CCW	Counter Clock Wise
DC	Direct Current
DE	Driving End
DIN	Deutsches Institut für Normung (German Institute for Standardization)
DN	Nominal Diameter
DOL	Direct On Line
DSC	Digital Selective Calling
DVD	Digital Versatile Disc
ECR	Engine Control Room
EEDI	Energy Efficiency Design Index
EIAPP	Engine International Air Pollution Prevention
EMC	Electro Magnetic Compatibility
EMS	Energy Management System
EOL	End Of Life
EPR	Ethylene-Propylene Rubber
ER	Engine Room
ESD	Emergency Shut Down
FAT	Factory Acceptance Test
ESS	Energy Storage System
FAT	Factory Acceptance Test
FO	Fuel Oil
FSS	Fire Safety System (code)
FTP	Fire Test Procedures (code)
FW	Fresh Water
GNSS	Global Navigation Satellite System
GRP	Glass fibre Reinforced Plastic

Abbreviation	Meaning
HF	High Frequency
HHP	High Holding Power
HIL	Hardware In Loop
HMI	Human Machine Interphase
HO	Hydraulic Oil
HP	Holland Profile
HPR	Hydro-acoustic Position Reference
HPU	Hydraulic Power Unit
HT	High Temperature
HTC	Heat Transfer Calculation
HVAC	Heating, Ventilation & Air Conditioning
IACS	International Association of Classification Societies
IAPP	International Air Pollution Prevention (certificate)
IAS	Integrated Automation System (Also known as ICMS in Transpetro Specification)
IBTS	Integrated Bilge water Treatment System
ICCP	Impressed Current Cathodic Protection
IEC	International Electrotechnical Commission
ILO	International Labour Organization
IMCA	International Marine Contractors Association
IMDG	International Maritime Dangerous Goods (code)
IMO	International Maritime Organization
I/O	Input / Output
IP	Ingress Protection
ISO	International Standards Organisation
ISPS	International Ship and Port facility Security
ISSC	International Ship Security Certificate
ITU	International Telecommunication Union
LAN	Local Area Network
LCC	Local Control Cabinet
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LFL	Low Flashpoint Liquids
LO	Lubrication Oil
LRIT	Long Range Identification and Tracking
LT	Low Temperature
MARPOL	MARitime POLLution (IMO convention)
MCB	Miniature Circuit Breaker
MCC	Motor Control Centre
MCCB	Moulded Case Circuit Breaker

Abbreviation	Meaning
MCR	Maximum Continuous Rating
MDO	Marine Diesel Oil
MED	Marine Equipment Directive
MF	Medium Frequency
MGPS	Marine Growth Prevention System
MoM	Minutes Of Meeting
MRB	Marine Radio Beacon
MSC	Maritime Safety Commission (IMO)
NDE	Non Driving End
ODM	Oil Discharge Monitoring
PA	Public Address
PABX	Private Automatic Branch eXchange
PC	Personal Computer
PC/UMS	Panama Canal / Universal Measurement System
PID	Proportional Integral Derivative (controller)
PMS	Power Management System
PPM	Parts Per Million
PS	Port Side
PTC	Positive Temperature Coefficient (thermistor)
PVC	Poly Vinyl Chloride
PWM	Pulse Width Modulation
RMS	Root Mean Square
RTD	Resistance Temperature Detector
SAT	Sea Acceptance Trial
SB	StarBoard
SCR	Selective Catalytic Reduction
SEEMP	Ship Energy Efficiency Management Plan
SFI	Skipsteknisk ForskningsInstitutt (Ship Research Institute of Norway)
SG	Steering Gear
SOLAS	Safety Of Life At Sea (IMO convention)
SPM	Shock Pulse Measurement
SSAS	Ship Security Alert System
SSB	Single Side Band
SSP	Ship Security Plan
SW	Sea Water
SWB	Switch Board
SWL	Safe Working Load
TBD	To Be Determined
TFT	Thin Film Transistor (display)
THD	Total Harmonic Distortion
UHF	Ultra High Frequency
UPS	Uninterruptible Power Supply

Abbreviation	Meaning
VDR	Voyage Data Recorder
VHF	Very High Frequency
VSAT	Very Small Aperture Terminal
VSD	Variable Speed Drive
WC	Water Closet
WB	Water Ballast
WLL	Working Load Limit
XXXX	To be solved in Basic/Detail Design phase
Y/D	Star/Delta

## Units

Table 0.2 Units

Quantity	Quantity name	Unit Symbol	Expressed in terms of SI units
Length	metre, nautical mile	m, nm	1 nm = 1852 m
Mass	kilogram, metric tonnes	kg, t	
Time	second	s	
Force, weight	Newton, tonne force, kilogram force	N, tf, kgf	
Pressure	Pascal	Pa, bar	N/m <sup>2</sup> , 10 <sup>5</sup> Pa
Hydrostatic pressure	Metre liquid column	mlc	
Energy	Joule	J	N·m
Energy	Watt hour	Wh	
Electric Current	Ampere	A	
Frequency	Hertz	Hz	s <sup>-1</sup>
Power	Watt	W	J/s
Voltage	Volt	V	J/C=W/A
Electric charge	Coulomb	C	
Electrical capacitance	Farad	F	C/V
Electric resistance, impedance, reactance	Ohm	Ω	V/A=1/S
Temperature	degree Celsius	°C	
Illuminance	lux	lx	
Area	square metre	m <sup>2</sup>	
Volume	cubic metre, litre	m <sup>3</sup> , l	
Volume	gross tonnage	GT	
Torque	Newtonmeter	Nm	
Viscosity	centiStoke	cSt	
Noise	Decibel, A-weighted decibel	dB, dB(A)	
Speed	metre/second, knot	m/s, kn	1 kn = 0,514 m/s
Rotational speed	revolutions per minute	rpm	

Table 0.3 Metric Prefix

Text	Symbol	Factor	Power
giga	G	1000000000	10 <sup>9</sup>

Text	Symbol	Factor	Power
mega	M	1000000	$10^6$
kilo	k	1000	$10^3$
hecto	h	100	$10^2$
deca	da	10	$10^1$
(none)	(none)	1	$10^0$
deci	d	0.1	$10^{-1}$
centi	c	0.01	$10^{-2}$
milli	m	0.001	$10^{-3}$
micro	$\mu$	0.000001	$10^{-6}$

## Definitions and Terms

Where the term **The Owner** is used it refers to:

Petrobras Transporte S.A. (hereinafter abbreviation),

~~Situated in Avenida Almirante Maximiano Fonseca, N 4361 - KM 6 BR 392 - Rio Grande - RS – Brazil Avenida Presidente Vargas, nº 328 – 9º andar – Rio de Janeiro, Brazil~~

Where the term **The Yard** is used it refers to:

consórcio Mare Nova (ajustar endereço),

Situated in Ilha da Conceição, Niterói - State of Rio de Janeiro, Brasil

Where the term **The Designer** is used, it refers to:

Kongsberg Maritime AS, Ship Design

Situated in Ålesund, Norway

Where the term **The Contract** is used it refers to:

The written agreement between The Owner and The Yard.

## A

## General intent of specification

### Vessel philosophy

This specification, together with the General Arrangement, describes a

Tanker for Oil of Kongsberg NVC-Design type NVC 615 PT.

The vessel (hull, systems and equipment) will be designed and optimized for minimum fuel consumption and reduction of air emissions, complying with the requirements of the Energy Efficiency Design Index (EEDI) Phase 3.

The vessel will be prepared arrangement / structure wise for methanol fuel, using a ~~dual fuel (HFO/LSFO/MGO/MDO and engine designed for covention to~~ methanol) engine, according to relevant class notation.

The design and construction of the vessel and selection of equipment to be installed shall be governed by the following considerations:

- Efficient usage of structural materials
- Efficient hull form and propulsion plant
- Fuel economy at service speed and in port

- Time- and cost efficient operation in port
- Minimum cargo residue and efficient tank cleaning
- Efficient draining and cleaning of cargo lines
- Ease of maintenance and inspection
- Environmental protection
- Underwater Radiated Noise reduction
- Protection of cargo against contamination
- Crew safety
- Energy Conservation

Ergonomic assessment reports shall be issued in accordance with the AET methodology described in NR-17 and shall be prepared by a qualified and certified specialist in ergonomics. In addition, rules and resolutions applicable to control stations, provided for in the Standards, Conventions and Codes, will be duly complied with.

### Duties

The vessel to be designed for the carriage of following cargoes for both full and partial filling:

- The vessel will carry oil products such as: Marine Diesel, Diesel S10 (Petrobras product), Diesel S500 (Petrobras product), AVGAS with specific weights ranging from 0,688 to 0,880 t/m<sup>3</sup>. E Capacities and tonnage.

### Intent of specification

This specification is intended to describe the technical features of the vessel and its contents, including, but not limited to, principal dimensions, tank capacities, etc. It can be changed due to further development and to the Owner's approval.

Other items not mentioned in the Owner's technical specification, but which are mandatory by the Classification Society and/or National Authorities rules and regulations, shall be applied according to the Owner's standard and practice.

If there are any discrepancies between documents the procedures as mentioned in the Contract shall be used.

### ~~Reference documents to the Specification~~

~~In addition to the Building Specification, reference is made to the Owner's Requirement Specification, I-ET 4880.00-9311-000-PDT-001-R0, for clarifications and where details might missing.~~

## B Arrangement, description

### Hull

The vessel is mono hull with a centre skeg.

The vessel will be constructed with double bottom and wing tanks for segregated ballast, as practical or as per General Arrangement, throughout the length of the vessel.

Cargo containment system and all steel exposed to cargo to be of normal steel. Upto 35% of the steel construction can be High Tensile Steel.

### Accommodation

The vessel shall have accommodation for a total of up to 36 persons, for crew and officers - all in single cabins - Of those 11 Crew, 10 petty officers, 6 officers, 3 senior officers. In addition 2 worker class cabin / 2 beds, 1 Pilot cabin / 2 beds and 1 Owners cabin / 2 beds.

Lifesaving equipment shall be arranged for 36 persons

Table 0.4 Cabins

Cabin Type	Quantity
State cabin (with separate sleeping room) (Senior Officers)	3
Single cabin (Officers)	6
Singel cabin (Petty Officers)	10
Singel cabin (crew)	11
Owners cabin	1 (2 beds)
Pilot cabin	1 (2 beds)
Worker class cabin	2 (2 Beds)

The accommodation shall be compliant with MLC 2006.

#### Arrangement

The vessel shall be arranged according to the General Arrangement.

The following compartments shall be arranged on each deck (from aft):

On Tanktop:

- Aft peak tanks
- Engine room
- Cargo area
- Forepeak tank

On 2nd. Platform Deck:

- Aft peak tanks
- Steering gear room
- Engine room
- Cargo area
- Forepeak tank

On 1st. Platform Deck:

- Aft peak tanks
- Steering gear room
- Rope store
- Aux engine room
- Engine room
- Separator room
- Cargo area
- Forepeak tank

On Main Deck:

- Hydraulic room
- Inertgas room
- Product store corrosive
- Refrigerant compr. room

- Engine workshop/store
- Engine room
- Engine change room
- Engine control room
- Central store/Eng.room loc.
- El.workshop
- Clean Agent Bottle Compart
- Hydraulic actuator room
- Foam room
- Pump room/technical room
- Methanol fuel treatment room (future)
- Cargo equipmen/deck store SB/PS
- Technical room/store
- Bosun store/rope store

On 01 Poop Deck:

- General store
- Paint store
- Store Ac/Ox
- Engine casing
- Garbage store
- Bosun Store
- Product store toxic
- Product store flameable
- Change room
- Chamber store room
- Provision store
- Laundry/Drying room
- Dirty linen room
- Clean linen room
- Meeting room
- Public toilets
- Galley
- Pantry
- Messroom
- Ship office
- Cargo control room
- Cargo tank gasfreeing vent.room
- Cargo sampl. room
- Deck store

On 02 Accommodation Deck:

- Engine casing
- HVAC room
- Auditorium

- Internet room
- Work class cabin
- Hospital
- Gymnasium
- Smoking room
- Officers living room
- Ratings living room

On 03 Accommodation Deck:

- Fire station
- Lifesaving equipment room
- Engine casing
- Emergency generator room
- Support laundry
- Crew cabins
- Petty officers cabins
- Cleaning locker

On 04 Accommodation Deck:

- Funnel
- Officers cabins
- Petty officers cabins
- Crew cabins
- Support laundry
- Cleaning locker

On 05 Accommodation Deck:

- Funnel
- Senior officers cabins
- Captains office
- Pilot cabin
- Owners cabin
- Steward cabin
- Technical room / instrument room
- El. equipment room
- Custom locker
- Cleaning locker

On 06 Bridge Deck:

- Funnel
- Wheelhouse
- Battery store

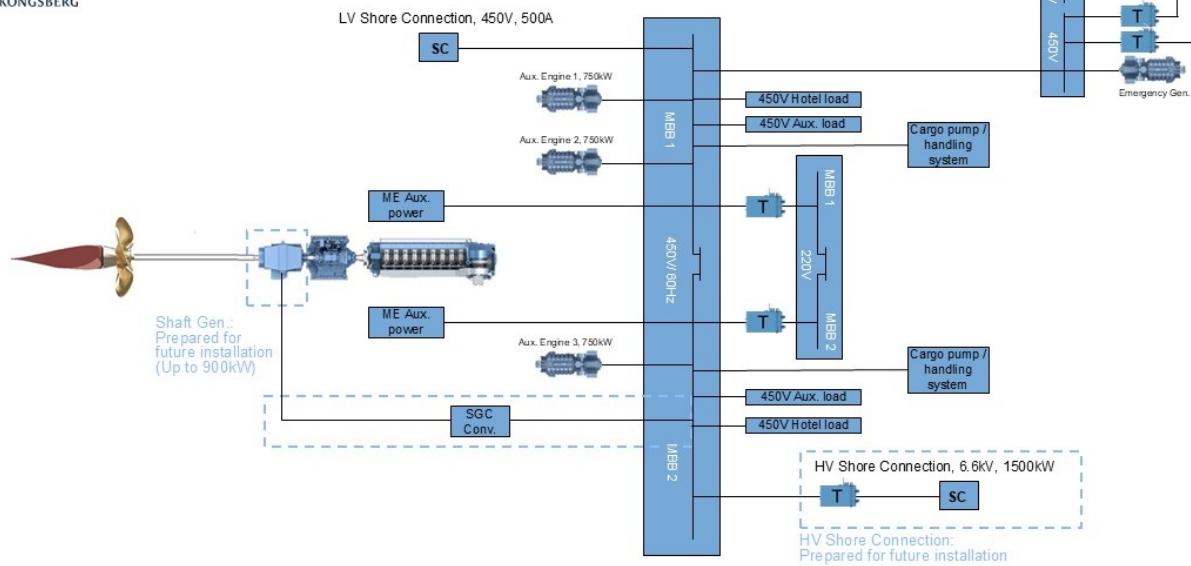
### **Main Power, Thruster, and Propulsion Concept**

The vessel has a hybrid power system consisting of an electric power plant and a conventional main propulsion system according to Figure 0.1.



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## Power System Setup



WORLD CLASS – Through people, technology and dedication

KONGSBERG PROPRIETARY - See Statement of Proprietary Information

Figure 0.1

### General

Main propulsion line shall be arranged according to SFI item 63 Transmissions

By using the lever on the wheelhouse panel, or any other panel in command, an order signal will be given to the main engine governor and the electromechanical actuator for pitch control. Propeller speed and pitch will be optimized according the operational mode and load and fuel curve on the engine as relevant to achieve the best fuel economic configuration on the vessel at any time.

### Propulsion-and-thruster-control

The propeller shall have CP with various pitch/rpm combinations embedded in its remote control system.

### Worst case failure intent

The vessel will be equipped with a single propulsion system, and as such a single component failure in the propulsion line (Main engine to Propeller) the may render the vessel without propulsion power. The two split electrical main power system shall maintain or be able to restore at least one section of the two-split main electrical system in the event of the worst single failure. (except for fire and flooding events).

## C

### Main Particulars

Table 0.5 Main Particulars

	Abbreviation	Dimension (approx.)
Length overall	L <sub>OA</sub>	150.60 m
Length between perpendiculars	LPP	146.60 m
Breadth moulded	Bm	23.40 m
Depth to freeboard deck amidships	D	11.20 m

	Abbreviation	Dimension (approx.)
Design draught amidships	Tdesign	8.20 m
Summer draught amidships	Tsummer	8.20 m
Scantling draught	Tscantling	8.40 m

## D Performance

### Endurance

The vessel shall have fuel and provision capacities for continuous operation for 34 days, at service conditions.

Cruising range to be minimum 10000 nautical miles considering conventional fuel (FO). Bunker capacity calculated for service condition.

### Environmental conditions

The ship shall be designed for the environmental conditions mentioned in the table below.

Table 0.6 Environmental conditions

	Temperature	Remarks
Outside air temperature	minimum -2 <del>-10</del> °C	
	maximum +45 <del>35</del> °C	
Engine room temperature		Ref. <a href="#">Environmental conditions</a>
Sea water temperature	minimum +4°C	
	maximum +32°C	

For accommodation HVAC design conditions ref. [57 Ventilation, air-conditioning & heating systems](#).

### Speed and Fuel Oil consumption

Table 0.7 Speed

Condition	Performance
Continuous Service speed (at CSR and Design draught given in <a href="#">C Main Particulars</a> )	12.5 knots
Maximum Speed at trial conditions (at Design draught given in <a href="#">C Main Particulars</a> )	Approx. 13,85 knots

This accounts under the following conditions (CSR Condition):

- 90% MCR on the main propulsor(s)
- 15% Sea Margin
- Even keel
- Calm weather (maximum Beaufort 2)
- Sufficient water depth (To be according to ISO-15016:2015)
- Clean hull and propellers

During the sea trial exact speed and power measurements shall be performed (Ref. SFI Item [154 Trial trips](#)).

Speed trials to be according to ISO 15016:2025.

### Fuel Oil consumption

Fuel consumption with the vessel sailing at Design/Summer draught and at continuous service power (CSR): Approx. 12,0 t/d at ~~MGO (residual marine fuel oil category ISO-F-RMG 380 type) RMA, according to ISO 8217:2024~~. Including 300 kW Hotel/System load the fuel consumption will be approx. 13,41 t/d

The fuel oil consumption given above is theoretically (including manufacturer's tolerance), calculated for continuous service condition as basis for calculation of fuel tanks storage capacities and endurance.

The guaranteed fuel consumption of Main Engine(s) to be confirmed as per maker's shop test.

In addition, the design shall include dedicated storage tanks for the consumption of distillate marine fuel oil ("DMA/DMZ"-ISSO 8217) with a low sulphur content (0,1%) with a capacity equivalent to at least 4 days of the vessel's daily consumption.

### Energy Efficiency Design Index

The vessel (hull, systems and equipment) will be designed and optimized for minimum fuel consumption and reduction of air emissions, complying with the requirements of the Energy Efficiency Design Index (EEDI) Phase 3, and CII- (Carbon Intensity Indicator) for the project premises.

## E Capacities and tonnage

Table 0.8 Capacities and tonnage

Cargo	Volume (approx figures)	Density	Remark
Cargo Tanks	<del>16940-16840</del> m3	0,88t/m3	
Slop tanks	<del>510-550</del> m3	0,88t/m3	
Cargo Drain Tanks	<del>40-70</del> m3	0,88 t/m3	
Methanol fuel tank ( Combined with Cargo tank no.6 SB )	<del>4050-1080</del> m3	0,88 t/m3	
Marine Gas Oil, including serv/settl. tanks [1]	<del>125-100</del> m3	0.9 t/m3	
MDO/Heavy Fuel Oil, including serv/settl. tanks [1]	<del>600-560</del> m3	0.98 t/m3	
Ballast Water	<del>8700-8650</del> m3	1.025 t/m3	
Potable Fresh Water	200 m3	1.0 t/m3	
Technical Fresh Water	<del>60-50</del> m3	1.0 t/m3	
Lubrication oil	<del>100-150</del> m3	0.9 t/m3	
Deadweight at Summer Draught (8,20 m)	15600 mt		( in sea water with specific gravity of 1.025 )
Gross Tonnage (international, approx.)	12716		

### Footnotes:

- [1] All tanks are designed for liquids with flashpoint above 60 °C, according IMO Resolution MSC.236(82) and IMO Res. A.673(16), except of Cargo/Methanol fuel tank 6 SB.

### The vessel to be designed for the carriage of following cargoes for both full and partial filling:

- Petroleum products according to Class notation and technical construction..

## F Class

The vessel will be designed, built, supervised/surveyed, tested and delivered in compliance with the Laws, Classification Rules, Conventions, Regulations, Standards, Resolutions, Circulars and the other associated documents in their latest revision as mentioned below:

- In force on the date the Construction Contract is signed, or;
- If not yet in force by the date of signature of the Contract, ratified and expected to be in force by the date of delivery of the vessel, and compulsory to obtain all Class and Statutory certificates for unrestricted navigation.

The vessel will be designed, built and equipped under the survey and according to the rules and regulations of:

- Bureau Veritas (BV) (hereafter called the Classification Society), alternatively according to in DnV or ABS with equal class notations,

that are, unless otherwise agreed, valid on the date of contract and certified upon delivery to the requirements of the Classification Society notations:

(In case the class society will be changed, Table 0.9 to be adjusted accordingly)

Table 0.9 Class notations

UNRESTRICTED NAVIGATION
I
OIL TANKER
ESP
METHANOLFUEL-PREPARED (S, T, <del>H</del> , <del>P</del> <sub>B</sub> , ME-DF, AE, <del>B</del> )
CPS(WBT)
COMF-VIB 3
COMF-NOISE 3
AUT-UMS
<b>AVM</b>
SYS-NEQ-1
CARGOCONTROL
LI-S3
VCS-TRANSFER
IG
SPM
CYBER SECURE
SMART (EnE2)
ETA
BWT
CLEANSHIP
SOX-x%
GREENPASSPORT
INWATERSURVEY
MON-SHAFT
ALM

The ship will fly the state flag of Brazilian and shall satisfy its latest rules and regulations for this special ship type and trade.

The Vessel shall comply with the relevant National and International rules and regulations for worldwide operation for such vessel.

Equipment onboard shall have valid certificates as applicable, ref.G Certificates.

## **G Certificates**

Compliance with applicable requirements of rules and regulations shall be documented by issue of certificates and/or statements by the relevant bodies.

The following certificates shall be obtained by the Yard and supplied to the Owner at the time of delivery of the vessel (at least, not limited to this list.) :

- *Class Certificate*
- *Cargo Ship Safety Radio Certificate + Form R + Initial Safety Radio Survey checklist*
- *Radio Station Licence*
- *Shore Based Maintenance Certificate*
- *VDR Type Approval Certificate*
- *VDR Initial installation Performance Report issued by Manufacture*
- *SSAS Type Approval certificate*
- *AIS Type Approval Certificate*
- *AIS Initial Installation report issued by Radio Surveyor on behalf of Classe Society*
- *EPIRB Type Approval Certificate*
- *EPIRB Test Report issued by Approved Service Supplier*
- *LRIT Type Approval Certificate*
- *Cargo Ship Safety Construction Certificate*
- *Cargo Ship Safety Equipment Certificate + Form "E" + Record of Safety Equipment*
- *International Load Line Certificate + Record of Conditions of Assignment*
- *Internation Oil Pollution Prevention Certificate + Form B*
- *Internation Sewage Pollution Prevention Certificate*
- *Statement of Compliance with Garbage Pollution Prevention*
- *International Air Pollution Prevention Certificate + Record*
- *NOx/ EIAPP certificates for all installed engines*
- *International Tonnage Certificate*
- *Panama Canal Universal Tonnage Measurement System (PC/UMS)*
- *International Anti Fouling System Certificate + Record*
- *Supplier Declaration for AFS tin free and AFS cybutryne free*
- *Statement of Compliance with Energy Efficiency + supplement*
- *MLC 2006 Certificate*
- *International Ballast Water Management Certificate*
- *Statement of Compliance with Honk Kong Convention + Inventory of Hazardous Materials*
- *Cargo Gear Certificates/ Records for Lifting Appliances*
- *Sanitization Certificate*
- *STATEMENT OF COMPLIANCE WITH SINGLE POINT MOORING ARRANGEMENT – "SPM"*
- *STATEMENT OF COMPLIANCE WITH SHORE POWER INSTALLATION PREPARATION (DESIGN LEVEL)*
- *TYPE APPROVAL CERTIFICATE (OIL FILTERING EQUIPMENT E OIL CONTENT METER)*

- Calibration certificate for 15 PPM alarm sensor
- Overload Test Certificate for Lifting Appliances
- Lifting Appliances wire cables certificates
- Lifting Appliances Class Certificates (Equipment certificate)
- Hydrostatic test reports/ certificates for CO<sub>2</sub> cylinders and others
- Type Approval certificate for rubber hoses intended for CO<sub>2</sub> cylinders and pilot receivers
- Type Approval Certificate for Fixed fire fighting system
- Fixed fire fighting system Initial installation report
- Commissioning/ test Report for Fixed Fire fighting Foam System.
- Foam Forming Liquid substance analysis report
- Foam Forming Liquid substance type approval certificate
- Fixed Foam System type approval certificate
- Watermist Commissioning/ Test Report
- Watermist System type approval certificate
- Lifeboat extinguishers hydrostatic test report
- Lifeboat extinguishers annual service report
- Wheeled Dry Powder extinguishers hydrostatic test report
- Wheeled Dry Powder extinguishers annual service report
- Foam form liquid substance sample analysis certificate/report
- Service report for breathing apparatus sets (incl. spares)
- Type approval certificate for breathing apparatus set
- Service report for inflatable liferafts
- Type approval certificate for Liferafts hydrostatic release
- Product certificate for Liferaft launching appliances
- Type approval certificate for Liferaft on/off load release hook
- Type approval certificate for all magnetic compass
- Deviation curve for all magnetic compass
- Calibration certificate for Wind sensor
- Type approval certificate for lifebuoys
- Type approval certificate for lifebuoys w/lights (Ex-rated)
- Type approval certificate for man overboard lifebuoys (Ex-rated)
- Hydrostatic test report for lifeboat air cylinders
- Service report for lifeboat air cylinders
- Hydrostatic test report for O<sub>2</sub> cylinders
- O<sub>2</sub> quality (purity) certificate
- Type approval certificate for Lifeboat and launching appliances
- Overload test certificate for Lifeboat launching appliances
- Wire certificates for Lifeboat winches
- Lifeboat equipment inventory list
- Type approval certificate for onload release gear
- Supplier's Commissioning report for Lifeboat and associated equipment
- Type approval certificate for Rescue boat and launching appliances
- Overload test certificate for rescue boat launching appliance
- Rescue boat equipment inventory list

- Type approval certificate for On/Off load release hook
- Mooring ropes and tails certificates
- Certificate for Towing cables and tails
- Type approval certificate for EEBD
- Hydrostatic test report for EEBD
- Service report for EEBD
- Certificate for Fire Wires
- Wire certificates for miscellaneous cranes
- Windlass class certificate
- Windlass brake test report
- Accommodation Ladder certificate
- Accommodation Ladder overload test certificate
- Gangway certificate
- Gangway overload test certificate
- Type approval certificate for Immersion Suit
- Type approval certificate for Pressure Vacuum Valves
- PV Valves test report
- Type approval certificate for O2, CH4 Gas Detectors, Tankscope meters
- Calibration certificate for O2, CH4, Gas Detectors, Tankscope meters
- ODME type approval certificate
- ODME calibration certificate
- Supplier's commissioning report for ODME
- VECS type approval certificate
- Supplier's commissioning report for VECS
- Type approval certificate for Cargo tank level gauge system
- Calibration certificate for Cargo tank level gauge system
- Supplier's commissioning service report for Cargo tank level gauge system
- Calibration certificate for sensors (pressure and temperature)
- Main/Emergency Switchboard Class certificates
- Pressure test report for cargo and fuel oil lines
- Accommodation Air quality certificate
- Potable water analysis report
- Hydrostatic test report for Deep fat frier cylinder
- Deep Fat frier type approval certificate
- Supplier's commissioning service report for deep fat frier
- MED Type approval certificates for firefighter's outfits
- Certificates for rubber mats
- UTI type approval certificate
- UTI calibration certificate
- Type Approval certificate for Gas detection system
- Calibration certificate for Gas detection system
- Supplier's commissioning service report for Gas detection system
- ECDIS type approval certificate
- Supplier's commissioning service report for ECDIS

- Construction Permit issued by Flag
- REB Preliminary Registry
- Warranty Declaration
- Inventory and Spares Declaration
- Delivery Confirmation for Design Drawings, As-Built Drawings and Manuals
- Delivery Confirmation for Design Drawings, As-Built Drawings and Manuals
- Delivery and Acceptance Declaration
- Painting Manufacturer Warranty Declaration
- Construction Certificate
- Fresh water tanks cleaning declaration
- Deadweight measurement certificate
- Asbestos Free Declaration
- Non- essential Deficiencies Declaration
- Hidrostatic Test Declaration for all Lines
- Main Engine Payment confirmation + Receipt
- Quay Trials Conclusion Declaration
- Sea Trials Conclusion Declaration
- Type Approval Certificate for Pilot Ladder
- Type Approval Certificate for Thermal Insulation
- Type Approval Certificate for Fire Doors
- Type Approval Certificate for A-60 Windows and Scuttles
- Classe Certificate for Overbord valves (side and bottom)
- Quick closing valves System certificate
- Type Approval Certificate for Air Vent Heads
- Type Approval Certificate for Pyrotechnics
- Type Approval Certificate for PA/GA System
- Type Approval Certificate for Sound Reception System
- Type Approval Certificate for Echosounder
- Type Approval Certificate for Daylight Signalling lamp
- Type Approval Certificate for Autopilot
- Type Approval Certificate for DGPS
- Type Approval Certificate for Radars
- Type Approval Certificate for Fire Hoses (ABNT)
- Type Approval Certificate for Fire Detection System
- Type Approval Certificate for MF/HF System
- Type Approval Certificate for VHF
- Type Approval Certificate for Emergency VHF (portable)
- Type Approval Certificate for NAVTEX
- Type Approval Certificate for INMARSAT-C
- Type Approval Certificate for SART
- Type Approval Certificate for FBB
- Type Approval Certificate for Unattended Machiney Space
- Type Approval Certificate for 2-Way automatic telephone system
- Type Approval Certificate for IAS

- *Type Approval Certificate for Self Powered Telephone*
- *Class Certificate for emergency fire pump*
- *Class Certificate for man fire pumps*
- *Class Certificate for ballast pumps*
- *FAT report for ballast pumps*
- *Supplier's commissioning service report for ballast pumps*
- *Type Approval Certificate for speed log*
- *Class Certificate for Emergency Diesel Generator*
- *Supplier's commissioning service report for emergency diesel generator*
- *FAT Report for Emergency Diesel Generator*
- *Type Approval Certificate for Vent Riser (including flame arrester)*
- *Class Certificate for Auxiliary Engines*
- *Supplier's commissioning report for auxiliary engines*
- *FAT report for auxiliary engines*
- *Class certificate for Thermal Oil Heater*
- *Supplier's commissioning report for Thermal Oil Heater*
- *FAT report for Thermail Oil Heater*
- *Class Certificate for Steering gear*
- *Supplier's commissioning report for steering gear*
- *FAT report for steering gear*
- *Class certificate for Main Engine*
- *Supplier's commissioning report for main engine*
- *FAT report for main engine*
- *Class certificate for shaft line system*
- *Commissioning report for shaft line system*
- *Class certificate for propeller*
- *CPP system certificate*
- *Class Certificate for Stern tube bearings (including sealing system)*
- *Class certificate for steel castings (rudder, Stern tube, horn) + rudder bearing bushing*
- *Type approval certificate for lifejackets*
- *certificate for gong*
- *Certificate for bell*
- *Type approval certificate for navigation lights*
- *Type approval certificate for Whistle*
- *Type approval certificate for Line throwing appliances*
- *Class certificate for anchor chain set*
- *Class certificate for anchors set*
- *Class certificate for chain stoppers*
- *Class certificate for starting air compressors*
- *Class certificate for Main Air Receivers*
- *Class certificate for service Air compressors*
- *Class certificate for service Air Receivers*
- *Class certificate for emergency starting system*
- *Class certificate for Incinerator*

- Type Approval certificate for Sewage Treatment System
- Class certificate for economizer
- Type approval certificate for electric breakers
- Test report for electric breakers
- Type approval certificate for electric cables
- Class certificate for Integrated Loading Computer and Trim Optimization System
- Type Approval certificate for Loading computer
- Class Certificate for Cargo Pumps
- FAT Report for Cargo Pumps
- Supplier's commissioning service report for cargo pumps
- Class Certificate for Heat Exchangers
- Class Certificate for Heat Exchangers
- Class Certificate for Main Engine heat exchanger
- Class Certificate for Fuel Oil Unit (Main/Auxiliary)
- Class Certificate for Purifiers (DO)
- Class Certificate for Purifiers (FO)
- Class Certificate for Purifiers (LO, main)
- Class Certificate for Purifiers (LO, auxiliary)
- Type Approval Certificate for Ballast Water Treatment System + USCG CERTIFICATE
- FAT Report for BWTS
- Commissioning Teste Report for BWTS according to Circ.70/Ver.1
- Type Approval Certificate for Anti Fouling System
- Class Certificate for Valves Remote Control System
- Type Approval certificate for Speed Control System
- Class Certificate for Deadman Alarm System
- Fire retardant declaration for mattresses
- Type Approval certificate for fire dampers
- Type approval certificate for Water/weather tight doors
- Class Certificate for Inert Gas System
- Supplier's commissioning service report for Inert Gas System
- Calibration certificate for O2 analizer (IGS)
- FAT Report for Inert Gas System
- Chocks and Bollards certificate (accord. International standard)
- Type Approval certificate for tank cleaning system
- Certificate for Impressed Current System
- Type Approval certificate for Emergency Towing Arrangements (aft/fwd)
- Class certificate for Emergency Towing accessories
- Class certificate for Electric motors intended for cargo pumps HPU
- FAT report for Electric motors intended for cargo pumps HPU
- Commissioning service report for Electric motors intended for cargo pumps HPU
- Class certificate for HPU auxiliary engines
- FAT Report for for HPU auxiliary engines
- Commissioning report for HPU auxiliary engines
- Class Certificate for Seawater cooling pumps

- *Class Certificate for bilge pumps*
- *Type Approval Certificate for Cargo Tanks Monitoring System*
- Declaration Concerning Compliance with U.S. Navigation Regulations

Declaration Concerning Compliance with U.S. Pollution and Sanitation Regulations

Any other certificates in addition to the ones listed above being required by the Classification Society and/or National Authorities shall be issued. If any of the above mentioned certificates are not required by the surveyors and/or any of the reports will not be issued by the survey authorities because they are not required, these documents shall not be delivered with the ship unless clearly specified.

## H Rules and regulations, tonnage regulations

The vessel shall be designed, built, equipped and certified in compliance with all relevant statutory conventions, codes and guidelines as in force on the date of keel laying, including but not limited to the following :

(For statutory documents, a Portuguese or bilingual version to be handed over.)

### a) International Maritime Organization (IMO):

1 - International Convention for the Safety of Life at Sea (SOLAS), its amendments and related Codes in its latest revision (and amendments), such as:

- LSA Code (2020 Edition and Consolidated Amendments);
- 2010 Fire Test Procedures (FTP) Code;
- 2015 Edition. Supplement. December 2019. Amendments to the International Code for Fire Safety Systems (FSS Code);

- ISM Code 2018 Edition;

- ISPS Code (2021 Edition and Consolidated Amendments);

- IGC Code (2016 Edition and Consolidated Amendments);

- IGF Code, Intact Stability Code 2008;

2 - International Convention for the Pollution Prevention of the Sea from Vessels (MARPOL), in its 2022 edition, resolutions, circulars and all amendments, referring to the annexes mentioned below:

- Annex I - Regulations for the Prevention of Oil Pollution and amendments;
- Annex IV - Regulations for the Prevention of Pollution by Sanitary Sewage and amendments;
- Annex V - Regulations for the Prevention of Pollution by Ship Garbage and amendments;
- Annex VI - Regulations for the Prevention of Air Pollution (MARPOL Protocol of 1997) and amendments;

- NOx Technical Code 2008.

3 - International Convention on Load Lines (ILLC), 1966, in its 2021 edition, resolutions, circulars and all associated amendments;

4 - Convention on the International Regulations for Preventing Collisions at Sea, 1972, and all associated amendments.

5 - International Convention on Tonnage Measurement of Vessels, 1969.

6 - Panama Canal PC/UMS Documentation of Total Volume.

7 - Specific resolutions:

- Resolution MSC.337(91) "Code of noise levels on board ships", 2012, except Sections stipulated in 1.13 (recommendatory and options);
- A.272 (VIII) - Recommendation on Safe Access to and Working in Large Tanks;
- A.330 (IX) - Amendment to the Recommendation on Safe Access to and Working in Large Tanks to include Large Water Ballast Tanks;

- Resolution A.446(XI), as amended by resolution A.497(XII)
- A.343(IX) - Recommendation of Methods of Measuring Noise Levels at Listening Posts;
- A.897 (XI) - REVISED SPECIFICATIONS FOR THE DESIGN, OPERATION AND CONTROL OF CRUDE OIL WASHING SYSTEMS (RESOLUTION A.446 (XI) AS AMENDED BY RESOLUTION A.497(XII))
- A.601(15) - Provision and Display of Maneuvering Information on Board Ships;
- MEPC.288(71) - 2017 Guidelines for ballast water exchange (G6);
  - MEPC.371(80) - AMENDMENTS TO THE 2017 GUIDELINES FOR BALLAST WATER EXCHANGE (G6) (RESOLUTION MEPC.288(71));
- 2017 Guidelines for the implementation of MARPOL ANNEX V
- Code for approval of ballast water management systems (BWMS CODE)
- A-889 (21) - Pilot Transfer Arrangements;
- A.962(23) Sec.5 on the recommendatory "IMO Guidelines on Ship Recycling" as amended by IMO Res. A.980(24). (Only concerned part to the Builder);
- A.1021(26) - Code on Alerts and Indicators, 2009;
- A.708 (17) "Navigation Bridge visibility and functions";
- A.868 (20) "Guidelines for the Control and Management of Ships Ballast Water" (Sequential Ballast Exchange Method);
- MSC/Circ.403 - GUIDELINE ON NAVIGATION VISIBILITY;
- MSC/Circ.913 - GUIDELINES FOR THE APPROVAL OF FIXED WATER-BASED LOCAL APPLICATION FIRE-FIGHTING SYSTEMS FOR USE IN CATEGORY A MACHINERY SPACES;
- MSC/Circ.568 - PILOT TRANSFER ARRANGEMENT AS AMENDED BY IMO MSC Circ.773;
- MSC/Circ. 730 (1996) RECOMMENDATION FOR VENTILATION OR INERTING OF DOUBLE HULL SPACES;
- MSC/Circ.834 - GUIDELINES FOR ENGINE ROOM LAYOUT, DESIGN AND ARRANGEMENT;
- MSC.1-Circ.982 - GUIDELINES ON ERGONOMIC CRITERIA FOR BRIDGE EQUIPMENT AND LAYOUT;
- MSC/Circ.1175 - GUIDANCE ON SHIPBOARD TOWING AND MOORING EQUIPMENT
- MSC/Circ.1053 - EXPLANATORY NOTES TO THE STANDARDS FOR SHIP MANEUVERABILITY;
- MEPC.1/Circ.906 - REVISED GUIDELINES FOR THE REDUCTION OF UNDERWATER RADIATED NOISE FROM SHIPPING TO ADDRESS ADVERSE IMPACTS ON MARINE LIFE.
- MSC.137(76) - STANDARDS FOR SHIP MANEUVERABILITY;
- MSC.192(79) - ADOPTION OF THE REVISED PERFORMANCE STANDARD FOR RADAR EQUIPMENT;
- MSC 978 - PERFORMANCE STANDARDS FOR NAVIGATIONAL EQUIPMENT (1988 EDITION);
  - MSC.494(104) - AMENDMENTS TO THE PERFORMANCE STANDARDS FOR SHIPBORNE VOYAGE DATA RECORDERS (VDRs) (RESOLUTION MSC.333(90));
  - MSC.452(99) - AMENDMENTS TO THE REVISED PERFORMANCE STANDARDS FOR INTEGRATED NAVIGATION SYSTEMS (INS) (RESOLUTION MSC.252(83));
  - MSC.530 (106) - PERFORMANCE STANDARDS FOR ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEMS (ECDIS);
- MEPC 368(79) - AMENDMENTS TO THE 2014 STANDARD SPECIFICATION FOR SHIPBOARD INCINERATORS (RESOLUTION MEPC.244(66));
- MEPC.219(63) - 2012 GUIDELINES FOR THE IMPLEMENTATION OF MARPOL ANNEX V;
- MEPC.300(72) - Code for approval of ballast water management systems (BWMS CODE)
- MEPC.378(80) 2023 GUIDELINES FOR THE CONTROL AND MANAGEMENT OF SHIPS' BIOFOULING TO MINIMIZE THE TRANSFER OF INVASIVE AQUATIC SPECIES
  - (TECHNICAL INFORMATION FOR BIOFOULING MANAGEMENT PLAN ONLY SHALL BE PROVIDED);
- MEPC. 285(70) - AMENDMENTS TO THE REVISED GUIDELINES AND SPECIFICATIONS FOR POLLUTION PREVENTION EQUIPMENT FOR MACHINERY SPACE BILGES OF SHIPS;

- MEPC.127(53) - GUIDELINES FOR BWM AND DEVELOPMENT OF BWM PLANS(G4) AS AMENDED BY RES. MEPC.306(73);
- MEPC.227(64) - GUIDELINES ON IMPLEMENTATION OF EFFLUENT STANDARDS AND PERFORMANCE TESTS FOR SEWAGE TREATMENT PLANTS AS AMENDED BY IMO RES.
- MEPC 108 (49) - REVISED GUIDELINES AND SPECIFICATIONS FOR OIL DISCHARGE MONITORING AND CONTROL SYSTEMS FOR OIL TANKERS, 2003;
- MEPC 107 (49) - REVISED GUIDELINES AND SPECIFICATIONS FOR POLLUTION PREVENTION EQUIPMENT FOR MACHINERY SPACE BILGE OF SHIPS;
- MEPC.325 (75) - INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER AND SEDIMENTS, 2004, Amendments to regulation E-1 and Appendix I (Commissioning testing of ballast water management systems)
- MEPC. 284(70) - AMENDMENTS TO THE 2012 GUIDELINES ON IMPLEMENTATION OF EFFLUENT STANDARDS AND PERFORMANCE TESTS FOR SEWAGE TREATMENT PLANTS
- MEPC.279(70) - 2016 GUIDELINES FOR APPROVAL OF BALLAST WATER MANAGEMENT SYSTEMS (G8);
  - MEPC.370(80) - AMENDMENTS TO THE GUIDELINES FOR BALLAST WATER MANAGEMENT AND DEVELOPMENT OF BALLAST WATER MANAGEMENT PLANS (G4) (RESOLUTION MEPC.127(53), AS AMENDED BY RESOLUTION MEPC.306(73))
- MEPC. 279(80) INVENTORY OF HAZARDOUS MATERIALS (The HMI shall be drawn up by the SELLER)
- MSC.353 - REVISED GUIDELINES FOR INERT GAS SYSTEM.
- MSC. 530(106) - PERFORMANCE STANDARDS FOR ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEMS (ECDIS);
- MSC.215(82) - PERFORMANCE STANDARD FOR PROTECTIVE COATINGS (PSPC) FOR DEDICATED SEAWATER BALLAST TANKS IN ALL TYPES OF SHIPS AND DOUBLE-SIDE SKIN SPACES OF BULK CARRIERS;
- MEPC.1/Circ.906 - Revised Guidelines for the Reduction of Underwater Radiated Noise from Shipping to Address Adverse Impacts on Marine Life;
  - MSC.428(98) Maritime cyber risk management in safety management systems;
  - MSC-FAL.1/Circ.3 - Guidelines on maritime cyber risk management;
  - MSC.1/Circ.1619 Guidelines on the design of mooring arrangements and the selection of appropriate mooring equipment and fittings for safe mooring;
  - MSC.1/Circ.1620 Guidelines for inspection and maintenance of grinding equipment including lines;
  - MEPC.182(59) 2009 GUIDELINES FOR THE SAMPLING OF FUEL OIL FOR DETERMINATION OF COMPLIANCE WITH THE REVISED;
  - MEPC.1-Circ.889 - 2020 Guidelines For On Board Sampling Of Fuel Oil Intended To Be Used Or Carried For Use On board;
  - MEPC.1/Circ.864/Rev.1 2019 Guidelines for on board sampling for the verification of the sulphur content of the fuel oil used on board ships.

**b) Other Conventions and Codes:**

- International Regulations for Preventing Collisions at Sea (COLREG), 1972;
- International Convention on the Control of Anti-fouling Systems on Vessels, 2001
- International Convention for the Control and Management of Vessels' Ballast Water and Sediments, 2004;
- International Convention for the Safe and Environmentally Sound Recycling of Vessels, 2009;

- International Convention on Maritime Search and Rescue (SAR), 2009
- Code on Noise Levels Onboard Ships;
- Maritime Search and Rescue (SAR) 1979;
- Code of Signals.

**c) International Labor Organization (ILO):**

- Maritime Labor Convention - MLC, 2006 ("MLC 2006");
- ILO 152.

**d) International Telecommunications Union (ITU), 1997 (Radio Regulation):**

**e) United States Coast Guard (USCG)**

- Rules and Regulations for Foreign Vessels Operating in the Navigable Waters of the USA.

**f) Rules of the Brazilian Maritime Authority - Directorate of Ports and Coasts:**

- NORMAM 201 - Embarcações Empregadas na Navegação em Mar Aberto (Vessels Used in Open Sea Navigation – document available only in Portuguese);
- NORMAM 401 - Prevenção da Poluição Ambiental causada por Embarcações e Plataformas (Prevention of Environmental Pollution from Vessels and Platforms – document available only in Portuguese);
- Circulars and Ordinances.

**g) International Electrotechnical Commission:**

- IEC TS 60034-25 - Rotating electrical machines - Part 25: AC electrical machines used in power drive systems
- IEC 60076-11 - Power transformers - Part 11: Dry-type transformers
- IEC 60079 - Explosive Atmospheres.
- IEC 60092 - Electrical Installation in Ships;
- IEC 60268-16:2011 - Objective rating of speech intelligibility by speech transmission index
- IEC 60331 - Tests for electric cables under fire conditions
- IEC 60332 - Tests on electric and optical fiber cables under fire conditions
- IEC-60533 - Electrical and electronic installations in ships - Electromagnetic compatibility (EMC) - Ships with a metallic hull
- IEC 60754 - Test on gases evolved during combustion of materials from cables
- IEC 60793 - Optical fibers
- IEC 60794 - Optical fiber cables
- IEC 60865 - Short-circuit currents - Calculation of effects.
- IEC 60909 - Short-circuit currents in three-phase a.c. systems.
- IEC 60945 - Maritime navigation and radiocommunication equipment and systems - general requirements - methods of testing and required test results
- IEC 61000-2-4 - Electromagnetic compatibility (EMC) Part 2-4: Environment - Compatibility levels for low-frequency conducted disturbances. IEC 61023 - Maritime navigation and radiocommunication equipment and systems - Marine speed and distance measuring IEC 61034 - Measurement of smoke density of cables burning under defined conditions
- IEC 61363-1 - Electrical Installations of Ships and Mobile and Fixed offshore Units - Part 1: Procedures for calculating short-circuit currents in three-phase a.c IEC 62040 - Uninterruptible power systems (UPS)
- IEC 62443 - Security for Industrial Automation and Control Systems
- IEC 62485 - Safety requirements for secondary batteries and battery installations.

- IEC 62613 - Plugs, socket-outlets and ship couplers for high-voltage shore connection (HVSC) systems
- IEC/IEEE 80005 - Utility connections in port

**i) Oil Companies International Maritime Forum (OCIMF):**

- Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases, 1st Edition, 2013 (Fixed fittings only for STBL)
- Recommendation for Equipment Employed in the Bow Mooring of Conventional Tankers at Single Point Moorings, 4th Edition, May 2007
- Recommendations for Oil and Chemical Tanker Manifolds and Associated Equipment, 2017;
- Recommendations for ship's fittings for use with tugs
- Effective Mooring, 2019
- Mooring Equipment Guidelines, 4th Edition, 2018 (Compliance with the Guidelines shall be as specified in Group 4 of the Specifications)
- Guidelines for Offshore Tanker Operations, 1st edition - 2018;
- Guidelines and Recommendations for the Safe Mooring of Large Ships at Piers and Sea Islands
- Prevention of Oil Spillages through Cargo Pump Rooms Sea Valves, 2nd Edition, 1991;
- ICS Guide to Helicopter/ship Operations, 2008 (Winching Area for Daylight Operations only, motion
- An Information Paper on Pump Room Safety, 1995;
  -  Onshore Power Supply Systems \_ Preliminary Design Recommendation 2023;
- International Safety Guide for Oil Tankers and Terminals (ISGOTT 2020);
- Information Paper on Pump Room Safety, September 1993 (Ch. 3 Recommendations for Equipment Fittings - New Ships, refer to Section 310)
- Vessel Inspection Questionnaires for Oil Tankers, Combination Carriers, Shuttle Tankers, Chemical Tankers, and Gas Tankers, latest revision;
- TSCF "Guidance Manual for Tanker Structures - Consolidated Edition 2022";
- "Guidelines for Ballast Tank Coatings Systems and Surface Preparation - 2014 Revised Edition".

**j) International Organization for Standardization (ISO):**

- Standards for shipbuilding, electrical and mechanical installations:
  - ISO 2923:1996 - Acoustics - Measurements of Noise on Board Vessels;
  - ISO 4406:1999 Hydraulic fluid power - Fluids - Method for Coding the Level of Contamination by Solid Particles
  - ISO 4867:1984 - Code for measurement and reporting of shipboard vibration data;
  - ISO 4868:1984 - Code for the Measurement and Reporting of Local Vibration Data of Ship Structures and Equipment
  - ISO 6954:2000 - Mechanical Vibration - Guidelines for the Measurement, Reporting and Evaluation of Vibration with Regard to Habitability on Passenger and Merchant Ships;
  - ISO 7574:2002 (Ventilation and Accommodation Conditioned Air) except for conditions of the design in the Chapter 5 - item 580;
  - ISO 8217:2024 - Specification of Marine Fuels
  - ISO 8468 - Ship's Bridge Layout and Associated Equipment.
  - ISO 8528 Reciprocating internal combustion engine driven alternating current generating sets
  - ISO 8648 - "Guidelines on Navigation Bridge Visibility and Equipment";
  - ISO 8861:1998 - Shipbuilding - Engine-Room Ventilation in Diesel-Engine Ships - Design Requirements and Basis of Calculations;
  - ISO 10816-1:1995 Mechanical Vibration - Evaluation of Machine Vibration by Measurements

- on Non-Rotating Parts - Part 1: General Guidelines;
- ISO 10816-3:2009 / 1:2017 Mechanical Vibration - Evaluation of Machine Vibration by Measurement on Non-Rotating Parts - Part 3: Industrial Machines with Nominal Power above 15 kW and Nominal Speeds Between 120 r/min and 15,000 r/min when Measured in situ;
- ISO 10816-6:1995/Amd 1:2015 Mechanical Vibration - Evaluation of Machine Vibration by Measurement on Non-Rotating Parts - Part 6: Reciprocating Machines with Power Ratings above 100 kW ;
- ISO 12944 - Corrosion Protection of Steel By Protective Paint Collection
- ISO 21984:2018 Ships and Marine Technology - Guidelines for Measurement, Evaluation and Reporting of Vibration with regard to Habitability on Specific Ships;
- ISO 20283-5:2016 - Mechanical vibration: Measurement of vibration on ships

#### **k) Brazilian Association of Technical Standards (ABNT)**

- ABNT NBR 6283 - Cálculo de níveis de iluminação em navios-Procedimento (Calculation of lighting levels on Procedure Vessels – document available only in Portuguese);
- ABNT NBR 9358 - Anodos de Liga de Zinco para Proteção Catódica (Zinc Alloy Anodes for Cathodic Protection – document available only in Portuguese);
- ABNT NBR 10387 - Anodos de Liga de Alumínio para Proteção Catódica (Aluminum Alloy Anodes for Cathodic Protection – document available only in Portuguese).
- ABNT NBR 16680 - Sistemas e revestimentos protetores de invólucros para conjuntos de manobra e controle (Protective enclosure

#### **I) PETROBRAS and TRANSPETRO**

- NI-1710 - Coding of Technical Engineering Documents;
- N-9 - Tratamento de Superfícies de Aço com Jato Abrasivo e Hidrojateamento, e demais Normas da PETROBRAS relativas a tratamento de superfícies e pintura (Treatment of Steel Surfaces with Abrasive Blasting and Hydroblasting, and other PETROBRAS Standards relating to surface treatment and painting – document available only in Portuguese);
- N-13 - Requisitos Técnicos para serviços de Pintura (Technical requirements for painting services – document available only in Portuguese);
- N-0858 - Construção, Montagem e Condicionamento de Instrumentação e Automação (Construction, Assembly and Conditioning of Instrumentation and Automation – document available only in Portuguese);
- N-1192 - Pintura de Embarcações (Painting of Ships – document available only in Portuguese);
- N-1219 - Cores (Colors – document available only in Portuguese);
- N-1503 - Cores para Pintura de Embarcações (Colors for Vessel Painting – document available only in Portuguese);
- NI-2838 - Cathodic Protection for Floating / Fixed Marine Facilities and Subsea Equipment.
- N-2900 - Gerenciamento de Alarmes (Alarm Management – document available only in Portuguese);
- N-2918 - Atmosferas Explosivas - Classificação de Áreas (Explosive Atmospheres - Classification of Areas – document available only in Portuguese);

Regulatory Norms (NR) of the Ministry of Labor, when applicable, with emphasis on:

- NR-17 - Ergonomia (Ergonomics – document available only in Portuguese);
- NR-30 - Segurança e Saúde no Trabalho Aquaviário (Safety and Health in Waterway Work – document available only in Portuguese);
- NR-32 - Segurança e Saúde no Trabalho em Serviços de Saúde (Safety and Health at Work in

- Health Services – document available only in Portuguese);
- NR-34 - Condições e meio ambiente de trabalho na indústria da construção, reparação e desmonte naval (Working conditions and environment in the shipbuilding, repair and dismantling industry – document available only in Portuguese);
  - NR-26 Código de cores (Color code – document available only in Portuguese).

#### **Ergonomics and Human Aspects norms, standards and guides**

- ASTM F1166-21 Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities
- ISO 9241, Ergonomics of human-system interaction (multiple parts)
- ISO 26800:2011, Ergonomics - General approach, principles and concepts

#### **m) Other**

- IACS Unified Interpretations, Requirements, Procedural Requirements and Recommendations;
- Society of Naval Architects and Marine Engineers - SNAME - Code for Sea Trials, 1989;
- The Tanker Structure Co-operative Forum (TSCF) - Guidelines for Ballast Tank Coating Systems and Surface Preparation, 2014;
- INTERTANKO 2021\_Bridge layout Guidelines;
- INTERTANKO Anchoring guidelines, 2019;
- Guidance on Cargo Compressor Room Entry On Board Gas Carriers, 2021;
- IMPA - International Maritime Pilot Association Guide
- ANVISA - RDC 72: Regulamento Técnico que visa à promoção da saúde nos portos de controle sanitário instalados em território nacional, e embarcações que por eles transitem (Technical Regulation aimed at promoting health in sanitary control ports installed in national territory, and vessels passing through them – document available only in Portuguese);
- ANVISA - RDC 216: Regulamento Técnico de Boas Práticas para Serviços de Alimentação (Technical Regulations on Good Practices for Food Services – document available only in Portuguese).
- ANVISA - RDC 217: Vigilância Sanitária de Embarcações, Portos de Controle Sanitário e da Prestação de Serviços de Interesse da Saúde Pública e da Produção e Circulação de Bens (Sanitary Surveillance of Vessels, Sanitary Control Ports and the Provision of Services of Interest to Public Health and the Production and Circulation of Goods – document available only in Portuguese)
- ANVISA - RDC 222/2018: Gerenciamento dos resíduos de serviços de saúde (Health service waste management – document available only in Portuguese)
- DNVGL-RP-B101 - Corrosion Protection of Floating Production and Storage Units
- DNVGL-RP-B401 - Cathodic Protection Design
- Suez Canal Navigation Rules including Tonnage Measurement
- Panama Canal Navigation Rules including Tonnage measurement
- Directive 2012/33/EU of the European Parliament and of the Council of 21 November 2012 amending Council Directive 1999/32/EC ad regards the sulphur content of marine fuels
- California Code of Regulations, title 13, section 2299.2 "Fuel and other operational requirements for ocean-going within California waters and 24 nautical miles of the California baseline."
- Regulation (EU) No 1257/2013 of the European Parliament and of the Council on vessel recycling (EU SRR);
- INMETRO PORTARIA No, 115/2022: Requisitos de Avaliação da Conformidade para Equipamentos Elétricos para Atmosferas Explosivas [ou Portaria mais recente emitida em substituição a essa] (Conformity Assessment Requirements for Electrical Equipment for Explosive Atmospheres [or most recent Ordinance issued to replace it] – document available only in Portuguese)
- Anatel Resolution 570 - Regulamento para Certificação e Homologação de Acumuladores

Chumbo-Ácido Estacionários Regulados por Válvula (Regulation for the Certification and Homologation of Valve Regulated Stationary Lead Acid Accumulators – document available only in Portuguese)

- ANSI/ISA 12.27.01 - Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids
- API RP 501 - Process Measurement
- NFPA 85 - Boiler and Combustion Systems Hazards Code - 2004 Edition.
- UL 1581 - Reference Standard for Electrical Wires, Cables, and Flexible Cords
- CENELEC CLC/TR 50427 - Assessment of inadvertent ignition of flammable atmospheres by radio-frequency radiation - Guide
- ANATEL - All applicable resolutions
- NATIONAL RESOLUTION GM/MS No. 888 - Procedimentos de controle e de vigilância da qualidade da água para consumo humano e seu padrão de potabilidade (Procedures for controlling and monitoring the quality of water for human consumption and its standard of potability – document available only in Portuguese)

\*all applicable rules cited by the rules defined above shall also be met in the project.

## I Drawings, instruction manuals, etc.

The builder shall prepare a list of certificates, to be supplied when the vessel is delivered, and submit it to the BUYER's representatives for verification. G Certificates contains a minimum, non-exhaustive list of certificates. One (1) original and two (2) hard copies shall be provided, as well as a scanned document in Databook format containing all the certificates. This Databook shall be submitted in the same way as the project documents.

The list of certificates shall include all the vessel's trading certificates, certificates for all the equipment and systems installed on board, calibration certificates for measuring instruments, overhaul/maintenance certificates for lifesaving and fire-fighting equipment, among others.

Certificates may be a Product Certificate or a Type Approval Certificate, in accordance with regulatory provisions.

For all the equipment, systems, components and materials used and supplied during the construction of the vessel, the "MD - Material Datasheet" and "SDoC - Suppliers Declaration of Compliance" forms shall be supplied along with their certificates, in accordance with the International Convention for the Safe and Environmentally Sound Recycling of Vessels, 2009 (The Hong Kong International Ship Recycling Convention, 2009).

All the Vessel's documents shall be delivered by the SELLER to the BUYER until delivery of the Vessel.

In the event that it is not possible for the SELLER to obtain any definitive trading certificates by the date of delivery of the Vessel, the corresponding provisional certificates will be provided on a temporary basis. In this case, the SELLER will be responsible for providing all the means and resources to obtain the corresponding definitive certificates and deliver them to the BUYER before the end of the Vessel Guarantee period. The same applies to the other certificates expected to be delivered.

The SELLER shall prepare an inventory of environmentally harmful materials on the vessel, indicating the quantities, location, handling and disposal of each type of material, in accordance with IMO MEPC recommendations. 279(80) INVENTORY OF HAZARDOUS MATERIALS (Ref: The "Green Passport" for Vessels), allowing the BUYER to supplement it with the harmful materials placed on board when the vessel is in service. The inventory of harmful materials shall be approved by the Classification Society.

The SELLER shall issue, as a vessel's document, a list of instruments, which shall contain instrument identification (tag), location, service or line, diagram, manufacturer, set/alarm point, model/certificate, date of last calibration.

## Delivery Plans and Manuals

The vessel's collection of "Plans and Manuals" shall be ready and approved no later than 30 (thirty) days before the vessel's scheduled delivery date and shall be delivered as follows:

2 (two) paper copy collections of the original construction plans and final manuals, organized in boxes with individual indexes, divided by discipline, with 1 (one) collection stored on a shelf in the vessel's office and 1 (one) collection stored on board, in a Locker to be defined.

3 (three) electronic collections of construction plans and final manuals, saved on a portable storage drive, the directory structure of which will be defined in advance and informed to the SELLER.

All manuals and procedures required by the Classification Rules and International Conventions/Codes shall be prepared and submitted for approval by the SELLER, even those that contain the BUYER's operational particularities. The statutory manuals and procedures shall be developed in bilingual format (Portuguese/ English), using the BUYER 's standard form (N-0381), which will be provided when requested by the SELLER.

All final/ delivery plans, documents and manuals shall also be delivered to the FTPS area in the same way as the design documents.

The documents delivered electronically shall be in searchable "PDF" format, except for the Fire Control and Lifesaving Plan, General Arrangement, Compartment Arrangements and Piping Diagrams, which shall be delivered in open "PDF" and "DWG" formats, compatible with the AUTOCAD ® program.

Copies of the software used by all equipment/systems installed on board the vessels that contain any PLCs, controllers or computers shall be provided and delivered, subject to an NDA (non-disclosure agreement), if necessary. Software for installing the applications on the controllers and computers shall also be supplied, as well as special tools and communication cables for downloading and uploading these applications.

The final construction plans and manuals shall incorporate all the design changes made during the construction of the vessel ("as built") and, where applicable, be the versions approved by the Classification Society.

Even if there has been no change to the plan approved for the series, a specific document set shall be submitted for each vessel, with its own coding by the delivery date

## Plans for Brazilian Authorities

The SELLER shall submit the bilingual plans required to obtain the Construction License in order to meet the deadlines required by the authorities.

All statutory documents in accordance with the Rules, Conventions, Codes and Regulations shall be issued in "bilingual" format.

The SELLER shall provide the BUYER, no later than 120 (one hundred and twenty) days before the delivery of each vessel, with the (bilingual) documents, for which the SELLER is responsible for, necessary for registering the vessel with the Maritime Authority.

The SELLER shall provide the BUYER, no later than 200 (two hundred) days before the delivery of each vessel, with the documents for which the SELLER is responsible for and which are necessary to obtain the Ship's Station License - LEN (GMDSS) for the vessel.

## Pictures/Posters, framed Plans and Nameplates/Signboards

The framed plans and documents required by the Rules shall be made of material that does not age due to exposure to light and shall be written in Portuguese and English. Whiteboards, for annotations with no permanent marker type pens, will be provided and fixed in the following places:

- Draft, trim and list records: on the navigation bridge;
- General notes: on the navigation bridge and in the vessel's office.

Notice boards, measuring 800 x 400mm, made of lined chipboard , with an aluminum frame, lockable, will be provided and fixed in the following locations:

- Officers' and Petty Officers' lounge;
- Ordinary crew lounge;
- Main deck corridors, PS and SB, next to the entrances to the accommodation.

One (1) notice board will be provided for the vessel's maneuvers, for use next to the accommodation ladder.

Two (2) notice boards will be provided, for use in the area of accommodation ladders, both sides,, with the following words "PROIBIDO FUMAR - NO SMOKING".

Two (2) notice boards will be provided, for use on the stern guardrails, at PS and SB, with the words " AFASTE-SE DO HÉLICE - KEEP CLEAR OF THE PROPELLER".

Two (2) notice boards will be provided for use on the fore bulwark and guardrails, at PS and SB, with the words "PROA BULBOSA - BULBOUS BOW".

One (1) notice board for Crew Shifting will be placed on Ship's Office deck.

Instruction boards, to be supplied by the BUYER, shall be framed and fixed by the SELLER on board, as defined below:

- Instructions regarding life jackets: in all corridors of the Accommodation decks, in the dining rooms and in the Ship's Office;
- Fire-fighting instructions: in all the corridors of the Accommodation decks, in the Engine Room and in the Messroom;
- Shaller List: in the Navigation Bridge, Messroom, ECR, CCR;
- Instructions on artificial breathing: Navigation Bridge, ECR, Infirmary/hospital;
- First aid instructions: Navigation Bridge and in the infirmary.
- Sea conditions board: on the Navigation Bridge;
- Box on cloud conditions: on the Navigation Bridge;
- RIPEAM board: at the Navigation Bridge;
- Whistle table: at the Navigation Bridge;
- Plate with the vessel's Call Sign (next to the GMDSS station);

One (1) ASTM A-316L stainless steel plate with at least the following information shall be fitted and fixed to each wing of the Navigation Bridge:

- Distance from Navigation Bridge to Bow;
- Distance from the Navigation Bridge to the stern;
- Distance from the Navigation Bridge to the cargo manifold;
- Distance from the Bow to the center of the Cargo Manifold;
- Distance from the Stern to the center of the Cargo Manifold;
- Height of the Navigation Bridge in relation to the baseline;
- Height of the Navigation Bridge in relation to the Normal Ballast Draught;
- Height of the Navigation Bridge in relation to the Summer draught;
- Height of Navigation Bridge in relation to full load draught;
- Height from Top of Masthead Light to Base Line;
- Height from Top of Masthead Light to Lightest ballast Draught.

On each of the side bulkheads of the Navigation Bridge, a fiberglass signboard with the vessel's name shall be provided and installed, protected and reinforced against strong winds, and clearly visible from below. The sign shall be illuminated by LED floodlights on the Navigation Bridge deck.

Two (2) stainless steel plates with the vessel's call sign engraved in black letters shall be provided and fixed on Navigation Bridge and the captain's office, next to the external communication equipment. All external signboards shall be made of ASTM A-316L stainless steel.

Machinery, equipment and accessories shall be fitted with nameplates made of ASTM A-316-L stainless steel, fixed by screws also made of the same stainless steel, with engraved characters and painted black.

Tank manholes in the Engine Room, except for those located on the double-bottom top tank, and

external fan and exhaust fan trunks, shall be fitted with nameplates made of ASTM A-316L stainless steel, fixed by screws also made of the same stainless steel, with characters engraved and painted in black, identifying the tank (name and number) and the equipment, respectively, in accordance with the final plans. The tank name shall reflect the Capacity Plan

The tank manholes located on double bottom tanks in the Engine Room, the hatches and manholes located on the exposed deck, the access holes and covers / coamings of the cargo and ballast tanks, the manholes of the chain locker mud box, the miscellaneous hatches and covers of the openings for cargo tank degassing exhausts shall be identified by means of weld seam and painted characters, going around the edge of the letter or number to be represented, indicating the name or number of the tank, in accordance with the final plans.

## J Materials

All steel and aluminium materials (if applicable) used to build this vessel shall be of marine standard with a certificate from the Classification Society. Exemptions shall be approved by the Classification Society, ref. [201 Hull materials](#).

All cast parts shall be without blisters of significance and without cracks or other defects. These parts shall not, under any circumstance, be repaired by plugging or similar without the Owner's approval.

All wooden materials shall be dry and of good quality.

Neither asbestos nor asbestos containing materials shall be used in the construction of the vessel.

Wherever galvanizing is mentioned, hot dip galvanizing is meant.

Wherever stainless steel is mentioned, AISI 316 L or similar shall be used.

Wherever Acid Resistant Steel (ARS) is mentioned, AISI 316 L or similar shall be used for welded parts, and AISI 316 L or similar for non-welded parts (like bolts etc.).

Type, size and material of equipment, machinery and fittings shall be in accordance with European Standard (EN) and/or Deutsches Institute für Normung (DIN), Norwegian Standard (NS), Yard standards and makers' standards.

## K Building method and workmanship

### Workmanship

All workmanship shall be carried out according to approved drawings and Yard practice.

All the installation instructions and recommendations from equipment and material makers shall be followed thoroughly.

### Building procedures & standards

The following procedures and workmanship standards shall be presented to the Owner for approval before the construction starts:

- Hull Ship building Process and Construction Standard (IACS REC 47 Shipbuilding and Repair Quality Standard).
- Ship Machinery Installation Standard
- Electrical Equipment and Cables Installation Standard
- Piping Practice
- Surface Preparation and Painting Standard
- Standard Procedure for Pipe Systems Cleaning

- List of Inspections and Tests for the Owner and Classification society
- Workmanship standards for all pipes, ref. 7 System for Main Engine Components and 8 Ship Common.

### **Storage, handling and protection of equipment**

The Yard shall provide proper and safe storage areas (clean, tidy, dry and against theft and physical damage) and ensure proper protection of all equipment at all times as per Makers' instructions. Electronic equipment shall be stored in an air conditioned space.

Handling/transport of all equipment shall be strictly according to the Makers' instructions.

Any damage to stored or installed equipment shall be reported to the Owner immediately.

Special care shall be taken to ensure proper protection of electric and electronic components and equipment during storage and throughout construction in order to ensure that no dust or humidity will damage or reduce lifetime of this equipment.

Records of stored and arrived equipment at the Yard's warehouse shall be reported to the Owner as per agreement.

### **Inconsistencies**

Throughout the construction period the Owner shall issue Correction Requests to the Yard whenever the Owner has detected inconsistencies between the Contract/ the Specification and vessel under construction. The Yard will precede the correction by the procedure agreed between the Owner and the Yard.

## **L Purchase routines**

The makers' list shall be a separate document and be part of the Building Contract documentation.

All substantial sub-contractors shall be approved by the Owner.

The equipment manufacturers shall be field proven (with recognized quality standards in the shipbuilding market) and defined as per some selection criteria:

- The equipment, components and their auxiliary accessories purchased shall be from the manufacturer's latest version, with characteristics equal to or greater than those specified. Equipment or components announced by the manufacturer expected to be phased out within next 10 (ten) years, considered to be at a mature stage in their life cycle by the manufacturer or in the "proof of concept" phase will not be accepted.
- The equipment shall be ordered, supplied and painted in accordance with Standard N-1503 (Colors for painting boats)
- The technical proposals ("PT's") for the equipment listed in Preliminary Document List LD-4800.00-9311-000-PTD-001, shall be forwarded to the OWNER for approval prior to the placement of orders for such equipment by the YARD with the respective manufacturers. The "PT's" shall consist of the technical specification and data sheets of the equipment and accessories, scope of supply, general arrangement with required maintenance area, installation manual, preservation procedures, clear indication of the model, list of deliverable documents, list of spare parts, required certification and list of deviations, as well as their respective delivery/ lead time.

If the equipment listed in this specification and the corresponding makers list is not relevant at the time of purchase because:

1. The equipment is not longer in production
2. The equipment is replaced by a newer generation

3. Equipment from another manufacturer is better suited for the purpose,  
the Yard shall propose another equipment maker with equal or better quality to the Owner for approval.

## M Owner Furnished Equipment

The following equipment shall be delivered by the Owner:

- Galley and Mess utensils
- Blankets and linen
- Books, charts
- Flags (including signal flags)
- Consumables (except for sea trials)
- Spare parts and other equipment above classification society requirements
- Gas welding and cutting equipment including hoses and bottles, ref. [441 Machine tools, cutting and welding equipment](#)
- Loose mooring equipment, ref. [436 Loose mooring equipment](#)
- Hand tools
- Personal protection equipment other than required by the Classification Society and National Authorities.
- Portable oxygen analyzer and gas meter;
- Portable level indicator/interface ("UTI") for cargo tanks;
- Portable gas detector and sampling tubes for vapors and gases;
- Subscription for electronic chart, exceeding 1 year, ref. [412 Satellite navigator](#)
- Medicines other than those in life boats and life rafts
- Decorations, ref. [545 Decorations](#)
- Scientific equipment if not specifically mentioned in this specification
- ...

Additionally the following systems shall be delivered by the Owner for the Yard to install and connect/ interface as stated below and according to Local Area Network solution ref. [855 Common computer systems](#).

- Spare part/ maintenance system, ref. [109 Maintenance systems, instruction material](#)
- Equipment for ISPS Gangway Control system, ref. [564 Pilot ladder, accommodation ladder, gangway and 88 Cable installation and cable support](#)
- Entertainment system (audiovisual equipment etc.), ref. [564 Pilot ladder, accommodation ladder, gangway](#)  
  
~~Equipment for Starlink installation, antenna, Starlink rack with content. Ref. <broken cross-reference>~~
- Equipment for VSAT installation, antenna, VSAT rack with content.
- WiFi system
- Mobile systems
- DECT system
- Telephone system
- Electronic master key locking system, ref. [512 Internal Doors](#)
- Servers and LAN system, ref. [855 Common computer systems](#)

For assistance with Owner Furnished Equipment, ref. [126 Assistance with owner's supply](#).

All other equipment necessary and according to normal ship building standard, unless expressively listed above, shall be delivered by the Yard.

## N Trim and stability

Minimum metacentre heights (GM) for fully equipped and loaded ship shall satisfy the requirements of the National Authorities. The same applies for the ship's GZ-curves for characteristic loading conditions.

The vessel will be designed so that during the voyage there is no need to move cargo or ballast for draught adjustments.

In the arrival conditions, the vessel should be approximately even keel (stern trim of no more than 30 cm). Under departure conditions, the vessel may have a stern trim of up to 1,5% of the length between perpendiculars.

A preliminary trim, stability and longitudinal strength calculation shall be submitted to the Owner for information.

After the inclination test (ref. [152 Tank capacity, inclination experiment, vibration measurements](#)) final stability calculations shall be submitted to:

- the National Authorities for approval
- the Owner for review

As soon as possible after the completion of the vessel the following final documentation shall be submitted to the Owner:

- Approved trim and stability booklet
- Damage control plans and booklets

The Trim and Intact Stability and Damage Manual will be prepared with required information to calculate the vessel's draft, stability and longitudinal forces (bending moments and shear forces), covering at least the following basic conditions:

- Light vessel\*;
  - Docking condition, with 10% consumables and ballast so that the vessel is trim-free\*;
  - Stern tube emersion (up to ship's allowable structure strength limit) \*;
  - IMO/MARPOL ballast condition;
  - Structural testing of cargo tanks (hydrostatic/chess test) \*;
- \*(For these conditions above it will not be necessary to meet the requirements of the stability criteria for this type of vessel set out in the 2008 IS Code)
- Design condition (full load), summer draft and product with a specific weight of 0,85 t/m<sup>3</sup>.
  - Normal and heavy ballast;
  - Full load for products with specific weights of 0,688/ 0,70/ 0,865 and 0,88 t/m<sup>3</sup>;
  - Cargo tanks cleaning condition (100% ballast in ballast tanks and collision tanks, and 50% ballast in port and starboard slop tanks);
  - Partial load condition with 1 (one) full segregation (for each segregation), considering all products;
  - Part load condition from 1 (one) full segregation to 4 (four) full segregations, considering all combinations between products;
  - Damage stability.

For ballast and cargo conditions, the calculation shall be made with 100% and 50% consumables on departure and 10% of consumables, equivalent to three days of fuel oil reserve in the storage tanks.

For each of the loading conditions listed above, an Addendum to the Trim and Stability Manual shall be prepared and approved, including alcohol based alternative fuels, with the following considerations:

- Volume of alcohol based fuel in the respective tanks equivalent to 50% of the total range;
- Volume of alcohol based fuel in the respective tanks equivalent to 100% of total range.

In addition to the Trim and Stability Manual, an optimum Trim table shall be prepared, approved and supplied for each loading condition between ballast and fully loaded, considering different speed ranges (between minimum and maximum operational speeds), aiming to obtain the lowest fuel oil consumption.

An optimal Trim Table to be included in the Final Stability Booklet.

The SELLER shall check and confirm that the vessel's movements/ seakeeping comply with the requirements of ISO Standard 2631 (Parts 1 and 3), for 30 min, 2h and 8h exposures, by analyzing the "RAO - Response Amplitude Operator". If necessary, the SELLER shall include in the project an active or passive system, with a control panel on the Navigation Bridge and CCR, which guarantees the range of movements within the limits defined by the aforementioned Standard.

The seakeeping criteria (~~thruster emersion~~, slamming and green water load) shall meet the requirements defined by the classification societies. The studies carried out to define the parameters of these events shall be submitted as project documents.

Calculations of the stability during launching shall be provided.

#### **Weight control**

The Yard shall maintain Lightship weight and Centre of Gravity (CoG) control and report regularly to the Owner and Designer. Weight reports shall include weight listing sorted on SFI standard and compared to the initial weight budget.

Weight monitoring of the vessel should be performed at milestones:

1. At date when numerical cutting information is available
2. At launching. Including buoyancy measurement
3. Before delivery. Final inclining experiment

## **O Vibration and Noise Control**

### **General**

Special attention shall be paid in the design and construction to limit the vibration and noise levels within the ship to those generally accepted, and which will not result in discomfort or annoyance to the crew, ensure safe and good comfort, if relevant, to passengers, and not cause damage to the main propulsion system nor cause damage or malfunction of other shipboard machinery and equipment.

### **Vibration and Noise Limits**

On vibration, reference is made to the International Standard ISO 20283-5:2016 "Mechanical vibration -- Measurement of vibration on ships -- Part 5: Guidelines for measurement, evaluation and reporting of vibration with regard to habitability. and to the Classification Society notation listed in F Classification and Flag, in O General, in LEVEL 0 SFI Master.

On noise, reference is made to resolution MSC.337(91): "Code on noise levels on board ships". This resolution shall be met in its entirety as a part of SOLAS. Additionally specific noise limits required by the comfort notation shall be met, ref. F Classification and Flag, in O General, in LEVEL 0 SFI Master.

### **Vibration and Noise analysis**

In order to demonstrate that the specified limits to noise and vibration will be met, noise and vibration analyses shall be carried out at the project stage (consultancy services, hired by the Designer, ref. 101 Contract/specification work, general design, model testing). The analyses will be used as a basis for the construction drawings and should at least include:

- Vibration analysis of local structures (decks and bulkheads in order to avoid magnification of vibration due to resonance with main excitation sources).
- Analysis of the expected noise levels to determine the necessary noise control measures to meet the specified noise limits.

The results of the analyses shall be documented and presented at the design stage. Based upon this analysis the actual extent and quality of the floating accommodation arrangement may be adjusted, as agreed between the Owner and the Yard in order to achieve the required standards. Further, the recommended structural and arrangement modifications shall be incorporated into the design, as agreed between the Owner and the Yard as required to meet the specified vibration and noise criteria. These will in general include:

- Floating accommodation system on accommodation decks according to recommendation from the noise analysis.
- The ~~switchboard room~~ ECR shall have a resiliently mounted raised flooring system.
- Air intake ducts, exhaust casing and air condition room, as well as room for emergency generator, shall be well sound insulated towards the accommodation.
- Resiliently mounted air intake fans
- Resiliently mounted main engines and (main) generators
- Exhaust system shall be resiliently mounted to stiff parts of the structure.
- The windows shall be double insulated with inner frames where required by the ~~report.r~~ eport.

### Special considerations

The analyses shall be extended to include analysis of the main excitation sources (propeller and main engine) and vibration analysis of the hull and sub-structures.

Vibration and noise to consider the Guidelines for the Reduction of Underwater Radiated Noise (URN)

### Verification measurements

Noise and Vibration evaluations shall comply with the standards below:

ISO 2923:1996 - Acoustics - Measurements of Noise on Board Vessels;

ISO 4867:1984 - Code for measurement and reporting of shipboard vibration data;

ISO 4868:1984 - Code for the Measurement and Reporting of Local Vibration Data of Ship Structures and Equipment

ISO 10816-1:1995 Mechanical Vibration - Evaluation of Machine Vibration by Measurements on Non-Rotating Parts - Part 1: General Guidelines;

ISO 10816-3:2009/ 1:2017 Mechanical Vibration - Evaluation of Machine Vibration by Measurement on Non-Rotating Parts - Part 3: Industrial Machines with Nominal Power above 15 kW and Nominal Speeds Between 120 r/min and 15,000 r/min when Measured in situ;

ISO 10816-6:1995/Amd 1:2015 Mechanical Vibration - Evaluation of Machine Vibration by Measurement on Non-Rotating Parts - Part 6: Reciprocating Machines with Power Ratings above 100 kW ;

ISO 21984:2018 Ships and Marine Technology - Guidelines for Measurement, Evaluation and Reporting of Vibration with regard to Habitability on Specific Ships;

And note, the evaluation of low-frequency ship motion which can result in motion sickness is covered by ISO 2631-1. For the evaluation of the global structural vibration of a ship, however, see ISO 20283-2.

If the vibration or noise levels exceed the requirements given in the specification, corrective measures shall be carried out by the Yard.

## P Surveyor

The Owner's representatives to be allowed to inspect the vessel, part of it and machinery at the yard at any time in the construction period.

At the request of Owner's representative the yard to arrange inspection at subcontractors premises. Inspector to have suitable office facilities at the yard and to be provided access to and assistance with telephone and pc with mail and scanner etc. in order to communicate with Owner.

Yard to assist in providing good accommodation, flats, bungalows or equivalent for inspectors and officers.

The Owner and his authorised representatives have the right to inspect the vessel, its machinery, outfit and equipment during construction. The Builder shall grant free access to the Owners representatives to the yard, the vessel and workshops for such purposes during working hours. The Builder will also obtain as far as possible access for the Owners representatives to subcontractors premises. All inspection will be carried out at the Owners own risk.

Costs involved with regard to Owners representatives inspection and stay at yard to be at the Owners expense. Cost involved with regard to owners representatives inspection of main machinery equipment at subcontractors to be at the Owners expense.

Inspector to receive copies of technical correspondence, minutes of meetings, technical matters etc. between builders and Owner. Inspector to receive items of inspections for approval. A schedule shall be provided showing major events and milestones, including test and trials. Events to be mutually agreed upon to avoid conflicts in time.

Written information of inspections and tests/trials to be submitted 24 hours beforehand.

If the inspections are to be carried out on facilities outside of the contracted yard area, yard shall give notice in reasonable time beforehand.

The Owners representatives shall observe the working rules prevailing at the Builders and subcontractors premises.

The Owner will advise the Builder as soon as possible of the inspections, tests or trials they wish to attend.

In case that the Owner's Representatives cannot attend the inspection and test due to their own cause, they are to be entrusted to the surveyors representing the Classification Society and/or authority and/or the Builder's inspector, then the result of which to be accepted by the Owner subject to a written report verifying the test results.

Where the Owners representatives discover any non compliance with the contract or specification, he shall give the Builder notice thereof in writing not later than 72 hours from discovery.

On receipt of such notice the Builder shall correct such non conformity.

In performing the supervision, the Owners representative shall ensure that the work is in accordance with the contractual documents, but without the right to stop, divert or delay the program of work in case of alleged conflicts.

The Owners representatives shall address their comments, remarks and recommendations in writing, exclusively to the Builders designated representative(s).

## **Q Delivery**

The vessel to be delivered to the Owner completely seaworthy including lubrication oil and hydraulic oil in systems ready for taking on board fuel, provisions, crew and cargo.

The entire ship to be properly cleared and cleaned, and all paint work finished to the satisfaction of the owner.

All flushing oils to be on yards account.

When the vessel has been completed, passed all tests, all the outstanding items from owner site have been solved, and has been certified as prescribed in this specification.

Documentation shall be delivered with no impeditive pending items (Design, Manuals, Class Certificates and Competent Bodies, etc).

The vessel shall be drydocked at the following stages of construction 144 Dry docking, slip docking:

- Before the Official Sea Trial;
- Before delivery.

## **R Routine by alterations**

The work to be carried out in conformity with good customary standards applied at the yard.

The yard, however, shall accede to the Owner's request with regard to materials or execution, providing that such demands are within the terms laid down in the contract and are conveyed in writing in reasonable time before the yard place their order or carry out the work.

Correction work due to non-conformity to specification/plans or to requirements of the classification society and regulatory bodies shall be carried out by the builder at prior to delivery of the vessel, unless otherwise is agreed with the owner.

The Owner may demand in writing the carrying out of minor alterations or additions over and above what is laid down in the specification.

Other work of this kind shall be carried out only after a special written agreement or according to the demands of the Owner as a result of amendments to the rules of Class or authorities.

Should the valid rules of Class or Authorities be modified after the contract has become effective, subsequent work shall be carried out in accordance with the new rules, if the owner demands that these should be followed. The yard shall to the best of their ability inform the owner of any

modifications in the rules of the Class and Authorities which affect the building of the vessel, and of the consequences, financial and technical due thereto.

The yard may alter constructional details, materials, or type of equipment described in this specification, if they cannot be obtained or be technically applied, provided that in all cases these alterations are approved by the Owner, as per the Technical consultation's submission flow, and that the changes will not impair the overall efficiency of the vessel or the efficiency of the equipment. Lists of extra and credit costs are to be kept by the yard and to be agreed upon with Owner continuously during the building period.

For work of above mentioned kind, an additional charge or deduction shall be calculated according to the ordinary rates of the yard, unless otherwise agreed in writing before the work is carried out. Any alterations or additional work to be submitted in due time before design work is completed.

The agreed time of delivery shall be prolonged with such period of time as is required for the preparation and execution of such work or alteration or addition, provided delivery time is affected.

Amendments and changes to be recorded in a memorandum or a written document signed by the Owner and the Builder, and these documents will become a supplement to the Contract Specification.

The buyer to be provided with copies of all correspondence with the classification society and national authorities.

## 1 SHIP GENERAL

### 10 Specification, estimating, drawing, instruction, courses

#### Documentation

The Yard shall be in charge of the as built documentation and as built drawings according to the agreed list, the documentation shall be delivered to the Owner electronically and 2(two) paper copy collections at delivery of the vessel.

Documents to be of searchable format.

#### Vessel's Operating Manual

The Yard shall prepare and supply the vessel's operating manual, containing a functional description of the equipment and systems, design assumptions and expected operating modes, divided into sections on machinery, navigation, operation (loading, unloading, tank cleaning, inerting, etc.), deck equipment, etc., taking into account the design and technical particularities of each system and equipment for correct operation. The manual shall reference the suppliers' documents and other related design documents.

The manual shall be prepared based on the approved design documentation.

In addition to the Operating Manual mentioned in the previous paragraph, a manual/list with all the operating parameters of each equipment or system, containing the acceptable and safety limits ("set points"), shall be supplied.

All components of the manual shall be identified in accordance with the project, using unique identification (e.g. tags). Operational manual valves shall have a unique tag for identification.

### 101 Contract/specification work, general design, model testing

The Yard shall deliver all analysis and studies required by the Classification Society and National Authorities. For details, ref. Contractual Document List.

#### Special studies / manuals

Table 1.1 Special studies / manuals

Study	Comments
Hydrodynamic model testing	Model test facility
EEDI calculation / SEEMP	Designer
EMC study	Yard
Heat balance of accommodation HVAC design	HVAC supplier
Noise level prediction (ref. <a href="#">O Vibration and Noise Control</a> )	Consultant (BV), for internal use by the Designer
Vibration study (ref. <a href="#">O Vibration and Noise Control</a> )	Consultant (BV), for internal use by the Designer
Alternative Design review (if DF Methanol)	Class /Flag/Yard/Designer

The results of the analysis studies shall be presented to the Owner on request.

#### CFD Calculations

The Designer shall perform CFD aided calculations in order to optimize the vessels speed and performance as stated in [D Performance](#).

#### Model Tests

The Designer shall arrange a model test program at a reputable model test facility, internationally recognized (ITTC) with a minimum ISO 9001 certification, in order to verify the vessels performance. The tests shall be in accordance with IMO EEDI requirements.

The tests shall include:

- Towing Test / two draughts (Summer Draught & Ballast Draught)
- Propulsion Test / stock propeller / two draughts
- Wake Test / two draughts (Summer Draught & Ballast Draught)
- Cavitation Test / two draughts (Summer Draught & Ballast Draught)
- Manoeuvring tests according to Resolution A.601(15)/Appendix 3

In addition, the following documents/data shall be provided:

- A model test report

The Owner is allowed to observe the tests. Eventual modifications of the hull lines after the model test shall be verified by CFD aided calculations.

Eventual modifications of the hull should be approved by Owners to decided if it's necessary or not to run a new model test.

The model test shall be witnessed by the Class Society

## **109 Maintenance systems, instruction material**

### **Equipment information/component list**

Equipment information/component list for the Owner's maintenance system shall be delivered from the Yard to the Owner.

1. Preliminary information no later than latest one (1) month before the vessel's launching.
2. Final information no later than one (1) month before sea trial.

The equipment list shall contain a brief description of all equipment as follows:

- - System Name:  
 - Short name of the device (25 characters):  
 - Full name of the equipment:  
 - Equipment model:  
 - Equipment Serial Number:  
 - Equipment dimensions and weight:  
 - Technical data (plate information) of the equipment:  
 - Equipment manufacturer and address:  
 - Observations (location on board, etc.)
- All parts delivered with the different components, standard spare parts, etc.
- All additional parts ordered by the Owner until two (2) months before delivery, shall be listed.
- Other relevant information for effective maintenance, ref. [Drawings, instruction manuals, etc.](#).

A spreadsheet template shall be provided by the Owner and populated by the Yard in order to ease the conversion of data into the maintenance system. The spreadsheet shall be aligned with the equipment list described above.

- Manufacturers' recommendations contained in manuals, drawings, diagrams, arrangements, project guides and data books relating to their respective equipment shall be followed by the OWNER, and it is the OWNER's sole and exclusive responsibility to develop, design, approve and execute the vessel's project, incorporating all the requirements and recommendations of the equipment's manufacturers from the design phase onwards, at no additional cost to the YARD.

- The equipment manufacturers' documents, such as maintenance and operating manuals, shall be sent to the OWNER in searchable electronic format as soon as possible before the installation of the respective equipment on board and at the latest by the date of submission for approval of the commissioning and testing procedures. The equipment and systems manuals shall be complete and comprise all relevant parts such as Storage and Handling, Installation, Operation, Maintenance, Spare Parts List, Complete Part List, Data Sheet (accessories and instrumentation), Factory Test Report and Certificates. Supplier manuals shall clearly indicate the items in the scope of supply, including models, type, parts and components.

### **Instruction material**

The Yard shall ensure that the ship's crew has the necessary instructions/ manuals on board for using the fitted equipment.

The Yard shall deliver three (3) copies of instruction manuals in English for all installed machinery and equipment. Instruction manuals shall be delivered electronically in a common readable format (e.g. PDF).

## **11 Insurance, fees, certificates, representation**

### **111 General insurance**

Ref. Contract.

### **112 Classification, statutory fees and certificates**

All fees to the Classification Society and National Authorities shall be paid by the Yard.

Any fees to external parties applicable to the construction of the vessel shall be the responsibility of the Yard.

A copy of all documentation and technical consultations exchanged between the YARD and the Classification Society shall be sent to the OWNER for information and filing, by electronic means (scanned), receiving the same treatment as other documents.

### **118 Launching & delivery representation**

Ref. Contract.

## **12 Quality assurance, general work, models**

### **121 Quality assurance, planning, work preparation**

The Vessel shall be built in accordance with a quality-plan provided by the Yard and approved by the Owner.

The Yard shall provide a detailed Progress-plan with milestones for the production and outfitting of the Vessel within 30 calendar days after signing the Building Contract. A monthly progress report shall be forwarded by the Yard.

Minutes of Meetings (MoM) shall be taken by the Yard at all important meetings between all parties. For efficient monitoring of the project, decisions, technical issues, progress and cost relevant decisions shall be included in the MoM. Agreements and decisions mutually decided upon between formal meetings shall be included in the MoM's where it is deemed relevant from either the Yard or the Owner.

The MoM's shall be signed by both parties and shall be formally binding documents.

The vessel's design shall be developed using industry practices and tools that are already consolidated and recognized, so as to allow the design to be drawn up in a 3D model and built in accordance with detailed design method/ strategy, making it possible to predict, visualize and correct possible errors, interferences, spaces for movement, impacts, simulate the sequence of construction of the blocks, etc., as well as issuing complete parts lists by blocks or units to be defined by the shipyard according to their construction, handling and transport capacity. A block in advanced outfitting is understood to consist of the steel structure, equipment, foundations, piping and accessories, whenever applicable. At the end, an unprotected and editable electronic copy of the project shall be delivered to the OWNER by the YARD. The 3D model (and its attributes) shall be prepared in accordance with I-ET-4800.00-9311-000-PTD-017 (Digital Engineering Requirements) and its annexes.

## **122 Work management, fire guard, supervision, watch keeping**

A comprehensive and effective system of fire detection, fire protection and fire fighting shall be organized and maintained while the Vessel is under construction and outfitting. Shore water supply for fire fighting shall be provided at all times while the Vessel is in the Shipyard.

Suitable fire resistant covers shall be used to protect intricate and vulnerable items of machinery and equipment from falling sparks or other potential sources of fire.

A fire watch shall be maintained continuously during welding operations. Insulation material shall be removed within approx. 1 m of the welding.

Special restrictions against smoking shall be enforced when danger of fire or explosion exists, as well as during fuelling or handling of volatile and flammable materials.

Bare lights shall not to be used in freshly painted compartments or other spaces where a fire hazard may exist.

## **123 Clearing and cleaning**

### **Cleaning**

The vessel shall be delivered totally cleaned up.

All tanks and compartments shall be cleaned of all dirt and tonnage.

Special care shall be taken that pipe lines and machinery are clean of foreign substances before filling, that all machinery is in good running order and that all equipment and stores are properly stowed onboard. Hydraulic pipe lines shall be flushed and proved cleaned and approved by the Owner's surveyor and equipment supplier before filling of the system.

### **Provisional rigging**

Temporary access openings, which may be provided in shell, bulkheads, decks, walls etc. shall be reinstated to the satisfaction of the Classification Society. However, such accesses shall be kept to a minimum.

Eye plates or lifting plates in relation with rudder blade and propeller removal/re-installation shall remain on the hull for future use as approved by the Owner's representative.

## **126 Assistance with owner's supply**

The Yard shall install the Owner furnished equipment, ref. M Owner Furnished Equipment.

The Yard shall provide:

- Storage place (safe and suitable for the products stored)
- Internal transportation

- Crane/barge assistance for Owner furnished equipment.

## **127 Models, albums, photos**

The Yard shall deliver One(1) model of the vessel, scale 1:100, in glass display case(s) upon completion of the first vessel in the series.

## **14 Work on ways, launching, docking**

### **144 Dry docking, slip docking**

The vessel shall be dry-docked within one month before delivery for:

- final inspection of:
  - sea intakes and overboard pipes
  - ventilation pipes for sea chests
  - antifouling systems
  - cathodic protection systems (ref. [278 External cathodic protection](#))
  - HPR gate valve(s)
- polishing of propellers
- removal of all brackets attached to the external shell, except for those for propeller removal

Alternatively to docking, the vessel shall be inspected by diver within one month before delivery or the paint manufacturer and the shipyard providing a painting warranty for a period of not less than 5 (five) years from the date of delivery, and are responsible for the cost of recovering the hull anti fouling paint system in the event of failure during this period or the appliance of an anti fouling painting scheme with a static period properties compatible with the vessel's idle time.

An inspection to confirm the cleanliness of the hull, propeller and sea chests is carried out by certified diving company.

Vessel performance tests (ref. [154 Trial trips](#)) shall be carried out between this dry docking or diver inspection and the delivery of the vessel.

## **15 Quality control, measurements, tests, trials**

### **151 Machinery testing**

#### **General**

Inspection, tests and trials of the vessel including her hull, machinery, equipment and outfits will be carried out by the Yard or the equipment manufacturers at their work shops or on board the vessel throughout the construction period of the vessel. This will be in accordance with the Contract, the Yard and/or the Makers' standards which will comply with the rules of the Classification Society and other rules and standards given in the contract. The programme shall, at least, consisting of the following tests mentioned in this section.

In order to observe the operation and performance of all materials, components, equipment and systems, the YARD shall prepare Quay and Sea Trials Procedures, in accordance with normal practice and the characteristics of the equipment and systems, as well as the Execution Schedule for these Trials in accordance with Annex I-ET-4800.00-9311-000-PTD-018 (Technical Requirements for Construction). These documents shall be submitted to the OWNER for approval at least 45 (forty-five) days before the tests are carried out. These documents shall have been previously approved by the OWNER before the respective Tests can take place.

The Quay and Sea Trials Procedure sheets shall be prepared on the basis of a Quay and Sea Trials List in accordance with item 5.1.1.3 of the contractual Annex A, doc. no. I-ET-4800.00-9311-000-PTD-018 (Technical Requirements for Construction). This List shall be submitted to the OWNER for approval one hundred and twenty (120) days after the enforcement of the Contract.

The Deadweight verification shall be carried out for all vessels in the series. The inclining experiment, will be carried out on the first vessel of the series, and every four (04) vessels, with the vessel's readiness level as much completed/concluded as possible in accordance with the requirements of the classification society and NORMAM.

A deadweight verification shall be carried out at the time of the inclining experiment

Tests of the vessel's installations, equipment, systems and operation as a whole will comprise the following phases and shall be carried out in accordance with the contractual Annex A, doc. no. I-ET-4800.00-9311-000-PTD-018 (Technical Requirements for Construction):

- Delivery Inspection, storage and preservation in accordance with the manufacturer's recommendations;
- Visual inspection, assembly and installation (piping, equipment, structures, systems, etc.);
- Pressure and leak tests, cleaning of piping and tanks;
- Calibration of instrumentation, safety protection tests, solution of pending items;
- Equipment start-up, equipment testing, system testing and sea trials;

The Sea Trial tests will only be carried out after the OWNER and the Classification Society have completed and approved all the tests and Quay Trials as per construction schedule, based on previously approved test procedures.

#### **Factory acceptance tests (FAT)**

In general Factory Acceptance Tests (FAT) shall be carried out in accordance with manufacturer's standard and in compliance with Classification Society requirements.

The full range of FAT's shall include but not be limited to the following list:

- main engines
- main generators
- main alternators
- main propulsors
- main switchboards
- winch systems
- cranes
- IAS
- Thermal Oil Heaters
- Cargo Pumps
- Ballast Pumps
- Ballast Water Treatment
- Steering Gear
- Inert gas generator
- MCB/ESB
- PMS

The Owner shall be invited to witness all Manufacturers' FAT's. A list of such trials shall be provided in the early stages of the contract. Where the Owner chooses to attend a FAT, a representative from the

Yard should also attend. The Owner shall be informed of the FAT schedule at least fortyfive (45) days in advance of the expected date of the FAT and the Owner's attendance shall be confirmed to the Yard five (5) days in advance of the date of the expected test.

Information regarding a FAT and procedures, shall be submitted at least forty (40) days prior to the FAT.

All machinery shall be tested to the Owner's, Classification Society and sub-contractor's satisfaction.

#### **Torsional vibration calculation (TVC)**

Torsional vibration calculations shall be carried out by:

- the engine/generator manufacturer for the generator sets
- the propulsion manufacturer for the propulsion line
- the engine manufacturer in case of a direct driven propeller

The calculations shall be submitted to the Owner and the Classification Society for approval.

#### **Harbour acceptance test (HAT)**

List of Quay Trials and associated procedures to be submitted by the Builder for Buyer's approval.

Before the trial trip all machinery, stated to be subject to test requirements, shall be tested at dock until the preliminary adjustments have been carried out to the equipment supplier's, the Owner's, the Classification Society's and the National Authorities' satisfaction.

The main machinery shall be tested at dock before the trial trip to the extent necessary to obtain temporary service permission for the trial trip from the Classification Society and National Authorities.

The Contractor shall arrange and be responsible for the HAT.

The respective Contractors are requested to provide details in their tenders for conducting the following specific integration HAT's (Note that the full range of HAT's shall include but not be limited to the following list):

- Combined engine and generator operation tests
- Propulsion Control System
- Instruments and alarm plant
- Inclining experiment, ref. N Trim and stability
- Winches
- Cranes

The Owner shall be invited to witness all harbour trials and system commissioning tests and a list of such trials and tests shall be provided in the early stages of the contract. A representative from the Contractor shall attend all harbour trials and tests.

#### **Sea Acceptance Test (SAT)**

For SAT, ref. 154 Trial trips.

Commissioning report issued by equipment's manufacturers to be handed over to Transpetro after completion of Quay/Sea Trials as part of Delivery documentation.

## **152 Tank capacity, inclination experiment, vibration measurements**

#### **Tank capacity**

All tanks shall be calculated and sounding and ullage tables (remote and hand dipping/manual device references) shall be made for the following conditions:

- One (1) condition with trim forward
- even keel condition
- Five(5) conditions with trim aft
- Five(5) correction conditions regarding the heel to SB (Only the cargo and slop tanks ullage tables.)
- Five(5) correction conditions regarding the heel to PS (Only the cargo and slop tanks ullage tables.)
- Sounding reading intervals stepped by 1 cm.
- Ullage reading intervals stepped by 2 cm.

Sounding and ullage tables (remote and hand dipping/manual device references) shall be based on detailed as built drawings of all sounding pipes and sounding and ullage devices (drawings shall be delivered by the Yard to the Designer).

#### **Inclination test**

When the vessel is as near completion as possible and to the National Authority and/or Classification Society surveyor's satisfaction, an inclination test shall be carried out by the Yard and witnessed by the Owner's and Designer's representatives.

### **153**

#### **Fuel & lube oil for tests and trial trips**

The Supplier of the lubrication oil(s) shall be decided by the Owner in due course before delivery of the vessel. The Yard shall supply a lubrication diagram (lubrication oil schedule) for the Owner's approval.

The Yard shall supply FO, lubrication oil and grease for initial filling of the systems. The Yard shall pay the cost of the quantities of FO, lubrication oil, hydraulic oil and grease for initial fill-up of equipment as well as consumed during tests and trials. The Owner shall pay the cost of the quantities of FO, lubrication oil, hydraulic oil and grease remaining onboard in storage tanks and drums after all tests and trials are completed.

Oil samples (taken jointly by the Yard and Owner's representatives) of all hydraulic and lubrication oils shall be sent to oil suppliers laboratory for analysis. Reports from analysis shall be sent to both the Yard and Owner directly from laboratory. In case oils are found unsuitable for further service, the Yard shall restore cleanliness in the systems and storage tanks immediately and replenish affected systems fully at own cost. Thereafter the oil sample- and analysis routine shall be fully repeated. If oils are found unsuitable for further service the Owner shall not compensate the Yard for any unsuitable oil remaining onboard.

When bunkering FO during construction the Yard shall take samples on the common filling line. Samples shall be sent to a FO testing laboratory for analysis. Reports from analysis shall be sent to both the Yard and Owner directly from laboratory. In case FO is found to be off specification the Yard shall restore cleanliness in the systems and bunker tanks immediately and replenish affected systems fully at own cost. Thereafter the FO sample- and analysis routine shall be fully repeated. If off specification FO is found the Owner shall not compensate the Yard for any unsuitable FO remaining onboard.

### **154**

#### **Trial trips**

When the vessel is substantially completed, the official sea trial shall be carried out by the Yard in accordance with the Classification Society's and National Authority's requirements and the Yard's practice.

A program for the technical sea trial shall be submitted to the Owner at least fortyfive (45) days before the trip.

DGPS for navigation used for trials should be type approved against IMO performance standard for speed & distance measuring equipment.

The results of the sea trials shall be sent to the Owner and the Designer.

The official sea trial shall consist of at least the test mentioned in Table 1.2. The trials shall be performed at ballast draught and laden draught<sup>[1]</sup> for first vessel and laden draught for sister vessels, and for a trim no greater than 30 cm as well as other requirements of the equipment suppliers<sup>[2]</sup>, Classification Society and/or the Regulatory Bodies concerned.

Further references are made to Chapter H : ISO Standard 15016:2015

Table 1.2 Sea Trials

Test	Engine load	Remarks
<b>Speed #</b>	100% MCR 90% MCR 78.26% MCR (Contract condition) 75% MCR (EEDI condition) 65% MCR On main engine(s)	The speed at the sea trial shall be measured by the DGPS. Each speed shall be the mean of 1 consecutive run alternating in direction, 1 up and 1 down on the test course. The power of the Main Engine shall be determined using a properly calibrated and certified torquemeter. The requirements of the ITTC, ISO 19019 and ISO 15016 shall be observed. The test shall aim to verify the contractual speed requirement and EEDI.
<b>Fuel Oil consumption #</b>	100% MCR 85% MCR 78.26% MCR (Contract condition) 75% MCR (EEDI condition) 65% MCR On main engine(s)	Shall be measured during speed trials. The vessel's fuel oil consumption shall be measured during 6 (six) hours of continuous operation of the Main Engine, operating at continuous service rating (CSR), and with 1 (one) Auxiliary Engine operating at normal voyage electrical load.
<b>Maneuvers Tests</b>	According to IMO A.601(15)	As pr. the resolution IMO A.601(15), the first vessel must be maneuvered at ballast condition to, and if applicable, the sister vessels could be estimated
<b>Crash stop</b>	From 100% MCR ahead to full astern	Until ahead speed becomes zero.
<b>Turning trial</b>	100% MCR on main propeller(s)	One SB turn and one PS turn
<b>Zig-zag test</b>	100% MCR on main propeller(s)	Port and starboard to each of 10°/ 10° and 20°/ 20°test
<b>Endurance test #</b>	According Classification Society requirements	4 hours at MCR, 2 hours at CSR and 0,5 hour at 110% MCR
<b>Unmanned ER operation test #</b>	According Classification Society requirements	4 hours during endurance test
<b>Anchoring test #</b>	According Classification Society requirements	According Classification Society requirements
<b>Noise level measurements #</b>	According National Authorities requirements	According National Authorities requirements. Performed during endurance test. Noise level measurements at a minimum of 40 (forty) points in the accommodation, Engine Room and service compartments, chosen by mutual agreement between the yard and the Owner, <i>and in full compliance</i>

Test	Engine load	Remarks
		<p style="color: red;">with item 2.4.1 from the contractual Annex A (doc. no. I-ET-4880.00-9311-000-PDT-001_R0), also under ballast condition (only for the first vessel in the series, and if applicable, every fourth vessel), with the Main Engine operating at continuous service rating (CSR) Ref. SFI item <u>O Vibration and Noise Control</u></p>
<b>Local vibration measurements #</b>	According Classification Society requirements	According Classification Society requirements. Performed during endurance test. Local vibration measurements of the structure at a minimum of 30 (thirty) points distributed in the Accommodation and in the Engine Room, selected by mutual agreement between the YARD and the Owner, and in full compliance with item 2.4.1 from the contractual Annex A (doc. no. I-ET-4880.00-9311-000-PDT-001_R0), under both design and ballast conditions, with the Main Engine operating at maximum continuous rating (MCR) (only for first vessel, and if applicable, every fourth vessel). Local vibration measurements on at least 30 (thirty) points of equipment, selected by mutual agreement between the YARD and the OWNER, and in full compliance with item 2.4.1 from the contractual Annex A (doc. no. I-ET-4880.00-9311-000-PDT-001_R0), also under ballast condition (only for first vessel, and if applicable, every fourth vessel) , with the Main Engine operating at maximum continuous rating (MCR)." Ref. SFI item <u>O Vibration and Noise Control</u>
<b>Linear vibrations for the hull and torsional vibrations for the shaft line</b>		As a result, part of the Sea Trial will have to be carried also at ballast condition (only for the first vessel in a series, if applicable, every fourth vessel).
<b>Joystick test #</b>		According Classification Society and Maker's requirement
<b>Compass #</b>		According National Authorities requirements
<b>Bridge equipment #</b>		Electric log (during speed trials) Radar(s) Doppler Echo Sounder Doppler Sonar Current Logger
<b>PMS test #</b>		According to Maker's test documentation

Test	Engine load	Remarks
Testing and demonstration of rescue equipment #		According to National Authorities
NOx measurement		3 <sup>rd</sup> party

Sea trials to carried out with specified fuel oil ISO8217 to be used for all trials at the discretion of the Yard.

Final list of complaints, recommendations, and alterations shall be handed over to the Yard within 24 hours from the end of the trial trip.

Full test result report for tests required by the Classification Society and Authorities shall be submitted to designer at latest by delivery of the vessel.

#### Sister Vessels

For subsequent vessel(s), only “#” marked tests shall be carried out. Consequently, the remaining trials and tests do not have to be performed. The results achieved from the first vessel shall be provided.

Crash stop astern trial for subsequent vessel(s) may be carried out for the machinery part only.

Footnotes:

[1] The vessel's draught shall be witnessed by the Owner from a boat immediately before starting the speed runs.

[2] Propeller(s) shall be polished, if necessary.

Ref. SFI item O Vibration and Noise Control

## 156 Testing electrical plant

The electrical plant shall be tested in all manners with regards to function and insulation conditions before delivery.

During the SAT (ref. 154 Trial trips) there shall be measurements of the line harmonics, voltage distortion for the main bus bars for all main AC voltage levels. Measurements shall be performed by main electrical system supplier or specialist. The results shall be analysed and a report shall be written.

The Owner's representative shall be informed so he/she has the opportunity to be present.

The tests shall be carried out as follows:

- All generators with switchboard equipment
- Power distribution system with sub cabinets
- Consumers in General:
  - Equipment and components function tests
  - Electric motors under normal service conditions
  - Load current and equipment temperatures to be observed
- Electrical installations:
  - Light switches
  - Light distribution
  - Plug sockets (receptacles)
- Alarm Plants

- Warning and alarm devices
- Tag numbering, Alarm points and settings according to I/O list (Instrumentation & automation list) and relevant system drawings
- Thermal Imaging of all major parts of the electrical distribution system (Main switchboard and distribution switchboards/panels) and their bus-bars (with bus-bar connections) as far as practicable.
- Thermal Imaging of main electrical power cables and their connection points as far as practicable.

## **16      Guarantee/mending work**

### **161     Mending work after trials**

The Owner will issue a separate warranty claim for each incident. The Yard shall respond with a plan for closing each claim within two (2) weeks after receipt from the Owner and issue updated status.

#### **Premises for the vessels delivery :**

The following conditions shall be met:

- 1) Clean sea chests, clean heat exchangers where backflushing is applicable, all filters cleaned and new filter elements in the vessel's systems, evidence of draining of trays via scuppers, floors and decks cleaned, tanks drained (sludge, separated oil, drain, bilge, slops, fuel overflow, grey water and sewage, waste water, grease trap, sumps), painted surfaces touched up or with paint scheme recovered where required, and ballast tanks cleaned.
- 2) All quay and sea trials shall be finished, approved and with no impeditive pending items preventing the vessel from operating."

### **162     Guarantee work**

Guarantee work shall be carried out according to the Contract.

## 2 HULL

### 20 Hull construction and materials

Compartments and tanks shall be formed by hull structural bulkheads and decks as shown on General Arrangement.

The vessel's entire structure will be designed using finite elements and will have a fatigue life of 30 (thirty) years. It shall be designed to carry a partial volume of product with a specific weight of 1,04 t/m<sup>3</sup> until it reaches the summer draft. A copy of the final approved finite element model and report (including the native files of the software used) shall be delivered to the BUYER.

No external structure of the hull, superstructure, access and service hatches or deck lockers shall be made of steel plates with a thickness of less than 8 mm.

The hull shall be built as an all-welded steel ship according to drawings approved by the Classification Society, Yard and Owner. As a minimum the requirements of the Classification Society notations shall be met.

Hull structural members shall be of normal strength steel (yield stress 235 N/mm<sup>2</sup>) / high strength steel (yield stress 355 N/mm<sup>2</sup>) in general, unless where the Classification Society has specific requirements.

On the vessel's hull, the use of high-tensile / special grade steel shall be limited to 35% of expected lightweight.

The areas where High Tensile steel can be applied are:

- Main deck plating and its longitudinal reinforcements.
- Bottom plating, double bottom tank top and its longitudinal reinforcements.
- Upper and lower strakes of the longitudinal bulkheads and ship's side, as well as their longitudinal stiffeners.
- Structures located in cargo tanks subjected to high stress concentrations.
- Locations where mild steel plates are required to be over than 25 mm thick.

Gratings and guardrails shall be installed at all stringers and cross-ties openings to prevent accidents.

The YARD shall prepare specific welding procedures for each type of weld to be used on board and submit them to the Classification Society for approval and copies forwarded to the OWNER for information.

The steel work shall be carried out in accordance with the construction standards and welding and non-destructive testing (NDT) inspection procedures approved by the Classification Society and the OWNER.

Construction of the vessel's hull and associated structures shall only begin after satisfactory approval by the Classification Society of the main structural drawings, confirmed by the respective approval letters.

Requirement for hull construction is to be primarily governed by document ET-4880.00-9311-000-ptd-001;

The fatigue calculations are to be delivered to Owner.

### 201 Hull materials

All steel materials (and aluminium if applicable) shall be of normal international shipbuilding and marine engineering quality.

All materials shall be tested inspected and certified as required by the Classification Society and relevant Regulatory Bodies.

Test certificates shall be delivered to the Owner where required by the Classification Society.

When galvanizing is mentioned, hot dip galvanizing shall be used, ref. [276 Galvanizing](#).

All non-steel items shall be of tested materials, and certificates shall be supplied where required by the Classification Society.

## 203 Blasting, shop-priming and cleaning of materials

### Grit blasting

All steel materials used in the building of the vessel shall be grit-blasted and cleaned according to standard SA 2.5 before priming.

### Shop priming

Immediately after the grit blasting the steel materials shall be coated with zinc primer.

The top coat system shall be compatible with the primer and approved by the paint supplier.

Where special coatings are required preparations and priming of steel materials shall be in accordance with the guide-lines of the product suppliers.

### Cleaning

Prior to applying each coat of paint, all surfaces shall be thoroughly cleaned. Cleaning materials and cleaning procedures shall be agreed with the paint supplier and in line with his recommendations.

The Owner shall be notified in due course and shall approve cleaning works before coat application.

### Owner's Surface Preparation requirement:

All structural steel shall be shotblasted to ISO 8501-1 Sa 2 ½ standard with profile (Surface roughness) between 30 and 75 µm and painted with one (1) coat of ethyl zinc silicate-based shop primer.

Blasting should not be carried out when: the relative humidity is above 85%; or the surface temperature of the steel is less than 3°C above the dew point.

The salinity limit for surfaces to be painted is 30 mg/m<sup>2</sup> of sodium chloride (milligrams per square meter).

In order to achieve a good standard of preparation for painting inside all tanks (ballast, fresh, drinking and distilled water), and empty spaces, all structural elements in the areas to be painted shall be free of grease, oil, salts, dust, all structural elements in the areas to be painted shall be free of grease, oil, grease, dust, salts, weld spatter, porosity, double lamination and biting, and all sharp edges of internal structural elements (reinforcement corners, through holes, relief holes, scallops, etc.) shall be eliminated....), allowing the paint to be applied to edges smoothed with 3 (three) passes of grinding machine (3G), in accordance with grade P2 of the ISO 8501-3 standard. All edges and weld seams shall have a stripe coat after each general coat and before the last, i.e. if the paint scheme is two coats, two stripe coats of different colors shall be applied between the first and second coats.

A Surface Preparation Standard shall be issued, in accordance with the paint manufacturer's recommendations for roughness, edge treatment, cut-outs, welding and surface preparation prior to the start of manufacture, as specified above.

The agreed standards shall be followed by the SHIPYARD as a level of internal quality in the manufacture and treatment of structures.

Erection joint welds (block and ring seams) shall only be painted after the tightness test is completed.

The treatment of the area shall meet the ISO 8501-1Sa 2.1/2 standard.

The painting schemes defined in the table below shall be applied to surfaces blasted with ISO 8501-1Sa 2 ½ grade abrasive.

After fabrication, the structural blocks shall have the damaged areas shotblasted to ISO 8501-1Sa 2 ½ and the remaining areas where the shop primer is intact and within the expiration date, shotblasted to ISO 8501-1Sa 2 over at least 70% of the area.

After construction, the erection joint weld seams and the painted areas of the tank bottoms shall be shotblasted to ISO 8501-1Sa 2 ½ and the other damaged areas treated to SSPC-SP 11. In such damaged areas treated to SSPC-SP 11 standard, a minimum roughness profile of 50 µm is required.

#### **Owner's Surface Cleaning requirement:**

The cleanliness of the steel surface and the roughness profile shall be checked at the end of surface preparation and before applying the shop primer, in accordance with the manufacturer's recommendations.

Dust removal from blasting shall be in accordance with ISO 8502-3.

No abrasive inclusions visible to the naked eye will be allowed.

All washing processes shall be carried out using clean fresh water, free from contaminants and with a pH ranging from 6.5 to 7.5.

Requirements for Painting and Corrosion Protection is to be primarily governed by document ET-4880.00-9311-000-ptd-001.

### **204 Testing of tanks, bulkheads**

The tightness of all tanks, cavities and conserved volumes shall be tested as required by the Classification Society.

No tank, or adjacent compartment, shall be coated or painted until such test is carried out and the result is approved by the Classification Society.

All openings in steel structure such as hatches, windows and outside doors etc. shall be hose tested as required by the Classification Society.

All test reports shall be available to the Owner's surveyor.

### **205 X-ray and ultrasonic testing of hull parts**

X-ray and ultrasonic testing of weld connections shall be carried out to an extent as agreed between the Yard and the Classification Society.

The tests shall not be approved before the results show a good welding technique in compliance with Classification Society requirements.

All test reports shall be made available to the Owner's surveyor.

### **207 Welding and steel construction**

Hull and superstructure shall be all welded.

Welding tables covering vessel's steel structure shall be worked out and approved by the Classification Society and the Yard.

All welding shall be carried out in accordance with Classification Society approved welding tables and to the Classification Society surveyor's approval.

Hull and superstructure shall be all welded double continuous fillet weld, intermittent welding is not accepted.

Full penetration welding shall be applied where required by the Classification Society.

## 208 Steel construction in general

### Scantlings

Scantlings of structural members and plates shall be in compliance with Classification Society requirements, unless where the Building Specification specifies scantlings exceeding these requirements.

Scantlings in some areas might be increased beyond Classification Society requirements to prevent vibrations and extensive deflection.

### Frame Spacing

The vessel shall have transversal frame spacings according [Table 2.1](#).

Table 2.1 Transverse frame spacings

Location	Frame	Distance
Stern - Bow	frame Stern - Bow	800mm

The longitudinal stiffener spacing shall in general be 700 mm.

### Quality standard

The hull structure shall be built in accordance with IACS REC 47 Shipbuilding and Repair Quality Standard.

### Material protection and Surface Preparation

Material protection and surface preparation shall be according to Yard standard and Yard supplied approved Paint Specification, ref. [27 Material protection](#), [28 Material protection, internal](#) and [203 Blasting, shop-priming and cleaning of materials](#)

### Owners requirement:

No external structure of the hull, superstructure, access and service hatches or deck lockers shall be made of steel plates with a thickness of less than 8 mm.

There will be no recess for the anchor. In the anchor stowage area, the ship's side plating shall be 50% thicker than the adjacent plating in order to protect it from anchor flukes.

The thickness of the plating on the sea chests and bilge wells shall be at least 5 mm greater than the adjacent plating.

The thickness of the ship's side and chain locker bottom plating will be at least 5 mm greater than that determined by the Classification Rules.

The structural profiles should preferably be laminated and easy to repair (e.g. "hp" profile).

Tug pushing areas of shipside at forward, mid and aft shall be strengthened with vertical stiffener according to the Yard's practice. These stiffeners shall be provided within draught range.

## 209 Watertight bulkheads with stiffening

The vessel shall be divided into watertight compartments by means of transversal- and longitudinal watertight bulkheads. The number of bulkheads, extent and positions of these shall be according to the General Arrangement, Classification Society requirements and relevant rules and regulations.

Doors in watertight bulkheads shall be arranged according to the General Arrangement, Classification Society requirements and relevant rules and regulations.

### Surface Cleaning scope prior to the surface painting:

The stiffeners of side bulkheads and bottom plating of cargo tanks shall be built externally in such a way as to facilitate cleaning (fitted within ballast tanks).

## 21 Afterbody

The aft ship shall be built with a centre skeg and hull form optimized for the main propulsion machinery.

Tug pushing areas on ship sides aft shall be reinforced according to recommended practice and strengthend with vertical stiffener according to the YARD's practice. These reinforcements shall be provided within draught range.

Head box for the rudder shall be arranged with stream lined shape to minimize resistance through water.

Special attention shall be paid to strengthening in this area to reduce transmission of noise and vibration to a minimum.

Additional stiffening shall be provided in the slamming area around the stern.

## 211 Shell plating

The shell plates in way of supporting propulsion and manoeuvring machinery, shall be increased locally with insert plates.

## 212 Eye plates

Streamlined lifting eye plates shall be arranged under the stern and on rudder to facilitate fitting and dismantle of rudder and propulsion machinery. These eye plates shall be permanently mounted.

Where eye plates are welded directly to the shell plating, without doubler plates. Local stiffeners shall be welded on the inside in-line with the eye plates.

All eye plates shall be marked with welding beads with their respective Safe Working Load (SWL).

## 214 Main deck with stiffening

Ref. [234 Main deck](#)

## 216 Stern sections

The stern shall be of square transom type above waterline, with open water stern frame shape and stern bulb below waterline, arranged for single screw and spade rudder.

A strong box type skeg shall be arranged at the centreline aft. The skeg structure shall be of sufficient strength to withstand the maximum loads that may occur whilst dry docking the vessel. Inaccessible parts of the skeg shall be conserved.

High floor frames with centre girder and web frames shall be arranged according to the Classification Society rules and regulation.

The aft end structure shall be arranged with ballast/fresh water tanks, store rooms and steering gear space.

Stern frame shall be of all welded construction. Steps of square bars shall be arranged inside the techincal fresh water tanks for inspection and also for the coating purpose.

A tank above the sterntube tank shall be arranged. The tank shall be blasted and coated same as cargo tanks. Ref. [28 Material protection, internal](#).

Stern frame shall be of open water type without solepiece. The stern shall be arranged for a balanced spade, high-lift type rudder. The propeller boss shall be of cast steel welded to the stern frame and bottom flooring.

The form of the stern frame shall be designed to give the proper clearance between the propeller and rudder.

A rudder stock trunk shall be arranged from the steering gear floor through the aft peak, with access through manhole in steering gear room.

Head box for rudder shall be arranged with stream lined shape to minimize resistance through water.

#### **Mooring deck aft**

A mooring deck aft of superstructure shall be arranged on poop deck as shown on the General Arrangement plan.

Local reinforcements for relevant deck equipment, such as mooring- and towing equipment, shall be arranged, ref. [434 Tugger winches, capstans, mooring winches with warping heads](#) [435 Fixed mooring equipment](#).

#### **Skeg structure:**

Drain plugs to be provided accordingly

### **217 Bulkheads with stiffening**

Ref. [209 Watertight bulkheads with stiffening](#).

### **218 Steering gear room**

Steering gear room(s) shall be arranged in accordance with the General Arrangement.

The room(s) shall be of sufficient size to accommodate the following type of equipment:

- Steering gear and associated equipment
- Relevant hydraulic equipment

Rigid foundations and supporting structure shall be arranged for the steering gear to minimize deflections and vibrations.

Access to-, and escape from the Steering gear room shall be arranged according to the General Arrangement and rules and regulations.

## **22 Engine area**

Fuel oil service/settling tanks and Lube oil stores tanks for main engine and auxillary generator sets shall be arranged in the engine room area as shown on General arrangement plan.

FO tanks shall be provided with openings/ hatches for removal of injured person and cleaning purposes.

Drain tanks shall be arranged in the engine room double bottom (ref. [238 Hull tanks in general](#), [70 Fuel oil systems](#), [711 Lube oil transfer & drain systems](#)).

Casings, ventilation ducts and access shall be provided from the machinery space as shown on the General Arrangement.

Sea chests in the engine room area ref. [262 Bottom plugs, sea chests, bilge wells, trunks/ casings for bottom equipment](#).

Side tanks in way of engine room shall be arranged as storage tanks for HFO, MGO, thermal oil and grey water as shown on General arrangement plan. HFO and MGO tanks shall be separated from outer shell by cofferdams.

HFO service and settling tanks and MGO service and settling tanks shall be integrated into HFO and MGO storage tanks as shown on General arrangement plan. A cofferdam shall be arranged above HFO / MGO tanks.

Two platform decks shall be arranged in the engine room as shown on General arrangement plan. Separator room and a separate room for auxiliay diesel generators to be arranged as shown on General arrangement plan.

Stores room shall be arranged as shown on General arrangement plan.

All tanks shall have accesses according to the requirements of Classification Society and National Authorities.

## **221 Shell plating**

The thickness of shell plates in way of sea chests and sea inlets shall be according to Classification Society requirements, and shall be at least 5 mm thicker than the adjacent plating.

Welding in sea chests and sea inlets areas shall be of full penetration type.

Ref. SFI item [231 Shell plating](#).

Ref. SFI item [262 Bottom plugs, sea chests, bilge wells, trunks/ casings for bottom equipment](#)

## **222 Bottom construction and keel**

Ref. [232 Bottom construction and keel](#).

## **223 Inner bottom and foundations**

### **Inner bottom**

Ref. [233 Inner bottom](#).

### **Main engine- and main generator (Option) foundations**

Foundations for main engine and main generator shall be integrated as a part of the double bottom construction, with continuous longitudinal girders with solid top flange, with strong and rigid connections in forward and aft end, and with good connections forward and aft in the deck.

The foundations shall follow the engine and generator manufacturers guidance and shall be approved by Classification Society and Owner.

### **Foundations for auxiliary and machinery equipment**

Foundations for auxiliary and machinery equipment (auxillary generator sets, compressors, pumps, separators etc.) shall be rigid and manufactured according to good shipbuilding practice, with local stiffeners and reinforcements in tank top and bulkheads.

### **Spill coamings**

Spill coamings of appropriate height shall be arranged around equipment containing oil. Capacity according National Authorities and Classification Society. Spill coamings to be 150 mm.

## **224 Decks above engine room with stiffening**

Ref. [234 Main deck](#).

## **226 Second deck, engine floors, platforms and hull tanks below main deck**

### **Platform deck 2 and 1**

Platform deck 2 and 1 shall be arranged according to the General Arrangement forming platform decks with openings in way of the main engine.

Scantlings shall be according to Classification Society requirements corresponding to the deck load, or relevant tank pressure where Deck 2 is part of a hull tank.

### Hull tanks below Main deck

Hull tanks shall be arranged according to the General Arrangement and the Tank Plan, ref. [238 Hull tanks in general](#)).

Manholes for tanks, ref. [304 Smaller hatches, emergency hatches and manholes](#).

Lifted floor and platforms in engine room, ref. [525 Loose floor plates, platforms & ladders in engine & pump rooms](#).

### Casing

Ref. [268 Casing, funnel and ducts](#)

## 23 Cargo area, midship

The cargo area is separated from machinery space aft by technical freshwater- and water ballast tanks and from the collision bulkhead forward by cofferdam as shown on the General Arrangement plan. Tug pushing areas on ship sides at midship shall be reinforced and strengthend with vertical stiffener according to the YARD's practice. These reinforcements shall be provided within draught range.

The cargo area shall be arranged with double hull throughout the vessel and designed to facilitate effective cleaning of cargo tanks.

Wing- and double bottom tanks in cargo area shall be arranged for water ballast, and shall be interconnected, as shown on the General Arrangement plan.

The cargo space is sub-divided into twelve (12) cargo tanks. Bulkheads shall be arranged as shown on the General Arrangement plan.

Two slop tanks shall be arranged aft below main deck as shown on the General Arrangement plan. Scantlings to be selected to given minimum section modulus according to Classification Society requirements.

### Deck

Design deck load in the cargo area: ref. SFI item [E Capacities and tonnage](#).

Table 2.2 Deck Chamber

Deck	Deck Chamber
Main Deck	Straight, 300mm height
Main deck, aft	NIL
Forecastle deck	NIL
Poop deck	NIL
Superstructure	NIL
Compass deck	Straight, 150mm height

Table 2.3 Sheer

Deck	Sheer
Main deck	Correspond to chamber
Forecastle deck	300mm
Other decks	NIL

### Tanks

Tanks in Cargo area shall be arranged as indicated on the General Arrangement. - See also [B Arrangement, description](#)

Measurement like reducing scallops, using rolled profiles, avoiding complex geometric configurations and ensuring that the structural configuration permits easy access for tools and to facilitate cleaning, drainage and drying of the space to be coated, to be taken for good coating performance in the water ballast tanks.

The vessel shall have 2 (two) slop tanks positioned aft of the aftmost cargo tank and in between the aftmost ballast tanks, with a minimum volume equal to 3% of the total volume of the cargo tanks, in accordance with the applicable Standards and Rules.

Table 2.4 Design criteria for cargo and slop tanks

Tanks	IMO type	Max Cargo SG [t/m³]	Max. Cargo Temp. [°C]	Design Pressure [bar]	Full tank	Partly filled Tank (20 – 90 %)
All	Product Tanker	E Capacities and tonnage	50	0.2	YES	YES

## 231 Shell plating

The shell plate thickness shall be according to the minimum requirements from Classification Society unless specified otherwise in this building specification. Plate thickness may be locally increased in areas subject to vibrations and deflections.

## 232 Bottom construction and keel

### Keel

The keel shall be made of a steel plate with extension and thickness according to Classification Society requirements. The keel plate shall be carefully adapted to the vessel's geometry in the fore and aft end.

### Centre girder

A centreline girder shall be continuously welded throughout the full length of the vessel except in way of trunks.

Thickness and height of the girder shall be, as a minimum, according to the requirements of Classification Society. The centre girder shall be of a watertight construction where forming boundaries of tanks.

## 233 Inner bottom

A double bottom shall be arranged according to the General Arrangement.

The following shall apply to the double bottom construction:

- The double bottom ballast tanks and side wing tanks shall be interconnected as shown on the General Arrangement plan.
- Access to double bottom tanks shall be through the wing tanks.
- Double bottom height in cargo area shall be 1600 mm or at least B/15 in center, measured to underside of the innerbottom plating.
- Double bottom in each cargo tank shall be ~~sloped approx horizontal. 2.0 degrees towards the centre line (min. 250 mm), with a horizontal section of abt. 2200 mm in center.~~
- Pump suction wells shall be recessed into the bottom of all cargo tanks, preferably aft towards either SB or PS (all to same side), as shown on the General Arrangement plan. The material of the pump suction wells shall be normal steel, and the structure of the recessed wells shall be strengthened for continuity purpose. Ref item 262 Bottom plugs, sea chests, bilge wells, trunks/casings for bottom equipment.

- Lighting holes in the floors and girders for inspection ballast tanks shall not interfere with structural integrity, nor be obstructed by the ballast pipes or/and hydraulic pipes of remote control valves.
- Non-watertight floors and girders shall have air- and drainage scallops of minimum 1.25 times of the suction area of the loading- and discharge pipe for the given tank at both lower and upper edge.
- Each double bottom tank shall normally have two manholes. For small tanks and small cofferdams one manhole is accepted, ref. [304 Smaller hatches, emergency hatches and manholes](#).
- Below manholes, tanks shall be provided with ladders or steps to give easy access to the tank, ref. [526 Ladders, platforms & railing in ballast & fuel tanks](#) [527 Platforms, ladders & railing in cargo tanks](#).

## 234 Main deck

The deck shall be arranged as shown on General Arrangement plan.

Main deck shall have sheer and camber according to [23 Cargo area, midship](#).

Design deck loads in the cargo area shall be according [E Capacities and tonnage](#).

The main deck shall be arranged as a continuous deck throughout the ship with camber as specified, Ref. [Table 2.2](#) and [Table 2.3](#).

Hatch coamings for cargo tank hatches, see [301 Hatches on weather decks](#)

Table 2.5 Stiffening of main deck in cargo area

Location	Type of stiffening
In way of cargo tanks	Stiffeners to be below deck plating
In way of ballast tanks	Longitudinal deck stiffeners below main deck (Inside ballast tanks)

Main deck stiffeners shall be of rolled section or flanged plate.

Drain wells for deck water to be arranged in the upper part of the aftermost wing tank, port and starboard. Capacity abt. 0,2 m3 each side.

## 236 Bulkheads with stiffening

Ref. [209 Watertight bulkheads with stiffening](#).

### Transverse bulkheads

Transverse bulkheads between cargo tanks shall be of vertically corrugated construction, without stools or supporting members such as webs, stringers, brackets etc. in the cargo tanks.

All watertight bulkheads of the cargo and slop tanks shall be corrugated type. The longitudinal bulkheads between cargo and ballast tanks, and between slop and ballast tanks, shall have their reinforcements/ stiffeners located inside the ballast tanks.

Sloping deflector plates shall be arranged in the corrugations at tank top. Space below plates shall be opened to double bottom.

Cut out for access shall be arranged, and space shall be coated as ballast tank.

Division of wing ballast tanks shall be watertight webframes, ref. [238 Hull tanks in general](#)

### Longitudinal bulkheads

Three (3) continuous longitudinal bulkheads including the inner wingtank bulkheads shall be arranged throughout the cargo space.

The longitudinal bulkheads in cargo area forming wing tanks shall be of plane type with stiffeners facing out of cargo tanks.

Inner wingtank bulkheads shall be located min. 1350 mm from outer shell, measured to outer side cargotank bulkhead.

The longitudinal bulkhead in centre shall be of vertically corrugated construction, without stools, or supporting members such as webs, stringers, brackets etc. in the cargo tanks.

The vertically corrugated center line bulkhead shall be extended into double bottom and be part of the center girder system.

Sloping deflector plates shall be arranged in the corrugations at tank top, for transverse bulkheads.

Space below plates shall be opened to double bottom. Cut out for access shall be arranged. Space shall be coated as ballast tank.

## 237 Decks above Main deck with stiffening

### Walkway

A walkway and compartments shall be arranged as shown on General Arrangement plan.

The walkway shall be arranged from Poop deck to Forecastle deck, and shall have no sheer and no camber.

The use of fiberglass (GRP) in pipe rack walkways shall be adopted as far as practical and in compliance with applicable rule and regulations.

Design loads shall be as minimum according Classification Society rules and regulation.

## 238 Hull tanks in general

### General

Hull tanks shall be arranged according to the General Arrangement and the Tank Plan and shall be in compliance with relevant Classification Society notations and relevant Regulatory Bodies.

### Drain wells

Drain wells shall be arranged in every tank except in double bottom and peak tanks.

### Special considerations for hull tanks

Table 2.6 Special Considerations for Hull Tanks

Tank content	Remark
Cargo tanks/methanol fuel tanks	Tanks shall be made of normal steel and coated with appropriate coating. Cofferdams two. methanol tanks shall be arranged with access from open deck. Cofferdams shall be prepared for sea water filling.
MGO/HFO	No MGO/HFO tanks shall be arranged in the double bottom, ref. CLEANSCHIP Class notation requirement.
Fresh Water	Cofferdams shall be arranged adjacent to tanks with content requiring such measures. Structure inside tanks, especially tanks for potable fresh water, shall be avoided as far as practical for easier inspection and cleaning.
Double bottom water ballast tanks	The water ballast double bottom tanks shall extend from side to side, separated with a longitudinal watertight bulkhead in centreline as shown on General Arrangement plan. Transverse bulkheads to correspond with the primary cargo tank bulkheads, as shown on the General

Tank content	Remark
	Arrangement plan.
<b>Wing water ballast tanks</b>	The water ballast wing tanks shall extend from the double bottom tank top to main deck. Transverse wing tank bulkheads shall correspond with the double bottom tank bulkhead arrangement as shown on the General Arrangement plan.

For fluid definitions, density and flash point, ref. [E Capacities and tonnage](#).

For coating requirements, ref. [28 Material protection, internal](#).

For manholes, ref. [304 Smaller hatches, emergency hatches and manholes](#).

## 24 Forebody

Foreship shall be arranged as shown on General Arrangement plan.

The collision bulkhead forward shall be arranged according to the General Arrangement plan and with a height and longitudinal position as per Classification Society requirements.

The vessel shall be built with a bulbous bow with Kongsberg 3 Wave Piercing technology as indicated on the General Arrangement

Tug pushing areas on ship sides forward shall be strengthened with vertical stiffener according to the Yard's practice. These reinforcements shall be provided within draught range.

A forecastle deck shall be arranged and provided with a suitable straight-line sheer, with no camber. Ref. [Table 2.2](#) and [Table 2.3](#).

## 241 Shell plating

The shell plating in way of anchor stowage, bolster, frog eye type, shall have locally increased thickness in excess of Classification Society requirements, and shall be minimum 50% thicker than the adjacent plating in order to protect it from anchor flukes.

Transition shall be made rounded or alternatively chamfered, and smooth to achieve better thrust performance and less noise.

## 243 Mooring deck

An mooring deck shall be arranged forward on forecastle deck as shown on the General Arrangement plan.

Local reinforcements for relevant equipment on this deck, such as anchor-, mooring- and towing equipment, shall be arranged, ref. [431 Anchors with chains and equipment](#), [433 Combined windlass/mooring winches with chain stoppers, rollers](#), [434 Tugger winches, capstans, mooring winches with warping heads](#), [435 Fixed mooring equipment](#)).

## 244 Decks below mooring deck with stiffening

Decks below mooring deck shall be arranged according to the General Arrangement.

Rope storage facilities shall be arranged in the store below the mooring deck.

For the rope hatches, ref. [304 Smaller hatches, emergency hatches and manholes](#).

## 245 Decks and stringers below main deck

Bow stringers and reinforced, horizontal stringers shall be mounted in ship sides, vertical distance shall be according to Classification Society requirements.

## 246 Bow and stem

The vessel shall be built with a bulbous bow with Kongsberg 3 Wave Piercing technology, arranged for optimum performance at design draught and high performance in heavy weather conditions.

The upper part of stem shall be a "soft nose" construction formed by well rounded steel plates.

## 247 Chain lockers

Chain lockers for anchor chain shall be arranged according to the General Arrangement.

The chain lockers shall have sufficient size, and be constructed for good self stowage of the anchor chain.

The plate thickness of the chain locker shall be at least 5 mm greater than determined by the Classification Society rules, or 12 mm whichever is greater.

The inboard end of the chain shall be attached according to Classification Society requirements, with emergency release from outside the chain lockers.

The following shall be arranged inside the chain lockers:

- Grating of hot dip galvanised perforated plates approx. 300 mm above bottom level
- Bilge pipes (well protected and arranged with mud box and suction well)
- Wooden plank covering from bottom level to approx. 2000 mm upwards
- Manholes and steps for access
- Ejectors for the chain locker mud boxes and bosun store drainage are to be installed. For the bosun store, the ejector capacity must be 10 m<sup>3</sup>/h.

### Spurling pipes

One spurling pipe shall be fitted from each chain locker to the mooring deck. The upper end shall be adapted to ensure a smooth entrance of the chain.

- Pipe diameter approx. 450 mm
- Wall thickness approx. 20 mm

A cover plate with handholds to be provided to minimize water ingress.

## 25 Deck houses & superstructures

Deckhouses, superstructures and wheelhouse shall be arranged as indicated on the General Arrangement and shall be built of steel.

All decks shall have no sheer and no camber.

Internal steel bulkheads shall be fitted around staircases, provision rooms, stores and ventilation room(s), etc. in accordance with applicable rules and regulations.

The whole structure shall be of welded construction with direct welded connections to deck plating.

Pillars below girders within deck houses to be adapted to accommodation partition bulkheads as far as practical.

The wheelhouse shall be arranged with large windows to achieve good field of vision. Framing between the windows shall be minimized.

The wheelhouse with associated arrangement may extend outside vessel full beam to allow a clear view of ship's side

## 251 Deck houses & superstructures

Outline and areas of deckhouses and superstructure shall be as indicated on the General Arrangement.

Deck heights in accommodation:

Table 2.7 Deck heights

Deck location	Approx. height (steel to steel)
Main deck - forecastle deck	3400 mm with straight sheer aftwards
Main deck - Poop deck	3100 mm
Poop deck - Deck 2	2800 mm
Deck 2 - Deck 3	2800 mm
Deck 3 - Deck 4	2800 mm
Deck 4 - Deck 5	2800 mm
Deck 5 - Bridge deck	2800 mm
Bridge deck - Wheelhouse top	3200 mm, including lifted floor

Special attention to gymnasium head clearance. Deck height in gymnasium is to be suitable for a safe use of treadmill.

Internal bulkheads in the accommodation may be of corrugated type.

Ship side and outer bulkheads in accommodation areas shall have gutters formed by flat bars, ref. [267 Gutter, bulwark, railings and cargo rails \(securing of deck cargo\), freeing ports](#).

## 252 Fan & winch houses

### Engine room ventilation duct

Engine room ventilation ducts shall be arranged aft of the superstructure, with air inlets as indicated on the General Arrangement.

Cut-outs in decks and foundations for the inlet fans shall be arranged.

Number of fans, louvres, access door/hatch and drain shall be according [574 Ventilation systems for engine rooms](#).

## 254 Bridge deck and wheelhouse

The wheelhouse shall be arranged according to the General Arrangement.

- Deck height, ref. [251 Deck houses & superstructures](#).
- Windows and external doors, ref. [514 Weathertight and Spraytight doors](#), [515 Side scuttles and windows with equipment](#)
- Outer bulkheads in wheelhouse shall have gutters formed by flat bars, ref. [267 Gutter, bulwark, railings and cargo rails \(securing of deck cargo\), freeing ports](#).
- Lifted floor frame made by angle profiles with a height 400 mm above Bridge deck. For floor details, ref. [522 Interior deck cover](#).

## 26 Hull outfitting

Hull and superstructure steel outfitting shall be according to normal shipbuilding standard, relevant rules and regulations, and as indicated on the General Arrangement plan.

All hull outfitting is to be welded on top of pad/doubler plates.

### 26.1 Hull and house markings

Vessel identification shall be clearly applied by suitable markings/signs on ship hull sides and superstructure, according to regulations and Owner's advice.

Other hull markings such as depth marks, load line marks, underwater equipment locations etc. shall be fitted according to normal standards.

In general all markings shall be made of minimum 4 mm plates and be fully welded.

#### Vessel Name and port of registry

Name in raised steel plate letters with height of 500 mm shall be welded to ship's side forward.

Name and port of registry in raised steel plate letters with height of 500 mm shall be welded to the transom.

#### Draft Marks

Metric draft marks of steel plates shall be welded on ship's side PS and SB at forward, midship and aft, and at centreline of the transom. The projected height of the marks shall be 100 mm.

#### Funnel Marks

The shipowner's Logo on funnel will be marked on both edges of the funnel by means of intermittent welding beads. The details and characteristics of the Logo will be supplied by the BUYER in accordance with Standard N-1503.

#### Warning Marks

Standard warning markings for proximity of speed log, echo-sounders and bulbous bow shall be welded on each side of vessel above the loaded waterline. Marks shall be of steel plate. All bottom equipment shall have markings.

#### Freeboard/Tonnage Marks

Freeboard and load line markings shall be welded on PS and SB side midship. Position shall be according to load line certificate and Classification Society Surveyor's satisfaction.

#### Tank Marks

Tank corners and tank number and content shall be marked by welding on shell plate. For tanks with bottom plug tank number and content shall be welded adjacent to the bottom plug.

#### IMO Marks

Vessels IMO number with letters of steel plates shall be welded forward on the accommodation bulkhead, at the transom and in the engine room. Heights of marks to be 200 mm and 100 mm respectively.

#### Bow mark

Owner's bow emblem to be made of steel plate and welded to the bow.

#### Push tug marking

Push tug markings shall be marked by weld beads on both sides of in the aft-, mid- and foreship.

### Frame marking

Every 10th frame shall be marked by welding of figures made of steel plates on both sides of the shipside. Figures 10 cm high

### Marking of cargo-tank hatches

All entrance hatches and butterworth hatches to cargo tanks to be marked with tank number/name by welding runs, approx. 100 mm high.

Marking to be painted white.

### House markings

On front of accommodation deckhouse the following to be painted with letters of ample size: **NO SMOKING**. Marking shall be arranged between windows at 5rd. and 4nd. tiers.

### Paint marking

Paint marking lines for waterline, etc. to be indicated on both sides with 50 mm long welding for every 1.5 meters.

The waterline marking shall have a sheer fore and aft of 0.5 % of LPP.

### Marking of life-boats, life-rafts etc.

Lifeboats, life preservers and other lifesaving equipment shall have the ship's name etc. painted thereon in accordance with the requirements of the regulatory bodies.

### Overboard pipes marking

Valves number shall be marked with welding beads in the shell.

**Domes, hatches, manholes, bottom plugs and tugboat area marks** shall be identified by capital letters and numbers 100 mm high and **20 mm wide strokes**, using weld beads around the letter or number to be represented.

## 262 Bottom plugs, sea chests, bilge wells, trunks/ casings for bottom equipment

### Bottom plugs

Bottom plugs of size Ø42 mm including bottom rings for welding according to NS 2573 or Owner standard shall be provided for all tanks and compartments in the bottom. Bottom plugs shall be of approved type in accordance with Classification Society requirements.

In oil product tanks, the drain plugs shall have hexagon socket wrench type.

In water tanks, the drain plugs shall have square socket wrench type.

A total of Five (5) spare of each type plugs shall be delivered.

### Sea chests

Sea chests shall be arranged according to 721 Sea water cooling system.

The thickness of shell plates in way of sea chests and sea inlets shall as a minimum be according to Classification Society requirements, and shall be at least 5 mm thicker than the adjacent plating.

The following shall be provided for all sea chests:

- Full penetration welding for boundaries direct to sea
- Removable strainers, 1 hinged, shall be provided.
- Inlet strainer plates shall be of hot dip galvanized steel.
- All strainers shall be flush with the shell plating.

### Bilge wells

Bilge wells shall be arranged in all rooms and compartments where applicable, except in the accommodation. Access for cleaning of wells shall be provided. Size shall be minimum 150 litres.

Each bilge well should preferably be provided with covers of galvanized perforated steel plates. The thickness of the plating on bilge wells shall be at least 5 mm thicker than the adjacent plating.

### Trunks/ casings for Bottom equipment

Required transducer tanks, trunks and valves for mounting the under water searching equipment shall be integrated in the hull, ref. [414 Underwater searching equipment](#).

### Trunks for Impressed Current Cathodic Protection (ICCP)

Required trunks for mounting of ICCP sensors and similar equipment shall be integrated in the hull, ref. [278 External cathodic protection](#).

## 263 Foundations and reinforcements

### Foundations and reinforcements

Foundations for deck machinery and equipment shall be designed and built for maximum loads as given by supplier, including relevant dynamic and safety factors as required by the Classification Society. The deck shall be reinforced accordingly.

Foundations on open deck shall preferably be of closed design for easy cleaning and maintenance.

For foundations for the main switchboard, drives, converters consoles etc. special care shall be taken for easy cable entrance.

## 264 Fender and bilge keels

### Fenders

Fenders are not applicable for oil tankers.

### Bilge Keel

A bilge keel shall be fitted on each side of the vessel. Position, size and extension of the bilge keel shall be according to recommendations from the model streamline test or CFD calculations.

The Bilge keel shall normally extend 25 - 30 % of L<sub>pp</sub>.

The bilge keel are to be built of a bulb-profile without notches, and to be welded to a doubler plate on to the shell plating.

Bilge keel shall be effective and demonstrated.

## 266 Anchor pockets and hawse pipes

### Anchor pockets

Anchor shall be arranged PS and SB side as indicated on the General Arrangement.

In the anchor stowage area, the ship's shell plating shall be minimum 50% thicker than the adjacent plating in order to protect it from anchor flukes

"Frog eye" anchor arrangement to be provided, no anchor pockets.

For anchor type, ref. [431 Anchors with chains and equipment](#).

### Hawse pipe

One hawse pipe shall be fitted from each "frog eye", to the mooring deck. The upper end shall be adapted to ensure a smooth entrance of the chain.

- Pipe diameter approx. 508 mm
- Wall thickness approx. 20 mm

For washing system, ref. [813 Fire line/deck washing system](#).

## **267 Gutter, bulwark, railings and cargo rails (securing of deck cargo), freeing ports**

### **Gutters**

Ship side and outer bulkheads in accommodation areas shall have gutters formed by flat bars. The flat bars shall be welded to the stiffeners, or the brackets for these. The flat bars shall be welded with double continuous fillet weld, intermittent welding is not accepted, ref. [251 Deck houses & superstructures](#).

### **Bulwarks**

On main- poop-, and forecastle deck bulwarks shall be arranged as shown on the General Arrangement plan.

### **Freeing ports**

Freeing ports and total area of these shall be in accordance with the International Load Line Convention.

## **268 Casing, funnel and ducts**

### **Casing**

Casing with funnel shall be made of steel and arranged as shown on the General Arrangement plan.

Structural capacity of casing shall be specially considered for stiff support of the exhaust system and surrounding superstructure.

Special care shall be taken to insure exhaust to be taken well away from accommodation.

Special care shall be taken to reduce transmission of noise/vibrations from propeller and machinery to accommodation.

For the casing the following shall be arranged:

- Access by steel hatches and/or doors as shown on the General Arrangement plan
- Platforms by open grating on each deck level
- Openings for ventilation gratings and louvres according to [574 Ventilation systems for engine rooms](#).
- Exhaust pipe systems, ref. [742 Exhaust gas system](#).

### **Ducts and trunks**

Air duct(-s) with fans for ventilation of engine room shall be arranged according to the General Arrangement plan, ref. [574 Ventilation systems for engine rooms](#).

Trunks for cables and pipes shall be arranged as required. Capacity and layout of the trunks shall be carefully considered.

## **27 Material protection**

### **Paint Specification**

A paint specification, describing all external paint systems, including preparation-, application-, and inspection procedures, shall be provided by the Yard.

~~Ref. Annex A TECHNICAL REQUIREMENT PRODUCT CARRIERS 18.000 DWT I ET 4880.00-9311-000-PTD-001~~

The vessel's structural design shall fully comply with the ~~CSR requirements~~, Classification Rules, and TSCF publications "Guidance Manual for Tanker Structures - Consolidated Edition 2022", and "Guidelines for Ballast Tank Coatings Systems and Surface Preparation - 2014 Revised Edition"

#### **Owner guidance for Hull corrosion protection:**

##### **PAINTING**

The painting of the vessel's tanks (ballast, fresh water, potable drinking water and distilled water) and void spaces shall be carried out in accordance with the recommendations described in the publication of the *Tanker Structure Cooperative Forum* entitled "*Guidelines for Ballast Tank Coating Systems and Surface Preparation*" in accordance with table "*TSCF 15: Guide for minimum of 15 years - System Specification*".

##### **STEEL PREPARATION**

All structural steel shall be shotblasted to ISO 8501-1 Sa 2 ½ standard with profile (Surface roughness) between 30 and 75 µm and painted with one (1) coat of ethyl zinc silicate-based shop primer. Blasting should not be carried out when: the relative humidity is above 85%; or the surface temperature of the steel is less than 3°C above the dew point.

The cleanliness of the steel surface and the roughness profile shall be checked at the end of surface preparation and before applying the shop primer, in accordance with the manufacturer's recommendations.

The salinity limit for surfaces to be painted is 30 mg/m<sup>2</sup> of sodium chloride (milligrams per square meter).

##### **PAINTING SCHEME**

The painting scheme and paint manufacturer shall be approved by the Owner.

The specification, preparation and application of the ballast tank paint system shall follow the recommendations for a 15-year system life, as defined in the SOLAS II-1 Convention and the INTERTANKO/TSCF Guide (TSCF 15: "Guide for minimum of 15 years - System Specification"). Petrobras Standards N-9, N-13, 1192, 1219, 1503 shall be considered for this purpose.

If there is a conflict between the TSCF 15 guide and one of the Petrobras reference standards, the minimum requirement indicated in the TSCF 15 guide shall be adopted.

The paint supplier shall provide a guarantee of 60 months from the date of delivery of the vessel (signing of the "Delivery and Acceptance Agreement"), assuming responsibility for the material and inspection costs of restoring the paint system of tanks (cargo, ballast, fresh, distilled and potable water) and voids, treated individually for the purpose of the guarantee, when they have paint faults that together represent an area involved in the repair greater than 2% of the area of the respective tank or void.

The paint supplier shall also provide a 60-month guarantee for the anti-fouling system, counting from the date of delivery of the vessel (signing of the "Delivery and Acceptance Agreement"), assuming responsibility for the material and inspection costs of recovering the hull's paint system when there are paint faults that together represent an area involved in the repair greater than 10% of the hull's area. The warranty conditions shall be in accordance with the manufacturer's standard conditions.

In order to achieve a good standard of preparation for painting inside all tanks (ballast, fresh, drinking and distilled water), and empty spaces, all structural elements in the areas to be painted shall be free of grease, oil, salts, dust, all structural elements in the areas to be painted shall be free of grease, oil,

grease, dust, salts, weld spatter, porosity, double lamination and biting, and all sharp edges of internal structural elements (reinforcement corners, through holes, relief holes, scallops, etc.) shall be eliminated....), allowing the paint to be applied to edges smoothed with 3 (three) passes of grinding machine (3G), in accordance with grade P2 of the ISO 8501-3 standard. All edges and weld seams shall have a stripe coat after each general coat and before the last, i.e. if the paint scheme is two coats, two stripe coats of different colors shall be applied between the first and second coats. A Surface Preparation Standard shall be issued, in accordance with the paint manufacturer's recommendations for roughness, edge treatment, cut-outs, welding and surface preparation prior to the start of manufacture, as specified above.

The agreed standards shall be followed by the Yard as a level of internal quality in the manufacture and treatment of structures.

The paint scheme shall be applied in accordance with the paint manufacturer's recommendations and other instructions for surface treatment, number of coats, film thickness (wet and dry), intervals between coats, application processes, temperature and humidity.

The parts welded by the Yard to support the scaffolding shall generally be removed, leaving only the supports (or eyebolts) selected in agreement with the Owner.

Erection joint welds (block and ring seams) shall only be painted after the tightness test is completed. The treatment of the area shall meet the ISO 8501-1Sa 2.1/2 standard.

Intermittent welding beads shall be made marking the water lines in normal ballast condition and at design load, executed during the assembly phase of the relevant blocks and before the internal coating is painted.

Tank boundary markings shall be made from steel plate measuring 100 x 20 x 6 mm and welded to the side, "boottop", vertical bottom and flat bottom before the internal plating is painted. All markings shall be provided during the assembly of the respective blocks according to detailed design. All the markings on the hull shall be painted with certified anti-fouling paint, in a contrasting color ("Munsell White") with the paint color of the rest of the vessel's hull.

The painting schemes defined in the table below shall be applied to surfaces blasted with ISO 8501-1Sa 2 ½ grade abrasive.

After fabrication, the structural blocks shall have the damaged areas shotblasted to ISO 8501-1Sa 2 ½ and the remaining areas where the shop primer is intact and within the expiration date, shotblasted to ISO 8501-1Sa 2 over at least 70% of the area.

After construction, the erection joint weld seams and the painted areas of the tank bottoms shall be shotblasted to ISO 8501-1Sa 2 ½ and the other damaged areas treated to SSPC-SP 11. In such damaged areas treated to SSPC-SP 11 standard, a minimum roughness profile of 50 µm is required.

Dust removal from blasting shall be in accordance with ISO 8502-3.

No abrasive inclusions visible to the naked eye will be allowed.

All washing processes shall be carried out using clean fresh water, free from contaminants and with a pH ranging from 6,5 to 7,5.

Table 2.8 Location & Painting System

Location	Painting System
Live Works (Flat Bottom, Rudder, Vertical Bottom)	Up to the ballast draft waterline: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm d.f.t each (320 µm total); - Epoxy sealant (tie coat) - min. 1 coat thickness according to manufacturer's recommendations. - Anti-fouling system (Foul release), with silicone hydrogel, with or without biocides, for stays in port of up to 120 days (minimum). Guaranteed performance throughout the docking period. They shall comply with the IMO convention on anti-fouling paints without tin and cybutryne. Consider

	60 months between dockings. Maximum speed loss factor of 1,5%. Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels. *
Live Works("Boottop")	Between the Ballast and Design/ Summer draft waterline: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm d.f.t each (320 µm total); - Epoxy sealant (tie coat) - min. 1 coat of 80 µm. - "Tin Free" anti-fouling system SPC ("Self Polishing Copolymer") - for stays in port of up to 40 days. Guaranteed performance throughout the docking period. They shall comply with the IMO convention on anti-fouling paints without tin and cybutryne. Consider 60 months between dockings. Maximum speed loss factor of 2,5%. CDP-type or hybrid anti-fouling paints will not be used under any circumstances. Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels. *
Dead Works (Ship's Side)	Above the draft corresponding to the waterline at the summer freeboard: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm each (320 µm total); - Finish: repaintable acrylic polyurethane, Petrobras standard N-2677 - two coats of 60 µm d.f.t. Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Main deck, accessories, deck equipment and its foundations, deck piping and supports, mooring accessories, masts, etc.	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm each (320 µm total); - Finish: repaintable acrylic polyurethane, Petrobras standard N-2677 - two coats of 60 µm d.f.t. Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
External areas of the superstructure, hatchway, deckhouses, masts and funnel, including all external decks (except the main deck), fittings, deck equipment and its foundations, pipelines, and so on decks and supports, etc.	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm each (320 µm total); - Finish: repaintable acrylic polyurethane, Petrobras standard N-2677 - two coats of 60 µm d.f.t. (120 µm total). Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Bulkheads and underdeck of internal areas of the superstructure, engine room, hatchway, deck store/ lockers and funnel.	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. One coat of 160 µm; - Finish: repaintable acrylic polyurethane, Petrobras standard N-2677 - two coats of 60 µm d.f.t. (120 µm total). Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Piping and their fittings, piping supports, interior decks and platforms, floors, equipment quarries, etc. In internal areas of the superstructure, engine room, hatchway, deck lockers and funnel.	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 150 µm each (300 µm total); - Finish: repaintable acrylic polyurethane, Petrobras standard N-2677 - two coats of 70 µm d.f.t. (140 µm total). Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Engine room tank top, including equipment's foundation, piping, accessories and supports.	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 150 µm each (300 µm total); - Finish: repaintable acrylic polyurethane, Petrobras standard N-2677 - two coats of 70 µm d.f.t. (140 µm total). Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.

Cargo and Slop tanks slop Total painting Note: The last coat inside the cargo tanks shall be white and have edge retention properties	Anti-corrosion system: - Painting total area; - Epoxy paint "Novolac" ", Type II, - min. 450 µm. If the scheme uses a different number of coats, the thickness of each coat shall follow the manufacturer's guidelines. In this case, the paint for the first coat shall contain additives for inspection with ultraviolet light. In the case of two coats, the colors shall be different. The paint system shall not soften or become impregnated with the product when transporting the products described in item 2.1.
Empty spaces ("voids and cofferdams")	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm each (320 µm total); Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Ballast tanks and empty spaces Total painting Note: The final coat inside ballast tanks, cargo tanks and cofferdams shall be white and should preferably have edge retention properties.	Anti-corrosion system: - Painting total area; - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm each (320 µm total); Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Fresh, distilled and drinking potable water tanks Total painting	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 160 µm each (320 µm total); Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels. For the drinking water tank, the paint shall have FDA approval and a certificate of potability or similar.
Galvanized surfaces	One coat of isocyanate epoxy wash primer, or equivalent, as recommended by the paint manufacturer responsible for supplying the paint scheme + anti-corrosion paint scheme and finish specified for the area.
Fans and exhaust hoods	Anti-corrosion system: - Epoxy paint system, solvent-free, tolerant of wet surfaces, Petrobras standard N-2680 - min. Two coats of 150 µm each (300 µm total); - Finish: repainting acrylic polyurethane, Petrobras standard N-2677 - two coats of 70 µm d.f.t. (140 µm total). Last coat in accordance with Petrobras standard N-1503 - Colors for Painting Vessels.
Stainless steel, CuNi, FRP pipes, etc	1st coat TASF, 2nd and 3rd coats to Petrobras Standard N-2677 of 60 µm d.f.t. (120 µm total)
Galvanized pipes	1st coat TASF, 2nd and 3rd coats to Petrobras Standard N-2677 of 60 µm d.f.t. (120 µm total)
Anchors	Petrobras Standard N-2680 160 µm
Anchor Chain (Length connections only)	Petrobras Standard N-2680 150 µm

## (\*) Note:

- The anti-fouling paint scheme specified above shall be considered a minimum specification. If assessed by the designer, more efficient schemes can be adopted to help achieve the required EEDI;
  - The paint used to identify tank limits, draft marks, bottom plugs and any other marking shall be confirmed and have the same properties as the anti-fouling system applied to the hull.
- The paint for the last coat inside ballast tanks, cargo tanks and empty spaces shall be white and should preferably have edge retention properties.
- PETROBRAS N-2680 paint, when applied to tanks (cargo, ballast, fresh water, drinking water and distilled water), empty spaces, external hull (flat bottom, vertical bottom, boottop and ship's side) and gates (Engine Room and Pump Room), shall show a result greater than or equal to 12 MPa in the

pull-off test, according to ABNT NBR 15877, with a failure standard of "Y" or "Z".

Paint schemes on ballast tanks shall meet the requirements of IMO PSPC-WBT standards (MSC 215 (82)).

**Table A.2 - Internal Areas - Superstructure**

Area	Period	Painting Treatment			Paint (Petrobras Standard)		
		Before Shop Primer	Shop Primer	After Shop Primer (See the note below)	1° Layer	2° Layer	3° Layer
Bulkhead and ceiling without isolation	Construction	As 2 1/2	zinc shop primer 15 µm	WJ-2	N-2680 160 µm	N-2677 60 µm	N-2677 60 µm
	Maintenance	SP-11	xxx	Washing 3 000 psi + SP-11	N-2680 160 µm	N-2677 70 µm	
Bulkhead and ceiling with isolation	Construction	As 2 1/2	zinc shop primer 15 µm	WJ-2	N-2680 160 µm	xxx	xxx
	Maintenance	SP-11	xxx	Washing 3 000 psi + SP-11	N-2680 160 µm	xxx	xxx
Floor without Coating	Construction	As 2 1/2	zinc shop primer 15 µm	WJ-2	N-2680 160 µm	N-2680 160 µm	anti-slip coating
	Maintenance	SP-11	xxx	Washing 3 000 psi + SP-11	N-2680 160 µm	N-2680 160 µm	anti-slip coating
Floor with Coating	Construction	As 2 1/2	zinc shop primer 15 µm	xxx	xxx	xxx	xxx
	Maintenance	SP-11	xxx	Washing 3 000 psi + SP-11	xxx	xxx	xxx
Refrigerated provision compartment	Construction	As 2 1/2	zinc shop primer 15 µm	WJ-2	N-2680 160 µm	N-2680 160 µm	xxx
	Maintenance	SP-11	xxx	Washing 3 000 psi + SP-11	N-2680 160 µm	N-2680 160 µm	xxx

NOTE: All washing and hydrojetting processes shall be carried out using clean freshwater, free from contaminants, with a pH ranging from 6.5 to 7.5.

## PAINTING MANUAL

The Yard will prepare and deliver with the on-board final plans, in a number of copies as specified, a detailed "Painting Manual" containing the following information for each compartment / location:

**翠 Compartment name / location;**

~~翠 Full description of the treatment and paint scheme applied, type of paint and its trade name, thickness (d.f.t.) per coat and colors;~~

~~翠 Total detailed painted area of the compartment / site ( $m^2$ ), for example:~~

~~黒 Main deck - plating;~~

~~黒 Main deck - accessories, net supports, etc;~~

~~黒 Main Deck - piping (per pipe);~~

~~黒 Flat bottom (up to the height of the bilge);~~

~~黒 Vertical bottom;~~

~~黒 Boottop;~~

~~黒 Ship's Side;~~

~~黒 External Superstructure bulkheads;~~

~~黒 Ballast Tanks - total per tank and, for each tank, subdivided into regions such as:~~

~~o Upper region: area from the deck to the upper surface of the first stringer;~~

~~o Intermediate region: area from the lower surface of the first stringer to the upper surface of the lowest stringer;~~

~~o Lower region: area from the lower surface of the lowest stringer to the bottom plating.~~

~~黒 Cargo and Slop tanks: total per tank;~~

~~黒 Engine Room - plating (bulkheads, decks and platforms);~~

~~黒 Engine Room - piping, supports and accessories;~~

~~黒 Bosun Store - plating (bulkheads, decks and platforms);~~

~~黒 etc.~~

~~This manual shall include the cargo compatibility list of the paint used in the cargo and slop tanks, containing information on all the products for which it has been tested, including the products that are not listed in item 2.1.~~

~~The document shall include all the datasheets of the products used, as well as all the product certificates required by the rules and regulations (anti fouling, ballast and cargo tanks, etc.).~~

- Compartment name / location;
- Full description of the treatment and paint scheme applied, type of paint and its trade name, thickness (d.f.t.) per coat and colors;
- Total detailed painted area of the compartment / site ( $m^2$ ), for example:
- Main deck - plating;
- Main deck - accessories, net supports, etc;
- Main Deck - piping (per pipe);
- Flat bottom (up to the height of the bilge);
- Vertical bottom;
- Boottop;
- Ship's Side;
- External Superstructure bulkheads;
- Ballast Tanks - total per tank and, for each tank, subdivided into regions such as:

o Upper region: area from the deck to the upper surface of the first stringer;

o Intermediate region: area from the lower surface of the first stringer to the upper surface of the lowest stringer;

o Lower region: area from the lower surface of the lowest stringer to the bottom plating.

- Cargo and Slop tanks: total per tank;
- Engine Room - plating (bulkheads, decks and platforms);
- Engine Room - piping, supports and accessories.

- Bosun Store - plating (bulkheads, decks and platforms);
- etc.

This manual shall include the cargo compatibility list of the paint used in the cargo and slop tanks, containing information on all the products for which it has been tested, including the products that are not listed in item 2.1.

The document shall include all the datasheets of the products used, as well as all the product certificates required by the rules and regulations (anti-fouling, ballast and cargo tanks, etc.).

## COATING TECHNICAL FILES

A Coating Technical File ( SOLAS XII/6.3 and MSC.1/Circ.1198) shall be prepared by the Yard in accordance with the applicable rules and regulations, containing the paint scheme, products applied and their respective data sheets and certificates, all the vessel's paint reports, list of deviations, inspection and maintenance/repair procedures during the vessel's construction and operation. This document shall be approved by the Classification Company and the Owner.

## SACRIFICIAL ANODES

~~Bolted anodes shall be provided in the following locations:~~

~~翠 Ballast tanks;~~

~~翠 Sea chests;~~

~~翠 Recess of Rudder Stock;~~

~~The mass of anodes required shall be calculated in accordance with the requirements of Standards N-2838, DNV GL RP-401, DNV GL RP-101 and the following parameters:~~

~~翠 Protection density:~~

~~黒 Sea chests and rudder stock recess: 100 mA/m<sup>2</sup>;~~

~~黒 Other areas: 5 mA/m<sup>2</sup>;~~

~~翠 Life Cycle of anodes: 5 (five) years;~~

~~翠 Percentage of time the anode is submerged:~~

~~黒 Ballast tanks: 50%;~~

~~黒 Recess of rudder stock and sea chests: 100%;~~

~~翠 Coating efficiency factor: 80%;~~

~~翠 Anode efficiency factor: 85%.~~

~~Obs: Zinc anodes shall be used in the ballast tanks and zinc or aluminum in the sea chest and rudder stock recess.~~

## IMPPRESSED CURRENT CATHODIC PROTECTION SYSTEM

~~An impressed current cathodic protection system shall be provided to protect the wet surface of the hull, including the rudder and propeller, with anodes on both sides (PS and SB).~~

~~The system shall be designed in accordance with the requirements of Standards N-2838, DNV GL RP-401 and DNV GL RP-101. The sizing of the system shall take into account an average coating failure factor of 20% for the largest area of wetted surface (live work area) and a final coating failure factor (for the period between dockings) of 30%.~~

~~Grounding devices shall be fitted to the intermediate shaft and the rudder stock.~~

~~The system shall have an output interface so that the voltage and current values of the anodes, the voltage of the reference cells and the automatic/manual mode indication can be monitored on the ICMS.~~

**(End of Owner guidance for Hull corrosion).**

## 276 Galvanizing

Galvanising of pipes shall be carried out after all welding and treatment has been completed, with a heavy duty coating of zinc of not less than 400 g/m<sup>2</sup> (55 microns). Unless stated otherwise in this specification, the following items shall be hot dip galvanised:

- External stairs
- Pipes and flat bars in external railing
- Internal ladders in fresh water, ballast and coated cargo tanks
- External cable pipes and trays
- External gratings and walkways, unless GRP
- Flag staff and fittings
- Steel fittings on gangway
- Anchor chain (short length)
- Chain locker perforated plate
- Steel fitting refrigerated and provision store
- Small steel loose fitting on masts
- Strainers in sea chest
- Covers for bilge wells
- Perforated plates in chain lockers

For sea water systems, ref. [721 Sea water cooling system](#).

Pipe galvanizing shall be according the different pipe system descriptions, ref. [~~<broken cross-reference><broken cross-reference>~~7 System for Main Engine Components, Table 7.1](#)

Galvanized equipment shall be painted with suitable primer coat if required, after which painting shall be same as surroundings except for the following:

- Galvanised steel sheet in accommodation
- Galvanised parts of air handling units
- Galvanised steel sheathing for heater insulation
- Galvanised steel sheet for exhaust pipe covering

## 278 External cathodic protection

The ship's hull shall have cathodic protection against corrosion.

### [Impressed Current Cathodic Protection System](#)

An Impressed Current Cathodic Protection (ICCP) system shall be provided for protection of the complete underwater hull. An impressed current cathodic protection system shall be provided to protect the wet surface of the hull, including the rudder and propeller, with anodes on both sides (PS and SB).

The system shall be designed in accordance with the requirements of Standards N-2838, DNV GL RP-401 and DNV GL RP-101. The sizing of the system shall take into account an average coating failure factor of 20% for the largest area of wetted surface (live work area) and a final coating failure factor (for the period between dockings) of 30%.

Grounding devices shall be fitted to the intermediate shaft and the rudder stock.

The system shall have an output interface so that the voltage and current values of the anodes, the voltage of the reference cells and the automatic/manual mode indication can be monitored on the IAS.

### Anodes

A five (5) years system for normal conditions shall be provided. Anodes of suitable type shall be used. The size, numbers and location of anodes shall be determined by calculations. The anodes shall be bolted to doubling plates on the hull. The bolts shall be of stainless steel.

Extra anodes shall be arranged during the building phase if required. Bottom inspection shall be carried out by the Yard prior to delivery of the vessel and anodes corroded more than 10% shall be replaced.

Bolted anodes shall be provided in the following locations:

- Ballast tanks;
- Sea chests;
- Rudder and Recess of Rudder Stock;

The mass of anodes required shall be calculated in accordance with the requirements of Standards N-2838, DNV GL RP-401, DNV GL RP-101 and the following parameters:

**Protection density:**

- ~~— Sea chests and rudder stock recess: 100 mA/m<sup>2</sup>;~~
- ~~— Other areas: 5 mA/m<sup>2</sup>;~~

- Life Cycle of anodes: 5 (five) years;
- Percentage of time the anode is submerged:
  - Ballast tanks: 50%;
  - Recess of rudder stock and sea chests: 100%;
- Coating efficiency factor: 80%;
- Anode efficiency factor: 85%.

Obs: Zinc anodes shall be used in the ballast tanks and zinc or aluminum in the sea chest and rudder stock recess.

Protection density must comply with the referenced standards. For sea chests and rudder stock recess, protection density shall be at least 100 mA/m<sup>2</sup>.

### Marine Growth Prevention System

A Marine Growth Prevention System (MGPS) shall be installed in the sea chests, ref. [721 Sea water cooling system](#).

## 28 Material protection, internal

For material protection internal, please see group 27. [27 Material protection](#)

## 3 EQUIPMENT FOR CARGO

Cargo handling equipment and arrangement shall fulfil the requirements for carrying oil products covered by the vessel's technical specification, Classification Society noations, rules and regulation.

### 30 Hatches

Emergency exit- and other access hatches, cargo-, provision- and stores hatches shall be fitted as indicated on the General Arrangement. Open deck hatches shall be of weathertight or watertight type as required by the Classification Society. Flush and cargo tank hatches shall be fitted as indicated on the General Arrangement. Manholes shall be arranged for access to tanks.

All hatches fitting to be SS316L.

#### 301 Hatches on weather decks

##### Hatches

Main hatches in decks shall be installed according to General Arrangement plan.

Table 3.1 Hatches on weather decks

ID / Description	Deck	Size (approx. light opening)	Position (Frame number)	Deck load	Flush/ Coaming	Hinges	Cover	Remark
Cargo tank hatches	Main deck	Ø 900 mm	See GA	-	Coaming 800 mm	Outboards / side swing	Normal steel	12 pcs. Coated as tanks inside. Guard stanchions
Slop tank hatches	Main deck	Ø 900 mm	See GA	-	Coaming 800 mm	Outboards / side swing	Normal steel	12 pcs. Coated as tanks inside. Guard stanchions
Hatch to engine workshop / Store	Poop deck SB	1750x1450 mm	10-12	-	Coaming 600 mm	Fwd.	Normal steel	Counterbalance
Hatch to engine room	Poop deck PS	3000x1900 mm	7-11	-	Coaming 600 mm	SB	Normal steel	

Hatches shall as a minimum be provided with required fire rating of the deck division they are installed.

All hatches with steel coamings shall be fitted with stainless steel roundbar on top for mating surface towards hatch seal.

All hatches mechanisms to be SS 316.

Locking device in open position shall be arranged if hatches can not be open above approximately 135°.

## 302 Hatches on internal decks

### Hatches

The hatches installed on internal decks are given in the table below.

Table 3.2 Hatches on internal decks

ID / Description	Deck	Size (approx. light opening)	Position (Frame number)	Deck load	Flush/ Coaming	Hinges	Cover	Remark
Hatch to lower engine room	Main deck PS	3000x1900 mm	7-11	-	Flush with steel deck	side/SB	Steel, uninsulated	Guard stanchions
Hatch to lower engine room	Main deck SB	2000x2000 mm	14-17	-	Flush with steel deck	forw.	Steel, uninsulated	Guard stanchions
Hatch to incinerator	Poop deck	800x800 mm	10-11 PS		Flush with steel deck	side/SB	Steel	Guard stanchions

Hatch cover to lower engine room shall be arranged with lifting eyes, and lifting points shall be arranged above the hatch for manual chain tackle.

Locking device in open position shall be arranged if hatches can not be open above approximately 135°.

## 304 Smaller hatches, emergency hatches and manholes

Steel hatches, with a size according to the National Authorities requirements (free opening minimum 800 x 600 mm), shall be fitted as emergency exits.

Access hatches and store hatches shall be arranged as indicated on the General Arrangement and described in Table 3.3.

Hatches on open deck shall be weathertight with steel comings and steel covers, upper edge of comings shall be stainless steel round bar.

Access step(s) on the side of the hatch coaming shall be arranged.

All emergency hatches shall have a central closing device, ISPS cover and shall have counter balanced covers.

The height of comings shall be in accordance with the "International Load Line Convention".

Hatches shall as a minimum be provided with required fire rating of the deck division they are installed to.

Table 3.3 Smaller hatches and emergency hatches

ID / Description	Deck	Size (light opening)	Position (Frame number)	Indication on bridge	Flush/ Coaming	Hinges	Cover	Remark
Emergency escape from methanol fuel treatment	Poop deck	800x600 mm	~Fr 45-46 PS		Coaming 600 mm	Fwd.	Steel	

ID / Description	Deck	Size (light opening)	Position (Frame number)	Indication on bridge	Flush/ Coaming	Hinges	Cover	Remark
room								
Emergency escape from pump room	Poop deck	800x600 mm	~Fr 45-46 SB		Coaming 600 mm	Fwd.	Steel	
Emergency escape from steering gear room	Poop deck	800x600 mm	~Fr -1-0		Coaming 600 mm	SB	Steel	
Rope hatch	Poop deck	Ø 350 mm	~Fr -2 SB		Coaming 600 mm	Aft.	Steel	A rope hook shall be provided inside the rope hatch.
Rope hatch	Forecastle deck	Ø 350 mm	~Fr 98 PS/SB		Coaming 600 mm	Fwd.	Steel	A rope hook shall be provided inside the rope hatch.

### Tank cleaning hatches

Each cargo tank shall be fitted with three (3) tank-cleaning hatches for use with portable tank - cleaning machines.

Slop tanks shall have two (2) tank cleaning hatches.

These hatches shall be positioned for total coverage of cargo tanks internally, according to shadow diagram.

One of these hatches shall be arranged with sight glas, seal and steel hatch cover on top, and shall be placed above of the cargo pump suction well.

Table 3.4 Tank-cleaning hatch data

Number of units	minimum 40
Type	Circular, with hinge and three cleats (Refer to CB/T 3728-95)
Dimensions	To suit tank cleaning machine (Ø 355 mm) Height abt. 250 mm above deck according to rules
Materials	Mild steel with stainless steel rim, AISI 316 Coated internally as cargo tanks Inspection hatch to be stainless steel, AISI 316 L
Packing type	Double packings, resistant acc. to cargo list. (PTFE)

One ball valve for connecting portable closed Ullage / cargo sampling system placed in deck outside in aft part in each cargo & slop tank. One stainless steel pipe with a lot of holes, connected with ball valve and down to abt. 25 mm - 50 mm over the tank top. These pipes need to be well supported in the aft bulkhead. To prevent damages to tank bottom a welded plate of 10 mm stainless steel shall be located just below the pipe.

### Manholes

Trunk hatches for access to ballast tanks (upper edge shall be stainless steel round bar) 800 x 600 mm, height approx. 600 mm or as per rule requirements. Located as far as practical to ship side.

Watertight manholes of 600 x 600 mm for openings, with mild steel bolted cover shall be provided on all FW tanks and other tanks not mentioned above.

Each water ballast tank in cargo area to be provided with manholes according to rules and regulations. In cargo area vertical openings shall be 800 x 600 mm.

Oil-tight manholes of 600 x 400 mm for vertical openings, oval with mild steel bolted cover shall be provided on each fuel oil, gas oil and lubrication oil tanks.

To rudder trunk, each tank in engine room, aft peak tank, forepeak tank, closed cofferdams and other closed spaces, there shall be arranged manholes, 600 x 600 mm (horizontal openings), and 600 x 400 mm (vertical openings).

All vertical manhole covers to be fitted with hand grips.

Other manhole covers to be fitted with hand grips as required, type of hand grips to be approved by owner. Thickness not less than the adjacent plating.

Cover to be bolted with welded-on stainless steel bolts and stainless steel nuts.

## 31 Equipment for cargo in holds/on deck

### 316 Canvas covers

Tarpaulins of PVC covered material to be provided for the following equipment and fittings on weather deck:

- Mooring drums of deck machinery
- Control stand of deck machinery
- Wire and mooring storage reels
- Winch drums of life boat davits
- Winch drum of accommodation ladder
- Embarkation rope ladders for life rafts
- Pilot ladders
- Navigational equipment
- Searchlights
- Magnetic compass and projector compass
- Ventilation tops
- Electrical motor for pumps on deck. Cover for the complete electr. motor.
- All P/V valves for cargo and slop tanks.
- Rescue boat

Material of tarapaulins to be checked by Owner, before ordering.

## 33 Deck cranes for cargo

### General

The vessel shall be equipped with electro-hydraulic deck cranes as indicated on the General Arrangement. The cranes shall be of marine design for shipboard use in open sea.

### 331 Rotating cranes with crane pillars

#### Provision- and Rescue boat Crane

Two(2) electro-hydraulic cranes shall be installed on 2. accommodation deck, one SB and one PS. One of the cranes (SB) shall be approved for launching of Rescue boat and liferafts, and shall also serve the hatch to machinery area.

Fittings, bolts, pipes maneuvering levers etc. to be of stainless steel.

Table 3.5 Provision- Rescue boat crane data

Type	Cylinder luffing and knuckle beam slewing crane.
Capacity	2.5 t SWL/8,2 m outreach
Slewing angle	360 degree
Operation	Motion by control levers on the crane and wireless remote operation from tank deck
Power supply	<a href="#">Table 8.6</a>

Table 3.6 Service crane data

Type	Cylinder luffing and knuckle beam slewing crane.
Capacity	8 t SWL/8,2 m outreach
Slewing angle	360 degree
Operation	Motion by control levers on the crane and wireless remote operation from tank deck
Power supply	<a href="#">Table 8.6</a>

### 334 Other cranes with equipment

#### Hose handling crane

One (1) electro-hydraulic crane of marine type shall be installed on main deck near the after end of cargo manifold station, suitable for cargo oil hose handling and handling of the Accommodation ladders.

Fittings, bolts, pipes maneuvering levers etc. shall be of stainless steel.

Hose handling crane to be fully compliant with OCIMF specification.

Table 3.7 Hose handling crane data

Type	Cylinder luffing and knuckle beam slewing crane.
Capacity	10.0 tons at 20.0 meters outreach
Slewing angle	360 degree
Operation	Motion by control levers on the crane and wireless remote operation from tank deck
Min out-reach	4.0 m outboard of ship side in line of cargo manifold
Hoisting speed	10 m/min on full load, 20 m/min with light hook
Power supply	<a href="#">Table 8.6</a>

## 35 Loading/discharging pumps & systems for liquid cargo

### General

The cargo handling system shall consist of submerged pumps and deck piping for each cargo tank.

The cargo pumps shall be electrically driven, each equipped with a dedicated frequency converter for individual rpm control. See Figure 0.1

Slop tank cargo pumps to be submersible with same working pressure as for main cargo tanks.

The cargo tank no.6 SB to be combined cargo tank / methanol fuel tank.

The cargo pumping system shall be designed to facilitate easy loading and cleaning operations, and to eliminate cargo pockets or collecting points within the system.

The vessel to be designed with 6 cargo segregations.

Cargo VDR monitoring system for monitoring reactive/inhibited cargo temp/press during voyages.

Cargo monitoring system to have possibility to log data and print status after voyage.

Cargo system to be designed in co-operation with owner.

Maximum cargo tank loading temperature to be 50 deg.

Maximum noise level during full discharge not to exceed 85 db (A) on main deck at ship side.

Table 3.8 General design criteria for discharge and loading:

Pressure head at manifolds:	100 MLC
Cargo density	0.9 t/m <sup>3</sup>
Cargo viscosity	18,2 cSt at 50°C
Design discharge time	Abt. 18 hours at design criteria with 6 cargo pumps running simultaneously, incl. stripping.
Maximum discharge rate	1200 m <sup>3</sup> /h at 100 MLC., Density 0.9 t/m <sup>3</sup>
Maximum loading rate	800 m <sup>3</sup> /h per tank / total 4800 m <sup>3</sup> /h. (Not loading through pumps)
Flow speed	The maximum flow velocities in the piping will be as follows: - unloading: 5 m/s; - Loading: 5 m/s;
Segregation	<ul style="list-style-type: none"> <li>• Simultaneous discharge of six (6) grades via separate pumps and manifolds.</li> <li>• Simultaneous loading of six (6) grades over manifolds and direct drop lines to cargo tanks, using common vapour line or venting to atmosphere if allowed by terminal operator. Full segregation . SEUT type valve segregation.</li> </ul>
Cargo drop line	The cargo drop line to be DN200 and positioned oposit of cargo pumps
Cargo loading time	Simultaneous loading of up to 6 (six) products shall be carried out in a maximum of 10 (ten) hours, considering that loading is carried out exclusively by drop lines, i.e. without passing through the cargo pumps and considering products with a viscosity of 18,2 cSt at 50°C and a density of 0,85 t/m <sup>3</sup> .

### 351 Loading/discharging systems

Deepwell cargo pumps to be installed, one pump for each cargo and slop tank. Two (2) fixed pneumatic diaphragm pumps will be provided, suction from drain tanks, tank deck, manifold drip tray. One (1) portable pneumatic diaphragm pump shall be arranged that can be connected with hoses to different locations. All cargo and slop pumps are delivering to discharge crossover manifolds. Cargo pumps and slop pumps are all single suction submerged pumps.

Each deepwell cargo pump shall be arranged in the after part of each tank.

Suction shall be arranged from suction wells in starboard and port tanks.

Table 3.9 Cargo pump data

Number of units	Twelve (12) (Including the two combined methanol fuel / cargo tanks in aft part of cargo area)
Type	Deepwell, single-stage centrifugal pumps, integrated with the vessel's flue gas inerting system for purging.
Design capacity	Abt. 200 m <sup>3</sup> /h each.
Design pressure at manifold	100 M.L.C., S.G. 0,9 t/m <sup>3</sup> .
Materials, pump impeller, stack	Acid resistant stainless steel, (AISI 316L)
Drive	Stepless electric motor (Frequency regulated 1-100%)
Mounting	Vibration damping resilient mount.
Seals (O-ring)	Teflon / Viton
Shaft seal	Mechanical seal. Double teflon lip seals running on ceramic sleeve against cargo side. Seal arrangement to withstand dry running during stripping and tank washing.

Table 3.10 Slop pump data

Number of units	Two (2)
Type	Deepwell, single-stage centrifugal pumps, integrated with the vessel's flue gas inerting system for purging.
Design capacity	Abt. 100 m <sup>3</sup> /h
Design pressure head at outlet	100 M.L.C., S.G. 0,9 t/m <sup>3</sup> .
Materials, pump impeller, stack	Acid resistant stainless steel, (AISI 316L)
Drive	Stepless electric motor (Frequency regulated 1-100%)
Mounting	Vibration damping resilient mount.
Seals (O-ring)	Teflon / Viton
Shaft seal	Mechanical seal. Double teflon lip seals running on ceramic sleeve against cargo side. Seal arrangement to withstand dry running during stripping and tank washing.

The pumps shall also work satisfactorily, with reduced capacity, at higher pressures and higher viscosity.

Cargo pumps shall be fitted with stripping pipes to the deck.

Manual purging system of pump and cargo lines shall be provided. Consideration will be given for efficient stripping system of the cargo pump stack and pipes in accordance with regulations.

Cargo pumps shall have the operation controlled locally at the pump stack and remotely from cargo control station.

Emergency stop button, protected by a stainless steel box, shall be situated at both sides of the manifolds and at the cargo control station. There should also be one possibility to have one remote emergency stop button in order to be placed at the berth and also pump side in pipe trunk.

Remaining cargo in pump suction wells after completion of discharge not to exceed 75 litres.

Ability to read cargo discharge pressure from cargo control station and locally at stack.

Cargo pumps shall be fitted with stripping pipes connected to the cargo manifolds on the manifold valve discharge side.

Table 3.11 Portable cargo pump for emergency discharge

Number of units	One (1)
Type	Submerged, centrifugal
Design capacity	Abt. 100 m <sup>3</sup> /h
Design pressure head at outlet	70 M.L.C., S.G. 0,9 t/m <sup>3</sup> .
Materials, pump impeller, stack	Acid resistant stainless steel, (AISI 316L)
Drive	Hydraulic
Materials against cargo	Stainless steel (AISI 316L)
Hoses for cargo/hydraulic	Acid resistant and electrically conductive

## 352 Loading/discharging systems on deck

### General

Arrangement of cargo system to be presented to Owner for approval before commencement of work.

Suction wells designed to comply with pump manufacturers recommendations and class requirement to be fitted in each cargo tank double bottoms and main deck for slop pump's suction.

All piping and equipment in cargo systems shall be designed for 16 bar.

All nuts and bolts used in connection to the cargo piping to be stainless steel AISI 316. Spring washer to be used for flange connection.

Lines from each pair of cargo and slop pump to be led to separate cross overs for each pair of cargo and slop tank. Each cross over to be connected to two collecting manifolds.

Each cargo tank to be fitted with separate direct loading drop line by-passing the cargo pump and extending to 0.25 \* pipe diameter (mm) above tank bottom with 90 degrees end elbow.

Variable Speed Drives (VSDs) for cargo pumps shall be installed in an air-conditioned compartment.

The cargo pump intended for the tank that may be converted to carry alcohol-based alternative fuel in the future shall be suitable for pumping alcohol-based products.

Each cargo tank shall be loaded via drop lines arranged from the loading manifolds of each segregation. Drop lines shall be positioned in front of each cargo tank and discharge into the lower area of each tank, approximately 500 mm from the bottom plating. Reinforcement doubler plates with anti-abrasive paint shall be fitted on the bottom plating below each drop line. Drop line branches shall be symmetrical with respect to the vessel centerline and equipped with isolation valves installed as close as possible to the cargo line. These valves shall be provided with remote control of the continuous (partial opening) type.

Emergency ballasting of the cargo tanks (heavy ballast) shall be performed by the ballast pumps or the tank cleaning pump via a branch of the ballast line on main deck, connected to the cargo line by

means of a removable spool piece. Deballasting operation shall be carried out by the cargo tank's own cargo pump through a high discharge branch, supervised and controlled by the oil discharge monitoring equipment (ODME).

The cargo pipes shall be supported on resilient Teflon packings on pipe stools with stainless steel clamps, to reduce the transmission of noise and vibration. The stainless steel clamps shall be imbedded with Teflon packing.

For piping systems on exposed decks, corrosion protection fittings shall be installed at all contact points between the piping and horizontal or vertical supports, including the fixing devices on the supports. Corrosion protection systems used shall be equivalent in performance and reliability to recognized solutions in the market (e.g. provided by Deepwater Corrosion Services).

All branches and other welded connections shall be flush inside the cargo pipe.

All cargo piping to have welded connections, with minimum flanged joints.

(Threaded joints except transmitter and sensor are not permitted.)

Removal of pumps shall not require dismantling of other pipes than those directly connected to the pumps.

Delivery lines to be arranged with expansion bends to compensate for thermal expansion in piping.

Pipe diameter to be suited to pump size ensuring good flow characteristics in accordance with pump suppliers recommendations.

Cargo pipes maximum flow rates:

- Pump discharge: 5 m/s;
- Loading: 5 m/s.

All cargo piping shall be fitted and arranged with gradient such that the residue in the line or discharging system can be reduced to a minimum (latest IMO regulations). Drain valves to be provided at low points, connected to a blowing line, ending in slop tank. Local drain valve with plug shall be arranged after each non-return valve of the cargo pump and slop pump.

Earthing of all piping shall be arranged.

The following pipe diameters are as general guidance, and will vary at certain locations:

Table 3.12 Cargo pipe dimensions

Pipes	Diameter
Discharge/loading line cargo tanks	DN 200
Discharge/loading line slop tank	DN 150
Dropline for loading	DN 200
Shore connections, Manifold	DN 250
Stripping lines to cargo pumps	DN 65
Crossover pipe	DN 250

### Cargo valves

All cargo valves to be suitable for use with a widest possible range of applicable cargoes, such as MTBE, Unleaded gasoline, Viton GF etc.

Cargo valves at cargo pump outlet and at drop line, to be of AISI 316 stainless steel, single-piece, throttle type (0-100%), butterfly type valves.

~~All cargo manifold valves to be steel butterfly type with hydraulic actuators. Valve control to be provided both locally and from ICMS. All cargo manifold valves to be steel butterfly type with hydraulic actuators. Valve control to be provided both locally and from IAS.~~

Folding blind flanges to be fitted on all manifold connections. The arrangement shall fully comply with OCIMF recommendations.

Each separate cross over to be separated from collector manifolds by two steel butterfly valves (on-off), fitted with hydraulic actuators.

Valve control to be provided both locally and from SSCI. In the spool piece between the two valves, there shall be a drain pipe DN 25 stainless steel and ball valve leading to the manifold drip tray (leakage control system).

Drain and purging valves to be DN25 stainless steel ball valves with cam lock quick coupling connection.

All the stainless steel ball valves shall have a lock at the handle.

All the drain valves shall be arranged with plug of stainless steel, and the quick coupling shall have cap.

#### **Hydraulic Control System for Cargo and Ballast Valves**

An electro-hydraulic control system shall be provided for the remote operation of all cargo and ballast valves, except sea chest, drain and interconnection valves. The system shall include at least:

- One (1) compact Hydraulic Power Unit (HPU) with two pumps (one standby), oil tank, accumulators, filters with bactericidal device, local control and pump start panels.
- ~~Solenoid valve racks, located midships and in the bosun store, dedicated to mid/aft and forward valve groups respectively. The Hydraulic Units shall each have a C.J.C. (C.C. Jensen) or similar off-line filtering system, and the system shall have a minimess or similar oil sampling outlet, enabling a representative quantity to be taken for analysis in accordance with the manufacturer's recommendations or best industry practice.~~
- ~~Portable hand pumps with gauges and quick-connect hoses for manual emergency operation. The minimum volumetric capacity per minute of each pump shall be 10% of the total volume of the actuators.~~
- ~~The minimum volume of the accumulator shall be 10% of the total volume of the actuators.~~
- ~~The minimum volume of the hydraulic oil tank shall be 20 times the total volume of the actuators.~~
- ~~Remote operation shall be possible, with the same functions as the local panel, via the IAS.~~
- ~~In addition to remote control, the manifold valves shall have local hydraulic manual control.~~
- ~~The opening and closing indications of the valves, as well as the hydraulic unit variables, shall be monitored by the IAS.~~
- ~~The solenoid control valve sets shall be installed in the hydraulic unit compartment controlling the valves located midships aft of the vessel, and in the bosun store controlling the valves located midships forward of the vessel.~~
- ~~Two (2) portable hand pumps, for emergency use, with pressure gauge, built-in oil tank and quick-connect hoses for manual emergency operation.~~
- Tubing material SS316L or 6Mo (NS31254) for sea spray areas. All tubing shall be installed in multi-tube arrangement with expansion loops.
- Double-acting actuators with analog position indication or flow position indicators where direct visual confirmation is not possible.
- On/off valves with ~~feedback devices for indication of fully open and fully closed~~ position-

**feedback**; continuous valves on drop lines and pump discharges shall have analog indication of opening.

- ~~All valves shall be ICMS-integrated with full supervision of position, alarms for failure to open/close, and valve control interface. All valves shall be IAS-integrated with full supervision of position, alarms for failure to open/close, and valve control interface.~~
- Manual emergency operation shall be possible via hand pump coupling, located nearby or in grouped boxes on deck for inaccessible valves.
- The system shall provide interlock for overboard ballast discharge based on ODME oil content signal, as per MARPOL limits.

### Cargo manifolds

The Oil Companies International Marine Forum's (OCIMF) Standard for Tanker Manifold and Associated Equipment, latest issue), to be FULLY complied with.

One crossover to be arranged for each pair of cargo and slop tanks. Crossovers to be of AISI 316L stainless steel. Total crossovers are six (6) for cargo tanks and two (2) for slop tanks.

Two (2) collecting manifolds to be arranged. All six (6) cargo and two (2) slop crossovers to be connected to two (2) collecting manifolds with 2-valve segregation.

In addition to the slop tanks, cargo tank no. 6 PS will be used for receiving oily residues and shall be equipped with the necessary and required piping arrangement.

Crossovers to be set down towards centre for drainage, with lowest point at cargo line connection.

Each cargo crossover and collecting manifold to be furnished with pressure gauges outboard of crossover valve. The pressure gauge to be of glycerine filled type with shut-off stainless steel valve.

All manifold flanges shall be sized as per the respective piping. Manifold flanges to be vertical, fixed, separate and arranged for easy use of reducers. Manifolds to be arranged to avoid spillage on disconnecting hoses.

All presentation flanges to be of ANSI type and to be "in-line".

Each cargo crossover to have connection for purging.

One 3/4 " shut-off ball valve with non-return valve shall be provided at each crossover inboard of connection valve, with snap coupling, for air/flue gas connection.

A strong saddle support to be arranged close to cargo manifold flanges.

Each loading connection at the cargo manifold shall be equipped with a pressure gauge, thermometer and sample connection. The pressure gauge and thermometer shall be installed with a protective housing. Sample connections shall be drip flange type in accordance with ISO 3170 or ASTM D-4057.

The foundation of each spill tank in the cargo manifold area shall be of flanged type, bolted to the vessel's structure.

~~Each loading connection shall be provided with a fold blind flange. Heated anti-pollution trays shall be arranged in accordance with OCIMF recommendations. Each tray shall be equipped with drain piping fitted with double isolation valves and a connection for portable compressed air pump, allowing discharge to the PS slop tank. A pressure transmitter shall be provided for each cargo segregation, with indication available in the ICMS. Two (2) pneumatic diaphragm pumps shall be installed in bypass arrangement on the residue line, to assist with draining trays and connections. Each loading connection shall be provided with a fold blind flange. Heated anti-pollution trays shall be arranged in accordance with OCIMF recommendations. Each tray shall be equipped with drain piping fitted with double-isolation valves and a connection for portable compressed air pump, allowing discharge to the~~

PS slop tank. A pressure transmitter shall be provided for each cargo segregation, with indication available in the IAS. Two (2) pneumatic diaphragm pumps shall be installed in bypass arrangement on the residue line, to assist with draining trays and connections.

Vent lines connected to the manifolds shall be fitted with double-isolation valves.

#### Drip trays, etc.

Drip trays with stainless steel AISI 316L gratings shall be fitted beneath port and starboard manifolds. Material of angle bars for supporting the gratings to be of stainless steel, and Teflon packing to be used between the grating and supporting angle bars. Material of drip trays shall be of mild steel and coated same as cargo tanks. Size and volume of trays shall as far as practical be according to OCIMF regulations. Upper edge around drip tray under cargo manifold to be round bar AISI 316

Drain tanks under drip try should be made in the same size, length and breath as drip try.

Drip trays and drain tanks to be connected with drain lines to the membrane pump and further to slop tanks.

The drain lines to be fitted with stop valves. Drain lines to be of stainless steel, AISI 316 L.

Drip tray with stainless steel grating, AISI 316L, also to be arranged on 01-poop deck forward of accommodation. Drain to drain wells on main deck below to be arranged.

Each drip tray shall be provided with a 150 mm drain with manual valve connected to the closest aft cargo tank through a U-shaped seal.

The foundation of each spill tank (drain tank) fitted for drip trays shall be of flanged type, bolted to the vessel's structure.

A gate with rubber packing at bottom to be arranged outside, in front of accommodation.,

#### Oil discharge monitoring system

Arrangement for using one of the slop tanks below main deck as primary slop tank and the other one as secondary slop tank, including slop tank equipment and piping arrangement according to MARPOL to be provided.

In addition to the slop tanks, cargo tank No. 6 PS will be designated for the reception of oil and water residue, and it must be equipped with the necessary piping for this purpose.

Monitoring points in each cargo discharge line to be fitted.

One oil discharging monitoring and control unit shall be provided in deckhouse / cargo control station in accordance with the requirement of MARPOL 73/78 Annex I.

The system comprises for the following main components:

- Oil content monitor
- Flow meter system
- Central control unit
- Sampling system
- Discharge control system
- Signal from speed log

Output information of the system shall be as follows:

- Instantaneous rate of discharge of oily water

- Total quantity of discharge of oily water
- Time and date
- Oil content (PPM)

A system for easy testing (bucket testing) of the ODME equipment should be provided and function agreed with owner.

The overboard discharge of oily water from slop tank shall be automatically stopped and dumped back to the secondary slop tank upon high oil content. The value of oil content shall be monitored. Equipment such as suction pump, sampling tube, flow meter, sensing unit, control system, monitoring device and recorders shall be provided in accordance with manufacturer's standard and to meet the rule requirement.

Ref. also section 381.

#### **Underwater discharge**

An underwater discharge to be arranged as a seachest, in accordance with MARPOL 73/78 Annex II.

#### **Cargo equipment stowage**

Supports/racks for cargo equipment stowage shall be arranged on platform above cargo manifold.

Arrangement for stowage of reducers with wooden bottom, impressed timber to be provided.

#### **Cargo hoses, blank flanges and spool pieces**

18 m chemical hose with couplings to be delivered by the Owner.

18 m hose for oil with couplings to be delivered by the Owner

Blank flanges of stainless steel material, AISI 316 L., for all cargo crossovers, arranged with lifting handles to be provided.

Reducers of AISI 316L for cargo manifolds to be in accordance with OCIMF recommendations.-

~~Quantity and dimensions - Dimensions to be agreed with the Owner. The total number of - principal and reserve reducers supplied for both cargo and vapour shall correspond to be defined by the required number of segregations - Owner in compliance with vessel category B and shall fully comply with OCIMF recommendations. Reducers to be stowed in a dedicated rack.~~

The following assorted spool pieces for cargo cross-overs to be supplied. Dimensions to be agreed with the owner:

- 3 off adapters ANSI - DIN shall be supplied.
- 8 off reducers according to Owners instructions.

## **356 Separate stripping systems**

#### **Stripping system**

A separate stripping system shall be arranged, with stripping lines from each cargo pump to the cargo crossover at the manifold valve discharge side.

Blowing/stripping of cargo pumps and cargo/slop lines shall be arranged using compressed air, with drain lines connected to the slop tanks.

Each cargo pump shall be equipped with a quick air connection for clearing remaining product from the outlet line after draining.

#### **Super drain pipe**

Each cargo pump to be arranged with a fixed super drain pipe, abt. 30 mm, arranged inside deck trunk, from pump to top of deck trunk vacuum tank of 400 litres located on top of deck trunk at cargo manifolds. Each tank to be fitted with a fixed pipe and valve (close to each tank hatch with sight glass)

between the pipe and the vacuum tank. The pipes, valves and quick connections to be stainless steel. A drain pipe and valve of stainless steel to be arranged from the vacuum tank to the slop tank. Top of vacuum tank to have shape as an oil drum. It should also be possible to make suction from fore and aft of pipe-trunk to vacuum tank.

## 36 Heating systems for cargo (Slop tks)

Table 3.13 Heat Exchanger

Heat exchanger	
No. of units	Two (2)
Primary side	Thermal oil, 6.5 bar
Secondary side	Water/glycol mixture
Type	Shell and tube
Total capacity	To be capable to supply 150% of cargo heating Requirement (75% on each)

Table 3.14 Circulating pumps

Circulating pumps	
No. of units	Two (2), common to circuit.
Capacity each	At least 100% of required flow at full heating capacity

Table 3.15 Expansion tank

Expansion tank	
No. of units	One (1)

Table 3.16 Storage tank for glycol

Storage tank for glycol	
No. of units	One (1)
Capacity	abt. 1m3

## 37 Gas/ventilation systems for cargo holds/tanks

Table 3.17 Design criteria for ventilation and vapour return system

System	Capacity
Ventline for each tank (Venting system)	Cargo loading of 800 m3/h.
Vapour return system collector lines and crossovers	Total cargo loading of 4800 m3/h.

### 372 Closed ventilation/return vapour systems for cargo holds

#### Cargo tanks

Cargo tank venting system to be arranged for closed loading and discharge according to USCG.

To ensure a controlled ventilation, each cargo and slop tank to be fitted with a gas freeing / venting line from tank hatch, fitted with gravity type pressure / vacuum valve and high velocity nozzle with discharges at required level above deck.

All tank vent-lines to be connected by one butterfly valve and one blind flange to one (1) separate gas return/vapour ashore lines on each side with crossovers (2 off) in manifold area and flange for land connection fore and aft of cargo manifold. Fourteen hoses 1.5 meter with quick couplings (3/4" camlock) at each end.

Cargo tank venting pipes to be fitted with ball valve with 3/4" cam lock coupling for flue gass hose mounted at ventilation riser, also as connection for portable pressure gauge, and for cleaning.

All vent pipes to be sloped to tank for drainage.

### **Return vapour system**

The return vapour system shall include:

- Double-blocked drain and sample withdrawal line for the O<sub>2</sub> analyzer at each vapor outlet.
- Connection piece with lifting eye, and a blind flange with hinge and handle for each vapor outlet.
- Set of flanged reduction pieces for each vapor outlet, each equipped with lifting eye and blind flange on the smaller diameter side.
- VECS system monitoring panel installed in the Cargo Control Room (CCR), with visual and audible alarms.

### **Gas-dangerous areas**

Cofferdams and enclosed structures above main deck in cargo area are all to be mechanically ventilated by permanent fans. Exhaust air to be expelled through vents according to class rules and supplier's recommendations.

## **374 Ventilation/gas freeing systems for cargo tanks**

### **Portable gas-freeing fans**

Portable gas-freeing fans: Four (4) portable reversible exhaust fans, made of aluminum, and powered by seawater, will be delivered. These fans will be equipped with flexible hoses connected to seawater outlets on the main deck and spiral, flexible, retractable exhaust ducts designed to reach 1 meter above the bottom of the tanks. The total capacity of all fans must enable degassing of all cargo and slop tanks within a maximum of 10 hours.

These fans shall be supplied from the **general services** seawater branch described in Section 813 Fire line/deck washing system.

## **376 Inert gas systems**

The inerting system will basically consist of injecting flue gas from inert gas generator, properly treated to achieve a maximum oxygen content of 5%, into the cargo, slop and ballast tanks.

### **Inert Gas generator**

One (1) Inert Gas Generator, burning Dual Fuel (DF). The capacity of the system shall be 125% of the actual maximum flow of the Cargo Pumps, as required by the rules and regulations (approx. 3 400 m<sup>3</sup>/h).

The IGS to include

- 1 (one) inert gas generator with built-in cooling system, burning diesel oil, with a gas washing and cleaning system (scrubber) to prevent contamination of the cargo by ash or humidity;
- 2 (two) diesel oil supply pumps, one as backup;
- 2 (two) electric centrifugal ventilation fans, each with a capacity of 100% of the system's total flow;

- 1 (one) Deck seal, hydraulic (wet type);
- 2 (two) seawater Pumps for the Deck Seal, each with 100% capacity;
- 2 (two) seawater pumps for cooling and washing gases, each with a capacity of 100%;
- 1 (one) pressure and vacuum switch;
- 2 (two) sets of oxygen analyzers and sensors;
- 1 (one) liquid separator;
- 1 (one) set of pipes, valves, fittings and inflation nozzles.

#### **Material and construction requirements**

- The scrubber shall be internally lined with fiberglass or other suitable corrosion resistant material.
- The drain piping from the scrubber and the sealing tank shall be lined with polyethylene.
- The sealing tank shall be internally lined with corrosion resistant material.

It should also be possible to operate from a mimic on the alarm and monitoring system.

IGS PLANT should be connected with one (1) mainline supplying starboard and port cargo tanks. From the main line one separate line to each cargo tank with a valve equipped with means of locking by the use of chains and padlocks. All padlocks shall be operable by a single master key. In addition, a blind flange shall be fitted downstream of the valve to allow complete mechanical isolation. The injection piping in the tanks shall be positioned on the centerline of the vessel, aft of each tank (the ventilation posts will be installed forward of each tank in order to avoid dragging cargo vapor during loading). Injection nozzles in the tanks shall be connected to the deck penetration pieces by means of flanges bolted with ASTM A-316L stainless steel stud bolts, washers and nuts.

Three (3) connections for receiving inert gas from an external source shall be provided: one (1) aft, one (1) amidships, and one (1) forward on the main deck.

#### **Inert Gas Control System**

- The inert gas control system for cargo tanks shall include at least:
  - Valve opening controls
  - Fan and pump start/stop controls
  - Inert gas pressure control
  - Safety protection devices
  - Thermomagnetic on-line O<sub>2</sub> content analyzer
  - Gas detour function due to high O<sub>2</sub> content
- Control panels:
  - The main control panel shall be installed in the Cargo Control Room (CCR)
  - Remote control panels with the same functions as the main panel shall be located in the inert gas compartment and the Engine Control Room (ECR)
  - A panel with required functions shall be installed on the navigation bridge
- The control system shall provide signals for remote monitoring and operation to the ICMS via an open industrial communication protocol, according to the ICMS point list agreed between the Owner and the Yard during design. The control system shall provide signals for remote monitoring and operation to the IAS via an open industrial communication protocol, according to the IAS point list agreed between the Owner and the Yard during design.
- If available from the manufacturer, the system shall include hardware and software for remote access via internet to the on-board system's operating data, parameters, and alarms.

## 375 High velocity pressure/vacuum valves

Table 3.18 High velocity pressure/vacuum valve

No of sets	One (1) for each cargo and slop tank, total fourteen (14)	
Type	Class approved type (also for IIB cargoes)	
Setting press	$+ 0.14 \text{ kg/cm}^2$ $- 0.035 \text{ kg/cm}^2$	
Venting velocity	Min 30 m/sec	
Material	Housing : Stainless steel Wire net : Stainless steel Other internal parts : Stainless steel	
Location	Close to each tank, on side of deck trunk	
Spare	One (1) Spare P/V valve	

P/V valves to be fitted with gas freeing cover.

Platform and vertical ladder shall be arranged for maintenance of the P/V valves.

### Vacuum breaker unit

The Vacuum Breaker Unit (VBU) shall be installed on the main deck. The VBU will serve as a secondary protection against overpressure and vacuum, activating at  $0.18 \text{ kg/cm}^2 \text{ G}$  for positive pressure and  $0.07 \text{ kg/cm}^2 \text{ G}$  for negative pressure, in case the primary P/V valves fail to operate.

## 378 Vapour return system

**Vapour Emission Control System (VECS)** shall be arranged in accordance with MARPOL Annex VI/3/15 and USCG regulations 46 CFR Part 39. The system shall consist of vapour return lines with valves and portable connections to cargo tank vent lines, and shall be provided as follows:

- Two (2) common vapour return lines shall be arranged from fore to aft on each side, with crossovers (2 off) in manifold area. Crossovers to be fitted with butterfly valves and blind flanges at both sides.
- Each vapour return line to have capacity of maximum loading rate,  $4800 \text{ m}^3/\text{h}$ .
- Vapour return lines also to be used for inerting of cargo tanks if inert gas is received from shore when discharging.
- The presentation flanges at the cargo manifolds shall follow the requirement of OCIMF.

## 38 Auxiliary systems and equipment for cargo

### General

This section provides an overview of auxiliary systems and equipment supporting cargo and ballast operations on board the vessel. ~~Cargo and ballast operations are performed from the Cargo Control Room (CCR) located on 01 Poop Deck, using a computerised cargo control system.~~

Detailed technical, functional, and equipment requirements for the Cargo Control System, including automation, monitoring, remote operation, alarm systems, measurement, and system integration, are specified in section [381 Cargo control systems](#).

Auxiliary requirements and equipment not included in the Cargo Control System are described in the following subsections.

### Davit for port. cargo pump and tank cleaning machines

One (1) combined davit for portable tank washing machines and portable cargo pump with air-powered winch to be supplied.

### Equipment Stowage

Shelves for stowage of cargo / tank washing equipment shall be located in deck stores forward.

### Overboard Discharges from cargo area

- Overboard Discharge Oil Content Monitoring System

Approved Oil Discharge Monitoring Equipment (ODME) and control system to be fitted in compliance with **MARPOL Annex I**. ODME system to meet MEPC.240 (65) with regards to biofuel blends.

- Underwater discharge

An overboard discharge line shall be arranged from the cargo piping system to a remotely controlled discharge valve on the ship's side, in compliance with **MARPOL Annex I and II**. This line shall be used exclusively for slop or emergency deballasting operations and shall be monitored and controlled by the Oil Discharge Monitoring Equipment (ODME). The arrangement shall ensure full compliance with discharge regulations and include all required isolation valves and flexible hose connections.

Special care shall be given to the overboard slop discharge lines to avoid intake of effluent into sea water systems of the engine room.

## 381 Cargo control systems

Cargo and ballast operations are carried out from the Cargo Control Room (CCR) located on 01 Poop Deck, using a computerised cargo control system.

Loading computer to be integrated with trim optimization system.

The CCR shall be equipped with a loading and operational computer, two terminals, and two display units, minimum 26 inch.

Start and stop of cargo and slop pumps, pump speed control, inlet and outlet pressure monitoring, - and the exhaust fan of pipe trunk shall be remote-controlled from the cargo control station.

Remote operated cargo and ballast valves shall be operated from cargo control station. All valve actuators are hydraulic, and the full hydraulic control system specification is provided in Section 352 Loading/discharging systems on deck under "Hydraulic Control System for Cargo and Ballast Valves".

The control system for cargo and ballast pumps shall also include:

- Hydraulic unit protection devices;
- Automatic reduction and stopping of pumps due to low pressure or low level in the cargo tanks, as recommended by the supplier;
- Power supply and control panels for the electric motors of the cargo and ballast pumps equipped with VSDs;
- System control and operation panels.

All valve actuators are hydraulic, and the full hydraulic control system specification is provided in Section 352 Loading/discharging systems on deck under "Hydraulic Control System for Cargo and Ballast Valves".

Emergency stop buttons for cargo pumps shall be installed in the following locations

- in the CCR
- near the loading manifolds, on both sides

- in the ECR
- on the control panel of the hydraulic units (if present) of the cargo pumps
- in the VSD compartment (if fitted) of the cargo pumps.

Remote operation and supervision of the critical variables of the hydraulic units and cargo and ballast pumps shall be carried out through the IAS, including the following features, among others:

- Monitoring of all hydraulic system variables, if present (\*)
  - Monitoring of the main electrical variables of the starting panels of the hydraulic unit motors (if present) or of the starting panels of the electric motors that drive the pumps (if present): opening status of circuit breakers/contactors, electrical current of the motor, instantaneous active power of the motor, temperatures of the electric motors, alarms, etc.
  - Start/stop commands for system equipment
  - Adjustments of pump speeds, system operating pressures, etc.
  - Emergency stop of cargo pumps
  - Monitoring system alarms and events
- (\*) In addition to the usual hydraulic system variables (pressures, flow rates, temperatures, equipment operating status, etc.), the control system shall provide the IAS with the instantaneous power measurement (in kW) of each cargo pump.
- If the system uses VSDs, all the parameters and measurements of the VSDs shall be available on HMIs mounted on the front doors of the electrical panels of each VSD and on a digital communication channel in open industrial network protocol for monitoring by the IAS.
- If available as an option from the manufacturer, the control system shall have hardware and software resources for remote access via the internet to the on-board system's operating data, parameters and alarms.

### **High-level alarm/overflow control**

Each cargo and slop tank shall be arranged with two (2) independent level alarm sensors:

- one high-level alarm sensor at 95% of tank volume
- one high-high level alarm sensor at 98% of tank volume.

All HFO storage tanks and FO overflow tank shall be arranged with one (1) independent level alarm sensor at 95% of tank volume. Level switch type.

These alarm sensors are to be independent of the level gauging device, and both sensors are to trigger visual and audible alarms installed in the Cargo Control Room (CCR) and on the main deck.

The high and high-high level alarm control panel shall be installed in the CCR.

### **Cargo and Slop Tank Measurement System**

- Each cargo and slop tank shall be equipped with:
  - A radar wave (microwave) level measurement system, with antenna at the top of each tank and pressure transducer for the tank's internal atmosphere.
  - Radar in slop tanks shall be able to measure oil-water interface.
  - Three (3) temperature sensors, positioned at different levels of each tank. These sensors shall trigger visual and audible high and low temperature alarms at preset temperature levels, with readout and alarms at the cargo control station.
- The measurement system shall also include:
  - Three (3) portable radio monitoring units for use on deck.
  - Two (2) UTI closed gauging devices for manual probing and sampling, with calibration certificates.
  - A low level alarm with cargo pump stop function.

- All measurements and alarms shall be supervised by the ICMS (IAS), with data available in synoptic diagrams of the vessel's tanks and interconnected to the loading computer and trim optimization system. All measurements and alarms shall be supervised by the IAS, with data available in synoptic diagrams of the vessel's tanks and interconnected to the loading computer and trim optimization system.
- Communication between the measurement system and ICMS shall be via open industrial communication protocol. Communication between the measurement system and IAS shall be via open industrial communication protocol.
- If available from the manufacturer, the system shall have hardware and software resources for remote access via internet to the on-board system's operating data, parameters, and alarms.

### Pump pressure alarm

One pressure transmitter to be fitted in each close to discharge valve. Read out of pressure in cargo control station.

There shall be two (2) operational computers with the following:

- 2 displays
- 1 keyboard, if possible.

One Loading computer (with intact and damage stability) with:

- 1 display
- 1 keyboard
- 1 colour printer in A4.

### Cargo monitoring system, control and operating equipment for cargo system

Table 3.19 The following equipment shall be provided and operated from cargo control room via the operational computers.

Mimic diagrams for:	Cargo loading/discharging system Cargo vapour system Cargo heating system Cargo washing system Fire system Water ballast system, including ballast water treatment. IGS system Gas freeing system
Remote cargo pump control.	
Remote control of ballast pumps, slop pump and tank cleaning pump, including start/stop, r.p.m. and delivery.	
Remote control of all valves in cargo and W.B. systems, with indicators for valve position included on the mimic diagram.	
Remote ullage measurement of all cargo and slop tanks.	
High and high-high level alarms in all cargo and slop tanks.	
Temperature monitoring of all cargo tanks and slop tanks.	
Remote level gauging of all ballast tanks, G.O. tanks, technical and potable F.W. tanks.	
Pump pressure	
Loading and discharge rate indication.	
Vapour space- / Inert gas monitoring with read-out and alarm for cargo tanks	

Loading instrument software programs to include:	Cargo discharge rate for each cargo tank Trim, draft, dwt, sheer forces and bending moments. Deadweight calculation. Stability program including intact and damage stability performed by direct calculations. Instructions.
Indicating diagram, with indication of:	Auxiliary engines generators electrical load

### Manual Ullage System

Local cargo tank ullaging to be through an "MMC or similar Vapour-Lock" system. The system to be arranged with two triple gauging tapes and one sample tape.

Cargo and slop tanks to be calibrated to ullage reference point for each 10 mm ullage difference with usual corrections for density and trims from -2,0 m to 0,5 m.

### Oil discharge monitor and control system

Approved Oil Discharge Monitoring Equipment (ODME) and control system to be fitted in compliance with MARPOL Annex 1.

### Portable tank level gauge and closed cargo sampling system

Two (2) portable gas safe (Hermetic or MMC), tank level gauging device which also serves as oil/water interface detector, with temperature interface and ullage gauge to be provided.

Two (2) portable, gas safe (Hermetic or MMC), cargo sampling device shall be provided for cargo and slop tanks. Sampling device capacity shall be minimum 400 ml.

For the above devices, one (1) ball valve with cap, and top part designed to support the above mentioned devices, shall be fitted on a 100 mm high stud pipe, located above cargo deck, for each cargo tank. Full depth sounding pipe in each cargo and slop tank, the pipe inside tank to be arranged with penetration holes, for cleaning purposes..

One (1) stores room to be arranged for stowage of cargo samples bottles and equipment in deck house on main deck.

### Portable vapour and gas detectors

Two (2) portable vapour detector sets, class approved type, to be provided by the buyer according to rules, with battery, battery charger, suitcase.

Portable vapour detectors shall be able to measure the following:

- Low hydrocarbon gas-content 0 to 100%
- Flammable vapours
- Toxic vapours
- Oxygen content

### Fixed gas sampling system

A fixed gas sampling system shall be installed with sampling lines from all cargo tanks, ballast tanks, aft peak tank, cofferdams, inert gas room, and HVAC unit. The system shall be capable of sequential sampling from each location and provide gas concentration measurements to a central unit located in the Cargo Control Room (CCR). The fixed gas detection system shall activate alarms when the measured values exceed the preset safety limits. Sampling points shall be designed with closed-type connections to avoid gas release.

## 382 Tank cleaning systems and equipment

A tank cleaning system shall be provided for cleaning of cargo and slop tanks.

The system shall operate using **cold sea water**, in compliance with applicable regulations and IMO Resolutions A.446(XI), A.497(XII), A.897(21).

The system shall be capable of simultaneous cleaning of two (2) largest pairs of cargo tanks using fixed cleaning machines. The cleaning system shall include:

- One (1) cleaning pump located on Main Deck, with flow capacity sufficient for simultaneous operation of cleaning machines in the two (2) largest cargo tank pairs.
- Two (2) fixed, programmable cleaning machines with one nozzle in each cargo tank.
- One (1) fixed cleaning machine of the same type in each slop tank.
- Four (4) portable, programmable cleaning machines with two (2) nozzles each.
- One (1) chemical tank for cleaning water.
- Shadow diagrams approved by the Classification Society for machine arrangement and coverage.

If shadow diagrams indicate insufficient coverage, additional fixed cleaning machines shall be provided.

Pump capacity calculations shall be submitted during design stage.

All fixed cleaning machines shall be of the same model and manufacturer.

### System Operation and Configuration

Cleaning shall be performed using cold sea water in a closed or semi-open loop. The system shall allow operation as follows:

- The cleaning pump shall draw from the ballast system and either:
  - fill the clean slop tank (Starboard), or
  - supply the tank cleaning machines directly.
- The cargo pump from the clean slop tank (Starboard) may also feed the tank cleaning machines.

A double-block valve arrangement shall be provided to connect the discharge line of the clean slop tank to the cleaning line, enabling closed-loop cleaning.

The cargo pump of the tank being cleaned shall return the oil/water mixture to the dirty slop tank (Port) via the waste line.

After separation, the water shall be transferred to the clean slop tank (Starboard) and then discharged overboard through the ODME system.

The waste line shall:

- include connections to both PS and SB,
- allow discharge to shore or overboard via ODME,
- be connected to the cargo system and trays through a double-block valve arrangement.

A Wilden-type air-driven pump shall be installed on a bypass of the waste line for drainage purposes.

### Fresh Water Sweetening

The system shall enable final freshwater rinsing of cargo and slop tanks for salt removal (sweetening).

To support this, the system shall include:

- Means to deliver fresh water to the cleaning line,
- Arrangement to receive fresh water from other vessel systems and from cargo manifolds (Port

and Starboard),

- Design-provided tank(s) with sufficient volume for the required freshwater, including definition of required capacity.

### Connections and Materials

Each cargo and slop tank shall be served by:

- Piping branches for fixed cleaning machines with AISI 316L stainless steel valves and spectacle blind flanges,
- Branches for portable machines with:
  - AISI 316L stainless steel valves,
  - spectacle blinds with bolts, nuts, washers,
  - bronze threaded hose connections.

Tank cleaning piping shall be sloped and arranged with drainage points at low spots.

Two (2) shut-off valves shall be fitted between the cleaning pump and machines.

### Operational Reference

The tank cleaning procedure shall comply with the operational requirements defined in Petrobras standard N-2673, considering the type of cargo handled.

### Reference Data – Typical Parameters for Tank Cleaning Equipment

The following tables contain indicative values based on typical supplier data for fixed and portable tank cleaning machines.

These values are for reference only and do not constitute binding performance criteria.

Final selection and documentation, including shadow diagrams and capacity verification, shall be provided by the system supplier and approved during the design phase.

Table 3.20 Fixed tank cleaning machines

No of sets	At least two (2) in each cargo tank and two(2) in each slop tank, according to shadow diagram.
Type	Programmable, single nozzle or
Material	Stainless steel AISI 316L double nozzle, single/multi stage type.
Nozzle diameter	9 mm
Capacity each	17 m <sup>3</sup> /h
Pressure	8 - 10 bar
Hose	40A x 10m 2 sets

Table 3.21 Portable tank cleaning machine

No of sets	Two(2)
Material	Stainless steel AISI 316L
Nozzle diameter	8 mm
Capacity each	14 m <sup>3</sup> /h
Pressure	10 bar
Hose	40A x 10m 2 sets

### 383 Hose handling system

One (1) electro-hydraulic hose handling crane shall be provided, installed on the centerline of the vessel to serve both port and starboard manifolds.

The crane shall have a lifting capacity of 10 tons SWL and be operated by remote control (radio or umbilical), certified for use in Zone 1 hazardous areas.

Crane outreach and speed shall comply with OCIMF recommendations.

A reinforced eyebolt and dynamometer (load cell) shall be installed on deck for load testing during operations.

For detailed crane specifications, see Section [334 Other cranes with equipment](#)

## 4 SHIP EQUIPMENT

### 40 Manoeuvring machinery and equipment

General layout and access arrangements shall ensure safe maintenance and inspection of the rudder and steering gear components.

Means shall be provided to prevent unauthorised access to the rudder recess area from inside the hull.

#### 401 Rudder, rudder stock and bearings

The vessel shall be equipped with one (1) suspended, semi-balanced rudder with a wing profile. The rudder shall be of fully welded construction and designed in accordance with Classification Society requirements.

##### Rudder

Manufacturer	Kongsberg Maritime
Type	CMP 3600x5900, Promas with twisted leading edge.
Dimension (l x h)	3900 x 5600 mm
Rudder angle	2 x 44°
Rudder stock length	6020 mm, estimated
Rudder trunk type	With SG foundation

The rudder shall be equipped with:

- Dismountable connection between rudder blade and rudder stock, it shall be possible to dismount the rudder without dismounting of steering gear. (There are two watertight recesses with screwed-on sheet metal covers (stainless steel stud bolts and nuts) to access the nuts securing the rudder stock and rudder pin).
- Rudder is internally protected against corrosion with VCpl-powder.
- Stainless steel drain plugs on top and bottom of rudder blade and flap
- Cathodic corrosion protection for 5 years interval.

##### Additional requirements:

- One (1) forged steel rudder stock, with AISI 316 stainless steel sleeve in the guide bearing area.
- One (1) forged steel rudder pin (pintle), with AISI 316 stainless steel sleeve in the bearing area.
- One (1) rudder carrier bearing incorporating a stuffing box.
- Bushings for rudder pin and guide bearing to be synthetic, Thordon SXL, lubrication-free.
- Rudder stock to be equipped with grounding braid.
- Two (2) watertight access recesses (with stainless steel studs and nuts) to access rudder stock and pintle nuts.
- Lifting eyes shall be fitted for rudder and propeller.
- A flat steel bar coaming shall be welded around the foundation area of the steering gear unit.
- Deck area in the steering gear compartment to be finished with non-slip surface in accordance with yard standards.
- Bulkhead, deck and ceiling in the compartment to be painted.

#### 403 Steering gear, rudder indicator and emergency steering plant

The vessel shall be equipped with One (1) steering gear.

**Steering gear**

Manufacturer	Kongsberg Maritime
Type	SR743 FCP, rotary vane
Drive	Electrical/Hydraulic motor and frequency controlled drive
Effective torque on actuator	650 kNm
Rudder angle, electrical	2 x 42°
Supply voltage/frequency	Ref. <a href="#">Table 8.6</a>

**Additional equipment:**

- Sleeve for hydraulic coupling
- Expansion tank
- Start/stop and control system
- Rudder angle indicator system
- Spare parts and special tools

**Steering Gear System Configuration**

The steering gear system shall be designed in accordance with Classification Society requirements.

It shall consist of two (2) identical hydraulic units (100% capacity each), where one unit serves as backup.

Each unit shall be capable of turning the rudder from 35° to one side to 30° to the other in maximum 28 seconds, with the vessel loaded at summer draught and main engine operating at MCR.

Hydraulic actuators shall be of rotary vane type.

**Lubrication and Operation**

- Rudder carrier bearing shall be lubricated with system hydraulic oil (no grease required).
- Emergency operation shall be possible locally by manual control acting directly on solenoid valves.

**Control and Monitoring**

- Steering gear alarms shall be provided locally, on the navigation bridge, in the engine control room (ECR), and logged in the Integrated Control and Monitoring System (IAS).
- The steering gear shall be integrated with the vessel's remote control system, ref. [793 Remote control of main propulsion and engine telegraph](#).

**Hydraulic Oil Storage and Sampling**

- A reserve hydraulic oil tank shall be installed with fill connection on the exposed deck, including a valve and blind flange, clearly identified.
- The transfer line from storage tank to service tank shall include:
  - One (1) filter rated at 10 µm / β100,
  - Local saturation indicator,
  - Sampling connection (minimess or equivalent) in accordance with best practice or supplier recommendation.

**Other Requirements**

- Means shall be provided to prevent unauthorised access to the rudder recess in the hull.
- All installation and configuration shall comply with the steering gear manufacturer's specifications and Classification Society requirements.

## 41 Navigation and searching equipment

### 411 Radar plants/electronic charting

#### Radar

The following radars shall be installed:

One (1) S-band (10 cm) ARPA/ATA radar

- TFT LCD 23" (Minimum) Colour display, minimum 340 mm effective display diameter
- 30 kW transmitter, 12-14' antenna according to manufacturers' standard.
- Performance monitor and Radar inter-switch
- The Radar display shall be capable to display selected parts of Electronic Navigational Charts (S57 format).
- Installed forward at Workstation for traffic surveillance/navigation/manoeuvring.
- Flat color display (LCD)
- 340 mm plan position indicator (PPI)
- Dedicated UPS
- Transceivers for installation on the navigation bridge bulkhead

One (1) X-band (3 cm) ARPA/ATA radar

- TFT LCD 23" Colour display, minimum 340 mm effective display diameter
- 25 kW transmitter, 6-9' antenna according to manufacturers' standard.
- Performance monitor and Radar inter-switch
- The Radar display shall be capable to display selected parts of Electronic Navigational Charts (S57 format).
- Installed forward at Workstation for Navigation support.
- Flat color display (LCD)
- 340 mm plan position indicator (PPI)
- Dedicated UPS
- Transceivers for installation on the navigation bridge bulkhead

Both radars shall have interfaces for:

- Gyro compass
- ECDIS
- AIS
- DGPS

#### ECDIS

Electronic Chart Systems (ECDIS) shall be provided as main chart system.

- TFT LCD 23" (Minimum) Colour display
- Track ball and keyboard (may be integrated in one unit)
- CD-rom for downloading of chart database
- Equipped for online downloading of chart updates
- The system is to be compatible with Electronic Navigational Charts of latest S57 edition 3.1 (or latest standard) and raster charts and corrections from major Hydro-graphic offices for worldwide coverage.
- Interface to DGPS, radar, echo sounder, gyro or magnetic compass, speed log, AIS and

Autopilot.

- System to have one (1) display at workstation for traffic surveillance and manoeuvring and one (1) display at workstation for route planning.
- Two (2) slave ECDIS displays at bridge wing consoles in wheelhouse. One connection to be provided to ECR, one connection to be provided in duty mess.

A chart radar may replace the back up ECDIS if approved by the National Authorities.

#### **Conning system**

One (1) Conning and Information System to be installed.

Signal fram DSGPS, gyro compass, speed log, anemometer, main engine & propeller data etc.

- Mass flow meters
- Fuel efficiency monitoring system installed on the bridge and use the information from the vessels navigation sensors, mass flow meters, engine data and emission sensors. TFT / LCD display, 26 inches diag.

See also [791 Manoeuvre desks, main consoles, instruments](#)

### **412 Satellite navigator**

#### **Satellite navigation systems**

A satellite navigation system with Differential Global Positioning System (DGPS) to be fitted. The system to be capable of providing direct reading of the following:

- Longitude
- Latitude
- GMT
- Distance and course of arrivals
- Waypoints

The DGPS system consisting of:

- 2 (two) DGPS receivers, with built-in differential correction receiver in accordance with the IALA(International Association of Marine Aids to Navigation and Lighthouse Authorities) standard, with automatic signal selection and distribution unit. One of the receivers shall be capable of speed-independent accuracy and heading.

### **413 Gyro plants, automatic steering, compass**

#### **Gyro plant**

2 (two) gyrocompasses, with no moving parts, with control unit and signal distribution; the control unit shall have an alarm device for the difference between the available signals.

5 (five) repeater units:

- 1 (one) on the navigation bridge forward bulkhead (with prismatic marking device)
- 1 (one) on the steering column
- 2 (two) on the navigation bridge wings
- 1 (one) in the steering gear compartment

Each digital gyro-repeater to be equipped with Rate of Turn indicator and off-course alarm, except digital gyro repeater in SG room. All repeaters to be fitted with dimmer, except digital gyro repeater in SG room.

The gyro should be capable to head up in one hour and arranged with interface to radars. Maximum error on course indication, 1 degree.

Interfaces for other systems requiring directional / rate information.

The gyro-compass to be operated on power supply directly from the emergency switchboard. Main power supply 220V, AC 60Hz, 24VDC back up

#### **Autopilot**

One (1) adaptive autopilot system, connected to gyro, with dual control of electric type for follow-up (FU) & non-follow-up (NFU), to be provided. The autopilot to be equipped with dual mode operation (manoeuvring / normal sailing). The autopilot to perform track steering acc. to rules and regulations.

The autopilot system to be operated on power supply directly from the emergency switchboard.

Transmitter for autopilot to be installed according to class.

System to have the following standards:

- Rudder steering system and autopilot - comprising the steering column with helm, remote control on the navigation bridge wings, controls and interfaces with the steering gear unit; the autopilot shall be self-adaptive and redundant, with a main control unit on the steering column and another on the navigation console; the steering wheel control (FU), the emergency control (NFU) and the rudder feedback unit shall also be redundant (dual). In addition to the alarms required by rule, the rudder control shall have an alarm for follow-up failure (FU)
- Rudder angle transmitters, with an accuracy of better than 1%, with dedicated indicators on the navigation bridge ceiling (three-sided panoramic), steering gear compartment and navigation bridge wings (system independent of the steering system)

#### **Course Control system**

The heading control system defines an optimal route using the vessel's heading between the current position and the final destination, calculating the influence of external environmental factors (current, wave, wind) to implement the best control of the steering system, allowing the vessel to always navigate the most efficient route compared to traditional heading control systems.

#### **Speed Control system**

Speed control system: The Speed Control System ensures a constant absolute speed of the vessel by automatically changing the propulsion order when environmental influences such as wind, current and waves change the vessel's speed during navigation

Satellite Speed Log complying with IEC 61023 for marine speed and distance measuring equipment (SDME - Speed and Distance Measuring Device), capable of measuring transverse bow and stern speed and longitudinal speed, and measuring and recording the distance sailed. The system shall include an illuminated display for operation

#### **Course Recorder**

Course recorder to be provided at chart table.

#### **Magnetic Compass**

Two (2) magnetic compasses, one of which shall be installed in a binnacle ar the compass deck, with periscope, lighting and heading transmitter for interconnection with the gyro control unit.

The second compass shall be a spare, identical to the first, in suitable packaging for storage.

### **ROT Transmitters**

**Rate of turn (ROT) transmitters, with an accuracy of better than 1%, with dedicated indicators on navigation bridge ceiling and wings of the navigation bridge. The indicators shall have a different appearance from the rudder angle indicator, in order to avoid misreading.**

## **414 Underwater searching equipment**

### **General**

Main units shall be installed forward at Workstation for traffic surveillance/navigation/manoeuvring, ref. 791 Manoeuvre desks, main consoles, instruments.

Depth information shall be available at:

- Workstation for Navigation support

### **Navigational echo sounder**

One (1) echo sounder system meeting IMO's performance standards to be installed in wheelhouse, consisting of:

- One (1) main indicator with graphic recorder and adjustable depth alarm at navigation / route-planning station.
- One (1) digital depth repeater on wheelhouse front wall
- Two (2) repeaters on Bridge wings
- Power source according to supplier.

Transducers fitted in void spaces in double bottom as follows:

- Below the bow
- In double bottom below engine room

System to be arranged with interface to the navigation system.

Echo sounder, with graphic (LCD) and digital display, interconnected to the Integrated Bridge System, transducers on the bow and stern and shallow water alarm, with display on the navigation bridge and wing consoles.

### **Speed log**

One (1) Doppler type IMO approved speed log to be installed, including speed through water as well as speed over the ground, consisting of the following:

- One (1) Main unit with speed and distance indicator, fitted at chart table.
- One (1) digital speed indicator (scale 0.1 knot), in wheelhouse ceiling.
- One (1) digital speed repeater indicator in engine control room
- One (1) Transducer 262 Bottom plugs, sea chests, bilge wells, trunks/ casings for bottom equipment
- One (1) Hull fitting complete, inclusive gate valve.
- Power source according to supplier

Bottom speed log with lateral speed measurement, operating in "bottom tracking" and "water tracking", with special valve for replacing the transducer while the vessel is afloat, and monitoring and operating HMI on the navigation bridge

Speed signal on NMEA format to radars, satellite navigator, gyro, ODME system and other relevant users to be provided

## 415 Clinometers, trim indicators, load indicators and loading computing system

### Clinometers

Clinometers shall be installed at the following locations:

- One (1) Wheelhouse
- One (1) Engine Control Room

### Trimindicator

One (1) integrated loading computer and trim optimization system shall be installed in the Cargo Control Room, consisting of one (1) approved and certified independent computer, interconnected to the measurement system of cargo, ballast and consumables tanks and draft, capable of performing bending moment, shear forces, intact and damaged stability calculations, as well as the definition of optimum navigation trim, with off-line mode (simulation - manual data input) and on-line mode (supervision - automatic data input), with automatic correction for vessel trim and list.

The level measurements of the fuel oil storage tanks and cargo tanks shall be automatically corrected according to the temperature of the product.

One (1) repeater panel with optimum trim indication shall be installed at the navigation bridge control station.

The loading computer software shall comply with IP/API calculation procedures and nomenclature/principles, with classification society and IACS requirements.

A copy of the software for the integrated load computer and trim optimizer system shall be supplied by the Yard to the Owner together with the Computational Fluid Dynamics study and optimal trim table used to make the system.

The cargo, slop and ballast tank level measurement system, independent cargo and slop tank level alarm system, draught measurement system, consumable tank level measurement system and load computer shall be supplied by the same manufacturer/integrator and be considered as a single package.

An inclinometer shall be installed in the CCR and integrated into the loading computer for use in automatic data corrections.

### Trim and list sensor

For trim and list sensors, [381 Cargo control systems](#)

## 416 Video surveillance

A Closed Circuit TV (CCTV) certified for marine application shall be installed. The system shall ~~comply with Transpetro Technical specification I-ET 4880.00-9311-000-PTD-001 and~~ minimum cover the following areas/equipment:

- Control and distribution matrix with 03 (three) control panels, located on the navigation bridge, CCR and ECR;
- 3 (three) mobile IP cameras with remote "pan", "tilt" and "zoom" control:
  - 2 (two) on the navigationbridge wings (port/starboard) for viewing the side area, accommodation/ embarkation ladders and cargo manifold;
  - 1 (one) for an overview of the engine room (top view of the Main Engine and Auxiliary Engines);
- 7 (seven) fixed IP cameras with zoom control:

- 2 (two) for the bow mooring area ( Port/starboard);
- 2 (two) for the stern mooring area ( Port/starboard);
- 1 (one) in the purifier compartment;
- 1 (one) in the inert gas generator compartment;
- 1 (one) for the thermal oil heater;
- 1 (one) fixed IP camera with "zoom" control in the cargo pump system hydraulic unit compartment (if any);
- 9 (nine) 17" LED video monitors, located 3 (three) in the navigation bridge, 3 (three) in the ECR and 3 (three) in the CCR;
- Computer and software capable of image recording, image alteration detection and other security function

The CCTV system shall consist of a standard package from one manufacturer, with components tested and supplied together.

Compositions of components from different manufacturers for the development of a specific application system will not be accepted. The video controllers shall distribute independent images to each monitor.

The cameras in the CCTV system shall have the following minimum characteristics:

- ONVIF compatibility;
- Continuous 360° rotation horizontally and from 0° to 90° vertically (PTZ cameras);
- Ethernet connection: RJ-45 100 Base-TX;
- Video compression formats: H.265, H.264 and MJPEG;
- Frame rate: 25 fps @ 1920x1080 pixel (full HD);
- Automatic night vision;
- Minimum lighting required: 0,03 lux (F1.6, AGC ON) in color and black and white;
- 25x optical zoom;
- Automatic iris;
- 120 db WDR;
- Operation at room temperature: 0°C to +55°C;
- Humidity operation: 0% a +90%;
- 316L stainless steel, aluminum or fiberglass-reinforced plastic housing;

Equipment intended for outdoor installation shall have: IP-66 degree of protection, infrared illumination with a range of at least 50 m.

Equipment intended for indoor installation shall have: IP-44 degree of protection. The installation of cameras in a hazardous area should be avoided.

The CCTV system will be optimized for vessels with a high vibration rate. All cameras shall be supported using vibration dampers, suitable for the technical characteristics (frequency, amplitude, acceleration, etc.) of the maximum vibration expected. IP cameras shall be installed with surge protectors to protect them from induced currents at communication or power cables caused by electrical discharges. Such devices shall have a high discharge current capacity, low residual voltage and fast response time.

The CCTV system shall monitor and record images from all cameras (for 30 days). The cameras shall be monitored and controlled independently via control panels. All cameras shall be associated with the same management and storage platform (hardware and software).

The CCTV system platform shall allow logical segregation for the different users, according to the groups and privileges defined by the Owner. For example, the operators in a zone will only be able to control the cameras deployed in that area, but the Captain to his satisfaction, is to be able to watch and control all the cameras.

The CCTV system platform shall allow remote access via Ethernet-IP to watch images in real time and recordings.

Final arrangement shall be agreed with the Owner/Client.

## 417 Clocks, facsimile recorders, miscellaneous nautical equipment

### General

Following equipment shall be delivered and installed according to regulations in force.

### Clocks / Chronometers

Separate wall-mounted clocks to be installed as follows:

- One (1) GMDSS Console
- One (1) Navigation Bridge roof console
- One (1) CCR
- One (1) ECR
- Three (3) Day rooms
- One (1) Gymnasium
- One (1) Auditorium
- One (1) Galley
- One (1) Mess room
- One (1) Ship office
- Collective and individual rooms

One (1) approved chronometer with GMT indication to be fitted in chart table.

### Environmental instruments

- One (1) Aneroid barometer
- Two (2) Thermometers
- One (1) Weather system interface to IAS
- One (1) Wind speed/direction indication sensor to be fitted in signal mast on top of wheelhouse with no moving parts.
- One (1) Wind speed and direction indication instrument to be provided with read-out in wheelhouse and interfaced with ECDIS.

### Miscellaneous Nautical Equipment

The following equipment also to be supplied and fitted:

- 3 (three) prismatic binoculars, two 7 x 50 mm and the other 15 x 80 nightvision, packed in a wooden case. The 15x80 binocular shall have bases for placement on the wings, enabling 360° rotation
- 1 (one) portable, hand-operated horn
- 1 (one) bell with a sound level of not less than 110 dB at a distance of 1 meter, made of corrosion-resistant material and designed to provide a clear timbre. The diameter of the bell mouth shall not be less than 300 mm

- 1 (one) gong with certificate - whose sound level is not less than 110 dB at a distance of 1 meter, made of corrosion-resistant material
- 1 (one) sextant, packed in a wooden box
- 1 (one) chronograph, 60-second scale, 1/5 s division
- 2 (two) stopwatches with gimbals
- 2 (two) seawater thermometers
- 2 (two) psychrometers
- 2 (two) 90 mm diameter magnifying glasses
- 2 (two) parallel transparent acrylic rulers
- 2 (two) 170 mm dividers for navigation
- 1 (one) 360 mm transparent acrylic navigational square
- 1 (one) protractor
- 1 (one) letter brush
- 4 (four) weights for cards
- 2 (two) prismatic alidade for the gyroscopic compass repeaters located on the wings of the navigation bridge
- 2 (two) maximum and minimum thermometers, scale in degrees Celsius
- 2 (two) clinometers with maximum balance records
- 1 (one) set of daytime signaling markings, consisting of
- 3 (three) ball marks
- 1 (one) cylinder type mark
- 1 (one) diamond mark
- 1 (one) cone mark
- 1 (one) green anchor buoy
- 1 (one) red anchor buoy

Otherwise all according to authorities and Owner's requirements and best practice for a vessel of this type and size.

Approved certificates to be delivered as relevant.

#### **Sound and Signal Reception System**

One (1) Digital Sound and signal reception system to be installed as per class requirement for vessels with closed bridge wings.

The Sound and signal reception system shall enable the navigator when standing inside the enclosed bridge space to listen to environmental sound signals from other ships and fog signals that are audible outside on open deck. The system shall monitor frequencies between 70 and 700 Hz.

Other minor equipment as required by applicable regulations.

#### **Chart table equipment**

- One (1) Parallel ruler
- One (1) Divider

#### **Clocks**

One (1) Master clock system.

Master and slave electronic clock system, with repeaters in the GMDSS console, navigation bridge roof console, CCR, ECR, collective and individual rooms, offices, training room, messrooms, gymnasium and galley.

### **Distributor Hubs**

**Individual distributor hubs shall be provided for DGPS signals and gyro compasses with at least 6 spare outputs each.**

## **418 Radar, signal, observation and antenna masts**

The vessel shall have masts in positions indicated on the General Arrangement.

### **Masts general**

Masts shall be provided as shown on the General Arrangement plan.

Necessary blocks and fittings shall be fitted on the masts.

Hand rails, guard rails, ladders / steps and platforms shall be fitted in way of blocks, lights and other fittings.

Supports and stays on masts shall be specially considered and care shall be taken to avoid vibrations.

Sliding bars or wire ropes (provided by the builder) shall be used together with safety belts/harness/sliders (provided by the owner).

Equipment with components installed on the main mast or compass deck shall have devices to protect against voltage surges induced by atmospheric discharges in the communication and power cables of external components, as well as grounding standards for non-energized conductive parts.

### **Radar mast**

Both radar antennas shall be mounted on easily accessible platforms above top of wheelhouse and so located to minimise blind sectors. Crossbars, posts and fittings for navigation- and signal-lights, and other equipment, antennas etc., shall be arranged.

Mast shall be constructed with strength and stays, to avoid abnormal vibrations.

Sliding bars or wire ropes (provided by the builder) shall be used together with safety belts/harness/sliders (provided by the owner).

### **Foremast**

One (1) foremast shall be arranged on forecastle deck, and fabricated of steel plate or pipes.

Sliding bars or wire ropes (provided by the builder) shall be used together with safety belts/harness/sliders (provided by the owner).

To be self supported type in order to reduce the blind sectors.

### **Radio Antennas (GMDSS) / DGPS Antennas**

The antennas shall be located in correct position and distance from other equipment on top of wheelhouse.

### **NOTE!**

**Final positions of equipment will be detailed in the Antenna arrangement and Navigation- and Signal lights drawing during basic design engineering.**

## **419 Integrated navigation systems**

### **Voyage Data Recorder**

One (1) Voyage Data Recorder (VDR) shall be provided to record the vessel's parameters. Type according to IMO Reg.20, SOLAS Ch.V

Main Power supply 220VAC, 60Hz.

The system to comprise the following:

- 1 Data acquisition unit
- 1 Crash survivable data storage module
- 1 Data interface unit Analogue / Digital
- Play-back function for PC, with removable data storage device for abt. 30 days

Computer and software shall be suitable for viewing data on-line, copying and transmission of data via satellite communication system. The software required for remote offline playback shall be supplied. The system shall be able to copy the recorded data to a portable memory device. The system shall be equipped with two capsules, one of which shall be fixed and the other float-free. One capsule shall be fitted with a beacon that transmits the position after an event.

#### **Automatic Identification System (AIS)**

One (1) Automatic Identification System (AIS) to be installed. Type in accordance with IMO Reg. 19 of SOLAS Ch.V.

Main Power supply 230VAC, 60Hz

- One (1) AIS transponder
- One (1) AIS processor

System shall be equipped with a dedicated HMI, pilot plug and a dedicated and identified 24 V socket

#### **Long Range Identification and Tracking system (LRIT)**

To be installed according to regulations and integrated in the INMARSAT-C.

#### **Bridge Navigational Watch Alarm System**

One (1) Bridge Navigational Watch Alarm System

The system is an integral part of the Bridge operator stations

Watch / responsibility panel, signal device etc.:

This include:

- One (1) Bridge Alarm Panel
- Four (4) Reset buttons
- Nine (9) Alarm Buzzers for public spaces and navigator cabins
- Two (2) Motion detectors
- One (1) Buzzer in wheelhouse

#### **Training**

The integrated bridge system shall be equipped with software (simulator) for crew training, to be installed on a personal computer (Computer Based Training).

## **42 Communication equipment**

#### **GMDSS installation**

A radio installation according to GMDSS Sea areas to A3 shall be provided.

Ref. SFI item [421 Radio plant, GMDSS](#).

System maintenance shall be based on duplication of equipment and shore based maintenance.

GMDSS maintenance contract.

A distress message control system shall be provided in order to be able to monitor and mute audible distress signals received by the GMDSS equipment. The control panel shall be located at the same location as the central alarm system or the system may be an integrated part of the central alarm system.

Antenna arrangement to be carefully planned in cooperation with supplier of radio and antenna equipment. VHF installation to be able to listen to 3 separate channels simultaneously.

Note: All telecommunications equipment must be approved by ANATEL. The approval certificate issued by ANATEL must be presented.

## 421 Radio plant, GMDSS

Table 4.1 GMDSS Sea areas A3

Quantity	Equipment A1, A2 and A3	Comment	Location
1	MF/HF SSB 150W Simplex radio <ul style="list-style-type: none"> <li>• MF/HF DSC terminal</li> <li>• MF/HF DSC Watch receiver</li> </ul>	Redundant power supply (24 Vdc and 220 Vac).	In GMDSS Console
1	Simplex VHF <ul style="list-style-type: none"> <li>• VHF-DSC En-/ decoder</li> <li>• VHF-DSC Watch-receiver (multi-watch)</li> </ul>	2 (two) VHF radio telephone systems (part of the GMDSS), USA and international maritime mobile channeling, redundant power supply (24 Vdc and 220 Vac).	Main unit shall be installed in forward wheelhouse. Slave units shall be installed in the CCR and in the ship's office
1	Simplex VHF <ul style="list-style-type: none"> <li>• VHF-DSC En-/ decoder</li> <li>• VHF-DSC Watch-receiver (multi-watch)</li> </ul>	Duplication of equipment. One (1) remote/slave control units <u>with redundant power supply (24 Vdc and 220 Vac)</u>	Main unit shall be installed in GMDSS Console. Slave unit shall be installed in the CCR
1	Inmarsat C from recognized GMDSS satellite provider <ul style="list-style-type: none"> <li>• Terminal unit,</li> <li>• Printer,</li> <li>• Keyboard</li> <li>• EGC receiver</li> </ul>	Redundant power supply (24 Vdc and 220 Vac).	In GMDSS Console
1	Inmarsat C from recognized GMDSS satellite provider <ul style="list-style-type: none"> <li>• Terminal unit,</li> <li>• Printer,</li> <li>• Keyboard</li> <li>• EGC receiver</li> </ul>	Duplication of equipment <u>with redundant power supply (24 Vdc and 220 Vac)</u>	In GMDSS Console
1	SSAS	Shall be implemented in satellite system(s) as required. Ref SFI <u>423 Data transmission plants, satellite communication, in Building specification, in 24-7153 - UT 7420 - PSV</u>	
1	LRIT	Shall be implemented in satellite system(s) as required. Ref SFI <u>423 Data</u>	

Quantity	Equipment A1, A2 and A3	Comment	Location
		<u>transmission plants, satellite communication, in Building specification, in 24-7153 - UT 7420 - PSV</u>	
1	Navtex receiver		In GMDSS Console
1	EPIRB-AIS , COSPAS/ SARSAT <ul style="list-style-type: none"> <li>• 406 MHz.</li> </ul>	Complete with heated free-float bracket	Adequate place on wheelhouse top
1	EPIRB-AIS , COSPAS/ SARSAT <ul style="list-style-type: none"> <li>• 406 MHz.</li> </ul>	May be omitted if the EPIRB above is: <ol style="list-style-type: none"> <li>1. Equipped with remote activation from the position from which the ship is normally navigated</li> <li>2. Can be manually activated</li> <li>3. Can be easily retrieved by one person and brought onboard lifeboat/ life raft without putting the person at risk.</li> </ol>	Close to the position from which the ship is normally navigated.
2	Radar transponders <ul style="list-style-type: none"> <li>• 9 GHz</li> </ul>	For life- raft/ boat.	By exit(s) from wheelhouse
3	Portable waterproof VHF radios Each with: with: <ul style="list-style-type: none"> <li>• Dual slot charger</li> <li>• Spare battery</li> </ul>	For life- raft/ boat.	In "Radio station" in wheelhouse. Accordance with the requirement for tankers to be delivered. Additional six (6) rechargeable batteries shall be delivered.
1	Meteorological facsimile		

## 422 Lifeboat transmitters with equipment, Emergency beacon

See [421 Radio plant, GMDSS](#).

## 423 Data transmission plants, satellite communication

### Satellite Communication

The on-board data network shall be connected to the broadband satellite communication system (supplied by the Owner), in accordance with I-ET-4800.00-9990-000-PTD-002.

See also SFI item [425 Calling/command/crew call telephone plants](#)

## 424 VHF telephones

The following equipment shall be delivered and fitted (in addition to the table in SFI item [421 Radio plant, GMDSS](#)).

Fixed VHF:

- One (1) VHF radio sets, 32 channels, fixed installed in the Wheelhouse.
- One (1) VHF radio set, 32 channels, fixed installed in the ECR.

Portable VHF stations:

- Two (2) Portable Ex- type VHF with

- One (1) multi charger (Location to be agreed with owner)
- Three (3) Portable VHF stations, all with hands free helmet connection, and all shall be intrinsically safe (Gas proof IIC) and waterproof (IP65) (also to be connectible to Fireman's helmet). With four (2) multi chargers on the bridge (1), and ECR (1).  
One charger for each shall be provided.
- Three (3) headset for use in noisy areas.

An VHF radiant antenna system shall be installed in order to get coverage in the whole vessel also including outside area.

If number of fire parties listed on the ships muster list is higher than number of VHF radios with connection to fireman's helmet listed above, the number of VHF radios shall be increased accordingly.

## **425 Calling/command/crew call telephone plants**

The vessel to be equipped with an automatic exchange telephone system, sound-powered telephone system and a command- and calling/talk-back systems with certificates, as described below:

### **Automatic telephone system**

An automatic exchange telephone system, operating on 220V AC 1-phase current main supply, and 24V DC battery supply in case of power failure, with capacity for three (3) simultaneous users and extension lines to the telephones listed below:

- One (1) Bridge console
  - One (1) Radio station
  - One (1) Wing console PS
  - One (1) Wing console SB
  - One (1) Office (on bridge)
  - Two (2) Captains cabin
  - Two (2) Chief engineer cabin
  - One (1) Chief engineer office
  - One (1) Captain office
  - Twentyeight (28) Officers/crew cabins
  - Three (3) Dayrooms
  - One (1) Auditorium
  - One (1) Galley
  - One (1) Dry Provision
  - One (1) Gymnasium
  - One (1) Hospital
  - One (1) Messroom
  - One (1) Ship Office
  - One (1) Cargo Control room
  - One (1) Meeting room
  - One (1) Engine Control room (ECR)
- One (1) Switchboard room**

Heavy duty type which shall be suitable for the surrounding noise and a separate microphone:

- One (1) CO2 room
- One (1) Forecastle deck mooring area

- One (1) Poop deck mooring area
- One (1) Emergency generator room
- One (1) Foam room / station
- One (1) Steering gear room
- One (1) Engine room
- One (1) Aux. Engine room

Telephone in ECR to be connected to the light signal columns in engine room areas in addition to normal acoustic signals.

The system to be connected to the public address system.

Automatic telephone system to be interfaced with the Iridium system and VSAT.

#### **Command - , Call / Talkback Intercom and Public Address System**

A talk-back intercom system, combined as Command, Call and Public Address system complying with authorities requirements for alarm systems, to be fitted.

The system to be connected to the automatic telephone system.

~~Talk-back control stations to be installed in navigation bridge, cargo control station, steering gear room, wing consoles, forecastle deck (mooring area), pump room and engine control room. Talk-back control stations to be installed in navigation bridge, cargo control station, steering gear room, wing consoles, forecastle deck (mooring area), stern mooring area, midship main deck, pump room and engine control room.~~

Additional Alarms / Public Address speakers to be arranged as follows:

- In corridors and in public rooms on all decks
- All cabins
- On wheelhouse roof
- Manifolds / Bunker stations
- Steering gear room, with head set
- Wheelhouse
- Engine control room, with ear-phones
- CPP station, with head set
- Stern mooring area, with head set
- Main deck area, with head set
- Otherwise throughout the ship according to authorities requirements

Public address system shall have the following noise levels:

- Interior spaces including sleeping positions and cabin bathrooms: 75 dB(A) and at least 20 dB (A) above the speech interference level
- Exterior spaces: 80 dB(A) and at least 15 dB(A) above the speech interference level.

Loudspeakers for PA function shall be mounted in public areas such as corridors, mess/dayroom, etc. as well as outside decks and engine areas as required by Classification Society and National Authorities. The PA system shall be interfaced to the telephone system for augmentation of PA and alarmdistributon.

Public Address speakers - wide coverage, with separation of areas (minimum 4 (four), including cabins, collective rooms, control rooms, engine room, main deck, bow and stern; system equipped

with multimedia function with USB input and bluetooth connection; the speakers shall have volume control with "by-pass" and the system shall be interconnected to the PABX system. The sound broadcasting system shall include General Alarm functions, in accordance with the classification society's rules and the Owner's master table. The system shall include buttons configured to automatically trigger the sequence of alarm pulses for general alarm, abandon alarm and emergency station alarm. The system shall receive an alarm from the internal alarm system (alarm column).

One (1) load-speaking command system with talk back for orders from bridge / bridge wings to mooring stations aft and forward, lifeboat / rescue boat locations with attention demand.

### **Sound powered telephone**

Sound-powered telephones or safety automatic telephone system approved according to relevant rules, to be provided between wheelhouse and the following locations:

- One (1) Captain's cabin with buzzer in bed room.
- One (1) Chief eng. cabin with buzzer in bed room.
- One (1) Ships Office
- One (1) Fire stations
- One (1) Cargo Control room (CCR)
- One (1) Cargo pump room
- One (1) Engine control room (ECR)
- One (1) Steering gear room
- One (1) Engine room
- One (1) Main Engine local control station
- One (1) Next to CPP Hydr. unit
- One (1) Cargo pump VSD room
- Two (2) Cargo manifold (Both sides)
- One (1) Inert Gas Generator compartment
- One (1) Emergency manoeuvring stand in engine room, with sub-receiver in ECR.
- One (1) Emergency generator room

The sound-powered units in the engine room, steering gear room & emergency generator room to be provided with headsets.

## **427 Light and signal equipment, lanterns, whistle**

### **General**

One (1) Navigational Lanterns system, included control panel and navigation lights shall be installed according to the authorities' requirements.

### **Lantern Controllers**

All navigation lights to be controlled from indicator panels of graphic type, located in wheelhouse. Each navigation light to be controlled and protected by double pole switch and fused on each conductor.

Visual and aural indicator to be fitted.

Following navigation and signal light controls to be arranged:

- One (1) controller for navigation lights
- One (1) controller for signal lights

Navigation lights to have power supply as follows:

- Normal operation : 220VAC
- Stand-by navigation lights : 24V DC, charged from emergency switchboard

### **Navigation and signal lights**

Navigation and signal lights to be arranged according to class and authorities requirements.

#### **Signal light control panel(s)**

The following signal light control panel shall be arranged:

- Steering light according to Panama requirements shall be installed.

#### **Morse signal lights (also used as whistle light)**

The following morse signal light to be provided:

- One (1) morse signal light (white) (Aldis) on radar mast, synchronized with air whistle and arranged with an operating handle/switch in wheelhouse main control console (two pieces) and at each bridge wing.

#### **Searchlights**

- Two (2) remote operated search lights, LEDtype, to be installed under bridge wings, one each side, capacity abt. 2000W each. The searchlights shall be installed on a removable base.

All searchlights to be separately controlled.

#### **Illumination for plaques**

2 (two) illuminated plaques with the vessel's name, installed on the edge of the compass deck. The lights to be powered from Emergency switchboard.

#### **Day signal equipment**

The following day signals shall be supplied:

- Required number and types of "Shapes" to enable the vessel to show all relevant combinations according to COLREG requirements.
- One (1) Day light signalling lamp complete with:
  - Battery with charger
  - Transformer for the charger, supply from emergency system
  - Two (2) socket outlets installed on the bridge

#### **Air whistle**

- ~~Two (2) air-driven tyfon (7 bar) with 230V heater to be provided in radar mast. 2 (two) electric whistles (foremast and radar mast), with manual and automatic activation, whistle-Morse light synchronization, and push buttons for activation on the forward bulkhead of the bridge and on the wings~~
- One (1) whistle control system with time controller, operated on 220VAC / 1 ph, to be provided in the wheelhouse, provided in the wheelhouse:
- One (1) push button to be provided in the wheelhouse and one (1) on each bridge wing.
- A second electromagnet for emergency voltage shall be provided, and controlled from
  - the bridge console, only for air whistle for emergency use.
  - The whistle to be interfaced to the General alarm system

The Morse signal light to be commonly used as whistle light.

Compressed air pipe of stainless steel tubes quality on open deck and shall be laid easy accessible as far as possible, not exposed to frost (Insulated where necessary) and without water pockets. Drain(s) shall be arranged if necessary.

## 43 Anchoring, mooring and towing equipment

### Equipment number

Equipment number approx. 2031.

The anchoring and mooring equipment shall be selected and designed in accordance with the recommendations of the OCIMF MEG 4th Edition, Classification Society Rules, IACS Recommendations and shall be submitted to the BUYER for verification and approval.

Anchor and mooring winches shall be of low pressure type.

The surface of the braking drum of the windlasses and mooring winches shall be made of stainless steel (ASTM A-316L).

Winches and windlasses shall have an electro-hydraulic drive and if they are fitted with independent Hydraulic Power Units, their tanks shall have a filtration system with an automatic filter unit, working off-line, with its own circulation pump, suitable for marine applications, with a fine mesh filter and coalescing element for water separation. (CJC - C.C.Jensen or equivalent).

Mooring winches and windlasses shall be designed, manufactured, installed and tested in accordance with the requirements of SOLAS II-1/3-8, OCIMF/MEG 4th edition, and Circular MSC.1/1619 - Guidelines on the design of mooring arrangements and the selection of appropriate mooring equipment and fittings for safe mooring".

Test Kit required for traction and braking tests of all drums shall be provided (typically: lugs, slings, hydraulic cylinder, pump and load cell - depending on the arrangement).

### The following equipment shall be provided for emergency towing:

Reference also to Table 4.2

#### In the bow:

~~翠 2 (two) bow chain stoppers to receive properly positioned chafing chains, with capacity defined in accordance with the rules and recommendations;~~

~~翠 2 (two) closed chocks as per OCIMF MEG 4th rules. Edition, at least measuring 600 x 450mm;~~

~~翠 2 (two) rollers aligned with the windlass drum;~~

~~翠 2 (two) chafing chain with a diameter of 76mm and a length of 8m; Chafing chain complete set to be provided and properly stowed.~~

~~翠 1 (one) set comprising a 15-ton winch for picking up and storing cable during operations on monobuoys ("SPM Pick-up winch") and closed chocks. This winch shall be straight aligned with the ETA chocks;~~

#### At the stern ("SPM / Pull-back" and "ETA - emergency towing"):

~~翠 1 (one) reinforced closed chock with a capacity of 200 t;~~

~~翠 1 (one) bollard/stopper with a capacity defined by the rules and recommendations, associated with a remote quick release system;~~

~~翠 1 (one) nylon rope with a diameter of 40 mm and a length of 100 m;~~

~~翠 1 (one) messenger cable with a diameter of 16 mm and a length of 20 m;~~

~~翠 1 (one) marker buoy with flashing light;~~

~~翠 1 (one) steel cable with a diameter of 80 mm and a length of 90 m.~~

- 2 (two) bow chain stoppers to receive properly positioned chafing chains, with capacity defined

in accordance with the rules and recommendations;

- 2 (two) closed chocks as per OCIMF MEG 4th rules. Edition, at least measuring 600 x 450mm;
- 2 (two) rollers aligned with the windlass drum;
- 2 (two) chafing chain with a diameter of 76mm and a length of 8m; Chafing chain complete set to be provided and properly stowed.
- 1 (one) set comprising a 15-ton winch for picking up and storing cable during operations on monobuoys ("SPM Pick-up winch") and closed chocks. This winch shall be straight aligned with the ETA chocks;

#### At the stern ("SPM/ Pull-back" and "ETA - emergency towing"):

- 1 (one) reinforced closed chock with a capacity of 200 t;
- 1 (one) bollard/ stopper with a capacity defined by the rules and recommendations, associated with a remote quick release system;
- 1 (one) nylon rope with a diameter of 40 mm and a length of 100 m;
- 1 (one) messenger cable with a diameter of 16 mm and a length of 20 m;
- 1 (one) marker buoy with flashing light;
- 1 (one) steel cable with a diameter of 80 mm and a length of 90 m.

This equipment shall follow the definitions in the OCIMF/ MEG 4th publication. Edition and OCIMF/ Recommdnations for ship's fittings for use with tugs".

Generally : To be according to OCIMF MEG 4th, MSC.1/Circ.1619 and MSC.1/Circ.1620.

### 431 Anchors with chains and equipment

Three (3) SPEK or High Holding Power anchors shall be provided. The spare anchor should be stowed on the main deck, preferably in the area within the cargo hose handling crane range.

Anchor chain set is to be grade 3. 1 (one) spare chain length shall be provided with kenter link. There shall be hangers/hooks for stowage of spare links in the Bosun Store.

The anchor chain lengths will be joined by kenter links enabling any length to be inverted during drydocking. All chain lengths are to be duly identified.

The anchor in their stowed position shall rest against the ship's side on 03 points. No anchor pocket forseen. (ref. SFI 266 Anchor pockets and hawse pipes).

Anchors and anchor chain

Anchor type	SPEK-type (alternatively High-Hold anchor - weight reduced with 25%)
Anchor weight	6000 kg
Chain diameter	60 mm
Chain length (total of 2 chains)	577,5m
Chain Material	Steel grade Q3

### 433 Combined windlass/mooring winches with chain stoppers, rollers

Two (2) combined anchor windlass/mooring winches shall be installed on the Forecastle deck.

Combined windlass/mooring winch

Manufacturer	Kongsberg Maritime
Type	MW 120 L / CU 60 K3
Cable lifters	1
Chain diameter	60 mm

Nominal pull	17,4 t at 9 m/min
Maximum pull (Anchor break-out)	26,1 t
Brake holding load	127 t
Declutchable	Yes
Warping head(s)	1
Warping head dimensions	dia. 450 x 490mm length
Mooring drum(s)	2 (split drums)
Drum (dia. x length)	dia. 420/1300 x 530+390 mm wide
Storage capacity	220 m of 48 mm rope
Nominal pull	13 t at 0 - 18 m/min
Maximum pull	20,5t
Brake holding load	34 t
Declutchable	Yes
Driving unit	Electro hydraulic - low pressure
Speed control	Two speed ranges - Zero to maximum speed
Tension control	No
Type of starter	Star/Delta with overload protection in marine type IP54
Power supply	Ref. <a href="#">Table 8.6</a>
IP class	IP54
Controls	Local
Emergency stop	Yes

### Chain Stopper

Two (2) roller type Chain stoppers with lashing hook suitable for 60 mm dia. grade 3 chain cable shall be installed, one each side, adjusted or made adjustable for maximum tightening of anchors.

### Local Control Stand:

Two (2) Single control stands, with one speed/rotation direction control lever, one emergency stop.

### Remote Control

~~Remote start/stop and running indication of HPU for windlass from wheelhouse forward/IAS shall be arranged, ref. 792 Alarm and monitoring system.~~

## 434 Tugger winches, capstans, mooring winches with warping heads

### Mooring winch fwd on Forecastle Deck

One (1) mooring winch fwd shall be installed on the Forecastle deck.

With two split mooring drums and one warping end.

Mooring winch	
Manufacturer	Kongsberg Maritime
Type	MW 156 L (2 m/d+1w/e)
Warping head(s)	1
Warping head dimensions	Ø560 mm
Mooring drum(s)	2
Drum (dia. x length)	dia. 560/1400 x 500+390 mm wide

Nominal pull	15 t at 0-15 m/min
Brake holding load	34 t
Declutchable	Yes
Warping head	1
Nominal pull	approx. 13 t at approx. 0-15 m/min
Warping head dimensions	approx. Dia. 560mm
Driving unit	Electro hydraulic - low pressure
Speed control	Two speed ranges - Zero to maximum speed
Tension control	No
Type of starter	Star/Delta with overload protection in marine type IP54
Power supply	Ref. <a href="#">Table 8.6</a>
IP class	IP54
Controls	Local
Emergency stop	Yes

### Bow Chain Stopper for SPM

Two (2) roller type Chain stoppers with lashing hook, suitable for chain dimensions and quality acc. to rules, shall be installed, one each side on bow according to General Arrangement.

### Local Control Stand:

One (1) Single control stand, to be ergonomically located, with one speed/rotation direction control lever, one emergency stop.

### Mooring winch fwd On Main Deck and Mooring winches aft

One (1) mooring winch fwd shall be installed on the Forecastle deck, and three (3) mooring winches shall be installed on the Poop deck aft as indicated on the General Arrangement.

Each with two split mooring drums and one warping end.

Mooring winch	
Manufacturer	Kongsberg Maritime
Type	MW 120 L (2 m/d+1w/e)
Warping head(s)	1
Warping head dimensions	Ø450 mm
Mooring drum(s)	2
Drum (dia. x length)	dia. 420/1300 x 530+390 mm wide
Storage capacity	220 m of 48 mm rope
Nominal pull	13t at 0-18 m/min
Brake holding load	34 t
Declutchable	Yes
Warping head	1
Nominal pull	approx. 13t at approx. 0-18 m/min
Warping head dimensions	dia. 450 x 490 mm length
Driving unit	Electro hydraulic - low pressure
Speed control	Two speed ranges - Zero to maximum speed
Tension control	No

Type of starter	Star/Delta with overload protection in marine type IP54
Power supply	Ref. <a href="#">Table 8.6</a>
IP class	IP54
Controls	Local
Emergency stop	Yes

#### Local Control Stand:

Four (4) Single control stands, with one speed/rotation direction control lever, one emergency stop.

#### Drums for safety wires

2 (two) safety fire wires, made of galvanized steel, with a diameter, capacity and length defined by the lashing calculations defined by the SDBL OCIMF MEG 4th rules. Edition, Class and IACS, stored in their own drums, with compressed air collection motors, on the main deck, one forward and one aft.

### 435 Fixed mooring equipment

Bollards, chocks, and (roller) fairleads shall be fitted as indicated on the Mooring Arrangement and approved by the Owner.

Fixed mooring equipment shall be according to the calculated Equipment number of the ship, if not specified otherwise.

Bollards and fairleads shall be locally reinforced. The SWL shall be welded to the top of all bollards and fairleads.

Table 4.2 Fixed mooring equipment

Deck	Item	Quantity	Purpose	SWL	Standard/ Type
Mooring Fwd.	Bollard	6	Mooring		NS2584
Mooring Fwd.	Chock	20	Mooring		NS2587
Mooring Fwd.	Chock	3	Emergency towing		NS2589
Mooring Fwd.	Towing bracket	2	Emergency towing		SPM stopper, 200 tons, Ø76 mm
Mooring Fwd.	Rollers	2	Mooring		NS2585
Mooring midship	Bollard	4	Mooring		NS2584
Mooring midship	Chock	4	Mooring		NS2688
Mooring Aft.	Bollard	4	Mooring		NS2584
Mooring Aft.	Bollard	1	Emergency towing		NS2584
Mooring Aft.	Chock	16	Mooring		NS2587
Mooring Aft.	Chock	1	Emergency towing		NS2589

\*The bollard can be loaded with 2 ropes with MBL not exceeding the values in the tables.

Alternatively 1 rope with 180° circumference.

### 436 Loose mooring equipment

Loose mooring equipment according to Classification Society requirements shall be delivered by the Yard.

Loose mooring equipment beyond the Classification Society rules shall be delivered by the Owner, ref. [M Owner Furnished Equipment](#).

#### CABLES/ ROPES

The following ropes shall be provided:

- 12 (twelve) nylon mooring ropes, each 220 m long, of braided construction (double braid), with a diameter and capacity defined by the mooring calculations (SDBL OCIMF MEG 4th Edition, Class and IACS). The mooring lines shall be properly mounted on the winch drums. Each mooring rope shall be supplied by the manufacturer with two braided eye splices, made from the cable's own material, with a length of approximately 1.80m;
- 2 (two) spare nylon ropes for mooring, stowed in the bosun store and in the steering gear compartment;
- 4 (four) nylon towing ropes for tugboat maneuvering, each 100 m long, to be stowed in an appropriate place inside the bosun store and steering gear compartment, with a diameter and capacity defined by the mooring calculations set out in the SDBL OCIMF MEG 4th rules. Edition, Class and IACS;
- 2 (two) safety fire wires, made of galvanized steel, with a diameter, capacity and length defined by the lashing calculations defined by the SDBL OCIMF MEG 4th rules. Edition, Class and IACS, stored in their own drums, with compressed air collection motors, on the main deck, one forward and one aft, according to the aforementioned document.

The following equipment shall be provided for emergency towing:

In the bow:

- 2 (two) bow chain stoppers to receive properly positioned chafing chains, with capacity defined in accordance with the rules and recommendations;
- 2 (two) closed chocks as per OCIMF MEG 4th rules. Edition, at least measuring 600 x 450mm;
- 2 (two) rollers aligned with the windlass drum;
- 2 (two) chafing chain with a diameter of 76mm and a length of 8m;
- 1 (one) set comprising a 15-ton winch for picking up and storing cable during operations on monobuoys ("SPM Pick-up winch") and closed chocks. This winch shall be straight aligned with the ETA chocks;

At the stern ("SPM/ Pull-back" and "ETA - emergency towing"):

- 1 (one) reinforced closed chock with a capacity of 200 t;
- 1 (one) bollard/ stopper with a capacity defined by the rules and recommendations, associated with a remote quick release system;
- 1 (one) nylon rope with a diameter of 40 mm and a length of 100 m;
- 1 (one) messenger cable with a diameter of 16 mm and a length of 20 m;
- 1 (one) marker buoy with flashing light;
- 1 (one) steel cable with a diameter of 80 mm and a length of 90 m.

This equipment shall follow the definitions in the OCIMF/ MEG 4th publication. Edition and OCIMF/ Recommmendations for ship's fittings for use with tugs".

## 438 Hydraulic oil system for winches

### LP hydraulic oil system for winches

In general, the arrangement of hydraulic pipe systems winches shall be in accordance with the Kongsberg equipment supplier's recommendation.

The systems shall include:

- Pump(s)
- Level regulated expansion system(s)

- Valves
- Filters
- Starter cabinets
- Oil cooler(s) and thermostatic valve(s) shall be included where required.

Low pressure hydraulic oil supply tank, stores tank and drop tank, ref. SFI [71 Lube oil systems](#)

Hydraulic oil transfer pump, ref. SFI [71 Lube oil systems](#).

Low pressure hydraulic pipes general:

- Shall be of seamless steel quality.
- Dimension DN50 and above shall be flanged with o-ring flange MFAS or similar.
- Dimension DN40 and below shall be of precision steel tubes with compression ring fittings (bit type) make Ermeto or similar.
- On open deck, precision steel tubes to be of stainless steel quality.
- LP hydraulic pipes on open decks shall have galvanized pipe clamps.
- Deck- and bulkhead connections by flanges, shall be of approved standard by the LP hydraulic equipment supplier.
- First time filling of hydraulic oil systems shall be carried out and paid for by the Yard.

Cleaning and internal surface treatment of the pipes shall be in accordance with the recommendations from winch equipment supplier.

#### **Remote Control**

Remote start/ stop and running indication of HPU for windlass and tugger winches from wheelhouse forward/IAS shall be arranged, ref. [792 Alarm and monitoring system](#).

## **44 Repair, maintenance and cleaning equipment & arrangements**

### **441 Machine tools, cutting and welding equipment**

The work benches, lockers, tools and equipment that shall be delivered and installed in the different workshops are mentioned below.

#### **Workshop /Engineers tools**

- 1 mechanical lathe with 1,5 m tip spacing and 250 mm tip height;
- 1 drilling machine, max. 30 mm in diameter;
- 1 grinder, double head, 255 mm wheel diameter;
- 1 gas welding set;
- 1 electric welding machine, alternating current, 300 A;
- 1 test bench for Main Engine injectors;
- 1 test bench for the Auxiliary Engines injectors;
- 1 machine for grinding Main Engine discharge valves;
- 1 tube bending machine;
- 1 hydraulic press;
- 1 bench vice, type Morsa nº 6;
- 1 bench vise, walrus type No. 7;
- 1 worktop with wooden top;
- 1 steel cabinet for storing tools;
- 1 steel cabinet for storing instruments;
- 1 shelf with bins for small items;

- 1 shelf for storing tubes, bars, and so on;
- 1 ASTM A-304 stainless steel tank with cold water tap.

Protective curtains shall be installed in the welding areas.

There shall be fresh water and compressed air points in the workshop room.

### **Workshop /Electrician tools**

- The electrical workshop shall be equipped with the following items:
  - . 1 wooden workbench with lathe;
  - . 1 steel cabinet for storing tools;
  - . 1 steel cabinet with 4 (four) drawers;
  - . 1 cabinet for storing materials;
  - . 1 insulated rubber mat placed in front of the wooden bench;
  - . 1 electrical testing panel;
  - . 1 set of shelves.

The electrical testing panel shall have the following characteristics:

~~. 440 Vac emergency power supply, 3 phases, with 20 A circuit breaker; . 450V emergency power supply, 3 phases, with 20 A circuit breaker;~~

~~. 220 Vac emergency power supply, 3 phases, with 10 A circuit breaker; . 220V emergency power supply, 3 phases, with 10 A circuit breaker;~~

~~. Sockets for testing all types of lamps installed on board, including projectors and fluorescent lamps;~~

~~. Continuity and fuse testing;~~

~~. Power output terminals, with protection against accidental contact, sockets, universal type with grounding pin, and disconnect switches for the 440 Vac and 220 Vac circuits. . Power output terminals, with protection against accidental contact, sockets, universal type with grounding pin, and disconnect switches for the 450V and 220V circuits.~~

### **Cutting equipment**

Four (4) Oxygen bottles and two (2) Acetylene bottles shall be arranged in separate stores.

The Oxygen /Acetylene lockers shall be equipped with local reducing outlet station(s).

The outlet station(s) shall include a cabinet with twin valve unit, Oxy/Ace regulators, flashback arrestors, hose stems and stretch relief bracket for the welding hoses. One (1) welding and cutting equipment-set with two (2) x 30 m approved hose for oxygen and acetylene shall be supplied.

- One (1) outlet station in engine room workshop
- One (1) outlet in deck workshop

### **Welding equipment**

One (1) Welding transformer for stick electrode and for TIG welding shall be located in the engine workshop. Welding current range approx. 5-400 A. One (1) socket for welding cable shall be located in engine workshop and one (1) in the deck workshop. Two (2) x 30 m welding cable shall be delivered.

Gas welding and cutting equipment including hoses and bottles shall be delivered by the Owner, ref. M Owner Furnished Equipment.

### **Gas protection Equipment**

Gas detector(s) (oxygen, flammable gases or vapours, hydrogen sulphide and carbon monoxide) according to SOLAS requirement for Atmosphere testing of enclosed spaces shall be available (ref. SOLAS XI-1-7).

## 442 Engine- and hand tools

Propulsion machinery, auxiliary engines and separators hand tools shall be delivered according to the manufacturer's standard delivery, including special tools for removal of pistons.

All tools shall be located on tool boards, in shelves and in drawers/lockers arranged in the engine room workshop.

The Yard will supply the following items from the machinery inventory:

- 1 (one) internal measuring compass, 325 mm;
- 1 (one) external micrometer from 0 to 25 mm;
- 1 (one) dial indicator;
- 1 (one) magnetic base;
- 1 (one) caliper, 300 mm;
- 1 (one) manual tachometer;
- 1 (one) metric clearance gauge, with 13 sheets of 150 mm, range from 0,05 mm to 1 mm;
- 1 (one) metric thread pitch gauge, with 18 sheets, range from 0,4 mm to 7 mm;
- 1 (one) copper tube cutter, capacity 3,17 mm to 25,4 mm;
- 1 (one) portable electric drilling machine 220 Vac, steel capacity up to 13 mm;
- 1 (one) set of 2 mm to 38 mm screw-machine drill bits;
- 1 (one) 2 kg sledge hammer;
- 1 (one) set of 200 mm files (1 flat, 1 triangular, 1 round);
- 1 (one) set of 5 double spline wrenches, from 6 mm to 41 mm;
- 1 (one) pipe wrench, 250 mm;
- 1 (one) pipe wrench, 450 mm;
- 1 (one) manual grease pump, with side lever, 400 g capacity;
- 2 (two) oilers with pressure pumps, rigid nozzle, 170 g of capacity;
- 1 (one) gasket puller, length 273 mm, diameter 6 mm;
- 1 (one) gasket puller, length 158 mm, diameter 4,7 mm;
- 2 (two) pulley pullers of different sizes;
- 2 (two) tape measure for sounding tanks, 30 m foil tape, with plumb bob, graduated in the metric system;
- 1 Pneumatic Oil transfer pump for drum of 200 L;
- 1 set of hydraulic bolt cutters;
- 2 (two) air-powered impact wrenches  $\frac{1}{2}$ ";
- 2 (two) air-powered impact wrenches  $\frac{3}{4}$ ";
- 2 (two) battery-operated impact wrenches  $\frac{1}{2}$ ";
- 1 (one) Aviation snip straight;
- 1 (one) Offset Right-Cutting Snip;
- 1 (one) Off Left-Cutting Snip;;
- 1 set of professional stud bolt puller;
- 1 (one) professional millimeter taps and die set ;
- 1 (one) professional inch UNC and UNF taps and die sets for diameters only <3/4";
- 3 sets of drill bits for steel from 1 to 13mm (for chuck);
- 1 set of rotary files

## 444 Cleaning equipment, garbage chutes

### High Pressure washer(s)

One (1) HP washer (approx. 200 bar - 25 l/min) with hot and cold water supply shall be delivered and installed in the deck General Store.

Capacity, temperature, arrangement, hose connections, etc. shall be in accordance with NOFO 2021.

Steam outlet with lance shall be in accordance with NOFO 2021.

Capacity shall be sufficient for use of two (2) lances simultaneously.

- Hoses:
  - Two (2) x 20 m
  - One (1) x 10 m hose
- Lances:
  - One (1) "long"
  - One (1) "tank" gun

Further, quick coupling type hose connection including closing valve shall be located:

- One (1) in Steering gear room
- One (1) on mooring deck forward
- One (1) on Wheelhouse top
- Three (3) Aft of superstructure
- Two (2) in Engine room
- Five (5) on external deck

Pipe system shall be of precision steel tubes of AISI316L stainless steel quality.

A possibility to isolate and drain parts of the system exposed to frost shall be arranged.

## 445 Garbage disposal plants, incinerators

### Incinerator

One (1) garbage and oil sludge incinerator of the type approved by the IMO/Marpol Convention Annex VI shall be provided and installed in the Engine Room. Provision shall be made for the use of fuel oil (HFO/LFO and/or DO) for the incinerator. A monorail shall be provided for moving the garbage.

The incinerator shall allow continuous burning and feeding of solids and waste produced by the purifiers, waste from the separated bilge oil tank, drain tank and sanitary holding tank.

It shall be possible to feed solids while the incinerator is running.

It shall be able to burn sludge with up to 50% water content, without using diesel oil. The system configuration shall have automation for autonomous operation and the sizing of the tanks shall follow the standards recommended by the manufacturer.

The incinerator's emergency stop shall be installed in the ECR.

The nominal capacity should be around 300.000 kcal/h to burn the expected amount of oily waste produced per day by the vessel over a 10-hour period, and it shall have a hatch to feed solid waste and a premixing tank (conditioner or service tank) as recommended by the manufacturer.

The incinerator shall comply with the ISO 14000 emissions standard.

#### Incinerator capacities

Calorific capacity	300.000 kcal/h (420 kW)
Sludge capacity	50 l/h
Solid waste capacity	50 kg/h

The incinerator shall be complete including:

- Control panel
- Flue gas fan and flue gas damper
- Exhaust gas spark arrestor

- System for automatic burning sludge and manual feeding of garbage while burning sludge
- Device for feeding waste during operation
- Sludge /mixing tank system with electric heater (approx. 500 l)
- Necessary valves, level gauges and switches, thermostats
- Emergency stop switch shall be installed outside the Incinerator room
- IMO resolution MEPC 244(66) as amended.

### Garbage room

The capacity of the garbage room shall be according to Classification Society requirements and/or ISO 21070. The following equipment shall be installed in the garbage room:

- One (1) Garbage compactor
- Sorting bins
- Storage containers
- Minimum one (1) scupper with connection to the grey water system
- Hatch to incinerator

The hospital and any other relevant areas of the vessel shall be provided with means to comply with ANVISA RDC 222/2018 for health care waste management.

## 446 Outfitting in store rooms and workshops

### General

~~For equipment/outfitting details, reference is made to Technical Specification I-ET 4880.00-9311-000-PTD-001~~

### Store rooms

Store rooms shall be arranged according to the General Arrangement.

Separate store room for paint and chemicals shall be arranged with ventilation and fire fighting according to the Classification Society and National Authorities requirements (ref. 579 Ventilation/AC systems for various compartments and 81 Fire and lifeboat alarm, fire fighting and wash down systems).

Shelves and other outfitting in the rooms shall be arranged according to agreement between the Yard and the Owner.

### Workshops

Workshops shall be arranged according to the General Arrangement and equipped as listed in 441 Machine tools, cutting and welding equipment.

## 447 Clamps/foundations for spare parts

Lockers and shelves for smaller spare parts shall be delivered and fitted by the Yard.

Heavier spare parts shall be stored in special clamps or foundations at suitable places in the engine room or a store room.

Clamps and foundations shall be fitted by the Yard.

All major spare parts shall be supplied with corrosion protection.

**448 Name plates/markings on machinery, equipment, pipes, cables****Machinery equipment**

Machinery equipment shall have markings and signs according to Owners Standard N-1503 . For Language ref. I Drawings, instruction manuals, etc..

**Pipes and armatures**

Marking to be according to Owners Standard N-1503

**Electric cables and equipment**

Marking to be according to Owners Standard N-1503

**45 Lifting and transport equipment for machinery components****452 Travelling cranes and lifting gear in engine rooms****Engine Room and Auxiliary Engine Room**

An overhead travelling crane with the capacity to lift the heaviest component of the main engine, shall be provided.

Monorails - Monorails with trolleys and hoists shall be installed to move parts on the following equipment/locations:

- 1 (one) over each auxiliary diesel generator set, with a capacity of 500 kg;
- 1 (one) in the workshop, with a capacity of 500 Kg.

Monorails with trolleys for moving parts shall be installed over the following equipment/locations:

- 1 (one) over fuel oil and lubricating oil purifiers with a capacity of 200 kg for transporting the rotors to the cleaning table;
- excluded
- 1 (one) over each hydraulic unit of the cargo system, with a capacity compatible with the heaviest part of the set;
- 1 (one) in the spare parts locker with a capacity of 500 Kg.

Two (2) 200 kg and two (2) 500 kg hoists shall also be supplied apart.

Eyebolts over equipment served by cranes or monorails shall be installed for equipment weighing 60 kg or more.

**454 Travelling cranes and lifting gear outside engine rooms**

In general, lifting eyes shall be arranged above all equipment heavier than 60 kg for demounting and maintenance.

Lifting eyes used during the building period for mounting of components may be kept if practical, according to agreement with Owner.

**Engine workshop**

Traveling beam and one (1) electric driven travelling chain tackle with 500 kg approved by Owner shall be provided.

**Miscellaneous Lifting Equipment outside Engine Room**

The following miscellaneous lifting equipment shall be provided complete with winches with pneumatic motors fitted with filters and lubricators, air hoses, cables, chain hoists, etc., or alternatively with hoists and/or jibs:

**Table 4.3 Miscellaneous lifting equipment outside engine room**

<u>Equipment</u>	<u>Quantity</u>	<u>Purpose</u>	<u>Minimum capacity</u>	<u>Drive</u>
a) Tripod portable	2 (two)	Removal of gravel and mud from cargo, slop, fuel oil storage and ballast tanks	0,2 t	Air motor
b) Bosun store davit	1 (one)	Removal of parts from Bosun Store	0,5 t	Air motor
c) Cargo manifold	1 (one)	Handling of cargo reducers and others	0,5 t	Chain Hoist

## 5 EQUIPMENT FOR CREW AND PASSENGERS

### 50 Lifesaving equipment

The vessel shall have safety equipment according to SOLAS and the National Authorities for the total number of crew and passengers onboard as described in B Arrangement, description.

The survival and rescue boat crafts and their launching devices will be supplied in compliance with the latest IMO/MSC, SOLAS and LSA requirements resolutions and recommendations, and will be certified in accordance with the EU Marine Equipment Directive (MED) - 2014/90/EU.

All lifesaving & FiFi equipment are to be duly certified as per EU-MED requirements - Ref. ET-4880.00-9311-000-ptd-001.

Equipment mentioned under SFI Main Group 50 shall have certificates with a 12 months period of validity from the vessel's delivery date.

#### 501 Lifeboats/Rescue boats with equipment

##### Lifeboats/Rescue boats with equipment

Lifeboat and SOLAS Rescue boat shall be fitted as indicated on the General Arrangement plan, and shall be built and equipped according to Class and National Authorities requirements.

A socket for the lifeboat battery charger shall be provided.

##### Rescue boat

One (1) SOLAS Rescue boat shall be fitted as indicated on the General Arrangement.

##### Rescue boat

Hull	GRP
Davit type	Provision crane to be used for launching of Rescue boat, ref SFI <u>331 Rotating cranes with crane pillars</u>
Size included davit (LxBxH):	Maker's standard
Capacity:	6 persons
Speed:	Capable of maintaining a speed of 20 knots while carrying full capacity
Propulsion:	Inboard motor with water jet propulsion

##### Life boat

One (1) totally enclosed fire-resistant free fall, SOLAS approved, life boat shall be fitted according to the General Arrangement.

##### Life boat

Hull	GRP
Davit type	Freefall launch arrangement of approved type to be arranged at the stern, maintenance platform with handrails on each side of the davit
Size included davit (LxBxH):	Maker's standard
Capacity:	36 persons
Speed:	Not less than 6 knots in smooth water
Propulsion:	Inboard motor with propeller

**Notes:**

- All piping for davits and cranes shall be of stainless steel.
- The manoeuvring panels for the provision crane shall be arranged for optimal view of ship side.
- Rescue boat - arrangement for fuelling, ref. SFI item 701 Fuel oil transfer & drain systems.

**502 Life rafts with equipment****Life rafts**

Life rafts with approved launching system shall be fitted as indicated on the General Arrangement Plan, and shall be built and equipped according to National Authorities requirements.

The life raft capacity on each side of the vessel shall be as required by the National Authorities for the total number of persons as described in B Arrangement, description.

The life rafts shall be stowed in GRP-containers, and the containers shall be fixed in solid cradles.

Provision crane shall be used for launching of liferafts, ref. SFI 331 Rotating cranes with crane pillars.

**503 Lifesaving, safety and emergency equipment****Lifebuoys**

Fourteen (14) lifebuoys will be provided, located in accessible positions on the exposed decks, marked with the vessel's name and port of registry, distributed as follows: Seven (7) buoys with buoyant lifelines of at least 30 m in length; Five (5) buoys with self-igniting lights; Two (2) buoys with (electric battery) self-igniting light and self-activating smoke signal located at both navigation bridge wings.

**Life jackets/Immersion Suits**

Life jackets will be provided in accordance with SOLAS Convention Chapter III, CLASS I, for the entire capacity of the vessel including possible passengers, with a capacity of 55 to 110 kg and at least Six (6) with a capacity of over 110 kg. Each crew member will have a life jacket stowed in their cabin. Three (3) life jackets will be supplied and installed in the engine control room, Three (3) on the navigation bridge, Two (2) in the infirmary/hospital, Eighth (8) for the shaller stations and Two (2) in the cargo control room and Two (2) on the forward liferaft. All lifejackets will be marked with the vessel's name and port of registry and will have a selfignition light and whistle. In addition, Six (6) life jackets for children will be provided.

Immersion suits will be provided for the entire capacity of the vessel. Each crew member will have an immersion suit in cabin, including the workers' cabin. In addition, Two (2) immersion suits will be supplied/installed near the forward liferaft, Two (2) at the stern, Two (2) on the navigation bridge and Two (2) in the Engine Control Room. The immersion suits that are part of the survival and rescue craft's equipment are not included in this figure.

Emergency Escape masks (EEBD) will be provided, certified and positioned as required by the rules and regulations and according to approved Fire Control and Lifesaving Plan. Emergency Escape masks (EEBD) will be maintenance free type.

**Distress Signals**

One (1) set of pyrotechnic devices stowed on the Navigation Bridge will be provided, consisting of at least: Twelve (12) rockets parachutes and red lights; Eighteen (18) hand-held flares, Six (6) with a green star, Six (6) with a red star and Six (6) with a white star.

### **Line Throwing Apparatus**

One (1) pneumatic line throwing appliance will be supplied, equipped with the following items: Four (4) 230 m long lines; Four (4) projectiles; ~~Two (2)~~ Two (2) air cylinders of 1,45 liters x 30 MPa (305,81 kgf/cm<sup>2</sup>).

### **504 Hospital/treatment facilities and medical equipment**

The hospital/treatment room shall be arranged and equipped according to Classification Society, National Authorities requirements, and RDC 72 of The Brazilian Health Regulatory Agency (ANVISA).

The hospital shall be conveniently separated from other rooms, have a physical space that provides adequate care for the patient and the entrance shall be arranged to permit a stretcher to easily pass through (> 1000 mm).

A separate bathroom with sink, toilet and shower shall be arranged, for the exclusive use of hospital occupants, ref. [583 Bathtubs, showers, WC, washbasins](#).

The room shall be arranged for wet treatment by a shower reaching treatment bench, arranged on wet space flooring with sufficient drains.

Cabinets shall be provided for storing medicines and medical-surgical materials, as well as all the necessary furniture. Medicines and medical equipment shall be stored in a lockable cabinet in the hospital, under the responsibility of the medic. First aid cabinets shall be arranged in the galley and the ECR.

A hospital alarm shall be installed, ref. [792 Alarm and monitoring system](#).

Table 5.1 Hospital equipment

Equipment	Quantity	Remarks
Examination couch	1	Three parts with shoulder support and adjustable heights
Medical cabinet	1	Including refrigerator, poison locker etc.
Examination lamp	1	Approved type
Stretchers	1	Ambulance type
Instrument table	1	Moveable type
Bookshelf	1	
Desk with drawers	1	
Wardrobe locker	1	
Three (3) Beds with bedside Table	3	One (1) call button will be installed at the head of the beds, which will activate the bells installed in the corridor next to the medical assistant's cabin and in the corridor next to the messroom
Office chair	1	
Soft chair	1	
Individual sanitary unit	1	Equipped with shower

For radio communication to shore, ref. [42 Communication equipment](#).

For waste management, ref. to requirement in [445 Garbage disposal plants, incinerators](#).

## 505 Loose firefighting apparatuses and equipment, firemen's outfit

### Fire extinguishers

**PORTABLE FIRE FIGHTING EQUIPMENT** The quantities and location of fire extinguishers shall comply with the rules and regulations. Firefighter's outfit set (protection clothing, self-contained breathing apparatus, axe, guide cable, safety flashlight, etc.) shall be stored in fixed boxes on the bulkheads, each with a complete set.

Protective clothing shall be certified in accordance with directive EN 469, level 2 (X2, Y2, Z2). A VHF radio certified as intrinsically safe shall be provided for each rescue/firefighting team (four).

The extinguishers shall be suspended on hooks and fixed with clamps.

All loose fire extinguishers shall be of cartridge charged type.

In rooms with electric installation, extinguishers shall be of the CO<sub>2</sub> type.

### Fire axes

Fire axes shall be delivered and suspended on bulkheads in accommodation and corridors according to requirements.

### Fireman's outfit

The following fireman outfits and breathing equipment shall be provided:

- Required Complete fireman's outfits shall be supplied and stowed according to National Authority requirements and Classification Society requirements.
- Minimum One (1) Breathing air compressor, 300 bar, shall be supplied for filling of air bottles. The compressor shall have electrical supply also via the emergency generator switchboard. The compressor shall be arranged for refill of Emergency Escape Breathing Device (EEBD) sets on board. For each pair of breathing apparatus there shall be provided one water fog applicator stored adjacent to such apparatus.

A single designer, hereinafter referred to as the Fire Station (ECI) Integrator, who is a renowned designer of fire detection and firefighting systems, shall be responsible for designing the integration of the Fire Station's systems. The architecture of ECI's systems shall be submitted to the Owner for approval. The layout of the ECI compartment shall accommodate complete fire-fighting sets (fire brigade) and spare cylinders of breathing air and portable extinguishers.

### FIRE FIGHTING STATION ("ECI")

The Fire Station (ECI) shall be located in a compartment near the entrance to the Engine Room, on the main deck of the Accommodation. The installation and equipment of the Fire Station shall be arranged in an integrated manner, including but not limited to the following systems, controls, and indicators:

- Central control panel of the fire detection and alarm system with repeaters in the Navigation bridge, ECR and CCR;
- Release and alarm panel for fixed clean agent fire-fighting system (novec, inergen or similar) for the various compartments,
- Starting, stopping and supervising of the emergency fire pump and the general services, bilge and fire pumps in the Engine Room;
- Control panel for the foam system with start and stop of the bilge, fire and general services water pump and Foam Forming Liquid pump;
- Shutdown of the fans and exhaust fans in the accommodation with repeaters in the Navigation bridge, ECR and CCR;
- Shutdown of the fans and oil pumps in the Engine Room;

- Remote start panel for ventilation and exhaust dampers in compartments protected by clean agents (novec, inergen or similar);
- Gas detection system panel of ballast tanks and cofferdam;
- Activation of fixed fire-fighting systems (clean agents, foam, water, etc.);
- Remote actuation for quick-closing valves;
- Manual compressor and air bottle for breathing apparatus.
- Automatic telephone;
- Remote closing of fire doors;
- General Alarm Push Button;
- Fire alarm push button.
- Fire detection system;
- Remote closing of dampers and doors;
- Remote closing of oil tank valves;
- Emergency stops;
- Gas detection in ballast tanks and cofferdams;
- Clean agent flooding system (novec, inergen or similar).

## 51 Insulation, partition bulkheads, ceiling, doors, side scuttles, windows

### 511 Insulation, partition bulkheads, ceiling and wall panels

All accommodation shall be arranged so that deck area and free deck heights shall be in accordance with common practice for this type of ship and to fulfil the Classification Society's, National Authorities' and Marine Labour Code 2006 rules and regulations.

All works shall be carried out according to common practice and Yard standards.

Access to concealed pipes, cables etc. shall be arranged where necessary by means of hinged inspection doors. Removable sections/hatches in walls and ceilings may be accepted where doors prove to be difficult.

Dead space behind lining may be utilized for space and storage where not limited by building principles and noise reduction requirements.

The Yard shall send colour proposal and material samples to the Owner for consideration and approval.

Accommodation drawings shall be worked out and approved by the Owner and National Authorities before the work starts.

#### **Walls/bulkheads**

The panelling system shall be chosen according to noise reduction requirements. The lining system shall be easy to install and meet the following criteria:

#### **Quality:**

- Pre-arranged connecting pieces for modular system
- Accurate and rapid installation

#### **Flexibility:**

- Possibility for modular system in 100 mm or 50 mm

#### **Fire:**

- According to minimum Classification Society rules and according to the method of construction

#### **Sound reduction:**

Sound reduction shall as a minimum satisfy IMO Noise Code indexes.

Where noise reduction is required, lining shall not be penetrated for electrical cables or equipment.

#### **Ceiling**

The ceiling system shall be chosen according to noise reduction requirement. The ceiling system shall be easy to install and meet the following criteria:

#### **Quality:**

- Accurate and rapid installation

#### **Flexibility:**

- Possibility dismounting for easy access.

#### **Fire:**

- According to minimum Classification Society rules and according to the method of construction

#### **Sound reduction:**

- For noise reduction, execution and workmanship shall be as to minimize noise transfer between compartments.

Table 5.2 Linings & ceilings

Compartments	Lining	Facing/ materials	Ceiling	Facing/ materials			
Cabins	Standard panels 25 mm Double walls between cabins and between cabins and public spaces, with air gap/ or insulation per noise reduction measures	PVC Galvanised steel sheets coated with a halogen-free decorative finish on one or both sides	Standard type 25-50mm	Painted Galvanised steel sheets coated with a halogen-free decorative finish			
Corridors, stairs, recreation, mess rooms, offices,- <u>pantry</u> ,- gymnasium	Standard panels 25 mm	PVC Galvanised steel sheets coated with a halogen-free decorative finish on one or both sides	Standard type 25-50mm (perforated finish in public spaces)	Painted Galvanised steel sheets coated with a halogen-free decorative finish			
Wheelhouse	Standard panels 25 mm	PVC Galvanised steel sheets coated with a halogen-free decorative finish on one or both sides	Standard type 25-50mm (perforated finish)	Painted Galvanised steel sheets coated with a halogen-free decorative finish (dark, non-reflex)			
Galley, <u>pantry</u>	Wet-room	PVC Stainless	Standard type	Stainless steel			

Compartments	Lining	Facing/ materials	Ceiling	Facing/ materials			
	panels 25/50 mm	<u>steel sheets coated with a halogen-free decorative finish on one or both sides</u>	25-50mm	<u>sheets coated with a halogen-free decorative finish</u>			
Provision rooms	Polyurethane panels 50-100 mm	<u>PVCStainless steel sheets</u>	Polyurethane panels 50-100 mm	<u>PVCStainless steel sheets</u>			
Laundry	Wet-room panels 25/50 mm	<u>PVCGalvanised steel sheets coated with a halogen-free decorative finish on one or both sides</u>	Standard type 25-50mm	<u>PaintedGalvanised steel sheets coated with a halogen-free decorative finish</u>			
Stairs	Standard panels 25 mm	<u>PVCGalvanised steel sheets coated with a halogen-free decorative finish on one or both sides</u>	Standard type 25-50mm	<u>PaintedGalvanised steel sheets coated with a halogen-free decorative finish</u>			
ECR	Standard panels 25 mm	<u>PVCGalvanised steel sheets coated with a halogen-free decorative finish on one or both sides</u>	Standard type 25-50mm	<u>PaintedGalvanised steel sheets coated with a halogen-free decorative finish</u>			
Switchboard room	Standard panels 25-mm	PVC	Standard type 25-50mm	Painted			
HVAC room	Sheet metal lining	Painted	Sheet metal lining	Painted			
Stores inside Accommodation	Standard panels 25 mm	PVC	Standard type 25-50mm	<u>Galvanised steel sheets coated with a halogen-free decorative finish on one or both sides</u>	Painted	Standard type 25-50mm	<u>Galvanised steel sheets coated with a halogen-free decorative finish</u>
Stores outside Accommodation	Sheet metal lining	Painted	Sheet metal lining	Painted			
Workshops	Sheet metal lining	Painted	Sheet metal lining	Painted			
Compartments on WH top	Sheet metal lining	Painted	Sheet metal lining	Painted			
Instrument room	Sheet metal lining	Painted	Sheet metal lining	Painted			
Wardrobes	Wet-room panels 25/50 mm	PVC	Standard type 25-50mm	<u>Galvanised steel sheets coated with a halogen-free</u>	Painted	Standard type 25-50mm	<u>Galvanised steel sheets coated with a halogen-free</u>

Compartments	Lining	Facing/ materials	Ceiling	Facing/ materials			
				<a href="#">decorative finish on one or both sides</a>			<a href="#">decorative finish</a>

Plywood used in accommodation, control stations and service spaces shall be of approved type with regards to low flame spread and smoke toxicity.

For details regarding insulation, ref. [517 Insulation](#).

For details regarding ceiling, ref. [518 Ceiling](#).

For Provision rooms, ref. [555 Insulation, lining & battening in provision rooms, doors & ports](#).

The thin steel cladding (sheet metal lining) may be exchanged with perforated steel sheet (with acoustic foil or glass tissue, in case covering mineral wool), or glass cloth as a final surface, especially on the deckhead, where approved by Owner if not contradicting with durability and easy cleaning requirements. Spaces with high noise resources (e.g. HVAC room, Workshop, Engine room) shall be specially considered.

## 512 Internal Doors

### General

A master key locking system shall be provided for external and internal doors and hatches in accordance with common practice. The locking system shall be approved by the Owner's representative. The locks on the compartment doors will have a general master key and group master key system.

### Fire class doors

#### B-class doors

Interior doors shall meet the following requirements:

- Incombustible (B15) and to the standard of the adjacent bulkheads.
- Frames shall be of steel.
- Doors shall be fitted with stainless steel thresholds.
- All doors shall have gaskets for noise reduction.
- All cabin doors shall be equipped with noise traps in the ventilation openings.
- Kick out panels shall be installed if required.
- Doors for cabins and mess room shall have minimum light opening according to the authorities requirements.
- Interior sill in wet-rooms shall be constructed to avoid water to enter into dry compartments.

#### A-class doors

Fire doors shall meet the following requirements:

- All doors shall have as a minimum the same fire rating as the bulkhead where it is fitted.
- Door leaf: Minimum 1,5 mm primed/painted mild steel or stainless steel surface. Door leaf core shall be of mineral wool, or of ceramic fibre. Reinforced plates for hinges, door closer and panic opening devices shall be welded on inside of the door leaf.
- Door frame: 3 mm painted mild steel or stainless steel surface. Welded door frame as standard. Bolted frames as option if approved certificate. Adjustable gasket for gas-tightness and sound

reduction.

- Hinges: The hinges shall be welded to the surface of the door frame and inside the door leaf. The hinges shall be provided with washers between the top and bottom parts to reduce friction.
- Doors to rooms with risk of hazardous or toxic zones shall be of gas tight type.
- Fire doors shall close automatically when fire alarm is activated, if normally open. In addition remote release in central control station and locally shall be installed. For indication panel mounted in the wheelhouse, ref. <broken cross-reference>.

#### **Provision room doors**

Provision room doors shall meet the following requirements:

- Refrigerated/Cooler provision room doors shall have stainless steel fittings.
- Door frames for freezer room shall have heating cables with thermostatic control.
- Emergency opening devices shall be in accordance with requirements.

### **514 Weathertight and Spraytight doors**

Exterior doors shall be according to the Classification Society and National Authorities requirements. The doors from accommodation and wheelhouse to open deck shall be fitted with portholes or windows. All external doors shall be of steel (or GRP if allowed by the Classification Society and National Authorities) and have central closing appliances.

The entrance doors to the accommodation and control rooms shall have anti-piracy locking devices that can be easily opened from the inside (emergency).

Light opening shall be approx. 730 mm. All moveable parts/hinges shall be protected by cover plate, and all moveable parts, hinges and securing locks shall have lubrication nipples.

Weather tight minimum standard according to ISO 6042:2015 Weathertight single-leaf steel doors.

Weather tight steel doors for workshop and similar rooms on open deck shall have light opening approx. 700 mm.

Spray tight doors shall be built and certified according to relevant international standards

Spray tight doors for minor compartments shall have light opening of minimum 600 mm and sill height minimum 250 mm.

All external doors shall be arranged with framing of ARS.

Doors shall have hinges on the forward side as far as practical.

### **515 Side scuttles and windows with equipment**

Side scuttles and windows shall be arranged as indicated on the General Arrangement.

The wheelhouse shall be arranged with large, heated windows to give a good field of vision (ref. Table 5.4). Framing between wheelhouse windows shall be minimized.

Side scuttles shall be in accordance with International standard ISO 1751.

Standard windows shall be in accordance with International standard ISO 3903.

Inner windows where required for noise reduction shall be installed resiliently mounted in lining walls, without any direct rigid connection to the ship structure or the windows coamings. Any support of the window box shall be fixed to the inner lining or to the floating floors. Inner windows shall be openable for accessing openable windows, hinged deadlights and for cleaning and maintenance of windows.

For noise requirements, ref. [O Vibration and Noise Control](#).

The number of windows and dimensions in the tables below may vary according to the final arrangement.

Table 5.3 Side scuttles and windows

Area	Side scuttles		Standard Windows	Special Windows		Marine Glazing	
	Fixed	Openable		Qty.	Size LXH	Qty.	Size
Main Deck in ECR/ <a href="#">SWBD</a>				1	1000x600		
01-POOP Deck			18				
02-ACC. Deck			11				
03-ACC. Deck			20				
04-ACC. Deck			16				
05-ACC. Deck			15	4	1000x1500		

Table 5.4 Wheelhouse windows

Location	Qty.	Electric heated	Defrosting air	Wipers with heating ( <a href="#">de-icing device</a> )	Sun protection	Flushing
Forward	<a href="#">1517</a>	<a href="#">717</a>	<a href="#">1517</a>	<a href="#">717</a>	<a href="#">1517</a>	<a href="#">717</a>
Bridge wing each	6	6	6	6	6	6
Aft	<a href="#">914</a>	<a href="#">94</a>	<a href="#">914</a>	<a href="#">94</a>	<a href="#">914</a>	<a href="#">94</a>

Window wipers shall be installed according to Classification Society requirements and ISO 17899.

Window wipers shall be positioned below the windows, where applicable, for safe access during maintenance.

For flushing of fixed windows in the wheelhouse, spray nozzles with connection to the compressed air system and hot water hydrophore system shall be installed. A mixing valve for hot and cold water shall be arranged. Solenoid valves shall be used for air and water. Nozzle pipes shall be mounted inside bulkhead with branches to each fixed window.

Water supply for window flushing for all windows, shall be arranged in three (3) loops forward, one(1) loop each bridge wing and one (1) aft. Each loop shall have a separate solenoid valve for water supply and air blowing.

A common control system for window wipers, window flushing and wiper heating shall be supplied. [Wipers shall be equipped with speed control for continuous and intermittent action](#). Control panel(s) for each primary workstation shall be installed. The control panel in each primary workstation shall be able to control wipers relevant for that particular workstation.

Heated wheelhouse windows according to Classification Society requirements and ISO 3434 and 8863 as relevant shall be installed. Window heating shall be controlled by switches, at least one switch for each group of windows (ref. window flushing above and [791 Manoeuvre desks, main consoles, instruments](#)).

**516 Skylights with equipment****517 Insulation****Thermal Insulation**

General Type: Mineral wool, density: approx. 32 kg/m<sup>3</sup>

Alternative: Mineral or glass wool, lightweight type, density: approx. 18 - 26 kg/m<sup>3</sup>

All outer deck-heads, walls and bulkheads of steel, as well as ship sides shall be insulated towards all accommodation. Insulation shall be calculated according to environmental temperatures in D Performance, however as a minimum 150 mm thick mineral wool between stiffeners and 50 mm thick mineral wool around stiffeners shall be used.

The hot surfaces of all machinery, equipment, tanks and pipes operating at temperatures normally above 60° C shall be thermally insulated, as well as the flanges, valves and fittings of these piping. The ends of the thermal insulation of pipes near flanges, valves, fittings and supports shall be finished in such a way as to allow the bolts to be removed and the piping to be moved on their supports, in accordance with the Yard's practice to be approved by the Owner. Galvanized steel plates with a thickness of 0,4 mm shall be used for thermal insulation of tanks, machines, equipment and exhaust gas discharge of the thermal oil heater, main engine and auxiliary engines. The flanges, valves and fittings of insulated piping shall be thermally insulated with a mattress made of lined insulating material. The fuel oil settling tanks, fuel oil service tank, fuel oil storage tanks, purifier sludge tanks and Hot Water Tank and other heated tanks in the Engine Room, whose working temperature exceeds 60° C (except the side, bulkheads bordering tanks, double bottom tank top) and bulkheads below the double bottom tank top will be insulated with blankets or plates of insulating material, in accordance with the Yard's practice. The following regions shall also be isolated: ~~翠 Bulkheads and upper deck (if exposed to the sun) of the Emergency Diesel Generator compartment; TECHNICAL SPECIFICATION I-ET 4880.00-9311-000 PTD 001 REV.: 0 SHEET: 101 of 200 TITLE: TECHNICAL REQUIREMENT PRODUCT CARRIERS 18.000 DWT TP/DTM/EMTM/ENG/TEC/EST INTERNAL NP-1 翠~~

~~Bulkheads and upper deck (if exposed to the sun) of the clean firefighting agent bottle compartment; 翠 Bulkheads and upper deck of the Steering Gear Compartment. The thermal insulation will be designed to achieve a maximum temperature on its external surface of around 60°C, considering the temperature of the air in contact with this surface to be 45°C. The hot water piping for human consumption shall be insulated so that the minimum temperature of the return water is 51°C. The thermal insulation of the thermal oil, hot water, fuel and lube piping shall be insulated with rock wool or glass wool. The exhaust gas discharge piping shall be insulated with rock wool. The refrigerant gas piping shall be insulated with polyurethane foam (non-combustible type and certified) and covered with a single layer of raw cotton canvas fabric. The Yard shall design the thermal insulation so that there is no condensation on its external surface. All materials used as thermal insulation shall be in full compliance with the applicable rules (ref. SOLAS/FSS-FTP Code, Hong Kong Convention, 2009 / MEPC. 379(80)).~~

Insulation shall be fitted to the structure by means of steel studs and caps. Lining of steel bulkhead not exposed to weather or casings shall not have additional thermal insulation.

**Fire Insulation**

General type for bulkheads: Mineral wool, density: 90-130 kg/m<sup>3</sup>

General type under deck: Mineral wool, density: 90-130 kg/m<sup>3</sup>

General type on deck under floor covering: Mineral wool, density: 140-200 kg/m<sup>3</sup>

Fire insulation shall be installed, in compliance with the descriptions on the Type Approval certificate by the Classification Society or the National Authorities, on every horizontal or vertical divisions according to relevant rules and regulations.

### Noise Insulation

General Type: Mineral wool, normal density: approx. 60 - 80 kg/m<sup>3</sup>.

Special attention shall be paid to sound insulation of rooms in the accommodation bordering the following compartments:

- Casing
- Air Condition room
- Engine Control Room**
- Laundry
- Galley
- Mess & Day rooms/lounges
- Emergency Generator room

In addition special attention shall be paid to sound reduction:

- between cabins
- between cabins and corridors
- between cabins and offices
- between cabins and public spaces

### Floating Floor and dampening layers on deck

Floating floor based on mineral wool, visco-elastic layers and steel plates shall be applied as required for necessary sound reduction and vibration dampening. Constraining layer in wet-rooms may be exchanged with concrete compound. Installation details shall follow certificates, where fire rated floors are required.

~~For heating in floors, ref. 577 Central heating systems for accommodation and electric heating cables shall be installed. In wardrobe areas below wardrobe lockers shall also be covered with heating cables.~~

## 518 Ceiling

All deck heads or ceilings facing open air shall be insulated with mineral wool. Thickness and density of insulation shall be according to requirements.

All insulation shall have a suitable protective cover.

Ceiling heights shall be as given in the relevant rules and regulation, but as a minimum the heights as stated in MLC 2006.

Supports for the ceilings shall be resilient mounted to the deck beams.

## 52 Internal deck covering, stairs, ladders, railing

### 521 Underlay composition for interior deck cover

#### Underlay Composition for Interior Deck Cover

For description of the floating floor systems, ref. [517 Insulation](#).

If accommodation is located above machinery spaces of category A, a floating floor of A-60 class shall be provided.

## 522 Interior deck cover

~~In cabins, alleyways and locations not specially described, a vinyl deck cover of 2 mm thickness shall be fitted. Rubberized coating over the underlay composition shall be applied in:~~

~~Wood imitation vinyl shall be applied in:~~

- ~~Wheelhouse all cabins~~
- ~~Captain and Chief cabins infirmary~~
- ~~Mess room(s) offices~~
- ~~Day room(s) and lounges public areas (Mess room, lounges, auditorium, gymnasium, meeting room and similar compartments)~~
- ~~Auditorium control areas (Bridge, ECR and CCR)~~
- ~~accommodation corridors and staircases~~

Non-skid ceramic tiles shall be applied in:

- Wet rooms
- Galley and Pantry
- Store rooms in accommodation
- Garbage compartment

Flooring shall be of approved material and construction and have a non-slip, moisture proof and easy to clean surface.

Floors in refrigerated provision stores and freezer shall be provided with a suitable anti-slip surface.

The floor in the ~~switchboard~~ ECR and Cargo control room, shall be covered with non-slip rubber tiles of Classification Society approved type certified against the generation and spread of fire/smoke and with electrical insulation properties.

Raised floors shall be applied in wheelhouse, ~~switchboard rooms~~ and ECR. If necessary raised floor shall also be applied in Cargo Control room and offices.

All coating and colours shall be approved by the Owner.

All rooms where no coating is specified shall be painted as specified in the painting manual.

Yard and Owner shall be responsible for selecting materials in compliance with regulatory requirements and with necessary certification, for relevant compartments.

## 523 Internal gratings and rubber mats

If the deck is made of conducting material the passageways in front of and behind main and emergency switchboards shall be covered by mats or gratings of oil resistant insulating material.

Mats or tiles of oil resistant insulating material shall be installed in the ECR.

## 524 Stairs, ladders, railings and handrails in accommodation

Stairways and corridors used as means of escape shall be arranged with the required clear passage width per escape requirements as a minimum. Clear width shall be measured between handrails or between handrail and bulkhead.

Handrails in internal stairs and corridors shall be in accordance with the FSS-code or National Authority requirements.

All internal staircases shall be built in steel. The steps shall be covered with ~~vinyl or carpet~~ rubberized coating with noses of non-skid material. Handrails shall be mounted on both sides of every staircase and on one side (or 2 sides, depending on corridor width) in corridors and inside the wheelhouse.

## **525 Loose floor plates, platforms & ladders in engine & pump rooms**

Floor Plates or galvanized steel grating shall be provided where necessary in engine rooms, workshops, stores rooms etc. in order to provide easy and safe access to all working positions:

- Main passage/escape routes: 5 mm chequered steel plates or galvanized steel grating
- Elsewhere: 6 mm chequered aluminium plates or galvanized steel grating

Small flush hatches for access to piping and valves below, shall be arranged where necessary.

The plates shall be fastened onto angle steel profiles by countersunk stainless steel screws, or clamps where galvanized steel grating.

Inclined ladders (stairs) of steel with steps of galvanized steel grating shall be arranged.

Handrails in the engine room shall be of circular steel bars or pipes of suitable dimension, de-mountable where required.

All inclined ladders and stairways fitted with open treads in machinery spaces being part of or providing access to escape routes, but not located within a protected enclosure, shall be made of steel and they shall be fitted with steel shields attached to their undersides such as to provide escaping personnel protection against heat and flames from beneath.

## **526 Ladders, platforms & railing in ballast & fuel tanks**

Vertical ladders and intermediate platforms shall be mounted in all voids and tanks where required for safe access.

Internal ladders in coated tanks shall be galvanized and bolted with stainless steel bolts.

Vertical ladders in methanol tanks shall be of Acid Resistant Steel (ARS), AISI 316 L.

## **527 Platforms, ladders & railing in cargo tanks**

Vertical ladders and intermediate platforms shall be mounted in all tanks where required for safe access.

Internal ladders in coated tanks shall be galvanized and bolted with stainless steel bolts.

Vertical ladders in methanol tanks shall be of Acid Resistant Steel (ARS), AISI 316 L.

## **529 Emergency exits**

Stairways and corridors used as means of escape shall be arranged with the required clear passage width per escape requirements from FSS-code/National Authorities as a minimum, measured between handrails or between handrail and bulkhead. Hand rails in internal stairs and corridors shall be in accordance with the FSS-code/National Authorities requirements.

For emergency hatches, ref. 304 Smaller hatches, emergency hatches and manholes.

## **53 External deck cover, stairs and ladders**

### **531 External deck covering**

External deck covering shall not be provided. All exposed parts of steel deck shall be painted.

## 533 Handrails, railing, rail gates

Railings shall be arranged around the deck perimeters and superstructure as indicated on the General Arrangement.

The railing shall be made of hot dip galvanized steel pipe with stanchions of hot dip galvanized steel flat bars., ref. [276 Galvanizing](#). Stanchions shall be galvanized before mounting.

Stanchion flat bars shall be arranged on every 2<sup>nd</sup> frame. Every 2<sup>nd</sup> stanchion shall be equipped with a sloping bracket from the lowest row to the deck.

Handrails in the Accommodation shall be in accordance with requirements in the Fire Safety System code, and ref. [524 Stairs, ladders, railings and handrails in accommodation](#)

## 534 External platforms, stairs, ladders & grating with equipment

External ladders, platforms, stairs ladders and gratings shall be arranged as indicated on the General Arrangement.

External stairs shall be built of HP-profiles or standard side profiles with prefabricated, non skid steps.

All Istaïs and adders shall be hot dip galvanized steel and equipped with hot dip galvanized railings.

# 54 Furniture, inventory, entertainment equipment

## General

Furniture will be installed as indicated on the General Arrangement and in line with requirements from MLC and the National Authorities.

Furniture shall be made up as per European standard.

All beds to be arranged in longitudinal direction with head area facing forward.

Furniture and fittings shall be of durable marine construction and quality and shall match with the decorative arrangement of the intended space. In general fixed furniture shall be made of laminated plywood construction, edged with hardwood lists.

All items shall be strengthened with reinforcing panels, channels, angles etc. where necessary to ensure proper rigidity. Where required, furniture shall be fitted with a durable and effective securing device to prevent movement.

Hat and coat hooks shall be fitted in cabins, public spaces and toilets.

Builders suggested colour scheme for furniture, drapes and deck coverings shall be subject to Owner's approval.

For lighting and power supply to minor electrical equipment (receptacles), ref. [892 Electrical installations in accommodation](#).

## 541 Furniture for crew

### General

Accommodation throughout shall be provided with furniture according to the rules and regulations. Unless otherwise specified, main material for bunks, drawers, desks, wardrobes similar furniture, shall be of plywood with laminated surfaces.

Drawer fronts and profiles shall be of solid wood, such as beech or similar. Tables and work desks shall have plastic laminate surface, equipped with fiddle guard and placed on fixed sockets

throughout accommodation. All work desks shall be equipped with reading lamps. Outlets for power and network shall be provided above all work desks (ref. <broken cross-reference>).

Upholstery throughout the vessel shall be flame retardant. Decorative loose pillows with leather skin of high quality shall be supplied for sofas. Type and colour of furniture shall be approved by the Owner.

The accommodation shall be provided with hooks, handle and straps according to common practice. Wardrobe lockers shall have hooks, handles and hangers. Drawers shall be secured against wobbling.

Paper and trash bins shall be provided for each cabin, office and day room.

Precautions shall be made in order to avoid mounting of sound emitting alarm devices on bulkheads dividing adjacent cabins.

#### Crew cabins

Crew cabins shall be provided with the furniture complying with minimum requirements as listed below.

Table 5.5 Minimum requirements for cabin furniture MLC 2006

Minimum inside dimension for bunks	2000 x 800 mm
Minimum dimension for wardrobe	475 litres (600x500x1900 mm)
Minimum volume for drawers	0,056 m <sup>3</sup>

#### Captain, Chief engineer- and Chief officer cabins sleeping area:

~~One (1) Sofa~~

~~One (1) Coffee table~~

~~Two (2) Relaxing chairs, leather~~

~~One (1) Writing desk with lockable filing lockers~~

~~One (1) Lockable archive/safe (Captain's cabin only)~~

~~One (1) Office chair~~

~~One (1) Bookshelf for A4 bindings~~

~~Two (2) bulkhead hangers~~

~~One (1) Built in refrigerator with room for bottles and glasses~~

~~One (1) Section/shelf for audiovisual equipment~~

- One (1) Double lockable wardrobe approx. 900 x 600 mm
- One (1) simple closet
- One (1) queen-size bed with four drawers
- Two (2-) bedside tables
- ~~One (1) chair with armrest~~
- ~~Two (2) bulkhead hangers~~
- One (1) smart 43" 4K LED TV
- One (1) 5.1 channel home theater, Bluetooth
- One (1) Fully equipped WC/shower, ref. 583 Bathtubs, showers, WC, washbasins.

#### Senior Officers' cabins:

~~One (1) Sofa~~

~~One (1) Side table~~

~~One (1) Writing desk with lockable filing drawers~~

One (1) Relaxing chair, leather  
 One (1) Double lockable wardrobe approx. 900 x 600 x 1900 mm  
 One (1) simple closet  
 Two (2) bulkhead hangers  
 One (1) double bed with two drawers  
 One (1) bedside table  
 One (1) Shelf for audiovisual equipment  
 One (1) smart 43" 4K LED screen  
 One (1) 5.1 channel home theater, Bluetooth  
 One (1) Fully equipped WC/shower, ref. 583 Bathtubs, showers, WC, washbasins.

**Officer class cabins:**

- One (1)- Three-seater Sofa with armrests  
One (1) Side table
- One (1) chair with armrests
- One (1) Writing computer desk with lockable drawer
- One (1) bulkhead desk with one drawer
- One (1) Double lockable wardrobe approx. 900 x 600 mm
- One (1) Book shelf with room for audiovisual equipment
- One (1) double bed with two drawers
- One (1) bedside table
- Two (2) bulkhead hangers
- One (1) 43" smart LED screen TV
- One (1) domestic refrigerator. 100 liter capacity
- One (1) Fully equipped WC/shower, ref. 583 Bathtubs, showers, WC, washbasins.

**Petty Officer class cabins deck 04 and Petty officer class cabins deck 03 (cadets):**

- One (1) Three-seater Sofa without armrests  
One (1) Side table
- One (1) chair with armrests
- One (1) Writing simple bulkhead desk with lockable drawer
- One (1) Book shelf with room for audiovisual equipment
- One (1) double widows bed with two drawers
- One (1) bedside table
- One (1) simple single size closet (> 500 l)
- Two (2) -bulkhead hangers
- One (1) 32" smart LED screen TV
- One (1) domestic refrigerator. 46 liter capacity
- One (1) Fully equipped WC/shower, ref. 583 Bathtubs, showers, WC, washbasins.

**Petty Officer class cabins deck 03 (bosun/health assistant):**

- One (1) Three-seater Sofa without armrests
- One (1) chair with armrests
- One (1) desk with a drawer
- One (1) Book shelf

- One (1) single bed with two drawers
- One (1) bedside table
- Two (2) single size closet (> 500 l)
- Two (2) bulkhead hangers
- One (1) 32" smart LED screen TV
- One (1) domestic refrigerator. 46 liter capacity
- One (1) Fully equipped WC/shower, ref. 583 Bathtubs, showers, WC, washbasins.

**Rating class cabins:**

- One (1) Three-seater Sofa without armrests
- ~~One (1) Side table~~
- One (1) chair with armrests
- One (1) ~~Writing simple bulkhead~~ desk ~~with lockable drawer~~
- One (1) Book shelf ~~with room for audiovisual equipment~~
- One (1) ~~double-widows~~ bed with two drawers
- One (1) bedside table
- One (1) simple single size closet (> 500 l)
- Two (2) bulkhead hangers
- One (1) 32" smart LED screen TV
- One (1) domestic refrigerator. 46 liter capacity
- One (1) Fully equipped WC/shower, ref. 583 Bathtubs, showers, WC, washbasins.

**Official class cabins (Owners and Pilot cabin):**

- One (1) Three-seater Sofa with armrests
- One (1) chair with armrests
- One (1) ~~Writing computer~~ desk ~~with lockable drawer~~
- One (1) ~~Bookshelf desk~~ with ~~room for audiovisual equipment~~ a drawer
- Two (2) Single beds with two drawers
- Two (2) bedside tables
- Two (2) double-sized ~~closet~~ closets
- Four (4) -bulkhead hangers
- One (1) Fully equipped WC/shower, ref. 583 Bathtubs, showers, WC, washbasins.

**Workers class cabins:**

- Two (2) Bunk beds
- Three (3) Industrial double steel closets
- Six (6) bulkhead hangers

**Captain's Officer's, Chief Officer's and Chief Engineer's Lounge/ Sitting Room**

- One (1) Three-seater Sofa with armrests
- Two (2) chair with armrests
- One (1) ergonomic office ~~chai~~ chair
- One (1) coffee table
- One (1) ~~Book Wall~~ shelf
- One (1) Filing cabinet
- One (1) microcomputer desk

- Two (2) Corner Tables
- Six (6) bulkhead hangers
- One (1) Drawer cabinet
- One (1) domestic refrigerator, capacity 100 liters

### **Living rooms**

Public areas shall be arranged as shown on the General Arrangement. Chairs and sofas shall be delivered according to list below:

One day room/lounge may be arranged as a smoking area. If such area is prepared, a separate exhaust fan shall be arranged, ref. [579 Ventilation/AC systems for various compartments](#).

Sofas and chairs in day rooms shall have upholstery of foam plastic and covered with imitation leather. Chairs in mess room shall have upholstery of imitation leather.

Final dimension of furnitures shall be as shown on the accommodation drawings.

The tables shall be of laminated plywood and equipped with hard wood or vinyl edging.

### **Mess**

The mess shall be arranged for approx. 30 persons and be equipped with:

- Five (5) dining tables with 6 (six) seats
- Thirty (30) chairs with arms
- One (1) utensil cupboard
- Twelve (12) bulkhead hangers
- One (1) water bottle holder with cooling
- Two (2) drawer cupboards
- One (1) hot self-service counter
- One (1) cold self-service counter
- Two (2) support benches
- One (1) ice machine (without manual contact)
- One (1) Rack for dish washing baskets for used cutlery, ref. [552 Equipment and outfitting in galley](#).
- Serving equipment, ref. [553 Crew mess and dayrooms equipment](#).

### **Officers living room**

- Two (2) three-seater sofas with armrests
- Two (2) armchairs
- Two (2) corner tables
- One (1) coffee table
- Two (2) games tables
- Eight (8) chairs with armrests
- Six (6) bulkhead hangers
- One (1) 55-inch 4K smart TV
- One (1) 5.1 channel home theater, Bluetooth
- One (1) bluetooth speaker
- Clothing hooks

### **Rating living room**

- Two (2) three-seater sofas with armrests
- Two (2) corner tables
- One (1) coffee table
- Two (2) games tables
- Eight (8) chairs ~~with~~ without armrests
- Six (6) bulkhead hangers
- One (1) 55-inch 4K smart TV
- One (1) 5.1 channel home theater, Bluetooth
- One (1) bluetooth speaker
- Clothing hooks

### **Smoking room**

- Two (2) three-seater sofas with armrests
- Two (2) corner tables
- One (1) coffee table
- Four (4) bulkhead hangers

### **Auditorium**

- Twenty (20) chairs with armrests in modules
- One (1) 55-inch 4K smart TV
- One (1) 5.1 channel home theater, Bluetooth
- One (1) ceiling projection device
- One (1) whiteboard for projection and notes
- One (1) network point
- One (1) raised table on a platform

### **Gymnasium**

- One (1) bodybuilding machine (multi-exercise)
- One (1) treadmill for running
- One (1) exercise bike
- One (1) mirror across the width of the bulkhead
- One (1) smart 43" 4K LED TV
- One (1) Bluetooth stereo
- One (1) water bottle holder with cooling
- Clothing hooks

**Gymnasium equipment shall be according to recognised fitness standard brands.**

### **Captain's office**

- One (1) L-shaped table for a microcomputer with a drawer
- One (1) ergonomic rotating office chair
- Two (2) armless chairs
- One (1) filing cabinet with drawers
- One (1) cupboard with shelf:
- Four (4) bulkhead hangers
- One (1) clavicle (keybox)
- One (1) network connection point

**Internet room**

- Three (3) microcomputer tables with rotating chairs
- Two (2) armless chairs
- One (1) printer table

**Meeting room**

- One (1) meeting table for 10 people
- Ten (10) chairs with armrests
- One (1) tall cupboard with shelves and doors
- One (1) magnetic whiteboard for notes
- One (1) SMART TV LED 55"
- One (1) videoconferencing device
- One (1) network connection point

**Changing room with toilet at the access to the Engine Room**

- Two (2) washbasins
- Two (2) mirrors
- One (1) dispenser for liquid soap
- Two (2) paper towel dispensers
- One (1) waste garbage can with lid and pedal
- Two (2) safety handles
- One (1) shower and plastic curtain
- Six (6) bulkhead hangers
- One (1) industrial steel closet with individual doors for 18 crew members
- One (1) wooden bench with 4 (four) seats
- One (1) washbasin
- One (1) paper towel dispenser
- One (1) waste garbage can with lid and pedal
- One (1) simple mirror
- One (1) toilet
- One (1) toilet paper holder
- One (1) dispenser for liquid soap
- One (1) paper towel dispenser
- One (1) waste garbage can with lid and pedal

**Changing room at the entrance to the accommodation on the main 01 Poop deck**

- Two (2) washbasins
- Two (2) mirrors
- One (1) dispenser for liquid soap
- Two (2) paper towel dispensers
- One (1) waste garbage can with lid and pedal
- Two (2) safety handles
- One (1) shower and plastic curtain
- Six (6) bulkhead hangers
- One (1) industrial steel closet with individual doors for 18 crew members

- One (1) wooden bench with 4 (four) seats

#### **Public toilets**

- One (1) washbasins
- One (1) single mirror
- One (1) toilet
- One (1) toilet paper holder
- One (1) dispenser for liquid soap
- One (1) paper towel dispenser
- One (1) waste garbage can with lid and pedal
- One (1) safety handles

#### **Cargo Control Room combined with Vessel's Office and Engine Room Supervision**

- Integrated control system comprising 3 (three) workstations with mouse, keyboard and 26" LED monitor.
- One (1) console for installing workstations and other CCR equipment
- One (1) standard microcomputer for the stress calculator function
- Three (3) microcomputer tables with a drawer.
- Five (5) ergonomic swivel office chairs
- Two (2) VHF control units (system I and II)
- Two (2) automatic telephones (independent)
- One (1) self-powered phone
- One (1) control unit with microphone and 1 (one) loudspeaker for the sound diffusion system
- One (1) clinometer
- One (1) watch
- One (1) draft indicator with interface to the integrated load and ballast control system
- One (1) portable self-contained breathing apparatus
- Three (3) filing cabinets with drawers
- One (1) cupboard/shelf
- One (1) printer table
- Eight (8) bulkhead hangers
- One (1) clavicle (keybox)

#### **Firefighting Station ("ECI") / Firefighting equipment storage room**

- Fire-fighting system equipment
- 2 (two) layers of wooden shelves with protective bars
- Space for storing spare portable fire extinguishers in quantity as defined by SOLAS
- **Below main deck**

For switchboard/control room/ECR for machinery, ref. 542 Wheelhouse, Navigation/Radio room, Office furniture/equipment.

## **542 Wheelhouse, Navigation/Radio room, Office furniture/equipment**

#### **Wheelhouse**

The wheelhouse shall have shape and size as shown on the General Arrangement.

Concerning floors, walls, bulkheads and ceilings, the insulation and lining, ref. 51 Insulation, partition bulkheads, ceiling, doors, side scuttles, windows.

Crossbars between windows shall have lining.

In the wheelhouse work stations shall be arranged, ref. 791 Manoeuvre desks, main consoles, instruments.

Additional work station(s):

- Office area

Pilot Chairs:

- Two (2) chairs on rails for the pilots.

Additional equipment/ furniture:

- One (1) 100l refrigerator
- One (1) three-seater sofa
- One (1) domestic electric coffee machine
- One (1) desk with chair
- An ergonomic office chair
- Four (4) Single chairs
- One (1) clavicle (keybox)
- One (1) whiteboard
- Book shelf arrangement according to Owner's recommendation
- Binocular boxes (forward and aft)
- Flag locker/ cabinet

Electric cabinets and signal light controllers shall be fitted in a suitable place. The arrangement should be carried out as practical and surveyable as possible and according to the Yard's practice.

### **Navigation room and radio space**

The Navigation and radio space shall be arranged as part of the wheelhouse. The navigation space shall be equipped according to common practice and provided with a planning station consisting of a combined writing and chart table with a breadth of at least 1.30 m.

The table shall have minimum one lockable drawer.

Over the chart table a suitable chart lamp shall be fitted.

A curtain shall be installed around the radio/chart "room", if required by the National Authorities. The curtain(s) should be stored in a position that does not reduce the required field of vision from workstations.

### **Engine Control Room (ECR)**

~~The design of the ECR shall provide space for the future installation of an additional column in the MSB to interconnect the main 440 Vac bus with a future onshore power supply system (cold ironing), maintaining good conditions and space for circulation in the ECR, operation and maintenance of the installed equipment. The design of the ECR room shall provide space for the future installation of an additional column in the MSB to interconnect the main 450V bus with a future onshore power supply system (cold ironing), maintaining good conditions and space for circulation in the ECR, operation and maintenance of the installed equipment.~~

~~ECR-The room~~ shall be thermal insulated as required.

The ECR ~~area~~ shall be equipped with:

[450V Main switchboard](#)[220V Main switchboard](#)[Frequency system for cargo handling](#)[ECR Desk](#)

A desk with a chair.

An ergonomic office chair

~~An independent air conditioning unit: 578 Central cooling systems~~

1 (one) domestic refrigerator with a capacity of 100 liters (approx.)

1 (one) domestic electric coffee machine

2 (two) single chairs

2 ~~(two)~~ lockable cupboards for special equipment and electronics.

1-~~(one)~~ Clavicle.

1-~~(one)~~ Whiteboard.

1 (one) drinking fountain with support for a 20-liter water bottle with cooling

### **Cargo Control Room combined with Vessel's Office and Engine Room Supervision**

CCR shall be thermal insulated as required.

The CCR shall be equipped with:

- Integrated control system comprising 3 (three) workstations with mouse
- Keyboard and 26" LED monitor.
- 1 (one) console for installing workstations and other CCR equipment.
- 1 (one) standard microcomputer for the stress calculator function.
- 3 (three) microcomputer tables with a drawer.
- 5 (five) ergonomic swivel office chairs.
- 2 (two) VHF control units (system I and II).
- 2 (two) automatic telephones (independent).
- 1 (one) self-powered phone.
- 1 (one) control unit with microphone and 1 (one) loudspeaker for the sound diffusion system.
- 1 (one) clinometer.
- 1 (one) watch.
- 1 (one) draft indicator with interface to the integrated load and ballast control system.
- 1 (one) portable self-contained breathing apparatus.
- 3 (three) filing cabinets with drawers.
- 1 (one) cupboard/shelf.
- 1 (one) printer table.
- 8 (eight) bulkhead hangers.

### **543 Linen and mattresses**

Spring mattresses with a fire proof cover shall be delivered for all beds.

Pillows, bedcovers and linen shall be delivered by the Owner, ref. [M Owner Furnished Equipment](#).

### **544 Curtains with equipment**

All windows and port holes, except in wheelhouse and galley, shall be provided with curtains. All windows in cabins shall have sun proof blinds in addition to curtains.

Curtains shall be arranged for beds in cabins for more than one person according to rules and regulations. The curtains shall be flame retardant.

All windows in wheelhouse, mess and day room shall have sun shielding shades, ref. [515 Side scuttles and windows with equipment](#).

Colour, textures and patterns shall be approved by the Owner.

## **545 Decorations**

Decorative flower or plant arrangements, statues or other objects of art such as paintings etc. shall be supplied by the Owner, ref. [M Owner Furnished Equipment](#). The Yard shall assist in mounting the pictures and decorations, ref. [126 Assistance with owner's supply](#).

## **546 Hobby, sports & entertainment equipment**

### **Entertainment equipment**

Above the superstructure on highest deck a satellite antenna system for TV and radio shall be installed.

Internal TV (satellite) reception and distribution system with DVD - including stabilized Ku-band reception antenna, "tracing" system and signal distribution in cabins and collective rooms.

The signals shall be distributed via a central unit, ref. [855 Common computer systems](#). The system shall include:

- 1,2 meter parabolic antenna (marine gyro stabilized), The antenna shall be mounted ensuring continuously signal reception, as far as possible.
- Distribution throughout the vessel through an IPTV gateway
- Three (3) transponder interfaces prepared for Conditional Access Multicam cards. The system shall to provide a user-friendly and cost-effective integrated solution with the following functions:
  - Satellite TV
  - Satellite Radio
  - Info channel

Cabins in 05-Acc. Deck and lounges to have installed 55" Televisions connected to the Satellite TV system.

## **55 Galley, messes, provision room and laundry arrangement and equipment**

### **551 Galley machinery**

The capacity of the galley equipment shall be suitable to serve 36 persons.

Galley equipment shall be arranged for efficient service-logistics and high hygienic standards. The equipment shall be made of stainless steel where required.

The arrangement of equipment and selection of materials and finish details shall comply with relevant applicable public health regulations, and shall be provided with details for marine use (like storm rails).

The following equipment shall be fitted in the galley:

- One (1) four-plate electric stove with oven attache (approx. 20 KW)
- One (1) stainless steel galley hood with grease filter on the stove and fryer, in accordance with ABNT NBR 14518
- One (1) electric oven of around 8 KW with two chambers

- One (1) electric steam boiler type with 50 liter capacity
- Two (2) duplex refrigerators with capacity of 450 liters
- One (1) universal mixer with stainless steel container with a capacity of 20 liters
- One (1) water heater (float) with a capacity of 10 liters
- One (1) 8-10 liter/7,2 kW electric fryer (with fire extinguishing protection devices approved in accordance with SOLAS)
- One (1) automatic electric cold cuts slicer
- One (1) drinking fountain with support for a 20-liter water bottle with cooling
- One (1) industrial blender
- One (1) kitchen worktop cabinet with 1 stainless steel sink and garbage disposal
- One (1) food preparation table with a stainless steel top and stainless steel bowls at the bottom
- One (1) pot rack
- One (1) general purpose shelf
- One (1) industrial dishwasher
- One (1) stainless steel tank with hose for washing pans
- One (1) stainless steel worktop with 1 (one) garbage can with garbage disposal
- One (1) dish drainer (approx. 40 plates and glasses)
- One (1) cupboard for storing devices
- One (1) defrosting unit
- One (1) Can opener,

Power supply for the equipment shall be according to [Table 8.6](#).

Some of the equipment mentioned above may be placed in the Mess room in accordance with the final arrangement drawings.

## 552 Equipment and outfitting in galley

### General

The catering spaces shall be equipped with benches, drawers and wall cabinets in stainless steel, in areas indicated on the General Arrangement, dimensioned and equipped according to capacity, function and concept of the vessel. Drawers and lockers shall be arranged to common practice and as place permits.

Fire protection shall be arranged according to Classification Society and National Authorities requirements, ref. [815 Fire fighting systems with gas, in 8 Ship Common systems, in LEVEL 0 SFI Master](#).

Plug sockets for machinery shall be arranged.

Washing equipment, ref. [583 Bathtubs, showers, WC, washbasins](#).

A complete galley plan with location of equipment, benches, drawers, shelves and cabinets shall be made by the Yard and approved by the Owner before production and purchase can commence.

A complete set of utensils (e.g. pots, pans, cutlery) to prepare and serve food shall be specified by Owner and purchased by the Yard.

### Galley and mess room serving equipment

For galley and mess room serving equipment, ref. [553 Crew mess and dayrooms equipment](#).

## 553 Crew mess and dayrooms equipment

The mess and dayrooms/lounges shall be arranged as shown on the General Arrangement.

Furniture as sofas and chairs shall be of the quality mentioned in 54 Furniture, inventory, entertainment equipment.

Drinking water cooler in service areas and accommodation ref. 584 Drinking water coolers.

### Pantry as part of Mess room

- One (1) duplex refrigerator, domestic type, with a capacity of 450 liters
- One (1) electric coffee maker, domestic type
- One (1) automatic electric toaster, in stainless steel, for 4 slices
- One (1) microwave oven with a capacity of 17 liters
- One (1) utensil cupboard
- One (1) countertop cabinet with sink, in stainless steel, with hot and cold fresh water and cupboard at the bottom.

## 554 Freezing/refrigerating systems for provisions

### General

Refrigerating, cooling and dry provision rooms shall be arranged according to the General Arrangement and Table 5.6.

Table 5.6 Provision rooms

Type	Quantity	Temperature (approx.)	Size (approx.)
Antechamber	1	+4°C	12m <sup>3</sup>
Dry provision room	1	+10°C Ref. internal conditions in Table 5.9	52m <sup>3</sup>
Vegetable/dairy chamber	1	+2°C	16aream <sup>3</sup>
Freezer provision rooms for fish	1	-18°C	16m <sup>3</sup>
Freezer provision rooms for meat	1	-18°C	16m <sup>3</sup>

The ceiling height in the provision rooms shall be approx. 2050 mm.

### Freezing and cooling systems for provision

A refrigerating plant for the provision rooms shall be installed and meet the following requirements:

- Fully automatic
- One(1) set of two(2) 100% capacity air-cooled compressors having the capacity to maintain the specified temperatures by operating maximum 14 hrs/day. The compressors shall be "stand-by" for each other.- During "cooling down" the two units will operate simultaneously;
- Cooling/ refrigerant medium compliant with Classification Society requirements
- Cooling elements equipped with electric de-icing with driptray underneath
- Insulated refrigerant pipes between freeze/ cool units and compressors (capped with stainless thin plates where pipes lay open in rooms)
- Local reading of temperatures outside of each room.
- Remote temperature reading of the provision rooms in the galley
- Automatic electric defrosting shall be arranged, with drain to scupper
- Heating cables in drain pipes and scuppers in the freezer room

- The refrigeration plant shall be resiliently mounted.
- "Locked in alarm" ref. 795 Automation equipment for diesel generators.

The freezing and cooling compartments shall be located according to GA, and in such a manner that they are not exposed to sunlight to avoid direct sun radiation.

Air curtain shall be arranged to minimize the ingress of humidity and maintain the internal temperature.

The lights in the chambers/compartments shall operate automatically, switching on when the access doors are opened and switching off when they are closed again.

Each chamber/compartment shall be cooled by means of 1 (one) evaporator made up of 1 (one) evaporation coil and 1 (one) electric fan that will recirculate the air. The materials used shall be in accordance with the manufacturer's standards.

The units shall be designed so that the refrigerant in the condensers is sub-cooled.

An electronic controller shall be provided to monitor the temperatures in the cold rooms, with local alarms and logs and an IAS fault alarm. The chambers/compartments shall have an adjustment thermostat and thermometers that shall be easy to read and calibrate, with a display installed on the outside of the anteroom.

## 555 Insulation, lining & battenning in provision rooms, doors & ports

### Insulation provision rooms

Table 5.7 Insulation of provision rooms

Room	Floor	Bulkhead	Ceiling
Dry provision room	Polyurethane plates or concrete with anti-slip surface	70-75 mm prefabricated polyurethane panels (approx. U-value of 0,29 W/m <sup>2</sup> K)	70-75 mm prefabricated polyurethane panels (approx.U-value of 0,29 W/m <sup>2</sup> K)
Cooler provision room	approx. 100 mm Polyurethane plates covered with anti slip surface	100 mm prefabricated polyurethane panels (approx. U-value of 0,22 W/m <sup>2</sup> K)	100 mm prefabricated polyurethane panels (approx. U-value of 0,22 W/m <sup>2</sup> K)
Freezer provision rooms	approx. 100 mm Polyurethane plates covered with anti slip surface	100 mm prefabricated polyurethane panels (approx. U-value of 0,22 W/m <sup>2</sup> K)	100 mm prefabricated polyurethane panels (approx. U-value of 0,22 W/m <sup>2</sup> K)

Alternative solutions providing equivalent thermal resistance with mineral wool application on steel structure may be considered (see table below). All lining and ceiling shall be of stainless steel plates.

Table 5.8 Alternative insulation of provision rooms

Room	Floor	Bulkhead	Ceiling
Dry provision room	concrete with anti-slip surfaces	2 x 100 mm Mineral wool	2 x 100 mm Mineral wool
Cooler provision room	Mineral wool covered with compound and anti slip surface	2 x 100 mm Mineral wool	2 x 100 mm Mineral wool
Freezer provision rooms	Mineral wool covered with compound and anti slip surface	3 x 100 mm Mineral wool	100 + 150 mm Mineral wool

Hard, durable, non-absorbent deck covering, like tiles or stainless steel plate with non-skid pattern, shall be installed in provision rooms, with attention to pallet handling equipment routes. Light

~~coloured painted steel may be an option in transportation corridors, provision passageways and dry storage areas. All materials applied to lining and insulation to be certified in compliance with SOLAS and Hong Kong convention/MEPC.379(80).~~

~~Provision room doors, ref. Hard, durable, non-absorbent deck covering, like tiles or stainless steel plate with non-skid pattern, shall be installed in provision rooms, with attention to pallet handling equipment routes. Light coloured painted steel may be an option in transportation corridors, provision passageways and dry storage areas. Provision room doors, ref. 512 Internal Doors.~~

## 556 Walls, bins, shelves, racks, grating & inventory in provision rooms

The following shall be provided in the dry provision room:

- ~~Shelves as indicated on the General Arrangement or as space permits. Shelves shall be of stainless steel, Shelves as indicated on the General Arrangement or as space permits. Shelves shall be of stainless steel, or of material as agreed between the Owner and Yard. or of material as agreed between the Owner and Yard.~~

## 558 Laundry, ironing and drying equipment

The Common laundry shall be provided with:

- One (1) electric industrial washing machine with a capacity of 30 kg
- One (1) combined washing machine and dryer
- One (1) A semi-industrial with a minimum capacity of 10 kg
- ~~One (1) Industrial type electric rotary dryer, with a capacity of 20 kg~~  
~~One (1) Industrial-type electric rotary dryer, with a capacity of 20 kg~~
- ~~One (1) Rotary clothes press, with a roller with 1,800 mm roll~~  
~~One (1) Rotary clothes press, with a roller with 1,800 mm roll~~
- ~~One (1) tall steel cabinet~~  
~~One (1) tall steel cabinet~~
- ~~One (1) ironing board~~  
~~One (1) ironing board~~
- ~~One (1) bench for folding clothes~~  
~~One (1) bench for folding clothes~~

~~The Support laundry shall be provided with:~~  
~~The Support laundry shall be provided with:~~

- ~~Two (2) 10kg domestic washing machines and dryers~~  
~~Two (2) 10kg domestic washing machines and dryers~~
- ~~One (1) cupboard for cleaning products~~  
~~One (1) cupboard for cleaning products~~
- ~~One (1) two person sit bench~~  
~~One (1) two person sit bench~~

~~The Drying compartment shall be provided with:~~  
~~The Drying compartment shall be provided with:~~

- ~~One (1) clothesline with hooks and nylon threads (total of 5 clotheslines for drying clothes)~~  
~~The parts of the clothesline in contact with the clothes will be mostly plastic or stainless steel~~  
~~One (1) clothesline with hooks and nylon threads (total of 5 clotheslines for drying clothes)~~  
~~The parts of the clothesline in contact with the clothes will be mostly plastic or stainless steel~~
- ~~One (1) electric heater~~  
~~One (1) electric heater~~

Scuppers and washbasins ref. 583 Bathtubs, showers, WC, washbasins

Power supply for the equipment shall be according to Table 8.5

All the washing machines and tumble dryers shall be installed about 100 mm above floor on vibration free dampers, preferably as tower models with tumble dryer on top of washing machine.

## 56 Lifting and transport equipment

### 563 Provision cranes and derricks

Ref. 331 Rotating cranes with crane pillars.

### 564 Pilot ladder, accommodation ladder, gangway

Two (2) accommodation ladders,

made of aluminum alloy and powered by pneumatic motors, shall be provided, and located at midship, aft of cargo manifolds.

A gangway

made of aluminum alloy shall be provided, with a length compatible with the vessel's dimensions (at least 6 m) and 600 mm wide, with railings, guide cable and accessories, stowed on main deck within reach of the deck cranes. The stowage of the ladder on the main deck shall be of the sliding type on rails and not the folding type.

Two (2) pilot ladders

will be provided, adequately stowed on deck, which shall meet the requirements of the Rules, Conventions, Recommendation and standards mentioned in item 2.4.1 of this specification.

Arrangements will be made on the vessel's guardrails, on both sides, to allow the use of the pilot ladder in conjunction with the accommodation ladder, in a combined manner when required, as per SOLAS Convention.

Fittings will be installed on the ship side plating to secure the ladders (accommodation and pilot) to the shell plating, as required by SOLAS.

All ladders and gangways and their respective arrangements shall comply with the ISO standards intended for this purpose and the latest revisions of the IMPA (International Maritime Pilot Association) recommendations.

Provisions to keep the Pilot Transfer Arrangement adjacent at all times to ship's hull to be provided at different positions ("sunken eyes").

## 57 Ventilation, air-conditioning & heating systems

### General

All ventilation shall be in accordance with Classification Society and National Authorities' requirements.

The air conditioning shall be by DX system for accommodation and self-contain fan-coil units were applicable elsewhere.

Air inlets and outlets (unless stated otherwise):

- Supply and exhaust air ducts shall be arranged from and to open deck.
- Air inlets and outlets shall be separated to avoid contaminated air in inlet openings.
- Inlet louvres shall be of mist eliminator/ droplet separator type.

- Outlet louvres shall be of single stage weather louvre type protecting the duct from rain and light sea spray.
- Louvres exposed to hard weather shall be of seawater resistant aluminium and arranged with efficient drainage. Closable hatches and fire dampers shall be fitted as per regulations.
- Exhaust and natural ventilation may also be ventilated through a ventilation-hood/mushroom

### Design conditions

Table 5.9 HVAC Design Conditions

Basis for calculations	Dry bulb temperature	Corresponding humidity	Remarks
Summer internal	+23°C	50%	
Summer external	+35°C	70%	
Winter internal	+20°C	50%	
Winter external	-10°C	75%	

Reference is made to the following design conditions:

- Sea Water and Fresh Water Temperatures, ref. [72 Cooling systems](#)
- Power supply, ref. [Table 8.6](#)

### Standards

The following international standards shall be used in their latest editions:

- ISO-7547 Ships and marine technology - Air-conditioning and ventilation of accommodation spaces and other enclosed compartments on board ships - Design and basis of calculations
- ISO-8861 Shipbuilding - Engine-room ventilation in diesel engined ships - Design requirements and basis of calculations
- ISO 9943 Shipbuilding – Ventilation and air-treatment of galleys and pantries with cooking appliances

All exceptions and deviation from standards and building specification shall be defined.

### Ventilation for Methanol fuel system, ducts & rooms

~~All rooms where methanol fuel leakage may occur shall be ventilated according to the Classification Society and National Authorities requirements.~~

### Ventilation Control system(s)

One automated control system shall be delivered for the HVAC system.

One local central HVAC operator station with full control and overview of the HVAC system shall be provided (location shall be agreed with owner) and one HMI touchscreen (minimum 24") shall be installed in HVAC control cabinet door. The OS shall have user-based access control login.

The HVAC local control system shall provide automatic operation of the HVAC system as well as full manual control when needed. The automatic functions shall ensure energy efficient operation and high comfort on board without user interaction.

Further, the HVAC control system shall provide sufficient separation to follow the general redundancy philosophy for the HVAC system. Operation and control of the system shall be possible locally on the control panel(s) and starter(s).

Common- and safety critical alarms shall be interfaced with the IAS alarm system.

The ventilation control system integration level, shall include:

- Common and safety critical alarms with timestamp and running signals for the main

equipment including monitoring of system status and available energy and sensor data, as well as control of the main parameters and setpoints for automatic operation.

- IAS Interface to other compartments (e.g. Fan Start/Stop/running/Failure/Remote/ indication), either as hardwired signals or on Modbus RTU communication link to ventilation control system. (Limited to 400 IAS IO-signals. Mimic in vessel IAS system)

## 571 Ventilation/AC systems for accommodation

### Location and construction of ventilation plant

All accommodation spaces shall be air-conditioned. Return air from cabins and living rooms shall be lead partly through sanitary spaces and partly through grilles at lower part of the entrance doors. Return air shall be lead back to the AHU(s) for the accommodation.

The supply and exhaust system shall be of low-velocity type of maximum 15m/s

In general, all starters for ventilation fans serving accommodation areas shall be located in the HVAC room.

Table 5.10 Ventilation overview

Space	Type of ventilation	Air changes/h	Supply fan	Exhaust fan	Remarks
Cabins	AHU	6	AHU		Exhaust partly trough sanitary room and grill in cabin door back to AHU
Sanitary rooms in cabins	AHU	20	AHU (From cabin)		Separate pipes for sanitary rooms back to AHU
Public sanitary rooms	AHU	20	AHU		Separate pipes for sanitary rooms back to AHU
Hospital (Infirmary)	AHU/ Mechanical	8	AHU	1	Exhaust to open deck (Underpressure in room according to requirements)
Support laundries	AHU/ Mechanical	10	AHU/Natural		Tumble driers shall have exhaust to open deck
Linen Laundry	AHU/ Mechanical	10	AHU/Natural	1	Tumble driers shall have exhaust to open deck
Gymnasium	AHU	10	AHU		
Messroom, dayroom(s)	AHU	10	AHU		
Smoking room	AHU/ Mechanical	20	AHU	1	The fan shall have stepless rpm control and sufficient capacity to maintain underpressure in the room to make sure that no smoke extends into surrounding

Space	Type of ventilation	Air changes/h	Supply fan	Exhaust fan	Remarks
					area.
Galley	Mechanical	30/40	1	1	
Engine change room	AHU	5	AHU		
Electrical workshop	AHU	6	AHU		
Central store	AHU	4	AHU		

The number of air changes for air-conditioned rooms shall be based on a HTC (heat transfer calculation)

For instrument room in accommodation block and Wheelhouse/ demisting system, see [573 Ventilation/AC systems for control rooms](#)

#### Combined air handling/refrigeration compressor unit:

Refrigeration Plant and Air Handling Unit shall be built together as one integrated unit. The Refrigeration Plant shall be direct expansion type with refrigerant for compliant to F Class to evaporate inside cooling coil of air handling unit. The evaporators shall have electronic expansion valves. The plant shall consist of 2 semi hermetic compressors of piston type echa covering 50\_100% of the total cooling demand, including compressors driven by VSD and backup temperature and/or pressure control with automatic start/stop control of compressors. Condenser shall to be fresh water cooled (37-36 °C) shell-and-tube type.

The Air Handling Unit shall be constant airflow high pressure single-pipe unit containing the following sections:

- Heating section with heating coil hot water. Materials of tubes and fins to be CU/Al.see [577 Central heating systems for accommodation](#)
- Cooling section with cooling coil for direct expansion and electronic expansion valve. Materials of tubes and fins to be CU/Al. Marine type stainless steel drain pan to be included.
- Fan section with direct driven centrifugal type fan mounted on a common base frame with vibration dampers and flexible connections.
- Discharge section

The Refrigeration Plant and Air Handling Unit shall be fully automatic operated. One common control panel shall be arranged on the Unit, including starting of fan motor, control of compressor and cooling coil, control of heating coil and all necessary safety controls for the refrigeration plant.

All internal piping and electric wiring shall be factory made and tested before leaving the factory.  
In the event of failure of the variable speed drive (VSD), the equipment shall operate with automatic start and stop, controlled by thermostats and/or pressure switches in order to maintain the specified temperatures or another equivalent method.

The units of the central air-conditioning system shall be designed in such a way that the refrigerant in the condensers is sub-cooled.

The units will be interconnected by a duct with a manually operated damper and equipped with a fan, cooling and heating coils, a humidification section and a regulator for mixing fresh air and circulated air. A heating system shall be provided to maintain thermal comfort in the event of low temperatures. Spare refrigerant gas containers and their respective support hangers shall be provided in sufficient quantity to replace 100% of the system's gas, including the total quantity provided for the refrigeration system.

## Galley

The galley shall be equipped with:

- A separate supply fan(system) with 30 air-changes/hour capacity and step less speed control.
- A duct heater on the supply fan duct may be considered.
- A self contain fan coil unit, ref. [578 Central cooling systems](#)
- A separate exhaust fan with 40 air-changes/hour capacity and step less speed control
- Frequency controlled fans with remote control (start/stop) located in the galley
- Stainless steel fat filter(s) installed above the galley range
- Fire dampers fitted in ventilation ducts as per regulations

Alternativly, the Supply air /heating/cooling to Galley, can be served by a dedicated Galley AHU (Air handling Unit)

~~Where exhaust ducts from the galley ranges pass through accommodation spaces or spaces containing combustible materials, they shall be constructed with A-class divisions. Each exhaust duct shall be fitted with: The galley exhaust ducts shall have circular section, independent of the vessel's structure with flanges and joints, and fitted with bolted manholes for cleaning.~~

The suction and discharge air inlets/outlets to open air shall be fitted with ASTM A-316L stainless steel screens.

The internal ventilation and exhaust end openings in lockers, stores and compartments will be fitted with ASTM A-316L stainless steel mesh.

Where the exhaust ducts from the galley pass through accommodation spaces or spaces containing combustible materials, they shall be constructed with A-class divisions. Each exhaust duct shall be fitted with:

- Grease trap readily removable for cleaning
- Fire damper located in the lower end of the duct
- Arrangements, operable from within the galley, for shutting off the exhaust fans
- Fixed means for extinguishing a fire within the duct

## Heating of floors

~~Heating of floors shall be arranged by:~~

~~Electric heating cables, ref. [892 Electrical installations in accommodation](#)~~

## 572 Ventilation systems for provision rooms

The dry provision room shall have a separate exhaust fan with speed control and a capacity of 4 air ch/h.

Refrigeration system, ref. [554 Freezing/refrigerating systems for provisions](#).

## 573 Ventilation/AC systems for control rooms

Instrument room(s) shall have room temperature control adequate for the equipment installed.

Table 5.11 Ventilation/air conditioning systems for control rooms

Space	Type of Ventilation	Air changes/h	Supply fan	Exhaust fan	Remarks						
Wheelhouse	AHU	10	AHU		Fresh						

Space	Type of Ventilation	Air changes/h	Supply fan	Exhaust fan	Remarks					
					air from AHU for accommodation					
Engine Control Room (ECR)	AHU	25	1 as backup							
Instrument room(s) in accommodation block	AHU	4	1 as backup							
Instrument room(s) outside accommodation block	Mechanical	4	1							
Switchboard Room	(AHU)	Switchboard/ Engine Control room/ Room	4	(AHU)	(AHU)	4	(AHU)	Pressurized floor for cooling shall be considered.		Pressurized floor for cooling shall be considered.

For fan coil units, ref. [578 Central cooling systems](#).

#### Wheelhouse

The wheelhouse shall have two split type AC units approx. 10 kW each, aircooled working together with the aircondition AC plant.

The external units to be located on wheelhouse top.

Fresh air to the wheelhouse shall be supplied from the AHU for the accommodation.

#### 574 Ventilation systems for engine rooms

The engine room(s) shall be provided with a ventilation system designed for 25 air changes per hour, taking into account the volume of the Engine Room, ECR, and the Main Engine consumption at its maximum continuous rating, in compliance with ISO 8861:1988, using the largest volume for calculations.

#### Fans

Four (4) frequency controlled fans of axial type shall be arranged for air supply to the main engine room.

Fan characteristics:

- Static Pressure: minimum 500 Pa
- Efficiency: 70% ± 5%

The fans shall be fitted with:

- Automatic closing and fire damper of ASTM A-316L. (Open/closed position of the damper shall be interlocked with start/stop of the fan)
- Sound attenuator (silencer)
- Flexible connection including vibration dampers
- Fan control shall be Local and remote from the IAS
- Remote control from the IAS shall be Manual/Auto, Start/Stop and % RPM (4-20mA = 0-100%), Running feedback to the IAS.
- Emergency stop, see 811 Fire detection, fire and lifeboat alarm systems
- Automatic Speed control controlled by temperature and over pressure in the Engine room by temperature sensor and differential pressure sensor connected to the frequency converter. The required temperature and differential pressure shall be set at the frequency converter.  
Automatic bypass of ER ventilation VSD in case of Automatic Speed control failure of the system.
- Two (2) fans shall be reversible

#### Ducts

Necessary ducts shall be arranged to ensure satisfactory air distribution within the room and include:

- Manual operated flow regulating dampers on all duct outlets
- Noise trap and sound reduction insulation in inlet duct(s) above the fan(s)
- Hatch for easy access to the fans
- Lifting eye above fan for easy removal of electric motor
- Drain(s) for inlet duct(s)
- Distribution ducts inside the engine room of galvanized sheet metal
- Maximum air velocity in the main ducts of around 18 m/s and in the secondary branches of around 15 m/s.

#### Louvres

The louvres will meet the following requirements:

- Inlet louvres of mist eliminator / droplet separator type
- To reduce the risk of exhaust gas ingress, special attention shall be paid to the location of inlet louvres.
- Outlet louvres to be of single stage weather louvre type protecting the duct from rain and light sea spray.
- Outlet louvers shall also be fitted with ASTM A-316L stainless steel screens and integrated closable dampers.

#### Auxiliary engine room

The auxiliary engine room shall be equipped with:

- Minimum one (1) Air supply fan
- Fan control shall be Local and remote from the IAS
- Remote control from the IAS shall be Start/Stop and running indication

## 575 Ventilation systems for pump/cargo rooms

Table 5.12 Ventilation fans for pump/cargo rooms

Space	Air changes [ch/h]	Supply fan	Exhaust fan	Remarks
Technical/ pump room	Min. 30 ch/h		2 (Ex.proof)	According to rules

Fan control shall be local and remote from the IAS.

Remote control from the IAS shall be Start/Stop and running indication.

#### Tank de-gassing

For de-gassing of the cargo, slop and ballast tanks, fans powered by sea water, designed to degas all cargo and slop tanks in a maximum of 10 (ten) hours.

Four (4) complete sets consisting of reversible exhaust fans with flexible hoses, suitable exhaust ducts and various accessories shall be provided. The portable exhaust fans to have local Control, and shall be made of aluminum. Fed by flexible hoses connected to outlets on the seawater/fire line pipe on deck.

### 576 Ventilation/AC systems for steering compartments

Table 5.13 Ventilation fans for steering compartments

Space	Air changes / h	Supply fan	Exhaust fan	Remarks
Steering gear room	10		1	

Supply and exhaust ducts shall be arranged from and to open deck.

Vent inlets /outlets shall be protected from water ingress.

Supply Fan control shall be local and remote from the IAS.

Remote control from the IAS shall be Start/Stop and running indication.

### 577 Central heating systems for accommodation

#### General

The central heating system for the accommodation shall be common with the central heating system described in [84 Central heating systems](#).

The central heating system-[/ thermal oil-to-water heat exchangers](#), shall supply 85°C hot water to:

- Accommodation HVAC units heaters, ref. [571 Ventilation/AC systems for accommodation](#)

### 578 Central cooling systems

#### Fan Coils

Table 5.14 Fan coils

Space	No. of / type cooling unit(s)	Remarks		
Wheelhouse split unit (s)	2 Split units <a href="#">w/VSD</a>	see <a href="#">573 Ventilation/AC systems for control rooms</a>		
Acc. public spaces fan coil unit(s)	Self-contain units as required- <a href="#">w/VSD</a>	Depending on HTC (Heat Transfer Calculation)		
<a href="#">Engine Control Room ECR</a>	<a href="#">Min. 1 Self contain fan coil unit w/VSD</a> <a href="#">2 self-contain fan coil units</a>	<a href="#">100% capacity &gt;50% capacity each, downstream type for</a>		

Space	No. of / type cooling unit(s)	Remarks		
	w/VSD	<u>pressurized floor may be considered**</u>		
<u>Switchboard Room</u> <u>Steering gear room</u>	<u>2 self-contain fan coil units</u> <u>2 self-contain units w/VSD</u>	>50% capacity each; <u>down stream type for pressurized floor may be considered**</u>		
<u>Steering gear room</u> <u>Technical/Instrument Room</u> (05-Acc deck)	<u>2 self-contain units</u> <u>Min. 1 self-contain unit w/VSD</u>	>50% capacity each		
<u>Technical/Instrument Room</u> (05-Acc deck)	<u>Min. 1 self-contain unit</u>			
Engine room workshop	1 Self-contain fan coil unit w/VSD			
Electric workshop	1 Self-contain fan coil unit w/VSD			
Hospital	<u>1 self-contain fan coil unit</u>		<u>1 self-contain fan coil unit w/VSD</u>	
Galley	1 Self-contain fan coil unit w/VSD			
Garbage room	<u>1 self-contain fan coil unit</u>		<u>1 self contain fan coil unit w/VSD</u>	

Self-contain fan-coil cooling units not mentioned, shall be arranged as required according to rules and /or normal practice.

For drainage/recovery of condensate water from HVAC system, see. 762 Technical fresh water systems

\*\*Before starting up the downstream fan coils, the space below lifted floor must be thoroughly vacuum cleaned to assure a dust free air-stream.

## 579 Ventilation/AC systems for various compartments

Table 5.15 Ventilation/AC systems for various compartments

Space	Type of Ventilation	Air changes/h	Supply fan	Exhaust fan	Remarks
Bouson store/rope store	Mechanical	5		1	
Air drying equipment room	Mechanical		1		
Separator room	Mechanical	10		1	
Engine store/workshop	Mechanical	10		1	Suction from welding table. Self contain fan coil unit, ref. <u>578 Central cooling systems</u>
Inert gas generator room	Mechanical	10		1	According to regulations
AFT Hydraulic room	Mechanical	10		1	
Refrigerant compressor room	Mechanical	10		1	

Space	Type of Ventilation	Air changes/h	Supply fan	Exhaust fan	Remarks
Foam room	Mechanical	10		1	
Hydraulic room	Mechanical	10		1	
Chemical room	Mechanical	25		1 (Ex-proof)	
Future (Methanol fuel treatment)	Mechanical	30		1 (Ex-proof)	(OPTION) 1 additional ex.proof fan, according to regulations, (Catastrophe ventilation)
Chemical safety equipment store	Mechanical	25		1 (Ex-proof)	
O2 store	Mechanical	25		1 (Ex-proof)	
Acetylen store	Mechanical	25		1 (Ex-proof)	
Paint stores	Mechanical	25		1 (Ex-proof)	
Garbage store	Mechanical	10		1	
Dry provision room	Mechanical	4		1	
Cargo equipment sampling room	Mechanical	6		1 (Ex-proof)	
HVAC room	Mechanical	10		1	
Fire station	Mechanical	10		1	
Lifesaving equipment room	Mechanical	6	1		
Emergency generator set room	Mechanical	20	1		Inlet and outlet louvres shall be dimensioned according to radiator fan capacity and combustion air supply to the engine. Louvres to have integrated closable damper and of mist eliminator / droplet separator type if exposed for water ingress.
Stores	Mechanical	6	1		

The ventilation fans with separate starter cabinet, shall be controlled as follows:

- Control shall be Local and remote from the IAS
- Remote control from the IAS shall be Start/Stop and running indication

Other rooms not mentioned in the list above shall be ventilated, heated and cooled according to rules and /or normal practice.

## 58 Sanitary supply and discharge systems for accommodation

### Sanitary supply system

A sanitary supply system shall be arranged supplying hot and cold water to the accommodation, deck and other spaces.

### **Sanitary discharge systems**

The sanitary discharge systems shall be split into a black water system of vacuum type and a grey water system of gravity drain type.

One (1) biological type Sewage treatment plant shall be installed having capacity for all persons on board.

## **581 Sanitary supply systems**

### **Hydrophore system**

The fresh water hydrophore plant shall be arranged with suction from Three (3) FW tanks and shall supply fresh water to the WC/showers, laundry, wardrobes, galley, etc., and include a hydrophore tank with a nominal capacity of 500 liters for the hot water system.

The hydrophore pump capacity shall be calculated according to ISO 15748-2.

The hydrophore system shall operate fully automatically with one (1) pump in standby mode.

The hydrophore system shall operate with two circulation pumps (100% each), ensuring constant flow of hot water with a target temperature range of 10°C to 70°C.

The cold and hot water distribution systems shall be arranged with sectional shut-off valves at each accommodation deck level.

The system shall include one calorifier, designed to maintain hot water supply for accommodation areas

The calorifier shall have the capacity to raise water temperature from 10°C to 70°C, using thermal oil and electric resistors (as a backup heating source).

Table 5.16 Sanitary supply system components

Description	Capacity each	No's	Type / Remarks
Hydrophore pump	5 m³/h @ 5 bar	2	
Hydrophore tank	500L	1	Hot dip galvanized
UV sterilizer	5 m³/h	1	
Mineralizing filter	5 m³/h	1	
Sanitary hot water circulation pump	0.5 m³/h @ 2 bar	2	
Hot water calorifier	140kW, 2000L/h, 500L tank	1	4 x 35 kW electric heating elements

### **Technical particulars for the pumps**

Hydrophore system:

- Pressure holding centrifugal type
- Horizontal or vertical execution, self-priming
- Housing of Cast Iron, impeller of Brass and shaft of stainless steel
- Maximum 1800 rpm
- Electric drive – one speed

Hot water circulation system:

- Centrifugal type

- Vertical execution, self-priming
- Housing of Cast Iron, impeller of Bronze and shaft of stainless steel
- Maximum 3600 rpm
- Electric driven – one speed

### Bunkering system

The vessel shall be provided with two (2) shore connections for fresh water bunkering, one on each side, located on the main deck in the midship area, aft of and clear from the cargo manifold. Each connection shall be equipped with a valve and blind flange.

The system shall be dimensioned for 100 m<sup>3</sup>/h. The tank valves shall be remote operated from the IAS.

### Hot water system

A hot water system consisting of:

- 1 (one) fresh water heater (Calorifier) for the rooms and compartments of the Engine Room, with a hydrophore tank with a nominal capacity of 500 liters and a nominal flow rate of 2000 liters per hour, capable of raising the water temperature from 10°C to 70°C, using thermal oil and electric resistors (backup);
- 2 (two) hot water circulation pumps (100% each).

The hot water piping in the accommodation shall be thermally insulated.

### Potable water

A drinking potable water system consisting of 1 (one) electric sterilizer (ultraviolet) and 1 (one) mineralizing filter shall be provided.

The sterilizer and mineralizing filter shall be installed in the drinking water branch of the fresh water hydrophore system (cold and hot) for the supply of drinking water to the accommodation rooms, pantries, galley and infirmary taps, i.e. where there will be human consumption for drinking, food preparation and production, and personal care.

### Fresh water supply points – cold and hot water

The hydrophore system shall supply cold and/or hot fresh water to the following locations:

#### Cold and hot water:

- Rotor washing sink in the purifier compartment
- Purifiers (as per equipment manufacturer's recommendations)
- Cleaning system of the Main Engine scavenge air cooler
- Inert gas fan compartment

#### Cold water only:

- Workshop
- Thermal oil heaters (as recommended by the manufacturer)
- Location near the thermal oil heaters
- Expansion tank area
- For priming centrifugal and positive displacement pumps, where required
- Other connections as indicated by the Owner

See also [583 Bathtubs, showers, WC, washbasins](#)

### Outside taps – technical arrangement

The vessel shall be provided with external fresh water outlets for general maintenance purposes. Connections shall be fitted with shut-off valves and distributed along both sides of the vessel's superstructure, on the main deck (cargo area), extending to the bow, and one (1) additional connection at the stern.

All taps on open deck shall have closing valve inside to prevent freezing.

### References

Pipe materials, ref. [~~broken cross reference~~7 System for Main Engine Components](#)

FW production system, ref. [761 Fresh water production systems](#)

Technical FW system, ref. [762 Technical fresh water systems](#).

## 582 Sanitary discharge systems

### General

Combined sewage/ grey water holding tank(s) with capacity according to rules shall be arranged. However, minimum capacities shall be based on:

- 25 l/day/person black water
- 110 l/day/person grey water
- Holding tank capacity not less than 4 days

The tank shall be arranged with overflow, high level alarm and flushing with seawater supply from the fire system, ref. [813 Fire line/deck washing system](#).

Remote stop buttons for the sanitary sewage pump shall be provided next to the standard discharge connection on deck.

Tank ventilation, overflow and sounding for the sewage/ grey water holding tank(s), ref. [82 Air, overflow and sounding systems from tanks](#).

The sanitary sewage piping shall be independent and segregated from the waste water (grey water) piping and scuppers.

The discharge piping from the infirmary shall be independent from other piping in the rooms and shall be taken directly to the common entrance of the Sewage Treatment Unit.

The sanitary sewage discharge pump shall be connected to the Sewage Holding Tank and discharge to incinerator and sewage standard discharge connections on open deck, both side, fitted with a blind flange in compliance with the applicable regulations.

Waste water shall be able to be discharged directly by gravity into the Treatment Unit or into the sea, in accordance with regulations. If the wastewater is directed to the treatment plant, it shall enter at the initial stages of treatment, so that it passes through all the treatment stages.

The sewage pump shall have flow control to meet the requirements of Resolution MEPC.157 (55).

A table shall be prepared and submitted for approval showing the effluent discharge rate according to the vessel's draft and speed, as provided for in Resolution MEPC.157(55).

### Technical particulars for sewage discharge pump

Pump:

- Centrifugal type with non-clogging impeller for black water

- Housing and impeller of cast iron, shaft of stainless steel
- Maximum 3600 rpm
- Electric driven – one speed

Table 5.17 Sewage discharge pumps and ejectors

Description	Capacity each	Quantity	Remarks
Sewage discharge pump	20 m <sup>3</sup> /h – 25 mlc	1	Auto /manual control. Shore, incinerator, overboard (controlled) discharge

### Black water/ vacuum system

A sewage vacuum plant of marine quality shall be arranged for the toilets consisting of low volume fresh water flush toilets.

Sewage shall be collected by two (2) Vacuum pumps, 100% redundant with necessary control equipment for automatic operation.

Vacuum pumps to discharge directly to the sewage treatment plant with back-up for emergency discharge to a Sewage Holding Tank.

Automatic change-over of the vacuum pumps shall be provided in the event of a vacuum system failure or any pump failure.

Vacuum pipe system shall be arranged with service valves at each accommodation deck level.

Vacuum toilets shall be arranged with "rag hook" or equal arrangement to reduce risk of foreign objects clogging the pipe system.

For pipe materials, ref. [7 System for Main Engine Components](#).

### Grey water system

Grey water drain system from sinks, wash basins, showers, laundry, etc. shall have sufficient slope to the treatment system, with back-up drain to the Sewage Holding Tank.

Vacuum tank system(s) shall be arranged for grey water pipes with insufficient slope for gravity drainage.

Galley grey water shall be led via a grease trap to the grey water system. Drain from the grease trap shall be led to sludge tank or other suitable collecting tank in accordance with Classification Society requirements.

For gutters and drains from the galley, ref. [552 Equipment and outfitting in galley](#).

Discharge piping from the infirmary shall be routed independently from other sanitary spaces and connected directly to the common inlet of the Sewage Treatment Plant

Scuppers shall be of stainless steel, type Blucher or similar, where approved.

For bathrooms scupper, ref. [583 Bathtubs, showers, WC, washbasins](#).

For drain from gutter ways in the accommodation, ref. [809 Drain system interior spaces](#).

For pipe materials, ref. [~~<broken cross reference>~~7 System for Main Engine Components](#).

### Sewage treatment plant system

The plant shall have capacity for capacity for all persons onboard and shall be arranged with:

- Inlet tank, bio tanks, settling tank and clean water tank
- Complete, self-contained system for treatment of the ships grey - and black water before it is

- discharged to prevent pollution of harbour- and coastal waters
- One (1) air blower with back-up hose connection from working air system
  - Two (2) discharge pumps
  - One (1) dosing pump
  - Control panel
  - Compact, efficient and flexible system
  - Isolation valves on each tank to enable selective emptying
  - Type approval according to IMO resolution MEPC.227(64) as amended

Discharge from treatment plant via built-on discharge pump(s) to:

- Overboard below ballast water line. Overboard shall be located aft of the sea inlet for FW production
- Sewage Holding Tank.

A sample cock to be provided at the overboard pipe

## 583 Bathtubs, showers, WC, washbasins

Bathroom units shall preferably be of a prefabricated type.

Each unit in cabins and hospital shall be supplied with:

- Vacuum toilet
- Wash basin of suitable size with hot and cold water (mixing battery)
- Scupper
- Mirror
- Suitable number of clothes hooks
- Heated towel hook
- Fixture for toilet paper
- Fixture for spare toilet paper
- WC brush
- Plastic curtains
- Thermostatically controlled water supply (mixing battery)
- Handle and soap dish
- Portioned off to prevent extensive wetting of the bathroom with own scupper

### ~~Electric heating cables in the floor~~

Public WC's shall be supplied with:

- Vacuum toilet
- Wash basin of suitable size with hot and cold water (mixing battery)
- Scupper
- Mirror
- Suitable number of clothes hooks and towel hooks
- Fixture for toilet paper
- Fixture for spare toilet paper
- WC brush

Prefabricated bathroom units shall be fixed on top of floating floors where floating floors are required for noise reduction.

In the workers' toilets, hangers, 04 soap holders and 04 towel holders shall be provided

### References

Electrical installation ref. [892 Electrical installations in accommodation](#).

Ventilation ref. [57 Ventilation, air-conditioning & heating systems](#).

The engine room shall be equipped with:

- One (1) Stainless steel sink with mixing battery.

## 584 Drinking water coolers

A drinking potable water system consisting of 1 (one) electric sterilizer (ultraviolet) and 1 (one) mineralizing filter shall be provided.

The sterilizer and mineralizing filter shall be installed in the drinking water branch of the fresh water hydrophore system (cold and hot) for the supply of drinking water to the accommodation rooms,

pantries, galley and infirmary taps, i.e. where there will be human consumption for drinking, food preparation and production, and personal care.

Water bottle fountain (20 L) with cooling shall be provided in the following locations:

Navigation Bridge deck

Cargo Control Room

Gymnasium

Engine Control Room [\(ECR\)](#)

## 6 MACHINERY MAIN COMPONENTS

### General

The vessel shall have a power- and propulsion system according to [Figure 0.1](#). All machinery shall be delivered with spare parts and certificates according to the Classification Society requirements if nothing else is stated. All machinery shall be first class marine type with normal outfitting and accessories.

Spare parts and special tools shall be delivered in accordance with the manufacturers' recommendations, based on the equipment maintenance manuals, for a minimum period of 24 months, and in compliance with the requirements of IACS Recommendations 26 to 30.

The necessary foundations, supports and arrangements shall be provided to accommodate the spare parts that will be kept on board. The Supplier shall be responsible for receiving, storing, maintaining and protecting the machinery spare parts and tools until they are delivered and handed over to the Owner.

The following spare parts, equipment and special tools shall be supplied for each vessel, as required by Rules, Conventions and Codes:

- One (1) certified spare propeller shaft (if the number of vessels is less than four, one shaft for the series).
- One (1) complete set of certified CPP (Controllable Pitch Propeller) Hub for the series, to be delivered by the completion of the first vessel.
- One (1) certified spare propeller blade with screws for each vessel.
- One (1) certified anchor, stowed on the main deck, for each vessel in the series.
- Personal safety equipment, including self-contained breathing apparatus and spare units.
- Set of protective clothing, including gas and chemical-proof clothing.
- Emergency escape breathing apparatus (EEBD).
- Portable oxygen analyzer and gas meter.
- Portable level indicator/interface (UTI) for cargo tanks.
- Portable gas detector and sampling tubes for vapors and gases.
- Portable VHF communication radio certified for the specific purpose.

All quantities and certification shall comply with applicable Rules, Conventions and Codes.

The requirements for spare parts and special tools apply to all machinery and equipment on board, unless otherwise specified.

### Environmental conditions

Machinery has to fulfil Classification Society requirements and ratings according to ISO 3046/1 under the ambient reference conditions without any de-rating as mentioned in the tables below.

Table 6.1 Environmental conditions without climatic derating

Parameter	Value
Total barometric pressure	1 bar
Ambient air temperature	between 0°C and 45°C
Relative humidity	60%
Sea water temperature	32°C

All components and systems covered by the Classification Society shall be designed to operate under the following environmental conditions if not otherwise specified in the detail requirements for the machinery, component or system, but with reduced power in conditions with ambient temperature above 45°C:

Table 6.2 Environmental conditions with climatic derating

Parameter	Value
Ambient air temperature in the machinery space	between 45°C and 55°C
Relative humidity of air in the machinery space	between 60% and 96%
Sea water temperature	up to 32°C
List, rolling, trim and pitch	according to Classification Society requirements

Environmental conditions for the ship, see [Table 0.6](#).

The mounting of the equipment shall preferably be as follows:

Table 6.3 Mounting of equipment

Equipment	Mounting
Major components such as main gearbox, deck machinery, etc.	epoxy resin chocks
Components such as shaft bearings, steering gears, etc.	adjustable steel chocks
Components such as pumps, frequency converters, starters, etc.	directly onto a foundation
Main engines, auxiliary generator sets, emergency generator set, air compressors, large frequency converters, large switchboards and servo oil pumps.	resiliently (ref. <a href="#">8.5 Common electrical and electronic systems</a> )

## 60 Engines for propulsion

### 601 Main Dual Fuel MGO/Methanol engine for propulsion

One (1) four-stroke, single acting, medium speed, direct injection, non-reversible dual fuel engine (MDO/MGO/HFO/LSFO+Methanol), equipped with an exhaust gas turbocharger and connected via a gearbox to a CP propeller.

The main engine shall be Methanol Ready for future conversion to dual fuel operation (MDO/MGO/HFO/LSFO + Methanol).

The Main Engine or the remote control of the propulsion system shall be equipped with a system for monitoring and automatically adjusting engine performance, with the capability to provide diagnostics (Troubleshooting) and economic torque control.

~~A~~One complete swing set ~~of~~ spare parts for the main engine shall be delivered for serie's vessels, equivalent to one engine, and in accordance with the manufacturer's recommendations and class society standards. The swing set shall include: complete cylinder head and internal components, injectors, suction and discharge valves, seal and snap ring set, piston set, pins and piston rings, connecting rod set and main bearings, cylinder liner set, lube and cooling water pumps (if applicable), coolers (if applicable), and crankshaft bearings.

Automatic and remote control systems for the propulsion plant are to be in accordance with manufacturer's standard, and shall be arranged for remote manual control and monitoring from the centralised engine control room.

Tank level indicators and alarms for the Main Engine Lube Oil Sump Tank, including high and low level switches and water detection alarm, are specified in Section 822 Sounding system, Table 8.1

Table 6.4 Main engine technical data

Manufacturer	<del>MAN:TBD</del>
Type	<del>MAN 6L32/44 DF M:TBD</del>
Output (MCR)	: abt. <del>3480</del> -3600 kW (MCR)
Output (CSR)	: 100% of (MCR)
Speed	: 750 rpm at (MCR)
Fuel	: MDO/MGO/HFO/LSFO+Methanol
Cooling	: Fresh water
Starting	: Compressed air
Lubricating	: Dry sump
Cooling of lubrication oil, charge air and cylinder jacket	: Fresh water, with separate coolers

### Main Engine Certification and Emissions Compliance

The Main Engine to comply with IMO Tier II. Shall be factory tested and approved by the Classification Society. The manufacturer (licensor and/or licensee) is responsible for obtaining the EIAPP certificate and NOx Technical File, ensuring compliance with MARPOL Annex VI emission standards.

The main engine technical data to be finalised after confirmation of maker.

### Torsional vibrations

Torsional vibration calculations to be carried out, and main engine to be blocked to avoid continuous running within any restricted speed range.

A secondary order vibration damper shall be installed.

### Construction and material

The construction, material and fittings for main engine shall be in accordance with the engine manufacturer's standard.

### Accessories and fittings

The accessories and fittings for main engine shall in general be in accordance with the engine manufacturer's standard.

## 63 Transmissions

### Controllable Pitch propeller

One (1) Controllable pitch propeller plant for main propulsion shall be installed.

## 634 Controllable Pitch Propeller System (CPP)

Controllable Pitch Propeller System (CPP):

Manufacturer	KM
Propeller hub type	CP - Promas
Propeller power	3500 kW
Propeller diameter	5500 mm
Propeller speed	93 rpm (approx.)
Number of blades	4

Direction of rotation	Left, seen from aft (to be verified by model tests)
Propeller blade material	NiAl-Bronze
Propeller hub material	NiAl-Bronze
Propeller accuracy class	I
Stern tube bearing type	Water-lubricated composite bearing (Thordon)
Outer stern tube seal	Water-lubricated seal (e.g., Simplex or equivalent)
Inner stern tube seal	Water-lubricated seal (e.g., Simplex or equivalent)

### The CPP system shall include:

#### General Equipment

- Propeller shaft with oil shrink couplings.
- Water supply system for stern tube lubrication.
- Water-lubricated stern tube bearings.
- Mechanical seal with test/emergency valve for hull watertightness.
- Water monitoring and filtration system, including fine mesh filter with coalescing unit (e.g. CJC type) and dedicated circulation pump for off-line filtration.
- Rope cutting knives and net pick-up ring for protection of stern tube seal.

#### Monitoring and Measurement

- Shaft grounding assembly with analog (passive 4–20 mA) interface to the IAS and monitoring in the IAS. Shaft diameter in grounding area to be increased by 5 mm.
- Bearing wear sensors for stern tube and intermediate bearings, with alarm and display in the ECR, and signal to IAS.
- Shaft torsimeter installed on intermediate shaft, with dedicated display panel in the ECR and signal to the IAS for torque, RPM and power monitoring.
- Flow meter in lubrication circuit with low flow alarm to IAS.
- Two (2) temperature sensors per stern tube bearing and one (1) for intermediate bearing, with signals to the IAS.

#### Hydrodynamic Bearings and Shaft Dimensions

- Intermediate bearing of hydrodynamic type, cooled by low-temperature distilled water. Shaft diameter in bearing area to be increased by 5 mm for a length of 20 mm beyond bearing ends.
- Stern tube shaft diameter increased by 3 mm in the aft bearing zone, for a length of 15 mm beyond the bearing ends.

#### Pitch Control System

- Oil Distribution box (OD box) for pitch control:
  - Installed on a separate OD box shaft in the shaftline/on the forward end of the gearbox.
  - The forward part of the OD box shaft incorporates the pitch feedback mechanism and has an integral flange connection.
- Pitch pumps (2 × 100%), with automatic changeover and alarm to IAS.
- Local pump and connection for manual pitch adjustment and locking in case of HPU failure.
- A minimess or equivalent oil sampling point shall be provided to allow collection of a representative sample for condition analysis, in accordance with manufacturer recommendations or best industry practice.
- The hydraulic pitch control system shall be designed for minimum noise transmission.

### Cooling Water Supply for Bearings

- Two (2) sea water circulation pumps (100% each) with automatic changeover and alarm to IAS.
- Each pump with dedicated water conditioning filter.

### Spare Parts

- One (1) spare propeller blade, class certified, with bolts, stored on main deck within crane reach.
- One (1) spare propeller shaft for the series, stored in watertight steel box on first vessel, with access for periodic inspection.
- One (1) complete CPP system hub for the series, delivered to the Owner with the first vessel.

### Remote control system

The propulsion will have a Kongsberg control system.

Propeller speed and pitch shall be programmed to automatically follow the propeller curve for optimal performance in the speed range, ref. 793 Remote control of main propulsion and engine telegraph.

The CPP control system shall include:

- Remote control stations on the navigation bridge, bridge wings, and in the engine control room (ECR).
- Local control by direct actuation on solenoid valves at the OD box.
- Mode selector switch in the ECR to toggle between remote and local control.
- Two independent command loops:
  - One for standard pitch control via control lever,
  - One for emergency operation via push-button loop.
- In case of system failure, the pitch shall remain in the last commanded position ("fail-to-set"), unless otherwise agreed with the Owner and the CPP supplier.
- All system parameters, setpoints, feedback values, status, and alarms shall be transmitted to the IAS using an open industrial protocol.

## 637 Main reduction gear

Main reduction gear for propulsion shall be of single input/single output design (SISO) and single speed design with one built-in main clutch.

The clutch arrangement shall be in accordance with Classification Society requirements.

The oil temperature in the gearbox to be thermostatic controlled.

All bearings in the gearbox to be of plain bearing type.

The standby LO-pump shall be electric driven.

Table 6.5 Main reduction gear

Main reduction gear	
Manufacturer	: FLENDER
Input power	: 3600 kW (ME)
Input speed	: 750 rpm
Output speed	: abt. 93 rpmn
Offset	: Vertical
Propeller type	: CPP
Rotation direction input shaft Engine	: CCW (seen from aft)

Main reduction gear	
Rotation direction output shaft:	: CW (seen from aft)
Cooling:	: Fresh water cooler, tube type

## 64 Boilers

### General

The vessel shall be fitted with a thermal oil heating system.

The following equipment shall be supplied:

- One (1) oil-fired thermal oil heater;
- Four (4) exhaust gas heated economizers (Main and Auxiliary Engines) with by-pass for ME, all located in the engine room/casing;
- Two (2) thermal oil circulation pumps;
- Two (2) thermal oil transfer pumps;
- One (1) expansion tank;
- One (1) thermal oil cooler;
- One (1) storage tank;
- One (1) drain tank;
- Equipment and accessories for heater cleaning;
- Automatic electronic control for combustion, level and fluid pressure;
- Piping and fittings.

For details, see section [845 Thermal Oil Heating System](#).

### Operating Modes of the Thermal Oil Heating System

The thermal oil heating system, including the oil-fired thermal oil heater and exhaust gas economizers, shall be designed to operate under the following conditions, depending on the vessel's operational mode:

- Normal at sea – Mode A
- Normal at sea with ballast exchange – Mode A
- Normal at sea with inert gas topping-up – Mode C
- In-voyage cargo tank cleaning – Mode C
- Departure and arrival – Mode B
- Unloading product – Mode B
- Anchored with closed-circuit cargo tank cleaning – Mode B
- At anchor or in harbour condition – Mode B

Where:

- Mode A – Operating the Main Engine exhaust gas thermal oil heater
- Mode B – Operating the oil-fired thermal oil heater and the Auxiliary Engine exhaust gas heaters
- Mode C – Operating the oil-fired thermal oil heater and the Main Engine exhaust gas thermal oil heater

The oil-fired thermal oil heater shall be sized to cover the total heating demand of the vessel, including all equipment and tanks, in case of failure of all exhaust gas economizers (Main Engine and Auxiliary Engines).

## 646 Exhaust gas boiler

### Exhaust gas heated thermal oil boiler for main engine

One (1) exhaust gas heated economizers for thermal oil to be fitted in the casing, supplying thermal oil to the circuit in series with the oil-fired heaters.

The heater to be arranged with a dumping cooler and an internal by-pass flap for capacity regulation.

The heater to have the following data:

- Number of units : One (1)
- Type : Exhaust gas heated thermal oil boiler
- Capacity : To be suited to utilize the waste heat available from the main engine's exhaust.

The Main Engine economizer shall be designed to withstand the condition of no oil in the pipes (dry economizer) and shall have an automatic "flap" system that makes it possible to divert the flow of gases in such a way as to increase or decrease the thermal exchange and, consequently, control the temperature of the thermal oil. If the oil temperature remains high, it shall be deviated to the cooler. Alternatively, the temperature of the thermal oil can be controlled by an economizer flow control valve, as recommended by the manufacturer.

### Exhaust gas heated thermal oil boiler for aux. engines

Three (3) exhaust gas heated economizers for the auxiliary engines shall be designed in the same way as the main engine economizer, but will not have an automatic flap system to deviate the exhaust gas flow.

## 648 Thermal oil boilers

One (1) thermal oil boiler to be fitted in the engine room, supplying thermal oil to the heating circuit.

- The burner shall be a "Low NOx" type with low particulate emissions and certified in accordance with MARPOL Annex VI.
- Simultaneous operation of the oil fired heater with the economizers shall be provided.
- The oil fired heater and exhaust gas heaters (economizers) shall meet the vessel's operating conditions.
- The oil fired heater will be designed to consume HFO/LFO and/or DO. Diesel oil only for cold starting and for igniting the pilot burner.
- The oil fired heater shall be equipped with automatic combustion/thermal oil temperature controls and a cleaning system, consisting of a soot blower and relevant controls.

## 65 Main and auxiliary generator sets

### Auxiliary Generator set

Three (3) medium-speed (900 rpm) auxiliary generator sets, designed to operate on marine fuels including HFO, MDO, and MGO, shall be installed. The engines shall also be methanol-ready.

Each auxiliary generator set shall be supplied as a complete unit on a resiliently mounted, common skid and shall consist of a diesel engine coupled to an alternator.

Ref. also section [85 Common electrical and electronic systems](#)

## 652 Auxiliary generator set for electric production

## Auxiliary generator set - engine specification

Supplier	TBD
Manufacturer	TBD
Type	TBD
IMO tier	II without SCR
Engine power (MCR)	TBD bkW (to comply with 750kWe)
Engine speed	900 rpm
Cooling	FW

Each generator engine shall be equipped with:

- An engine governor system of electronic speed setting type with adjustable speed drop (3-5%).
- Pneumatic starting motor
- Hot water heated stand still heating
- Heat recovery system from cooling water systems
- Control system and monitoring system interfaced to the IAS
- Engine panel for ECR including rpm meters, push buttons and lamps.
- Safety system

## Auxiliary generator set - generator specification

Supplier	TBD
Type	3-phase, synchronous brush less, self-excited and self-regulated
Power	750 kW
Voltage/ frequency	Ref. <u>Table 8.6</u>
Number of phases	3
Cos φ	0.8 or system manufacturers' recommendation
Speed	According to engine rpm
Rating	S1 Continuous
Ingress Protection	minimum IP44
Insulation Class/Rise temperature	H/F
Bearing(s)	Single/double ball/sleeve bearing(s)
Cable entry	MCT
Efficiency	0.97 at full load
Cooling	FW

Each generator shall be equipped with:

- Automatic Voltage Regulator (AVR) according Classification Society requirements and with voltage adjustment from the main switchboard
- Digital Excitation system (DES to be mounted in a cabinet) including Over-voltage/Excitation fault detection system according to Classification Society requirements
- Anti condensation heater
- Winding temperature sensors
- Bearing temperature sensor(s)
- Cooler leakage detector
- Hatches for emergency air cooling, if medium speed
- Provided generator > 1500kVA, Transformers for differential protection according Classification Society requirements (both for generator and switchboard)

### Overall system characteristics:

The system shall be designed such that:

- The diesel generators can be started from a "dead ship"
- It shall be possible to adjust the rpm's by input from the PMS system/ Switchboard. The input signal to control the engine speed shall be approx  $\pm 5\%$  around nominal rpm.
- Protection and monitoring shall be as for a main propulsion engines

### Auxiliary engine and generator system requirements

The auxiliary engines shall be designed to operate on marine fuels including HFO, MDO, MGO and shall be methanol-ready. If retrofit kits for methanol conversion are not yet available, the selected engines shall be supported by a confirmed future upgrade solution provided by the engine manufacturer.

Each auxiliary engine shall be factory tested and approved by the Classification Society and the Owner, using marine fuel oil as per applicable standards. A cylinder pressure monitoring system shall be provided, capable of displaying compression and peak pressure values per cylinder, either on the IAS or a dedicated panel in the ECR. An injector test kit shall be delivered with the auxiliary engine supply.

The maximum permissible continuous load on a generator, in any service condition, using any fuel in the engines and other combustion equipment (HFO/LFO, MDO/MGO or alcohol based fuels), will be 85% of the rated power. This condition shall be demonstrated in the design documentation.

### References:

Fuel Oil, ref. [70 Fuel oil systems](#).

Lubrication Oil, ref. [71 Lube oil systems](#).

Cooling water, ref. [72 Cooling systems](#).

Start air, ref. [73 Compressed air systems](#).

Exhaust, ref. [74 Exhaust system and air intakes](#).

Hot water heated stand still heating, ref. [72 Cooling systems](#).

Heat recovery system from cooling water system, ref. [72 Cooling systems](#).

## 66 Other aggregates and generators for main and emergency electrical Power production

### Emergency generator set

One (1) Emergency generator set shall be installed, approx. 200kWe at 1800 rpm.

The generator set shall be supplied as a complete unit on a resiliently mounted, common, skid and shall consist of a diesel engine coupled to an alternator.

The Emergency system shall be able to feed the main system for "Dead Ship Recovery".

### 665 Emergency Generator set

#### Emergency generator set - engine specification

Supplier	TBD
Manufacturer	TBD
Type	TBD
IMO tier	II without SCR

Engine power (MCR)	TBD bkW (to comply with 200kWe)
Engine speed	1800 rpm
Cooling	Air (radiator cooled)
Cooling fan	Engine driven

The generator engine shall be equipped with:

- An engine's governor system of electronic speed setting type.
- Electric starting motor
- Stand still heating
- Local control and monitoring system
- Safety system

#### Emergency generator set - generator specification

Supplier	TBD
Type	3-phase, synchronous brush less, self-excited and self-regulated
Power	200 kW
Voltage/ frequency	Ref. <u>Table 8.6</u>
Number of phases	3
Cos φ	0.8 or system manufacturers' recommendation
Speed	According to engine rpm
Rating	S1 Continuous
Ingress Protection	minimum IP23
Insulation Class/Rise temperature	<u>According to Generator set manufacturers standard</u> <u>Insulation Class F with temperature rise corresponding to Class B.</u>
Bearing(s)	According to Generator set manufacturers standard
Cable entry	MCT
Efficiency	0.96 at full load
Cooling	Air

The generator shall be equipped with:

- Automatic Voltage Regulator (AVR) according Classification Society requirements
- Anti condensation heater
- Winding temperature sensors

#### Emergency generator – additional requirements

The Emergency DG control system shall be equipped with the following features, among others:

- Automatic start of the Emergency DG, due to voltage failure in the MSB ("blackout")
- Automatic shutdown of the Emergency DG after MSB voltage returns to normal
- ESB bus protection devices (short-circuit, under- and over-voltage, under- and over-frequency)
- Emergency DG protection devices (overload)
- Analog instrumentation and manual controls in ESB
- Manual controls and indications for opening and closing the ACB
- Manual Emergency DG rotation controls
- Selection of manual / automatic / test operating mode
- Blackout simulation test from the ESB

- Local Emergency DG control panel, with motor protections, local start/stop controls, emergency stop, maintenance lockout.

The Emergency DG local control panel shall be installed next to the Emergency DG.

The emergency generator shall be designed with insulation Class F and a temperature rise limited to Class B.

The generator shall run at 1800 rpm and be air-cooled in an open circuit, discharging outside the EDG compartment, with filters and protection against rodent ingress.

The cooling and lubrication systems shall be completely independent from any external supply.

The EDG shall be kept preheated by means of internal resistors installed in the cylinder jacket cooling water circuit.

Two independent starting systems shall be provided: one electric (primary) and one pneumatic or hydraulic (secondary). If two electric systems are used, the generator shall be equipped with two separate sets of batteries, chargers, and starter motors, allowing complete redundancy and interchangeability.

If batteries are used as starting source, they shall be of the AGM (Absorbent Glass Mat) type.

The generator shall be fully self-sufficient and able to operate without any external power source in both standby and running modes.

Mechanical ventilation of the compartment shall be provided and shall operate whenever the emergency generator is in standby mode.

#### **Overall system characteristics:**

The system shall be designed such that:

- The generator sets can be started from a "dead ship"

#### **References:**

Fuel Oil, ref. [70 Fuel oil systems](#).

El. start system, ref. [866 DC systems](#)

Exhaust, ref. [74 Exhaust system and air intakes](#).

Safety system, ref. [795 Automation equipment for diesel generators](#)

## 7 SYSTEM FOR MAIN ENGINE COMPONENTS

### Pipe Line Systems – General

- All pipe systems shall be according to system drawings approved by the Owner, Classification Society, and to the satisfaction of potential involved sub-contractors.
- The National Authority's approval shall be obtained on systems where required.
- The materials used in piping systems shall be certified and documented according to Classification Society requirements.
- The ANSI/ASME standard shall be followed for all the vessel's piping. If the manufacturer's standard for any equipment is different, a transition spool shall be installed only at the connection to the equipment, and the remaining complying with the ANSI/ASME standard.
- Piping shall be arranged to be as straight as possible, minimizing the number of flange connections and bends.
- Piping shall be installed with a minimum clearance of 150 mm above deck level, measured from the lowest point of the piping.
- Air vents, ullage and sounding pipes shall be tagged with stainless steel identification plates, engraved and painted black, indicating the system code and service.
- For piping systems on exposed decks, corrosion protection fittings shall be installed at all contact points between the piping and horizontal or vertical supports, including the fixing devices on the supports. Corrosion protection systems used shall be equivalent in performance and reliability to recognized solutions in the market (e.g. provided by Deepwater Corrosion Services).
- All flanged joints on exposed decks shall be protected with removable elastomeric coatings, resistant to UV radiation and marine environment.
- The arrangement of piping on the main deck shall allow free passage of cargo transport trolleys and maintenance access for deck coatings. Where such piping is unavoidable, provide removable platforms fixed with AISI 316L stainless steel bolts to allow trolley passage and deck maintenance.
- No oil or ballast piping shall pass through the Engine Room double bottom.
- The Yard shall prepare and submit for the Owner's approval the flexibility calculation reports for the exhaust gas discharge piping of the auxiliary engines, the main engine, the thermal oil heater, ballast piping and all the piping located on the exposed deck. The native electronic files of the flexibility software calculations shall also be sent to the Owner.

### Drain and Vent Provisions for Piping

All piping systems shall be arranged to allow complete draining and de-aeration before maintenance operations.

Drain and vent points shall be installed at the lowest and highest positions of piping runs respectively, in accordance with Petrobras Standard N-108, items 6 and 6.7.

### Material (Piping and armature)

Materials used in piping systems shall be suitable for the medium and service for which the system is intended.

The pipes shall meet the requirements defined in Table 7.1.

All overboard connections shall be Sch.160.

### Legend for Material Codes in Table 7.1

A—Seamless steel pipe ASTM A 53 or ASTM A 106 or API 5L, Sch. 40

- A**—Welded steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 40  
 \* Minimum wall thickness: 9.5 mm
- B**—Seamless steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 80
- BC**—Welded steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 80  
 \* Minimum wall thickness: 12.7 mm
- C**—Seamless steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 80, classified
- Cu**—Copper tube
- D**—Welded steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 20
- E**—Welded steel plate
- F**—Fiberglass tube (GRP – ISO 14692, IMO L3, filament wound, Bisphenol-based)  
 \* Use only on the inside of compartments
- G**—Hot-dip galvanized coating
- H**—Seamless aluminum brass tube ASTM B-11, alloy C68700
- I**—Stainless steel pipe ASTM A-316L  
 \* All stainless steel piping shall be SS-316L, including screws, stud bolts and nuts. When the operating temperature is higher than 60°C, the Yard shall offer another material for the cases that is resistant to stress corrosion.
- J**—Seamless drawn steel tube, DIN 2391 ("Ermeto" or equivalent)
- P**—Internally polyethylene-coated pipe  
 \* The polyethylene coating shall be applied by rotational molding. The supplier and the application procedure shall be qualified and approved by the Owner.  
 Alternatively, other coatings may be proposed by the Yard provided they demonstrate equal or superior performance and are approved by the Owner in accordance with the above paragraph.  
 Regardless of the type of coating, the Yard shall guarantee its preservation from application to final installation and shall present a specific procedure for preserving internally coated spools.
- PVC**—Plastic pipe for cold/hot water in superstructure
- MT**—ASTM A-316L stainless steel multi-pipe type with PVC cover (shall be limited to a maximum of 4 (four) pipes per group).
- \*<sup>1</sup> The seawater pipes between the sea-chest and the pump will be internally coated with polyethylene.

**A**—Seamless steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 40

**AC**—Welded steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 40

\* Minimum wall thickness: 9.5 mm

**B**—Seamless steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 80

**BC**—Welded steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 80

\* Minimum wall thickness: 12.7 mm

**C**—Seamless steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 80, classified

**Cu**—Copper tube

**D**—Welded steel pipe ASTM A-53 or ASTM A-106 or API 5L, Sch. 20

**E**—Welded steel plate

**F**—Fiberglass tube (GRP – ISO 14692, IMO L3, filament wound, Bisphenol-based)

\* Use only on the inside of compartments

**G**—Hot-dip galvanized coating

**H – Seamless aluminum brass tube ASTM B-11, alloy C68700****I – Stainless steel pipe ASTM A-316L**

\* All stainless steel piping shall be SS 316L, including screws, stud bolts and nuts. When the operating temperature is higher than 60°C, the Yard shall offer another material for the cases that is resistant to stress corrosion.

**J – Seamless drawn steel tube, DIN 2391 ("Ermeto" or equivalent)**

Not to be used for machinery piping systems in the Engine Room. For these systems, conventional seamless steel pipes shall be applied.

**P – Internally polyethylene-coated pipe**

\* The polyethylene coating shall be applied by rotational molding. The supplier and the application procedure shall be qualified and approved by the Owner.

Alternatively, other coatings may be proposed by the Yard provided they demonstrate equal or superior performance and are approved by the Owner in accordance with the above paragraph.

Regardless of the type of coating, the Yard shall guarantee its preservation from application to final installation and shall present a specific procedure for preserving internally coated spools.

**PVC – Plastic pipe, for cold/hot water in superstructure**

**MT – ASTM A-316L stainless steel multi-pipe type with PVC cover (shall be limited to a maximum of 4 (four) pipes per group).**

\*<sup>1</sup> The seawater pipes between the sea chest and the pump will be internally coated with polyethylene.

Table 7.1 Piping materials

System	Piping		Nominal Diameter	Material	Expansion Joint	Pipe Joint	Pressure Rating
Inert gas	Gas - Outside the Tanks		DN<250	AC	Dresser or expansion loop	Flange	ANSI 150 psi
			DN≥250	AC*			
	Gas - Inside the tanks		All	F			
Tank cleaning	Hot water		DN<250	BCG	Expansion loop	Flange	ANSI 150 psi
			DN≥250	BC*G			
Thermal oil	Heating coils		All	B		Sleeve	ANSI 300 psi
	General		DN>100	C		Flange	ANSI 150
			DN≤100	H			
Hydrophore	Fresh water	Cold	DN<20	BCG or PVC	Expansion loop	Flange or sleeve	ANSI 150 psi
			DN>20	ACG or PVC			
		Hot	All	Cu or PVC			
Ballast (inside tanks)	Sea water		All	F	Dresser or expansion loop	Flange or sleeve	ANSI 150 psi
Ballast	Sea water		DN<250	BCG		Flange	ANSI 150
			DN≥250	BC*G			
Fire and General Services	Sea water		DN≥50	BCG	Flange	ANSI 150 psi	
			DN≥50	ACG* <sup>1</sup>			
Sewage	Sewage, sludge, sanitary sewage and wastewater		DN<50	BCG	Expansion loop	Flange	ANSI 150 psi
			DN≥50	ACG			
Sea Water Cooling	Sea water		DN<50	BCG	Expansion loop	Flange	ANSI 150 psi
			DN≥50	ACP*			
Fresh Water	Fresh water		DN<50	BC		Flange	ANSI 150

System	Piping		Nominal Diameter	Material	Expansion Joint	Pipe Joint	Pressure Rating
Cooling			DN≥50	AC			
Fuel Oil	P ≤ 7 kgf/cm <sup>2</sup> G	T≤60°	DN≤20	BC	Expansion loop	Flange	ANSI 150
		T>60°	DN>20	AC		Flange	ANSI 150
	7 kgf/cm <sup>2</sup> G < P < 10 kgf/cm <sup>2</sup> G	DN≤20	B			Flange	ANSI 150 psi
		DN>20	A			Flange	ANSI 150 psi
	10 kgf/cm <sup>2</sup> G < P < 16 kgf/cm <sup>2</sup> G	All	C			Flange	ANSI 150 psi
		Thermal oil heater discharge	All	C		Flange	ANSI 150 psi
Lubricating oil	Transfer, purification and service	DN≤20	BC	Expansion loop	Flange	ANSI 150 psi	
		DN>20	AC		Flange	ANSI 150 psi	
	Drain and fill	DN≤20	BC		Sleeve	ANSI 150 psi	
Compressed Air	Air Vents and sounding	DN>20	AC				
	Starting air P ≥30 bar and emergency air	All	CG		Flange or sleeve	ANSI 300 psi	
	General service air P≥9.5 bar	DN≤20	BG		Flange or sleeve	ANSI 300 psi	
		DN>20	AG				
	Control air P ≤ 9.5 bar	All	Cu		Compression bonding	ANSI 150 psi	
Exhaust gases	Main Engine	All	E	Bellows	Special flange or sleeve	-	
	Auxiliary Engines and thermal oil heater	All	D				
Oxygen and Acetylene	Oxygen and acetylene	All	B		Sleeve	ANSI 150 psi	
Sounding	Water tanks	DN≤50	BCG or F	Not applicable	Sleeve	ANSI 150 psi	
		DN>50	ACG or F		Sleeve	ANSI 150 psi	
	Oil tanks	DN≤50	BC				
		DN>50	AC				
Fuel oil drain	Fuel oil	DN≤20	BC	Expansion loop	Flange	ANSI 150 psi	
		DN>20	AC				
Air Vents	Water tanks and cofferdam	DN≤50	BCG or F*	Not applicable	Sleeve	ANSI 150 psi	
		DN>50	ACG or F*				
	Oil tanks	DN≤50	BC	Not applicable			ANSI 150 psi
		DN>50	AC				
Scuppers	Scuppers	DN≤20	BCG	Not applicable	Sleeve	ANSI 150 psi	
		DN>20	ACG				
Hydraulic pipes	Inside Ballast tank	All	H or MT	Expansion loop	Sleeve	According to design pressure	
	Inside cargo tanks, slops tanks		I* or MT		Sleeve		
	Internal compartments in the superstructure and on the main deck		B or MT		Flange		
	Steering Gear		J		Union by pressure		
	Cranes		I*		Union by pressure		-
Electrical conduits	All	All	ACG	Dresser	Flange or Sleeve	-	

System	Piping	Nominal Diameter	Material	Expansion Joint	Pipe Joint	Pressure Rating
Fixed Fire Fighting System	$P \geq 10 \text{ kgf/cm}^2 G$	DN≤20	BG	Expansion loop	Flange or sleeve	According to the classification society's rules
		DN>20	AG		Sleeve	ANSI 150 psi
	$P < 10 \text{ kgf/cm}^2 G$	All	BCG			

### Valves – General and Material Requirements

Valves with nominal diameters less than or equal to 50 mm may be of the ball, globe or gate type. Bottom drain valves of fuel oil, diesel oil and lube oil tanks with net capacity above 0.4 m<sup>3</sup> shall be self-closing.

**Lug-type isolation valves shall be provided before and after equipment and for side/sea chest valves where butterfly valves are specified. Wafer-type valves shall not be used for hydrocarbon service.**

Sampling valves for fuel oil shall include local drip trays and protection against splashing on hot surfaces.

In storage and settling tanks, sampling valves shall be installed to ensure representative samples.

If handwheels are not easily accessible from platforms, stem extensions shall be fitted, or a covered access platform with locking chain provided. Where impractical, a remote manual hydraulic drive shall be fitted.

### Material Codes for Valves

- **FF** - Cast Iron (ASTM A 126);
- **BF** - Cast Bronze (ASTM B 62);
- **LL** - Brass (ASTM B 124-2);
- **AF** - Cast steel (ASTM A 216-WCB);
- **AI** - Stainless steel (ASTM A 314-S.41000).

For butterfly valves, the materials shall be:

- Body - Cast Steel ASTM A 216 WCB or Cast Iron ASTM A 126;
- Disc - Stainless Steel;
- Seat - Rubber (Viton);
- Stem - Stainless steel.

Butterfly valves shall preferably be of "Lug" type.

The valves will be according to the Table 7.2:

Table 7.2 Valve Material Selection by System

System		Nominal Diameter	Material			Pressure Rating
			Body	Disc/Seat	Stem	
Thermal Oil		All	AF	AI	AI	ANSI 300 psi
Sewage, Ballast, Fire Fighting, General Services, Fresh and Sea Water , Fresh Water for Domestic Service	$DN \geq 50$	FF	BF	LL		ANSI 150 psi
	$DN \leq 40$	BF	BF	LL		ANSI 150 psi
Compressed Air	$30 \text{ kgf/cm}^2$	All	AF	AI	AI	ANSI 300 psi
	$P \leq 9 \text{ kgf/cm}^2$	$DN \geq 50$	FF	BF	LL	ANSI 150 psi

System		Nominal Diameter	Material			Pressure Rating
			Body	Disc/Seat	Stem	
		DN ≤ 40	BF	BF	LL	
Side valves		DN ≥ 50	AF	AI	AI	ANSI 150 psi
		DN ≤ 40	BF	BF	LL	ANSI 150 psi
Fire hydrants		All	BF	BF	LL	ANSI 150 psi
Lubricating oil		DN ≥ 50	FF	BF	LL	ANSI 150 psi
		DN ≤ 40	BF	BF	LL	ANSI 150 psi
Fuel Oil	$P < 10 \text{ kgf/cm}^2$	DN ≥ 50	FF	BF	LL	ANSI 150 psi
		DN ≤ 40	BF	BF	LL	ANSI 150 psi
	$16 > P \geq 10 \text{ kgf/cm}^2$	DN ≥ 50	FF	BF	LL	ANSI 150 psi
		DN ≤ 40	BF	BF	LL	
	$P \geq 16 \text{ kgf/cm}^2$	All	AF	AI	AI	ANSI 300 psi

**Note:** Stainless steel AISI 304 shall not be used for any valve components.

### Filters – General and Installation Requirements

Filters shall be installed in accordance with equipment manufacturers' recommendations and as specified below:

- Filters shall be provided for all systems in the Engine Room.
- Shut-off valves shall be fitted before and after all equipment and filters to allow isolation and maintenance
- Filters on the suction side of pumps connected to sea chests shall always be installed upstream.
- Lube oil and fuel oil systems shall use duplex filters, with one unit automatic.  
A manual by-pass self-cleaning type with continuous "back-flushing" operated by the filtered oil shall be used.  
Contaminants shall be removed via automatic drains (e.g., Moatti-type or equivalent).
- Filters shall be installed upstream of all temperature and pressure control valves.
- Seawater system filters shall be internally lined with polyethylene.
- Lube oil pump suction filters shall have a minimum mesh size of 2 mm<sup>2</sup>.

### Workmanship

- For Cu.Nickel (90/10) pipes, flat steel clamps with linings shall be applied.
- For steel pipes galvanized flat steel clamps or U-type steel bolt clamps shall be applied.
- In general, all pipes shall be cleaned thoroughly.
- FW cooling, Fuel Oil, Lube Oil, ~~Methanol and~~ Hydraulic Oil pipes shall be cleaned according to the standards required by the engine/ equipment supplier.
- Where necessary, the pipe lines shall be equipped with expansion joints or shall be laid with expansion bends.
- In general, pipes passing through tanks shall be all welded.
- The pipe spool close to the tank suction well shall be flanged.
- Flexible connections shall be provided between resiliently mounted machinery and pipes.
- For oil pipes near hot surfaces, screens shall be arranged.
- Possibility to drain-off pipelines exposed to frost shall be arranged.
- Pipes passing through ~~switchboard room(s)~~ ECR or Instrument rooms shall be avoided/minimized and shall be all welded. Water pipes shall be isolated for condensate.
- Loops in closed circuit systems shall have drain plugs at lower ends and air plugs at top.

- In general, electric driven pumps shall be fitted with pressure gauges on inlet and outlet side.
- Coolers for SW and FW shall be fitted with thermometers on inlet and outlet side.
- Control valves shall be sized from the flow and pressure drop requirements of the system and not from the size of the adjacent pipes.
- All pressure system shall be pressure tested according to Classification Society requirements, but as a minimum 1.5 times design pressure and minimum 4 bar. Hydraulic piping does not need to exceed the design pressure by more than 70 bar.
- Push-fit pipe work for sanitary gravity drain shall be leakage tested at max. 0,5 bar and vacuum pipes shall be tested in accordance with recommendation from the vacuum system supplier.
- All piping systems shall be arranged to prevent the accumulation of liquids or gases in pockets; where not possible, drain connections shall be provided.
- Eccentric reducers shall be used in pump suction piping to prevent air entrapment.
- Movements caused by thermal expansion and vessel structure deflection (hogging and sagging) shall be absorbed by pipe arrangements; the use of expansion joints shall be avoided unless technically unavoidable and approved by the Owner.
- Expansion joints, if used, shall be of Dresser type with Viton seals and protected inner surfaces.
- Piping shall not penetrate control rooms or electronic spaces unless unavoidable; in such cases, gastight arrangements shall be made.
- Pressure tests shall be carried out at 1.5 times the design pressure, and at minimum 4 bar where applicable.

### Engine Room Tanks – Additional Requirements

- The capacity of the tanks shall be defined during the detailed design in accordance with this Technical Requirement and the manufacturers' recommendations.
- There shall be openings in the fuel oil storage tanks for the use of portable cleaning machines and exhaust fans, as defined in item 3.1.2.1.
- ~~The level transmitters can be bubble or electric (pressure sensor - 4/20 mA) with indication on the ICMS. The sensors shall be installed in such a way that they can be removed for maintenance or replacement without the need to open the tank. The level transmitters can be bubble or electric (pressure sensor - 4/20 mA) with indication on the IAS. The sensors shall be installed in such a way that they can be removed for maintenance or replacement without the need to open the tank.~~
- It shall contain a valve capable of isolating the sensor from the tank.
- All tanks will be supplied with manhole covers, fitted with handholds and seals.
  - The covers of the openings and manholes inside the Engine Room, above the tank top, shall be fixed using galvanized steel stud bolts, nuts, and washers.
  - The covers of the openings and manholes below the Engine Room floor shall be fixed using clamps (150 mm), stud bolts, nuts, and washers made of ASTM A-316L stainless steel.
  - The covers of the openings and manholes outside the Engine Room shall be fixed using ASTM A-316L stainless steel stud bolts, nuts, and washers.
- It shall be painted under the main deck and two meters below and one meter above the top surface of the stringers.
- Sampling valves for fuel and oil tanks shall be equipped with a drip tray and splash protection, to avoid spillage on hot surfaces and ensure safe handling during operation.

### Thermal Insulation Requirements

- The hot surfaces of all machinery, equipment, tanks, and pipes operating at temperatures normally above 60°C shall be thermally insulated, as well as the flanges, valves, and fittings of

these piping.

- The ends of the thermal insulation of pipes near flanges, valves, fittings, and supports shall be finished in such a way as to allow removal of bolts and the shifting of pipes on their supports, in accordance with the Yard's practice to be approved by the Owner.
- The ends of the thermal insulation of pipes near flanges, valves, fittings, and supports shall be finished in such a way as to allow the bolts to be removed and the piping to be moved on their supports, in accordance with the Yard's practice to be approved by the Owner.
- Galvanized steel plates with a thickness of 0.4 mm shall be used for thermal insulation of tanks, machines, equipment, and exhaust gas discharge of the thermal oil heater, main engine, and auxiliary engines.
- The flanges, valves, and fittings of insulated piping shall be thermally insulated with a mattress made of lined insulating material.
- The fuel oil settling tanks, fuel oil service tank, fuel oil storage tanks, purifier sludge tanks, and Hot Water Tank, and other heated tanks in the Engine Room, whose working temperature exceeds 60°C (except the side, bulkheads bordering tanks, double bottom tank top) and bulkheads below the double bottom tank top will be insulated with blankets or plates of insulating material, in accordance with the Yard's practice.
- The following regions shall also be isolated:
  - Bulkheads and upper deck (if exposed to the sun) of the Emergency Diesel Generator compartment.
  - Bulkheads and upper deck (if exposed to the sun) of the clean firefighting agent bottle compartment.
  - Bulkheads and upper deck of the Steering Gear Compartment.
- The thermal insulation will be designed to achieve a maximum temperature on its external surface of around 60°C, considering the temperature of the air in contact with this surface to be 45°C.
- The hot water piping for human consumption shall be insulated so that the minimum temperature of the return water is 51°C.
- The thermal insulation of the thermal oil, hot water, fuel, and lube piping shall be insulated with rock wool or glass wool. The exhaust gas discharge piping shall be insulated with rock wool.
- The refrigerant gas piping shall be insulated with polyurethane foam (non-combustible type and certified) and covered with a single layer of raw cotton canvas fabric.
- The Yard shall design the thermal insulation so that there is no condensation on its external surface.
- All materials used as thermal insulation shall be in full compliance with the applicable rules (ref. SOLAS/FSS-FTP Code, Hong Kong Convention, 2009 / MEPC. 379(80)).

### **Marking**

All valves, valve chests, pumps, tanks, machinery, starters, armatures, etc. shall be marked with identification signs made of ASTM A-316L stainless steel. The signs shall be engraved, painted black, and fixed with screws of the same stainless steel. The text shall be in English.

### **Colour coding of pipes**

The colour coding of all piping shall be performed in accordance with Petrobras standards N-1503 and N-1219.

Additionally, flow direction and pipe content shall be marked using labels and arrows in accordance with ISO 14726.

### Pipe penetrations through watertight bulkheads

- Plastic pipes are not accepted as watertight penetrations.  
~~Roxtec or similar bulkhead seals used for chilled water are subject for acceptance from the National Authorities, ref. type approval certificate.~~
- Steel piping is considered watertight.

## 70 Fuel oil systems

### General

The ship shall be arranged with a fuel oil system based on Residual/Heavy and Light Fuel Oil (HFO/LFO) and Distillate/Marine Diesel Fuel Oil (DO).

- Main engine HFO/LFO - DO
- Aux. generator set engines HFO/LFO - DO
- Emergency generator set engine - DO
- Oil fired Thermal Oil Heaters HFO/LFO - DO

### Service and settling tanks

- One (1) service tank and one (1) settling/service tank in Main engine room for MGO
- Two (2) service tanks and two (2) settling tanks in Main engine room for HFO
- One (1) service tank for Emergency generator set engine

### Transfer pumps and purifiers

- Two (2) FO transfer pumps for service and settling tanks in Main engine room, approx. 30 m<sup>3</sup>/h each (capacity of max daily consumption/h) one for MGO and one for HFO; one of which is a backup for the other
- Two (2) heaters for the purifiers; one of which is a backup for the other
- One (1) DO pump, approx. 6 m<sup>3</sup>/h (20% of FO transfer pumps)
- Backup filling of settling tanks with purifier feed pumps.
- One (1) FO transfer pump for Emergency generator set engine service tank, capacity approx. 1 m<sup>3</sup>/h
- Two (2) centrifugal HFO/LFO - DO purifiers, without gravity discs, of the self-cleaning type, driven by an electric motor without the pinion-crown assembly to drive the drum, one being a backup for the other
- One (1) FO automatic filtration unit with self-cleaning system;

### Bunkering system

From the bunkering stations, a separate filling line shall be arranged with distribution to all bunker tanks via remote operated valve chest(s). The system shall be dimensioned for 100 m<sup>3</sup>/h.

Each filling line shall comply with OCIMF recommendations and include:

- Independent filling piping
- Continuous sampling device
- Valve and blind flange

Sampling devices shall be installed close to consumers and equipped with:

- Drip trays with drain and protection
- Drain point at lowest part of tray

- Removable screens to retain solids
- Tapered bottom to facilitate drainage

## 701 Fuel oil transfer & drain systems

### Fuel Oil Transfer System

Technical particulars for the fuel oil transfer pumps:

- 3-spindle screw type, with built-on safety valve
- Casing in cast iron and screws in nitrated steel
- Electric motor – one speed
- Maximum 3600 rpm
- Suitable for low sulphur and low viscosity fuels

The fuel oil system shall include:

- Two (2) HFO/LFO transfer pumps
- One (1) DO transfer pump
- All pumps arranged for backup operation
- The HFO/LFO transfer pump shall transfer the daily HFO/LFO consumption in max. 1 hour
- The DO transfer pump capacity shall be at least 20% of HFO/LFO transfer pump

For tank sounding, level switches and alarm arrangement, see Table 8.1 in 822 Sounding system

### Transfer system layout:

- Pumps shall have suction from overflow tank and from bunker tanks valve chest
- Pumps to supply settling tanks (automatic) and service tanks (manual)
- Transfer pumps shall allow transfer between any tanks and recirculation to own tank
- Transfer pump for Emergency Generator set fuel oil tank shall also supply fuel to:
  - Incinerator fuel oil tank
  - Rescue boat filling station
- Remote stop push buttons for the HFO/LFO - DO transfer pumps shall be provided next to the FO (HFO/LFO - DO) connections on the main deck and on the navigation bridge.
- The Emergency Generator service tank shall be located in the generator compartment and shall have a capacity of 150% of the volume required by applicable regulations. A low-level alarm shall be set at 100% of the tank volume. The tank shall be filled via a dedicated pipeline, and the diesel oil transfer pump shall be powered by the emergency switchboard.

### Pipe routing and installation:

- No oil or ballast piping shall be installed in the double bottom of the Engine Room
- Rescue boat filling station shall include shut-off valve, hose, and filling nozzle

### Overflow Tanks & System

Overflow tank shall collect overflow from:

- Settling tank to overflow tank
- Service tank to settling tank
- Emergency Generator service tank to DO storage tank (with IAS flow indication)
- DO storage tanks to overflow tank (with IAS flow indication)
- HFO/LFO storage tanks to overflow tank (with IAS flow indication)

Overflow piping shall include:

- Sight glasses
- Observation lamps

Overflow tank shall also collect:

- Discharges from safety valves of supply/bunker lines
- Drip trays and leak trays from equipment

See also: [821 Tank venting and overflow system](#).

### Fuel Oil Service and Settling Tanks

Tanks shall include:

- Waste tray
- Drain pot and drain
- Overflow
- Tank sounding
- High/Low level alarms
- High/Low switches for auto start/stop of transfer pumps
- Quick-acting shut-off valves for remote operation

### Monitoring and Remote Control

Monitored via IAS:

- Tank levels (with separate high/low alarms)
- High/low level in Emergency Generator tank
- High level in overflow tank
- Flow indication in overflow lines

Remote control via IAS:

- Automatic start/stop of pumps
- Remote manual start
- Remote valve actuation (except quick-acting/service valves)

See also: [792 Alarm and monitoring system](#) and [822 Sounding system](#).

### Bunkering System

- Independent filling lines per OCIMF recommendations
- Fuel oil connections on port and starboard cargo manifold
- All connections to be equipped with:
  - Continuous sampling device
  - Valve
  - Blind flange

## 702 Fuel oil purification plants

The Fuel oil purification system shall consist of:

- Two (2) HFO/LFO feed pumps, one of which is a backup for the other;
- Two (2) heaters for the purifiers, one of which is a backup;
- Two (2) centrifugal HFO/LFO - DO purifiers, without gravity discs, of the self-cleaning type, driven by an electric motor without the pinion-crown assembly to drive the drum, one being a backup for the other;

- One (1) FO automatic filtration unit with self-cleaning system;
- Settling, service and sludge tanks;
- Piping and fittings.
- For tank sounding, level switches and alarm arrangement, see Table 8.1 in 822 Sounding system

The Fuel oil purifier(s) shall:

- Be of Automatic self-cleaning type
- Have loose supplied type electric driven supply pump
- Have capacity in accordance with recommendation from the engine supplier/ purifier supplier, approx 1,5 m<sup>3</sup>/h
- Have suction from the FO settling tank, main engine room FO service tank(s) and the FO overflow/ drain tank with clean oil delivery to the main engine room service tanks

Each fuel oil purifier (HFO/LFO - DO) shall have sufficient effective capacity (throughput = 25% of nominal capacity) to purify, in 20 (twenty) hours, a volume of oil equal to the vessel's daily consumption, with the Main Engine operating at its maximum continuous rating (MCR) and 1 (one) Auxiliary Engine operating at 100% load.

Fuel oil purifiers (HFO/LFO - DO) shall be equipped with a seal broken alarm, with automatic by-pass, high vibration alarm and other alarms and indicators recommended by the equipment manufacturer.

The feed pumps for the purifiers shall be able to operate in parallel, pumping from one or both HFO/ LFO settling tanks.

All the purifiers (except the Auxiliary Engine LO purifiers), heaters, Main Engine fuel oil supply and service pumps, thermal oil heater fuel oil burner supply pump, viscometer and flow meter shall be arranged in Separator Room

The purifier room shall have a dedicated and organized space with panels for the special tools needed for maintenance of the purifier sets, a bench for cleaning the purifier rotors, large enough to accommodate two (2) rotors and parts that are being cleaned and one (1) sink for washing the rotors, equipped with a cold water tap, compressed air and DO outlet, ultrasonic cleaning sink capable of accommodating at least the largest bowl of the largest purifier. This space should be located preferably at the end of the compartment with the best possible ventilation flow configuration for the best working conditions in the compartment.

The room shall be sized to allow easy access for maintenance of the installed heaters, valves and accessories. The compartment deck should have a raised platform provided with galvanized grating only where required for operation.

The equipment shall be equipped with coamings and a drainage system for possible oil leaks.

The room shall have ventilation and exhaust in diagonally opposite positions.

Sludge collecting tank shall be installed below FO and LO separators.

Sludge system, see 803 Bilge systems and oil/water separation.

## 703 Fuel oil consumption system

### Fuel Oil Supply Overview

Table 7.3 Fuel oil supply system

Item	Description
Main engine	Fuel oil supply from service tank. Back-up from settling/ service tank

Item	Description
Aux. generator set engines	Fuel oil supply from service tank. Back-up from settling/service tank
Emergency generator set engine	Fuel oil supply from separate service tank with capacity according to SOLAS requirement
Thermal oil heater	Fuel oil supply from service tank
Incinerator	Diesel oil supply from DO service tank via dedicated pump.
Inert Gas Generator	Diesel oil supply from DO service tank via dedicated pump.

### Fuel Oil Conditioning System for Main Engine and Auxiliary Engines

- One (1) compact pressurized conditioning unit serving both Main Engine and Auxiliary Engines, following the recommendations of CIMAC (The International Council on Combustion Engines), consisting of:
  - Two (2) supply pumps (1 operating + 1 standby), with safety filter at inlet and automatic changeover.
  - Duplex filter(s) as recommended by engine maker, including one automatic backflush filter.
  - Two (2) mass flow meters ("Coriolis") for Main Engine – supply and return, interfaced with IAS.
  - Two (2) mass flow meters ("Coriolis") for Auxiliary Engines – combined flow measurement for set of AE, interfaced with IAS.
  - One (1) deaeration and recirculation tank.
  - Two (2) circulation pumps (1 operating + 1 standby), with automatic changeover.
  - Two (2) heaters (1 operating + 1 standby), with thermal oil control valve controlled by viscometer.
  - One (1) viscometer with temperature or viscosity control mode.
  - Local control panel with graphic interface and remote supervision via IAS.
  - Piping arranged for continuous circulation without temperature loss. Insulation and tracing applied.
  - Interconnection with diesel oil lines for cold start and shutdown recovery.
  - Two (2) supply pumps (1 operating + 1 standby), with safety filter at inlet and automatic changeover.
  - Duplex filter(s) as recommended by engine maker, including one automatic backflush filter.
  - Two (2) mass flow meters ("Coriolis") for Main Engine – supply and return, interfaced with IAS.
  - Two (2) mass flow meters ("Coriolis") for Auxiliary Engines – combined flow measurement for set of AE, interfaced with IAS.
  - One (1) deaeration and recirculation tank.
  - Two (2) circulation pumps (1 operating + 1 standby), with automatic changeover.
  - Two (2) heaters (1 operating + 1 standby), with thermal oil control valve controlled by viscometer.
  - One (1) viscometer with temperature or viscosity control mode.
  - Other equipment for conditioning and burning 0.1% sulfur fuel oil.
  - Local control panel with graphic interface and remote supervision via IAS.
  - Piping arranged for continuous circulation without temperature loss. Insulation and tracing applied.
  - Interconnection with diesel oil lines for cold start and shutdown recovery.

### Main Engine

- Separate fuel oil consumption system.
- System designed according to engine manufacturer's recommendations.
- Built on fuel oil booster pump, mechanically driven.
- One (1) electric driven stand-by fuel oil booster pump, screw type.

- One (1) electric driven feeder pump (if required by engine supplier).
- One (1) fuel oil heat exchanger (if required by engine supplier).
  - Separate fuel oil consumption system.
  - System designed according to engine manufacturer's recommendations.
  - Built-on fuel oil booster pump, mechanically driven.
  - One (1) electric-driven stand-by fuel oil booster pump, screw type.
  - One (1) electric-driven feeder pump (if required by engine supplier).
  - One (1) fuel oil heat exchanger (if required by engine supplier).

### Auxiliary Generator Set Engines

- Separate fuel oil consumption system.
- System designed according to engine manufacturer's recommendations.
- Three way manual valves on fuel oil inlet and outlet to operate with HFO/LFO or DO.
- One (1) dedicated diesel oil pump.
- One (1) emergency start diesel oil pump (for blackout).
  - Separate fuel oil consumption system.
  - System designed according to engine manufacturer's recommendations.
  - Three-way manual valves on fuel oil inlet and outlet to operate with HFO/LFO or DO.
  - One (1) dedicated diesel oil pump.
  - One (1) emergency start diesel oil pump (for blackout).

### Emergency Generator Set Engine

- Separate fuel oil consumption system.
- One (1) DO service tank, located inside the emergency generator compartment.
- The DO tank shall have 150% of Class capacity, with low level alarm at 100% volume.
- The tank shall be filled by a diesel oil pump powered by the Emergency Switchboard (ESB).
- One (1) sampling point with self-closing valve.
  - Separate fuel oil consumption system.
  - One (1) DO service tank, located inside the emergency generator compartment.
  - The DO tank shall have 150% of Class capacity, with low level alarm at 100% volume.
  - The tank shall be filled by a diesel oil pump powered by the Emergency Switchboard (ESB).
  - One (1) sampling point with self-closing valve.

### Thermal Oil Heater

- Separate fuel oil consumption system.
- Two (2) FO firing pumps, each for 100% load.
- Two (2) FO heaters, each for 100% load.
- Two (2) mass type ("Coriolis") flow meters with monitoring in the IAS, with bypass valve and filters.
- Automatic pressure control valves.
- Fuel conditioning equipment for 0.1% sulfur fuel oil.
- Capability to use diesel oil for cold start ups (as approved by maker).
  - Separate fuel oil consumption system.
  - Two (2) FO firing pumps, each for 100% load.
  - Two (2) FO heaters, each for 100% load.
  - One (1) mass flow meter (Coriolis type) with monitoring in the IAS, equipped with a by-pass valve and filter, installed to measure the auxiliary boiler and composite boiler as a combined set.

- Automatic pressure control valves.
- Fuel conditioning equipment for 0.1% sulfur fuel oil.
- Capability to use diesel oil for cold start-ups (as approved by maker).

#### **Incinerator**

- ~~One (1) supply diesel oil pump.~~
- ~~System designed according to equipment manufacturer's recommendations.~~
  - One (1) supply diesel oil pump.
  - System designed according to equipment manufacturer's recommendations.

#### **Inert Gas Generator**

- ~~One (1) supply diesel oil pump.~~
- ~~System designed according to equipment manufacturer's recommendations.~~
  - One (1) supply diesel oil pump.
  - One (1) mass flow meter (Coriolis type) shall be installed in the diesel oil line supplying the inert gas generator.
  - System designed according to equipment manufacturer's recommendations.

#### **General Provisions**

- ~~Fuel consumption monitoring shall be provided individually for Main Engine, Auxiliary Engines, Emergency Generator, Thermal Oil Heater, Incinerator, and Inert Gas Generator.~~
- ~~Fuel sampling points shall be installed close to each consumer, with drip trays and protection from hot surfaces.~~
- ~~Viscosity control shall be included where required by the engine/equipment supplier.~~
  - Fuel consumption monitoring shall be provided individually for Main Engine, Auxiliary Engines, Thermal Oil Heater, and Inert Gas Generator.
  - Fuel sampling points shall be installed close to each consumer, with drip trays and protection from hot surfaces.
  - Viscosity control shall be included where required by the engine/equipment supplier.

### **704 Heating coils in fuel oil tanks**

Fuel oil tanks shall be fitted with thermal oil heating coils to maintain fuel viscosity and temperature. Heating coils shall be designed in accordance with the central heating system described in section 845 Thermal Oil Heating System.

Each fuel oil tank (storage, settling, service) shall be fitted with a minimum of two (2) independent heating coil sections.

### **705 Fuel oil sampling/stripping**

No stripping system to be arranged.

One (1) portable hand pump shall be delivered and utilized for sample taking from each tank. Sampling pipes shall end approx. 500 mm above the tank bottom.

There shall be valves provided for taking samples of service fuel oil in accordance with IMO Resolutions MEPC.324(75), MEPC.182(59), Circular MEPC.1/Circ.864/Rev.1 and Circular MEPC.1/Circ.889. Fuel oil supply piping for all consumers installed on board (including EDG) shall be considered, taking into account the various types of fuel.

A continuous fuel oil drip sampler according to MARPOL Annex VI and MEPC.182(59) Annex 7 shall be provided.

## 71 Lube oil systems

The Lube oil systems shall include:

- Lube oil transfer systems for filling and emptying of engines, etc. The systems shall be separated to avoid mixing of different lubrication oils
- Hull integrated lube oil (LO) - and hydraulic oil (HO) storage/drain tanks for major equipment/consumers
- Free standing storage tanks for minor consumers
- One (1) Lube oil transfer pumps,
- Two (2) self-cleaning centrifugal LO purifiers for the Main Engine, one of which is a backup
- Three (3) LO purifiers, 1 (one) for each Auxiliary Engine, centrifugal, self-cleaning type
- Five (5) heaters, 1 for each purifier
- Separate Lube oil system for each engine in accordance with the engine supplier's requirements
- Separate Lube oil system shall be arranged for the main propulsion unit. The systems shall be arranged according to the recommendations of the manufacturer

### 711 Lube oil transfer & drain systems

#### Transfer pumps

- Lube oil transfer pump main engine
- Lube oil transfer pump Aux. engines
- Lube oil transfer pump main propulsion system
- Hydraulic oil transfer pump LP deck winches system
- Hydraulic oil transfer pump HPU system

The transfer pump for the main engine shall be fitted with a flow-meter (manual reading).

Technical particulars for the LO/ Hydraulic oil transfer pumps:

- 3-spindle screw type, with built-on safety valve
- Casing in cast iron and screws in nitrated steel
- Electric motor – two speed.
- Maximum 3600 rpm

#### Hull integrated tanks

Hull integrated lube oil (LO) - and hydraulic oil (HO) storage/drain tanks for major equipment shall be arranged.

The tanks shall be arranged for the following purposes:

- LO storage tank(s) for main engine
- LO storage tank for Aux. generator engines
- LO storage tank for main propulsion system
- HO storage tank for LP deck winches
- HO stores tank for HPU
- Sludge tank for engine room systems
- Dirty oil tank for engine room systems

Each storage tank shall have a separate filling line from deck. The tanks shall be equipped with:

- High level alarm

- Drain cock
- Waste tray (waste trays in the engine room shall be gravity drained to the sludge oil tank)
- Vent and overflow, see 821 Tank venting and overflow system
- ~~Tank sounding, see~~Tank sounding, level switches and alarm arrangement, see Table 8.1 in 822 Sounding system

### Free standing storage tanks

The free standing storage tanks shall be installed and located adequate for the following purposes:

- 1 (capacity: 250 L) tank for windlass/mooring winches hydraulic system
- 1 (capacity: 250 L) tank for Emergency generator set engine lube oil
- 1 (capacity: 450 L) tank for steering gear system

Hand pumps shall be arranged for filling from:

- Free standing storage tanks to the systems
- Hull integrated stores tanks to systems without electric driven transfer pump

Provision shall also be made for filling LO tanks using portable pumps and LO drums.

## 712 Lube oil purification plants

The lube oil purification system shall be arranged for continuous cleaning of the oil for the main engine and auxiliary engines, using centrifugal purifiers.

- Two (2) automatic self-cleaning centrifugal lube oil purifiers for the main engine, one as a backup.
- Three (3) automatic self-cleaning centrifugal lube oil purifiers for the auxiliary engines, one for each engine.
- The LO purifier plant shall include five (5)~~electric~~ heaters, one for each purifier, supplied from the thermal oil heating system.
- Each LO purifier for the main engine shall have an effective capacity (throughput = 20% of nominal capacity) sufficient to purify, in 20 hours, a volume of oil equal to three times the total volume contained in the main engine system at a temperature of 98°C.
- Each LO purifier for the auxiliary engines shall have an effective capacity (throughput = 20% of nominal capacity) sufficient to purify, in 20 hours, a volume of oil equal to four times the oil load of one auxiliary engine at a temperature of 98°C.
- The LO purifiers shall be fitted with high vibration alarm.
- Provision shall also be made for filling the LO tanks using portable pumps and LO drums.
- The purifiers shall be without pinion-crown assembly to drive the drum.

## 713 Lube oil systems for propulsion machinery and transmissions

### Main engine (medium speed type)

The Main Engine Lubrication Oil (LO) system shall be designed in accordance with the engine manufacturer's recommendations and the applicable Classification Society rules.

The system shall include the following components:

- Two (2) LO supply pumps for the Main Engine (100% capacity each), with automatic changeover in case of pressure drop or electrical failure.
- Two (2) LO coolers, with a minimum 0.9 margin (combined minimum cooling capacity 190%).
- One (1) automatic LO filtration unit with backflushing system.
- Electronic temperature control system.

- LO tanks, piping and fittings.
- Tank sounding, level switches and alarm arrangement, see Table 8.1 in 822 Sounding system

If the Main Engine is of 4-stroke type, the above configuration may be adjusted as per the engine supplier's recommendation.

#### Cylinder Lubrication

Lubrication of the Main Engine cylinder liners shall be performed by a dedicated pump mounted on the Main Engine, drawing directly from the cylinder LO tank.

#### Ventilation and Piping Inclination

- All air vents shall be fitted with flame arresters.
- The air vent from the Main Engine sump tank shall have a minimum inclination of 5°.
- The Main Engine air vent piping shall terminate near the engine room exhaust fans.
- Cylinder LO piping shall be arranged with a minimum inclination of 10°.

#### Filters and Sampling

- Filters in the suction lines of the LO supply pumps shall be equipped with magnetic elements, if required by the Main Engine manufacturer.
- A sampling point shall be installed between the LO supply pumps and the Main Engine.

#### Intermediate Shaft Bearing

The intermediate shaft bearing shall be lubricated by hydrodynamic means.

Cooling shall be provided by the low-temperature cooling water system.

#### Transmissions

A separate LO system shall be arranged for the propulsion unit.

The systems shall be arranged according to the recommendations of the manufacturer. See [63 Transmissions](#).

## 714 Lube oil systems for auxilliary engines

#### Generator set engines (high speed type)

Separate LO system shall be arranged for each Aux. generator engine and should include:

- Engine built-on lubrication oil system
- A pump for emptying the sump to the dirty oil tank
- A closed circuit LO system with automatic alarms according to Classification Society requirements for unmanned machinery spaces
- Electric driven pre-lubrication pump powered by the ESB, with interval start for stand-still lubrication of the engine.
- Tank sounding, level switches and alarm arrangement, see Table 8.1 in 822 Sounding system

## 716 Stern tube and stern tube tank

The stern tube bearing system shall be water-lubricated and delivered as a complete integrated system by a single supplier. The system shall comply with the applicable Class requirements, including TMON (DNV), TCM (ABS), MON-SHAFT (BV), SCM (LR), without requiring the removal of the propeller shaft for a minimum period of 15 years.

The system shall include the following:

- Two (2) stern tube bearings and a mechanical seal with emergency/test valve for hull tightness.
- ~~Sea water circulation system with two (2) pumps, each with 100% capacity, automatic~~

~~changeover in case of failure, and alarm/monitoring via ICMS. Sea water circulation system with two (2) pumps, each with 100% capacity, automatic changeover in case of failure, and alarm/monitoring via IAS.~~

- A water conditioning filter installed in the circulation line.
- ~~Flow meter with low flow indication and alarm connected to the ICMS. Flow meter with low flow indication and alarm connected to the IAS.~~
- Corrosion protection in the area between the bearings.
- ~~Bearing wear monitoring system with indication on a dedicated panel in the ECR and integrated with the ICMS. Bearing wear monitoring system with indication on a dedicated panel in the ECR and integrated with the IAS.~~
- ~~Two (2) temperature sensors for each stern tube bearing (including one spare) and one (1) sensor for the intermediate bearing, with alarm in the ICMS. Two (2) temperature sensors for each stern tube bearing (including one spare) and one (1) sensor for the intermediate bearing, with alarm in the IAS.~~
- The diameter of the propeller shaft shall be increased by 3 mm over a distance of 15 mm beyond the aft bearing.
- The diameter of the intermediate shaft shall be increased by 5 mm over a distance of 20 mm beyond the intermediate bearing.

The design and arrangement shall follow the supplier's recommendation and meet the technical requirements of the Classification Society.

## 72 Cooling systems

The cooling systems shall be based on central cooler and provide necessary cooling for the connected equipment.

The central cooler shall be based on the sea water temperature of minimum 0°C and maximum +32°C where nothing else is described.

Fresh water (FW) low temperature (LT) systems shall be based on +36°C outlet temperature from the thermostatic valves where nothing else is described.

### Materials for Cooling Systems Equipment:

- Plate-type heat exchangers (for water systems):
  - Body: Steel plate
  - Plates: Titanium (for seawater side, ASTM B-265) and Stainless steel AISI 316L (for freshwater and oil side, ASTM A-240)
- Shell & tube type heat exchangers (for oil systems, if applicable):
  - Tubes: Aluminium Brass (ASTM B-111, alloy 687)
  - Tube plates (mirrors): Muntz Metal (ASTM B-171, alloy 365)
  - Shell: Steel plate or cast iron
  - Covers: Cast iron or steel, internally coated with neoprene or epoxy resin
  - Anodes: Mild steel
- Seawater centrifugal pumps:
  - Volute casing: Bronze (ASTM B-584)
  - Impeller: Aluminum Bronze (ASTM B-148)
  - Wear ring: Aluminum Bronze (ASTM B-148)
  - Shaft: Stainless steel (ASTM A-276)

- Zinc sacrificial anodes, either mounted on the equipment or as external devices
- Freshwater centrifugal pumps:
  - Volute casing: Cast iron (ASTM A-48)
  - Impeller: Phosphor Bronze (ASTM B-139)
  - Wear ring: Phosphor Bronze (ASTM B-138)
  - Shaft: Stainless steel (ASTM A-276)

**Note:**

Any replacement of the materials specified above shall only be allowed if approved by the Owner, and must offer equal or superior performance.

## 721 Sea water cooling system

The sea water cooling system shall include the following components:

- Two (2) seawater pumps, each with 100% capacity, equipped with variable speed drive (VSD). These pumps will serve to cool the heat exchangers of the low-temperature central cooling system.
- Two (2) seawater circulation pumps, each with 100% capacity, dedicated to the cooling tower and scrubber of the inert gas system.
- Two (2) seawater circulation pumps, each with 100% capacity, for the hydraulic deck seal tank.
- One (1) seawater pump for operating the vessel while in harbour mode. This pump can be omitted if the primary seawater pumps can meet harbour requirements at low speed, as verified during the design phase by the thermal balance calculation.

The system shall provide automatic pump changeover in case of a pressure drop or electrical failure. Additionally, temperature control in the low-temperature central cooling system shall be managed via a PID controller with pump speed regulation, ensuring optimal operation.

### Piping and Equipment

- Two (2) low-suction sea chests and one (1) high-suction sea chest shall be provided in the engine room to supply seawater to the system.
- Backflushing shall be arranged for the seawater side of the central coolers to allow for cleaning and maintenance.
- In-line seawater filters shall be installed at the seawater inlet of each plate heat exchanger.
- Each sea chest shall be equipped with a downstream filter. Additional filters shall be provided upstream of pumps supplying sensitive equipment, where required.
- The filters installed in seawater piping shall be internally coated with polyethylene.
- The main seawater pumps shall take suction from the sea chest and discharge to the central coolers. After passing through the central coolers, the seawater shall be either discharged overboard or returned to the sea chest or the after peak tank.
- Each suction branch from the sea chest cross-over pipe to each cooling pump shall be equipped with an isolation valve before the pump, and each pump shall be provided with an isolation valve at the discharge side.
- An emergency bilge connection shall be arranged according to class rules.
- The seawater ejector pump for the freshwater generator shall take suction from a separate sea intake and discharge to the heat exchanger and ejectors of the freshwater generator.
- Rubber-lined butterfly valves of bronze or ductile cast steel with bronze internals and EPDM packing shall be used. The pressure in the freshwater cooling system must be higher than the seawater system to prevent contamination.

- The sea inlet valves on the crossover and sea outlet valves shall be remote-operated, with outlet valves being regulating types (0%–100%).

### Sea chest arrangement

- Each sea box chest shall be provided with double isolation valves.
- Connections equipped with stop and check valves shall be installed for cleaning the sea chests using compressed air.
- Sea chests shall not have bulkheads adjacent to oil tanks.
- The total free area of the gratings of each sea chest shall be at least two (2) times the sum of the cross-sectional areas of the suction valves of the respective sea chest.
- All seawater filters installed on the suction lines from sea chests shall be equipped with differential pressure gauges.
- Sea chests shall be fitted with air vents or openings in the upper area to eliminate possible air pockets.

### Marine Growth Prevention System (MGPS)

One (1) marine growth prevention system shall be provided with aluminum and copper sacrificial anodes mounted on the sea chests and designed for 5 years of operation under maximum circulation flow conditions.

~~The control panel shall be installed in the ECR and shall provide current measurements for each anode and a system fault alarm for monitoring by the ICMS. The control panel shall be installed in the ECR and shall provide current measurements for each anode and a system fault alarm for monitoring by the IAS.~~

The system shall include all sea chests (high, low, emergency fire, ballast, etc.).

## 722 Fresh water cooling systems

### General

~~The fresh water cooling system shall consist of a centralized closed-loop cooling system, divided into two separate circuits:~~

- ~~— High Temperature (HT) circuit~~
- ~~— Low Temperature (LT) circuit~~

~~Both circuits shall be cooled via plate type heat exchangers connected to the sea water cooling system.~~

The fresh water cooling system shall consist of a centralized closed-loop cooling system, divided into two separate circuits:

- High Temperature (HT) circuit
- Low Temperature (LT) circuit

The HT and LT circuits shall be arranged in accordance with the engine supplier's standard system design. For medium speed engines, both circuits are normally connected to one common FW cooler, and the separation between HT and LT is made by piping and thermostatic (3-way) valves integrated in the engine cooling system.

### HT circuit shall supply cooling to:

- Main Engine cylinder liners
- Pre-heater for Main Engine jackets
- Fresh Water Generator
- Deaerator tank

### LT circuit shall supply cooling to:

- Lubricating oil coolers for Main Engine and Auxiliary Engines
  - Scavenge air coolers for Main Engine and Auxiliary Engines
  - Auxiliary Engines cylinder liners
  - Electric generators air coolers
- Chilled Water Units, including ECR air conditioning, accommodation air conditioning plant and provision refrigerating plant condensers**
- Main air compressors
  - Dehumidifiers
  - Hydraulic systems for submerged cargo, ballast and slop pumps (if applicable)

### System configuration:

- 2 × FW pumps per circuit (100% capacity each) – one duty, one standby, with automatic change-over in case of failure
- 2 × SW-cooled plate-type heat exchangers for the LT circuit, each sized for 100% of the required cooling capacity – one duty, one standby.
- 1 × Heat exchanger for HT circuit, cooled by the LT circuit
- 1 × Expansion tank per circuit, equipped with low level alarm
- 1 × Oil-in-water detector per circuit
- 1 × Conductivity sensor per circuit
- 2 × 3-way control valves, electric with PID control – one for LT circuit, one for HT circuit (ME)
- 1 × 3-way control valve, electric with PID control – for Fresh Water Generator
- Sea water flushing connections for heat exchangers shall be arranged for docking and emergency maintenance
- Dosing points for cooling water additives shall be provided in accordance with engine makers' recommendations

### Control and integration:

- LT circuit temperature shall be controlled by PID regulation of SW pump speed, with 3-way valve control as backup.
- Pumps shall be auto-started based on pressure sensor signals.
- Full monitoring and control shall be available from IAS, including local/remote operation, manual/auto modes, ready and running status, and standby alarms.
- All signals from sensors and controllers shall be integrated in IAS.

### Pump specifications:

- Vertical centrifugal type
- Cast iron housing, impellers in bronze or NiAlBronze, stainless steel shaft
- Max 1800 rpm
- Pumps to be arranged as duty/standby for each circuit

### Main Engine cooling system:

- The main engine shall have built-on, mechanically driven jacket water pumps for HT and LT circuits.
- Electric standby pumps shall be installed for both HT and LT.
- A separate hot water pre-heater unit with dedicated circulation pump shall be installed.
- A deaerator tank shall be installed in the HT circuit to remove dissolved gases before water is cooled in the LT circuit.

- The overall arrangement shall follow the engine maker's recommendations.

#### **Heat exchangers:**

- Plate-type heat exchangers shall be used for water cooling.
- Shell and tube heat exchangers or plate-type heat exchangers shall be used for oil cooling.
- Each heat exchanger shall be provided with pressure gauges and thermometers at the inlet and outlet of all fluid sides (freshwater and seawater).
- Sea water flushing connections for heat exchangers shall be arranged for docking and emergency maintenance.
- Cleanliness factor for design: **85%**.
- SW inlet temperature design basis: **32°C**.
- FW inlet to secondary coolers: **36°C max.**
- SW outlet from primary coolers: **45°C max.**

#### **Drain system:**

A drain system for the fresh water cooling system shall be arranged in the engine room, including:

- Drain tank
- Drain pump with local control only (approx. capacity: 5 m<sup>3</sup>/h)
- Drain lines from all parts of the FW system
- Refilling via expansion tanks

Note: The Emergency Diesel Generator (EDG) is equipped with an independent radiator-type cooling system and is not connected to the central fresh water cooling system.

## **73 Compressed air systems**

The compressed air systems shall include the following subsystems:

- Starting air system,
- Working air system,
- Instrument air system.

The compressors shall be arranged with air ventilation and exhaust branches according to the manufacturers' recommendations and shall be designed for ambient temperature of 45°C.

All air compressors shall operate with synthetic lubricating oil.

~~Each compressor and air dehumidifier shall be equipped with a dedicated control unit for system protection and automatic air pressure control. The control units shall send group alarm signals to the Integrated Control and Monitoring System (ICMS). Each compressor and air dehumidifier shall be equipped with a dedicated control unit for system protection and automatic air pressure control. The control units shall send group alarm signals to the IAS.~~

~~Each air receiver shall be equipped with an independent pressure transmitter for indication and alarm at ICMS. Each air receiver shall be equipped with an independent pressure transmitter for indication and alarm at IAS.~~

Filters installed in the compressed air systems shall be equipped with differential pressure gauges to monitor filter obstruction.

Where possible, specifications for general service and control air compressors shall be standardized to optimize maintenance and spare parts management.

Detailed requirements for each compressed air subsystem are specified in the following sections.

## 731 Starting air systems

The starting air system shall be arranged as follows:

- **Working pressure:** 30 bar.
- **Compressors:**
  - Two (2) main starting air compressors.
  - Piston type, vertical, two or three stages.
  - Electric motor driven.
  - Each compressor shall have capacity to meet the air consumption required by the Classification Society's Rules.
  - One compressor shall be supplied from Emergency Switchboard (ESB).
- **Air receivers:**
  - Two (2) main starting air receivers, equipped with automatic purging/bleeding devices.
  - One (1) emergency air receiver, if Emergency Diesel Generator (EDG) is started pneumatically, equipped with automatic purging/bleeding.
  - Each receiver shall have an independent pressure transmitter for indication and alarm in the IAS.
- **Automatic starting air valve:**
  - One (1) automatic starting air valve shall be installed for the Main Engine.
- **Pressure reducing unit:**
  - One (1) pressure reducing unit shall reduce air pressure from 30 bar to 8 bar.
  - The unit shall be fitted with filters to achieve air quality ISO 8573-1 Class 2.4.5.
  - It shall supply the General Services Air System.
  - The pressure reducing unit is intended for emergency use only, in case of failure of the General Services Air System.
- **Compressor and system control:**
  - Automatic start/stop of compressors.
  - Automatic draining at stop and unloading at start.
  - Oil and water separator.
  - Alarms for low pressure shall be installed.
  - Local and remote control from IAS.
  - Remote control functions: Auto1/Manual/Auto2 modes, Start/Stop, Ready signal (compressor available) and Running signal to IAS.
  - Automatic operation based on system pressure sensors, connected to compressor starters.
- **Additional requirements:**
  - Air compressors shall operate with synthetic lubricating oil.
  - Compressors and receivers shall be suitable for ambient temperature up to 45°C.
  - Ventilation and exhaust branches shall be arranged according to manufacturers' recommendations.
  - Filters installed in the system shall have differential pressure gauges to monitor obstruction.
- **Starting air supply consumers:**
  - Ship whistle(s), see [427 Light and signal equipment, lanterns, whistle](#)
  - Instrument air system for engines.
  - Wheelhouse window flushing system, see [515 Side scuttles and windows with equipment](#)
  - Control locker for quick closing valves.

- Air horn for fire alarm sounders.
- (Reduction valves shall be arranged where required.)

## 732 Working air system in engine room, etc.

The working air system shall have a working pressure of 7 bar and shall be arranged with back-up supply from the starting air system via a 30–8 bar pressure reducing valve.

The air quality shall comply with ISO 8573-1, Class 2.4.5.

Technical particulars for the working air compressor:

- Electric driven, fitted with variable speed drive (VSD)
- Screw type
- Air cooled
- Minimum capacity: 300 m<sup>3</sup>/h FAD (ISO 1217)
- Maximum 3600 rpm
- Built-on or loose supplied air dryer with a pressure dew point of +3°C

Service air receiver:

- One (1) air receiver with a capacity of approximately 5 m<sup>3</sup>, equipped with automatic purging/bleeding device.

The system shall be equipped with:

- Automatic start/stop
- Automatic draining at stop and unloading at start
- Oil and water separator
- Alarm(s) installed for low pressure

Control requirements:

- Control shall be local and remote from IAS
- Remote control from IAS shall include Auto1/Manual/Auto2, Start/Stop, Ready signal (Compressor available) and Running indication to IAS
- Automatic control of each compressor shall be performed by pressure sensors installed in the system, connected to the corresponding starter

Compressed air connections for the general services air system shall be provided, fitted with valves and quick connection couplings, at the following locations:

- Engine Room floor and platforms
- Engine Room casing
- Main deck
- Accommodation and Navigation Bridge top decks
- Workshop
- Electric Workshop
- Purifier compartment
- Steering Gear compartment
- Inert Gas System Compartment
- Main deck (bow, stern, next to the accommodation PS and SB, in the cargo manifold, etc.)
- Emergency Diesel Generator compartment
- Fixed firefighting system compartments

- Foam compartment
- Ventilation and air conditioning (HVAC) compartment
- Midship Deck Store
- Bosun Store
- Cargo and Ballast Valve Hydraulic Unit Compartment
- Others as required

Shut-off valves shall be provided for each distribution section in an organized and standardized manner.

Dedicated connections shall be provided where an air motor is to be used:

- Accommodation ladders, with valve, drain and lubricator
- Bosun Store deckhouse

In case of emergency, the General Services Air System shall be able to supply the Control and Instrumentation Air System. For this purpose, filters and valves shall be provided to raise the air quality from ISO 8573-1 Class 2.4.5 to Class 1.2.1.

The final quantity and distribution of connections shall be confirmed during the detailed design phase.

## 733 Working air system on deck

The working air system shall be extended to provide compressed air outlets at the following locations on the main deck:

- Bow area
- Stern area
- Cargo manifold – port side
- Cargo manifold – starboard side
- Next to the accommodation (central area)

Each outlet shall be fitted with a ball valve and a quick connection coupling.

The system shall be supplied from the working air system described in [732 Working air system in engine room, etc..](#)

A total of five (5) compressed air outlets shall be provided on deck.

The exact routing shall be confirmed during the detailed design phase.

## 734 Instrument air systems

### General

The Instrument Air System shall supply clean, dry compressed air for instrumentation and control systems throughout the vessel.

### System configuration

The Instrument Air System shall include the following components:

- One (1) air compressor for instrumentation and control, compact type, suitable for marine use.
  - Rotary (screw) type.
  - Electric driven, fitted with a frequency speed drive (VSD).
  - Air cooled.
  - Oil separator and redundant filters.

- Built-in air dryer.
- The compressor shall have a variable operational range between 50% and 100% of its nominal capacity.
- The nominal capacity shall be sized to meet the system's average consumption at 75% of the compressor's nominal capacity.
- Nominal pressure: 8 barg.
- Air quality shall comply with ISO 8573-1, Class 1.2.1 at compressor outlet.

#### **Receivers and Dehumidification**

- One (1) instrument air receiver, capacity approximately 5 m<sup>3</sup>, equipped with automatic purging/bleeding.
- One (1) air dehumidifier, adsorption type, with automatic regeneration, sized to serve the consumers located outside the machinery spaces.
  - Minimum dew point: -40°C.
  - Air quality at the outlet of the dehumidifier shall comply with ISO 8573-1, Class 1.1.1.

#### **Piping and connections**

- Piping shall be arranged with expansion loops to absorb displacements caused by thermal expansion or vessel movements.
- Connection points for pressure gauges shall be installed near the main consumers.
- Condensate trap shall be installed at the lowest point at the air outlet to the main deck.
- Shore connection points (with blind flange and valve) shall be arranged at:
  - Forward main deck,
  - Midship main deck,
  - Aft main deck.
- Shut-off valves shall be provided before the piping penetrations to decks and accommodation areas.

#### **Control and monitoring**

- The compressor and dehumidifier shall have independent control units for protection and automatic pressure regulation.
- ~~Group alarm signals shall be sent to the Integrated Control and Monitoring System (ICMS). Group alarm signals shall be sent to the IAS.~~
- ~~Independent pressure transmitters shall be installed on air receivers for indication and alarm at the ICMS. Independent pressure transmitters shall be installed on air receivers for indication and alarm at the IAS.~~

#### **Consumers**

The Instrument Air System shall serve, as applicable:

- Remote tank sounding system (ref. 822 Sounding System),
- Separators,
- Remote operated valve actuators,
- Hydraulic system pressurized expansion tanks (if applicable),
- Main engine instrumentation (if required),
- Other ship systems requiring clean, dry compressed air for control and instrumentation.

## 74 Exhaust system and air intakes

The exhaust systems shall include:

- Pipes in the engine rooms and casings made of welded steel pipes, on open deck of stainless steel quality
- Pipes in the engine rooms and casings insulated with mineral wool covered with galvanized steel lining
- Pipes /components resiliently suspended to rigid parts of the structure
- Four (4) exhaust gas economizers for Main and Aux Engines, ref. [646 Exhaust gas boiler](#), which shall also function as a silencer. Attenuation minimum 35 dB(A)

### 741 Air intakes for machinery

See [574 Ventilation systems for engine rooms](#) and Environmental conditions listed in [D Performance](#)

### 742 Exhaust gas system

#### General

Exhaust systems shall be arranged for all engines and thermal oil heaters.

Exhaust pipes in the engine room and casing shall be made of welded steel pipes and bends, and shall be equipped with stainless steel flanged bellows-type expansion joints where required.

All exhaust pipes shall be routed to the top of the funnel(s) and directed aft.

Penetrations in the funnel shall have rain-proof collars.

On open deck, exhaust pipes shall be of stainless steel.

Main Engine exhaust shall be routed via an exhaust gas economizer, which shall also function as a silencer.

Auxiliary Engines and Emergency Diesel Generator shall have independent exhaust lines, each equipped with a silencer integrated with a spark arrestor.

The oil-fired thermal oil heater shall have a dedicated exhaust duct discharging directly to open air.

Maximum back pressure in the Main Engine exhaust system, including economizer, shall not exceed 300 mmH<sub>2</sub>O.

Drain pots with drain piping to bilge tank via scuppers shall be provided on all exhaust lines.

NOx measurement connections shall be arranged on exhaust lines for Main Engine, Auxiliary Engines and Thermal Oil Heater, as per applicable rules and regulations.

#### Sound proofing

Exhaust systems from diesel engines shall provide minimum 35 dB(A) sound attenuation.

#### Suspension

Exhaust pipes and components shall be resiliently suspended to rigid parts of the structure.

Special attention shall be given to the suspension of exhaust pipes located near accommodation areas.

A design document including routing study, support calculations and detailed fixation arrangement shall be submitted for approval.

#### Insulation

All exhaust pipes shall be insulated with mineral wool, covered by galvanized steel sheeting.

Minimum insulation thickness shall be:

- 50 mm for Main Engine exhaust piping
- 40 mm for Auxiliary Engines, Emergency Generator, and Thermal Oil Heater

### Spark arrestor

Spark arrestors shall be installed on:

- Diesel engine exhausts
- Thermal oil heater exhausts

## 76 Distilled and make-up water systems

The fresh water production system shall include:

- One (1) FW generator of evaporator type. Capacity minimum 15 m<sup>3</sup>/24h at 25°C sea water temperature.

The technical fresh water system shall include:

- A separate system
- One (1) Technical FW pump
- One (1) Accumulator tank
- Technical fresh water storage tank(s)
- Filling line from bunker station
- Filling line from freshwater production plant
- Distribution lines to technical fresh water consumers
- Heating coils for preheating of cargo tank cleaning water

### 761 Fresh water production systems

A distilled fresh water system consisting of:

- 1 (one) complete Fresh Water generator, 1 (one) plate-type heat exchanger (plate material: titanium), capable of using both the residual thermal energy from the Main Engine jacket cooling water and the heat from the thermal oil (indirectly), with a minimum nominal production capacity of 15 (fifteen) tons of distilled water per day, considering the Main Engine operating at continuous service rating (CSR) and seawater at 25°C;
- 1 (one) ejector pump for the Fresh Water generator;
- 1 (one) distilled fresh water extraction pump;
- 1 (one) hydrophore system with distilled water and fresh water;

The daily production capacity of the Fresh Water generator shall be confirmed when the "PT's" are issued at the design stage with the assumptions and calculation log.

External filling of fresh water tanks and distilled water tanks shall be carried out through dedicated connections, fitted with a valve and blind flange, installed and duly identified on the main deck or through the Fresh Water generator.

The distilled water tank shall have a capacity greater than the volume of the machinery cooling system and shall have an overflow line to the fresh water tanks. The tank shall also supply water to the watermist firefighting system. The connections shall be arranged in such a way that the lower part of the tank constitutes a spare volume intended for firefighting.

The fresh water tank shall have the capacity to meet the expected consumption during the vessel's cruising range, regardless of the Fresh Water Generator output.

A bottom drain piping shall be provided for each tank to enable it to be completely drained for cleaning and maintenance.

The water produced by the Fresh Water generator shall be transferred by the distilled fresh water extraction pumps mounted on the Fresh Water Generator to the distilled water storage tank and to the fresh water storage tank via a salinity meter positioned at the distillate outlet of the Fresh Water

Generator. The distilled water production of the Fresh Water generator shall be measured by an ultrasonic flowmeter with digital display and communication with the IAS.  
A chemical cleaning system shall be provided with no need to open the Fresh Water Generator, with easy to use, pre-installed connections in accordance with the manufacturer.

## 762 Technical fresh water systems

### General:

Provision shall be made for filling the expansion tanks of cooling systems with distilled water directly from the distilled water tank. Segregation between general fresh water and technical fresh water shall be ensured at all times.

- Pipe material similar as the sanitary supply system, see [7 System for Main Engine Components](#)
- Pump capacity 10 m<sup>3</sup>/h - 35 m<sup>3</sup>/h
- Back-up from Hydrophore system to be arranged
- Accumulator tank capacity approx. 150L

### Consumers:

- HP washer
- Separators
- Expansion tanks for FW cooling systems
- Turbine washing for main engine(s) if applicable
- Hot water boiler system
- Other consumers in engine room areas, etc.

### Technical particulars for the pump(s):

- Horizontal or vertical execution, self-priming
- Housing of Cast Iron, impeller of Brass and shaft of stainless steel
- Maximum 1800 rpm
- Electric drive – one speed

### Recovery of condensate from HVAC system:

The Technical Fresh Water System shall be extended with a function for collecting condensate produced by the central air-conditioning (HVAC) system. Condensed water from HVAC units shall be drained into a dedicated collection tank, from where it will be transferred to the Technical Fresh Water System and further distributed to selected points on the main deck and in the engine room, for cleaning purposes only. The system shall include appropriate piping and valves. Cross-connection with other fresh water systems shall not be allowed.

## 79 Automation systems for machinery plant

The vessel shall be equipped with:

### Manoeuvre desks, main consoles

Manoeuvre desks and consoles according to the General Arrangement.

The bridge concept will be implemented in the wheelhouse, control consoles and desks shall be supplied for the ECR and Bridge.

Equipment stations shall be supplied for [Main Switchboard room ECR](#) and at the Bridge.

### Alarm and monitoring system

An Integrated Automation System (IAS) for monitoring and control of relevant parts of fluid systems, tank systems, methanol fuel system, power system, machinery systems, auxiliary machinery systems shall be installed.

### **Remote Control systems**

Propulsion control systems inclusive Steering gear control system, i.e. separate control system for each unit.

All these control systems shall be electrically independent. Operator stations for Main bridge, Helmsman and Bridge wings, monitoring stations in ECR.

### **Safety systems**

Independent remote control/safety systems for relevant equipment according to requirements in class rules- and regulations, and according to manufacturer's standard shall be installed. (e.g. for Engines, etc).

Emergency stop connected to the main engine safety system shall be installed in the Steering gear room (Citadel)

Hospital alarm, routed to Treatment Room and Medics cabin, and locked in alarm for cold stores shall be installed.

### **Remote access**

A remote access system shall be provided (including secured access to relevant control systems).

### **Energy Management**

An Energy Management (EM) software package shall be provided.

### **Integrated Vessel Management System**

An Integrated Vessel Management System shall be provided.

### **Cargo Control System**

An Cargo Control System shall be provided, ref. item 38 Auxiliary systems and equipment for cargo

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## **Manoeuvre desks, main consoles, instruments**

### **General**

One central control console installed in the bridge and one in the engine control room.

### **Wheelhouse**

Following equipment to be installed in the wheelhouse:

- Bridge control console with two (2) adjustable operator chairs on tracks
- Bridge wing consoles
- One radio desk
- One cargo-~~control monitoring~~ console

Bridge wing control consoles to be located at the navigation bridge wings and optimised for maximal access around console for operator.

### **Workstations in navigation space**

The system will consist of 5 (five) multifunctional workstations that will interface the operator with the navigation systems and equipment. 4 (four) workstations will form the main navigation console, and 1 (one) will be installed at the back of the navigation bridge as a planning station. All workstations shall be able to perform the functions of "S" and "X" Radar, Chart radar, AIS,

ECDIS, VDR, Autopilot and Conning Display. The interface system between the workstations and the various navigation devices will follow the manufacturer's standard. The console's central workstation should preferably be used for the "Conning station" function and shall be installed with manual steering control interfaces (Helm-FU and NFU) and Main Engine controls and alarms.

Each workstation shall be powered by a dedicated independent UPS. The IAS workstation to be installed on the navigation bridge should, if possible, be integrated into the front console. The navigation console shall have space for an additional workstation. The main console workstations shall have an LCD display that supports a PPI of 340 mm (23.1" form 4:3 factor) or 320 mm (23" form 16:10 factor).

### **Cargo ~~control~~ monitoring console in wheel house**

Ref. section 381 Cargo control systems

### **Engine control room**

Engine control room to be provided with the following consoles and equipment:

- One (1) log table integrated with engine control room console.
- One (1) self contained air cooler
- One (1) adjustable operator chair
- Two (2) separate workstations / office space with separate chairs
- Main switchboards

The above panels to be combined or divided into suitable sections depending on final detailed design.

**One-Two (12)** door to be provided for access to the control room from the engine room.

### **Engine room control console**

One (1) engine room control console to be provided in the engine control room.

The following instruments and equipment to be installed on the engine room control console:

- CPP control lever
- M/E RPM control lever
- Telegraph receiver (selector type)
- M/E emergency stop push button with cover
- M/E auto stop override button
- Main engine revolution indicator with run hour meter
- Turbo charger tachometer and vibration alarm device
- Emergency propulsion control.
- Engineer calling device
- Telephones
- Duty engineer selection switch
- Level indicators, pressure indicators
- M/E automatic shut down alarm lamps
- Writing table
- Pressure gauges
- M/E control station transfer device
- Propeller pitch indicator
- Rudder indicator

- Steering gear alarm panel
- General alarm button
- MIP indicator
- Fire alarm push button
- Fire alarm panel
- M/E start button
- M/E stop button
- M/E control mode selection device
- M/E overload indicator
- M/E load control
- Buzzer & lamp test switch
- Alarm acknowledge button
- Dead man alarm pre-warning lamp and system on/reset button
- Integrated alarm and monitoring system as per section 792 Alarm and monitoring system
- Propeller shaft revolution indicator
- Torque meter for propeller shaft.

## **792      Alarm and monitoring system**

### General

The vessel shall operate with an unmanned machinery space in accordance with the requirements of the rules.

It will be possible to supervise monitor all the vessel's machinery, navigation, cargo, ballast and other mechanical, electrical or electronic equipment and systems via the Integrated Automation System (IAS).

The IAS will be able to operate all the electrical generation, propulsion, steering, machinery, compressed air, cargo and ballast systems. It will be possible to monitor the equipment and systems needed for navigation operations via the IAS.

Engine room alarm and engine officer call extension panels shall be installed in the following locations:

- Navigation Bridge (1)
- Engine Officers' Cabins (4)
- Ship's Office (1)
- Officers' Recreation Room (1)
- Pantry/Messroom (1)
- Gymnasium (1)

### Integrated Automation System

An integrated control and monitoring system (IAS) shall be installed, consisting of redundant SCADA servers, redundant workstations (ETs), process stations (EPs), remote data acquisition stations (ERs) and redundant communication networks to interconnect the SCADA servers with the process stations.

All components of the Integrated Automation System shall have type-approval certificate issued by the classification society selected to certify the vessel.

These components include: computers, PLCs, processors, data storage devices, power supplies, signal conditioners, signal converters, monitors, operating or monitoring interfaces, keyboards and electrical or electronic instruments connected to the system (sensors, transmitters, transducers, actuators, solenoids etc).

The IAS's SCADA servers shall use the latest version of the available software. The main SCADA server shall be installed in the ECR and have development and runtime license. The secondary server shall be installed in the CCR and have runtime license. The servers shall have dedicated direct communication with each other for data synchronization. The licenses shall allow the configuration of 2500 points or more. The servers shall incorporate the latest version of Historian Essentials and the Industrial Gateway Server (IGS), and allow reading and writing to MQTT brokers. The workstations will be SCADA client stations with the function of operational console. The connection between the SCADA servers and the process stations shall use an Ethernet network (control network) that is independent of the communication network between the SCADA servers and the other Workstations (supervisory network). The control network and supervisory network shall be redundant with a ring topology.

Each SCADA Server or workstation will basically consist of a microcomputer, with keyboard, mouse and monitor. The SCADA and workstation servers will be used to display alarm lists, synoptic diagrams, variables, operating parameters as the IAS's main human-machine interface. The system's main server shall have Asset Management System software to record and control the hardware and software characteristics of each IAS device.

The supervisory network shall have switches in the ECR and CCR. Switches for automation network communication shall be of the industrial type, layer 3, manageable, with network redundancy protocols, VLAN creation capacity and routing between VLANs. Each process station will basically consist of redundant process controllers (PLC), I/O and digital communication modules and will be positioned appropriately in the ECR or other climatecontrolled room. The process stations shall have redundant power supplies for the PLCs. Each remote data acquisition station will consist of communication modules and I/O modules and shall be positioned throughout the vessel in such a way as to minimize the number of cables to be used. Remote data acquisition stations with a control function shall have a redundant power supply, with a diode module, and a power failure alarm monitored by an HMI. The system shall have the software and hardware capacity to monitor the points planned for the IAS. The equipment and systems supervised and controlled by the IAS shall make available all the signals (or sensors) considered relevant to the operation of the respective equipment or system. It will be the Yard's responsibility to supply and install sensors in other equipment or systems where, due to their nature or simplicity, this criterion is not applicable, such as: various temperature sensors, pressure sensors in cargo manifolds, etc. The synoptic diagrams and the IAS database shall be submitted to the Owner for approval during the design phase. The design of the IAS shall include complete integration between the IAS and the vessel's other systems.

An Integrated Automation System (IAS) for monitoring and control of relevant parts of the machinery systems for main- and auxiliary machinery, cargo/fluid/ballast systems and tank systems shall be installed.

The IAS is a redundant microprocessor based multi user system for cargo control, tank monitoring and alarm and monitoring of the vessel's main- and auxiliary machinery. Alarms shall be initiated if abnormalities are detected.

There shall be installed SCADA servers together with the workstations. Each SCADA Server or workstation will basically consist of a microcomputer, with keyboard, mouse and monitor. The SCADA and workstation servers will be used to display alarm lists, synoptic diagrams, variables, operating parameters as the IAS main human-machine interface.

The IAS project shall include the following information, among others:

- "Tag numbers (cross-reference with other project documents) and tag list divided by systems
- Diagrams interconnecting the various systems to the IAS
- IAS databases
- Characteristics of sensors purchased directly by the Yard for connection to the IAS
- Network interface parameters, protocols and variables.

### IAS Architecture

The IAS shall be a modular, open and distributed monitoring, alarm, recording and control system. A SCADA server shall be installed in the ECR and another in the CCR.

The SCADA servers and workstations shall be distributed as follows:

- 1 (one) SCADA server in the ECR
- 1 (one) SCADA server in the CCR
- 2 (two) workstations in the ECR
- 2 (two) workstations in the CCR
- 1 (one) workstation in the navigation bridge.

The IAS shall use industrial PLCs. All PLC modules and other components used in the system shall be the manufacturer's latest model. Equipment or components announced by the manufacturer to be phased out in the future, considered to be at a mature stage in their life cycle by the manufacturer or in the "proof of concept" phase will not be accepted. The input and output modules shall have individually insulated inputs and outputs (minimum 1500 V insulation), as well as surge protection. The analog input channels shall have HART communication. The status of each input/output shall be indicated by an LED on the front of the card. In the event of a power failure, the PLC shall maintain the internal programming, the operating system and the user application program, without the need to reload the program via any physical or external facility. The memory of the PLC and communication modules shall be sufficient to run the application with a minimum installed reserve of 20%. 10% spare input and output channels of each type (4-20 mA analog input, digital input, resistance input, digital output) shall be provided in each process station and remote data acquisition station. The cards shall be of the "plug-in" type, fitted with mechanical devices to prevent erroneous insertion into the slots. It shall be possible to replace any card while the PLC is energized, without having to undo the external wiring of the cards, without interrupting the operation of the PLC and without affecting internal programming.

The IAS shall use open (non-proprietary) communication protocols and the register layout of all digital communications in the system shall be supplied to the Owner as part of the system documentation. The use of the OPC-DA protocol is prohibited. All IAS programming files, licenses and configuration passwords (PLCs, software and supervisory system) shall be supplied as part of the IAS to the Owner. An additional iFix thick client license for operation and development shall be provided to the Owner for the series of vessels. SCADA servers and workstations shall have LED monitors, mounted on consoles and with a minimum size of 23" / 4:3 aspect ratio.

Two (2) printers shall be installed, one in the ECR and one in the CCR for printing reports and screens. The process stations shall interface with the remote stations, sensors, equipment and individual control systems and be able to operate independently ("stand-alone") in the event of a communication network failure, without loss of continuity and without compromising the operational safety of the individual control systems and supervised equipment. Communication of the monitoring and control signals between each individual control system and the IAS shall be implemented using a digital communication network, shall according to the the individual control system standard. The use of the OPC-DA protocol is prohibited. The IAS shall have the appropriate communication cards for the

communication protocol used, minimizing the installation of signal conversion gateways. The architecture of the IAS, with the arrangement of workstations, consoles and panels shall be submitted to the Owner for approval. The IAS shall be powered by redundant uninterruptible power supplies (UPS), so that it is immune to a simple power failure, i.e. a failure of any UPS will not cause the system to lose power.

### **Supervision- Alarm, Visualization and Logging**

The IAS shall display the values of the variables of the various systems and equipment on graphical screens (synoptic diagrams) and lists, activating the individual alarm and group alarm functions and recording changes in status (events) relating to the variables.

The main variables to be monitored by the IAS are listed below. This list is not exhaustive.

During the IAS design phase, the Yard and Owner shall jointly define the input and output signals to be configured in the IAS for each piece of equipment or system on the vessel, based on the remote monitoring and control signals provided by each equipment or system to be installed. These signals shall be described in the IAS signal list, which will be subject to analysis and approval by Owner during the IAS design phase.

All the input/output signals required by Owner shall be implemented in the IAS, limited to a maximum of 1500 physical points and 1000 points by communication network:

- Main Engine and Auxiliary Engines cooling water temperatures
- Lube oil inlet pressures at the Main Engine and Auxiliary Engines
- Load, fuel index and rotation of the Main Engine and Auxiliary Engines
- Pressure and temperature of the ME scavenge air
- Fuel inlet pressure and temperature in the Main Engine and Auxiliary Engines
- Maximum and combustion pressures of the Main Engine cylinders
- Exhaust gas temperatures from Main Engine and Auxiliary Engines cylinders
- Rotation of the Main Engine and Auxiliary Engines turbines
- Inlet and outlet gas temperatures in the Main Engine and Auxiliary Engines turbine
- Gas inlet pressure to the Main Engine turbine
- Variables from the Main Engine auxiliary and control systems (hydraulics, electronic injection, axial vibration, electrical isolation of the system, lubrication system, configured parameters, etc;)
- Monitoring of all Main Engine sensors
- Main Engine vibration damping system alarms
- Indications and various alarms from the Main Engine and generators control system
- Indications and various alarms from the Emergency DG and auxiliary equipment
- Individual alarms for the stern tube lubrication system
- Temperatures of the main shaft intermediate bearing and the stern tube bearings
- Main propeller pitch
- Individual alarms from the controllable pitch propeller system (CPP)
- Individual alarms from the propulsion control system
- Individual alarms from the Main Engine protection system
- Shaft earthing device indication
- Indications and alarms from the steering gear control and hydraulic system
- Indications and alarms of the thermal oil heaters
- Low oil level in the expansion tank of the thermal oil system

- Valves opening status of engines fuel system, thermal oil heaters, fuel pumps systems and service tanks
- Production flow rate of the fresh water generator
- Current of each anode of the anti-fouling system
- Potential of the reference electrodes, voltage and current of the anodes of the impressed current cathodic protection system
- Level of consumables tanks
- Level, pressure and temperature of cargo tanks
- Pressure and temperature of the cargo manifold
- Pressure from the cargo vapour manifold
- Pressure and temperatures of cargo system equipment
- Control, operation and monitoring of the hydraulic system equipment of the cargo and ballast pumps (if any)
- Control, operation and monitoring of the VSDs of the cargo and ballast pumps (if any)
- Cargo pumps discharge pressure
- Level of ballast tanks and seawater storage tanks
- Opening status, control and alarms of the cargo and ballast valves
- Indications and alarms from the hydraulic valve control system
- Ballast treatment system operating variables and alarms
- Sea water temperature
- Filters high differential pressure alarm
- Vessel's draft
- Equipment operating status, indication of process variables and inert gas system alarms
- Events and alarms from electrical systems and equipment (operation, tripping, faults, low insulation, etc.)
- Operating status and fault alarm of all the vessel's UPS
- Generator operating status and electrical parameters (current, active power, reactive power, voltage, alarms)
- Indications and alarms from switchboards and power management system - PMS (low insulation, busbar blackout, circuit breaker trip, load shedding, automatic start of generators, etc.)
- Generator winding and bearing temperatures
- Ambient temperature and pressure in the engine room
- Status and alarms of generator circuit breakers and busbar interconnections (between MSB busbars, between MSB and ESB , and between MSB and shorepower panels )
- Alarms and variables of cargo and ballast pumps (tank pressure, discharge pressure, bearing temperature, etc.)
- Various system and equipment variables (control air pressure, LO pump discharge pressure, etc.)
- Salinity in the fresh water system
- Indication of equipment status (on, off, stand-by)
- Various system alarms (sea water, fresh water, potable water, fuel oil, lubricating oil, compressed air, thermal oil, etc)
- Control, operation and monitoring of VSDs for various systems (sea water, ventilation of the engine room, etc.)

- Stand-by pump start alarm
- Oil content at the outlet of the oil-water separator
- Fire detection system alarms
- Indications and alarms from fire-fighting systems
- Gas detection system alarms
- Total operating hours of equipment
- Grouped alarms for various equipment
- Instantaneous and accumulated fuel consumption ("mass flow meter") for each group of equipment
- Power delivered to the shaft ("torsiometer")
- Bilge level indication and alarm
- Indications and alarms from the navigation systems (by GPS: geographical position, reference date and time, absolute speed (SOG); speedlog: heading and relative speed (STW); ECDIS: absolute distance sailed, relative distance sailed; anemometer: wind speed and direction; by gyro compass: heading, rate of turn (ROT); echo sounder: bow and stern depths; rudder angle indication, propeller rotation, alarms from BNWAS, radars, autopilot, trim optimization system, heading optimization system and speed optimization system)
- Other items mentioned in this Technical Requirement.

When grouped alarms are used, they shall be activated when any alarm from the respective equipment/system occurs. This feature shall be requested to the equipment/system manufacturer during the equipment tender phase. If it is possible to implement the grouped alarm by connecting all the alarms in series with dry contacts, this solution can be adopted. It is forbidden to use the same "common" conductor for more than one alarm or indication. The system configuration shall comply with the requirements described in PETROBRAS standard N-2900 - Alarm Management.

The system shall differentiate between events, alerts and alarms, in accordance with the requirements of the standard. The configured alarms shall be prioritized and classified. A list of alarms and set points (according to Annex G of N-2900) shall be drawn up documenting the alarm management analysis. The system shall be capable of automatically suppressing alarms, in accordance with the requirements of the standard. Alarms classified as required by classification society rules may not be suppressed. IAS servers and workstations shall display the values of the variables of the various systems and equipment, individual alarm events and group alarms relating to the monitored variables on graphical screens (synoptic diagrams) and lists. The color code used for the mimic diagrams and graphic displays should, as far as possible, be similar to the color code used at the machinery and cargo piping documents. The color standard for indicating the operation/stoppage of equipment shall follow that laid down in the design of the electrical switchboards. Signal acquisition of the variables can be done directly, via discrete sensors and I/O modules, or indirectly, via serial communication in an open, industry-standard protocol. Indirect acquisition shall be used when the equipment to be supervised has its own individual control system. The synopsis screens shall be submitted to the Owner for approval as a project document. All graphical screens and lists viewed via the IAS shall be printable via a printer connected to the system.

#### Control- Supervisory control over equipment and systems

Through SCADA servers, workstations and process stations, direct commands will be made to equipment, parameter settings and control loops, such as:

- Opening and closing of cargo and ballast system valves
- Operation of the hydraulic power units of the cargo and ballast pumps (if any)
- Operation of the VSDs for the cargo and ballast pumps (if any)

- Control the rotation of the cargo and ballast pumps
- Starting and stopping various equipment, selection of "stand-by", etc.
- Control of the start, stop, connection, disconnection and operating mode of generators
- Automatic start of sewage pumps
- Automatic shutdown of FO transfer pumps
- Fault indication of the main pumps to the stand-by pumps
- It shall be possible to adjust parameters and control loops in the IAS, such as:
  - control of thermal oil pressure reducing valves
  - temperature control of fresh cooling water system
  - setpoint adjustment of the loops and PID values
- The IAS shall perform the man-machine interface of measurement and alarm systems, such as:
  - engine room tanks and overflow tanks (as per item 5.2.4) level measurement
  - Cargo and Slop tanks measurement
  - Slop tank interface measurement
  - ballast tank level measurement
  - draught measurement
- The IAS shall perform the man-machine interface of individual control systems, such as:
  - drive system for the cargo and ballast pumps
  - control system for the cargo and ballast valves

Commands executed from the IAS on an autonomous device will act through signals sent to the respective individual control system, and not directly on the device. If a "local / remote" command is switched, it will always be in the individual control system. In equipment where, due to its simplicity, an individual control system is not applicable, the control functions shall be carried out directly by the IAS. The IAS shall directly carry out all data acquisition for measuring and alarming signals that do not belong to individual control systems of autonomous equipment.

#### **Diagnostic, Self-testing and remote monitoring**

The IAS shall have self-test functions and routines and shall send the system's data to the Owner's onshore server via an ethernet network segregated from the supervision network. The supervisory system shall include MQTT client drivers that enable publishing to MQTT brokers and reading publications from MQTT brokers. The software shall have functions for selecting the data to be sent and the sampling rate for publication. It shall be possible to send any input, output or internal system variables, alarms, alerts, events, operating conditions and internal diagnostics. The configuration for sending data for remote monitoring shall be included in the system's final technical documentation.

#### **Training**

The IAS shall be equipped with software (simulator) for crew training, to be installed on a personal computer (CBT - Computer Based Training).

#### **IAS Operational Functions**

The IAS shall offer the operator the following functions, among others:

- Alarms and events, for recognition
- Presentation of dynamic overviews
- List of the latest alarms
- List of recent events
- List of alarms by group
- List of inhibited points

- [List of excluded points](#)
- [List of variables showing the instantaneous reading](#)
- [Analog point tracking charts, with trend indication](#)
- [Full system report](#)
- [Monitoring report for a point, for a predefined period, at predefined intervals](#)
- [Changing database parameters](#)
- [Inclusion and exclusion of points](#)
- [Adding, modifying and deleting synopses](#)
- [Generation of alarm points by logical functions](#)
- [Print of machine log report, including resettable and non-resettable equipment operating hours counters](#)
- [Print screens as shown](#)
- [Log of events, alarms and commands executed, displayed on screen and with the option of copying the file to electronic media](#)
- [Self-test of the system, automatic or by manual command, with fault indications](#)
- [Inhibition of individual and group points](#)
- [Control of the operational functionality of workstations via passwords](#)
- [Engineer call](#)

The static text in Mimics as well as I/O discription shall be in Portuguese.

### **Operator stations**

One (1) Operator station shall be installed at the bridge. The operator station includes:

- Operator Station 1 aft:
  - One (1) 27" wide TFT LED colour monitors
  - One (1) PC with keyboard and pointing device
  - One (1) Colour laser printer

Two (2) Operator stations shall be installed in the IAS console in the ECR:

- Operator Station 1:
  - One (1) 27" wide TFT LED colour monitors
  - One (1) PC with keyboard and Pointing device
  - One (1) Colour laser printer
- Operator Station 2:
  - One (1) 27" wide TFT LED colour monitors
  - One (1) PC with keyboard and Pointing device

Two (2) Operator stations shall be installed in the IAS console in the Carge Control Room (CCR):

- Operator Station 1:
  - One (1) 27" wide TFT LED colour monitors
  - One (1) PC with keyboard and Pointing device
- Operator Station 2:
  - One (1) 27" wide TFT LED colour monitors
  - One (1) PC with keyboard and Pointing device

### **SCADA servers**

- One (1) SCADA server in the ECR
- One (1) SCADA server in the CCR

### **Alarm panels**

The following alarm panels shall be installed:

- One (1) Alarm panel at bridge
- One (1) Alarm panel at each Engine Officers' Cabins (4 in total)
- One (1) Alarm panel in Ship's Office
- One (1) Alarm panel in Officers' Recreation Room
- One (1) Alarm panel in Pantry/Messroom
- One (1) Alarm panel at Gymnasium

### **Control Cargo systems monitoring and control**

Ref. 381 Cargo control systems

#### **Remote access**

A remote access system shall be provided (including secured access to relevant control systems).

#### **Energy Management**

An Energy Management (EM) software package shall be provided.

#### **Integrated Vessel Management System**

An Integrated Vessel Management System shall be provided.

#### **Energy Efficiency system**

SMART class notation for energy efficiency enhancement - DNV SMART (EEN), BV SMART (EnE2), ABS

SMART (INF, AEM), or any equivalent notation/scope from IACS Classification Society - is to be focused on digital

solutions designed to collect, store, process, analyze and transmit ship's data to provide enhanced condition

awareness, guidance and recommendations for crew to achieve optimum vessel performance efficiency level,

leading to reduced fuel consumption and harmful emissions.

Smart system functionalities may be implemented as a standalone system or through integration/interaction

with other onboard systems provided that a failure will not render the operation of either system inoperative.

**Additionally, IAS shall comply with requirements stated at item 7.2 of Transpetro Technical Requirements (I-ET 4880.00-9311-000-PTD-001), which includes functions for ship's data collection and transmission to shore.**

#### **Internal Alarms**

Actuation pushbuttons, indication and alarm devices at signal light columns for the following internal alarms, defined in accordance with the Regulations and international practice, shall be installed in the navigation bridge, accommodation, engine room, steering gear compartment and other compartments where necessary:

- IAS alarms
- Main Engine automation alarms

- General alarm
- Fire alarm
- Fire alarm for fixed firefighting systems such as foam, clean agents, water mist, etc
- Bridge navigational watch alarm
- Presence alarm (in areas to be approved by the BUYER), with control at the navigation bridge
- Engine Room dead man alarm
- Call from the infirmary
- Calling up of engine officer in the Engine Room by the ECR

After timing out, unacknowledged alarms shall sound via independent devices or via sound broadcast.

#### **Fixed Gas Detection and Alarm System for Engine Room and Ventilation Spaces**

The fixed gas detection and alarm system is part of the Integrated Alarm System (IAS) and shall monitor the engine room and ventilation-related spaces for early detection of gas leaks or flammable vapors.

The system shall include the following main components:

- Fixed gas detectors installed in strategic locations in machinery spaces.
- Gas warning panels in the wheelhouse and engine control room.
- Automatic activation of ventilation in deck trunk spaces if gas concentration exceeds allowable limits, as measured by the gas detectors.
- Integration with IAS alarm management.

In addition, an Oil Mist Detection System shall be installed in the engine room and monitored by the IAS, with alarms displayed locally and in the CCR.

The table below summarizes the primary components of the fixed gas detection system:

Table 7.4 Fixed gas warning system

No.	Unit	Location
1	Gas detector	Monitored rooms
1	Gas warning panel	Wheelhouse (safe area)
1	Pump box	Engine room (safe area)
1	Flame trap	Engine room (safe area)

All alarms shall be connected to the IAS and visualized in the IAS and CCR panels. The system shall be designed in compliance with Class requirements for hazardous area monitoring.

### **793 Remote control of main propulsion and engine telegraph**

#### **General**

Remote control system for main engine and CPP to be provided at the engine control room and wheelhouse.

The engine control to be designed according to class requirement for unmanned engine room operation.

The Main Engine or the remote control of the propulsion system shall be equipped with a system for monitoring and automatically adjusting engine performance, with the capability to provide diagnostics (Troubleshooting) and economic torque control.

Remote control system of main engine and CPP to be divided into following modes:

1. In wheelhouse speed. - Combined or separate control of propeller pitch and main engine
2. In bridge wings speed. - Combined or separate control of propeller pitch and main engine
3. In engine control room (ECR) - Combined or separate control of propeller pitch and main engine speed.

Overload protection device to be operated in case M/E reaches the permissible value in order to reduce the pitch of CPP to the programmed value.

A control position change-over switch to be provided on the control console in engine control room.

Simple emergency manoeuvring device for main engine and CPP to be provided at the local station in accordance with manufacturer's standard.

The Main Engine control system shall be equipped with the following features, among others:

- Local manual control
- Remote control in the ECR
- Remote control in the navigation bridge (console and wings)
- Signaling devices for control transfer
- Independent telegraph system on site, in the ECR and in the navigation bridge
- Main Engine rpm and load indications, in strategic positions the Main Engine rpm and load signals shall be sent to the integrated navigation system
- A device that totals the revolutions and hours of operation of the Main Engine, with indications of these variables in the IAS
- Automatic combined control of Main Engine rpm and CPP pitch
- Acceleration program, with "by pass" of critical speeds
- Main Engine protection devices and their auxiliaries
- Analog measurement of critical variables
- Real-time Main Engine performance monitoring system (combustion pressures and shaft power).
- Communication channel in open industrial protocol for external supervision of all the variables, measurements, parameters and alarms of the main engine, auxiliary systems and control system.
- Hardware and software for remote access via the internet to data on all variables, measurements, parameters and alarms of the main engine, auxiliary systems and control system.

The CPP control system shall be equipped with the following features, among others:

- Local manual control, in the oil distribution box (engine room)
- Remote control in the navigation bridge (console and wings)
- Pitch indications, in strategic positions, among others: navigation bridgeconsole, navigation bridgeroof, wings, ECR console and near the CPP servomotor
- CPP hydraulic system protection devices
- Local control panel for the CPP's hydraulic system, with protections, local start and stop controls and more.
- Open industrial protocol communication channel for external supervision of all CPP variables, measurements, parameters and alarms.

The Main Engine and CPP control systems shall have isolated power supplies for the internal circuits of each system and insulation measuring devices with an indication of the insulation resistance of the internal circuit and a low insulation alarm. This alarm shall be made available to the vessel's integrated control and monitoring system (IAS). If the project includes the installation of an independent ME shutdown/slowdown system, this system shall also meet these requirements.

The control panel for the CPP's hydraulic system shall be installed close to the hydraulic unit.

The combined control of Main Engine rpm and CPP pitch shall act to optimize propulsion performance and minimize fuel consumption in all vessel loading conditions.

In the event of a failure in the CPP control system, the propeller pitch shall be kept in the position it was in immediately prior to the failure ("fail to set"). At the Owner discretion, another definition may be adopted for the system's behavior in the event of a failure, provided that the CPP manufacturer proves that this new philosophy is capable of guaranteeing a safer condition for the Vessel.

### **Propeller pitch**

Remote control system of propeller pitch is electro hydraulic, i.e. signal transmission from bridge/control room to propeller system is electrical which governs hydraulic valves/cylinders for the adjustment of propeller pitch.

The CPP levers on the bridge wing control stand to correspond with the movement of the bridge control stand CPP lever.

The system consists of two independent loops:

- One for normal operation by control lever.
- One for emergency operation by push button.

### **Engine rpm.**

Remote control of engine rpm. is electronic.

### **Emergency stop**

Under the following minimum conditions, the main engine to be stopped automatically with alarm:

- Low lub. oil inlet pressure
- Over speed
- High jacket coolant outlet temp.
- M/E bearing temp. high slow down.

Manual emergency stop button to be provided in the engine control room and wheelhouse. Manual emergency manoeuvring lever (including stop position) to be provided on the local control position.

### **Load reduction**

Slow down request to be arranged after the following conditions:

- Lub. oil inlet press. low (pre-alarm)
- HT Cooling FW press. Low
- LT Cooling FW temp. high
- LT Cooling FW temp. high
- Charging air temp. high
- Lub. oil inlet temp. high
- Exhaust gas temp. high

- Turbocharger exhaust gas temp. high
- Oil mist in crankcase high
- CPP servo oil press. Low
- Sleeve bearing temp. output shaft propeller side high
- Sleeve bearing temp. output shaft engine side high
- Stern tube bearing temp. high
- M/E HT Cooling FW temp. high
- M/E LO inlet temp. high
- Thermal oil system failure

Alarms to be transferred to the navigation bridge in unmanned machinery space (E0) mode.

Ref. table section [792 Alarm and monitoring system](#).

#### **Interlock of turning gear**

Interlock to be arranged for engine start when turning gear is active.

#### **Automatic overload protection**

The engine shall be equipped with an automatic overload protection.

### **794 Automation equipment for thermal oil heaters**

The control system and protection safety devices for thermal oil heaters shall be supplied together with the equipment.

The alternating power supply to the heater system shall be consistent (same source) with the supply to the peripherals (fans and pumps).

The control system for the thermal oil heaters shall be installed in the ECR (main) with a local control (auxiliary), installed near the heater, preferably on the burner floor. The heater shall be switched on fully automatically.

### **795 Automation equipment for diesel generators**

#### **PMS System**

The power generation system shall be controlled by a dedicated microprocessor-based power management system (PMS). The PMS shall be installed in the MSB and ESB with a digital humanmachine

interface. The PMS shall have the following functions:

- Diesel generator control
- Bus tie breaker control
- Control of onshore power supply synchronization with generators, temporary paralleling and load transfer
- Electrical protections for generators and busbars
- Control of starting and stopping of generators
- Automatic synchronization of generators and closing of circuit breakers
- Automatic control of frequency and busbar voltage
- Selecting the start and stop sequence for generators
- Automatic start of stand-by generator, due to high load
- Automatic generator shutdown due to low load
- Automatic generator shutdown on failure (triggered by alarms on equipment process variables - temperatures/pressures), with stand-by generator start-up (with and without

"blackout")

- Automatic start of the second stand-by generator when the first one fails to start
- Control of parallelism and load sharing between generators (symmetrical and asymmetrical)
- Blackout recovery functions
- Generator overload prevention function (heavy load start sequences)
- Monitoring the electrical parameters of generators and busbars
- MSB busbar protection functions (short-circuit, under- and over-voltage, under- and overfrequency)
- Generator protection functions (overload, reverse power, etc.)
- Interlocks
- Semi-automatic generator control mode with commands for starting, stopping, connecting and disconnecting generators triggered manually via the PMS human-machine interface located in the MSB and ESB, automatic synchronism, parallelism, load sharing and load transfer functions between generators
- Automatic generator control mode with generator start and stop, synchronism, parallelism, load transfer, connection and disconnection of generators on the busbar according to load demand
- Disconnection of non-essential loads by generator overload alarms (Load Shedding)
- Individual alarms for each electrical protection
- Individual alarms for configured electrical parameters (overcurrent, overload, active power, reactive power, reverse power, under-voltage, over-voltage, under-frequency, overfrequency, start fault, synchronism fault, short circuit).

The power management system (PMS) shall be able to control the temporary parallel connection between the on-board generators and an onshore power supply system to be installed in the future. The parallelism time shall be limited by the PMS.

The voltage of the on-board electrical system shall be controlled by the PMS in order to make the system's voltage level compatible with the port terminal OPS supply before the parallel connection. The load transfer between the generators and the port OPS system during connection and disconnection of the OPS system at the main bus shall be controlled by the PMS and comply with the characteristics of the speed governors of the on-board generators without causing excessive variation in voltage and frequency. The PMS shall block the connection or disconnection of OPS in situations that could cause a load step in the generators above the limits established by rule.

Non-essential loads shall be separated into priority groups to be shed at different alarm levels in the electrical system (overload and underfrequency). The list of non-essential load consumers shall be submitted to the Owner for approval. All the parameters configured in each vessel's power management system shall be recorded and incorporated into the system's technical documentation to be delivered to the Owner.

The system configuration files shall be delivered to the Owner together with the final technical documentation after commissioning. The PMS shall make available to the IAS, via a digital communication channel using open industrial protocol, at least the system's alarm signals and the signals provided for monitoring and operating the generators:

- Generator start/stop controls
- Circuit breaker connection/disconnection command
- Automatic/semi-automatic mode selection

- Generator start sequence selection
- Monitoring voltage, current, frequency, active power and reactive power of generators
- Busbar voltage and frequency monitoring
- Monitoring of circuit breaker status (open/closed)
- Monitoring of all PMS alarms

The data register layout sent via the communication protocol shall be part of the system's final technical documentation.

The system shall keep a record of events and alarms in chronological sequence in an internal memory for future verification and diagnosis of faults or anomalies in the electrical system.

If available as an option from the manufacturer, the PMS shall have hardware and software resources for remote access via the internet to the on-board system's operating data, parameters and alarms.

## **797 Automation equipment for other machinery components**

The Auxiliary Engines control system shall offer the functions of automatic equipment control, equipment protection, local operation (stop/start), emergency stop, maintenance lockout, local control of the pre-lubrication and pre-heating systems.

The Auxiliary Engines control panel shall be supplied by the engine manufacturer and can be mounted on the skid or on a support next to the Auxiliary Engines. The Auxiliary Engines manufacturer shall make the signals for remote monitoring and operation available to the IAS via an open industrial communication protocol and in accordance with the list of IAS points agreed between the Owner and the Yard during the design phase. The protection and locking sensors ("interlocks" and "trips") will be in accordance with the classification society's requirements and manufacturers' standards.

The Auxiliary Engines control system shall include the necessary hardware and software for remote access via the internet to the data of all the variables, measurements, parameters and alarms of the equipment and control system.

## **798 Instrumentation**

### **Coding, Identification and documentation**

The instruments shall have their technical information informed on data sheets. The instrument data sheets shall be collected and delivered to the BUYER, forming an Instrumentation Databook.

The instruments, including those supplied with the equipment, shall be coded in the vessel's design in accordance with the ISA standard. The vessel's system code on which the instrument is installed shall be part of each instrument's code.

The instruments shall be identified with a stainless steel plate containing tag and identification written in Portuguese.

The instruments installed in the vessel's systems shall be represented in the diagrams (P&ID) of these systems, or in specific diagrams for this purpose (instrumentation diagrams).

**The instruments installed in the equipment shall be represented in instrumentation diagrams. A Vessel's Instrument List shall be issued with the main characteristics of the instruments, including: code, function, process variable, location, type, setting, working range, calibration frequency, manufacturer, equipment description, tag, set point, ICMS acquisition station number, etc. All certificates of conformity with the respective national and international standards, as well as calibration certificates, shall be supplied with the instrument data sheets. The instruments installed in the equipment shall be represented in instrumentation diagrams. A Vessel's Instrument List shall be**

issued with the main characteristics of the instruments, including: code, function, process variable, location, type, setting, working range, calibration frequency, manufacturer, equipment description, tag, set point, IAS acquisition station number, etc. All certificates of conformity with the respective national and international standards, as well as calibration certificates, shall be supplied with the instrument data sheets.

### General

The instruments shall use materials and enclosures that are suitable for the process they are intended for and the mounting location.

The instrument enclosures shall be compatible with the installed environment, and for outdoor areas they shall be at least IP56. When using aluminum enclosures for instruments or junction boxes, they shall be of the copper-free type, suitable for marine environments.

The scale of analog reading instruments shall be sized so that the rated value or working range of the variable is between 25 and 75% of the instrument's full-scale deflection value.

The range of the sensors/transmitters shall be dimensioned so that the rated value or working range of the variable is between 25 and 75% of the range.

Analog pointer instruments installed in reciprocating machines (e.g. diesel engine, compressor) shall be filled with glycerin to dampen the vibration of the pointer and protect the instrument's internal mechanism.

Level gauges, flow gauges and other similar gauges shall have adequate local lighting to make it easier for the operator to see them. Tubular sight glasses will not be accepted. Magnetic sight glasses are acceptable for viscous fluids that cannot be read through glass sight glasses.

Pneumatic transmitters, controllers, etc. shall be equipped with a vent filter with pressure gauge in the control air supply line.

~~Mass flow meters ("Coriolis" type) shall be interconnected and monitored by the ICMS, for totalization and visualization in the synoptic diagrams, and also equipped with local indication/readout. Mass flow meters ("Coriolis" type) shall be interconnected and monitored by the IAS, for totalization and visualization in the synoptic diagrams, and also equipped with local indication/readout.~~

~~"Special" transmitters, i.e. those that require algorithms such as totalization, averaging, statistical filtering, etc. in order to be read properly, shall be monitored directly by the ICMS, which will perform these functions. "Special" transmitters, i.e. those that require algorithms such as totalization, averaging, statistical filtering, etc. in order to be read properly, shall be monitored directly by the IAS, which will perform these functions.~~

~~Instrumentation should be simplified wherever possible by using ICMS resources, such as duplicating 4~20mA analog instrument signals via galvanic isolators, rather than installing additional independent instrumentation. Sensor signals used by different control or monitoring systems shall be galvanically isolated. Instrumentation should be simplified wherever possible by using IAS resources, such as duplicating 4~20mA analog instrument signals via galvanic isolators, rather than installing additional independent instrumentation. Sensor signals used by different control or monitoring systems shall be galvanically isolated.~~

All instruments in contact with flammable fluids shall have a single seal certified in accordance with IEC 60079-40 (single process seal equipment) or ANSI/ISA 12.27.01 (single seal equipment).

Instruments installed in a hazardous area shall have intrinsic safety protection (Ex-i). Intrinsic safety barriers shall be galvanically isolated.

Instruments and related measuring elements shall be installed so that they are easily accessible from decks, platforms or walkways as far as possible and are not subject to excessive vibrations.

### **Pressure Instruments**

Pressure gauges, pressure switches, transmitters, etc. shall be equipped with a manifold in the impulse line close to the instrument, with the number of ports appropriate to its functionality. In addition to the manifold, instruments installed more than 2 m from the impulse outlet shall be fitted with a "root valve".

Pressure switches and pressure transmitters shall be installed with manifolds suitable for connecting instruments for testing and gauging purposes, without the need to remove connections or the instrument to be tested.

The pressure transmitters shall have the following characteristics:

- Differential capacitive measuring cell or strain gauge
- Suitable for use in industrial automation
- Accuracy better than 0,1%
- Local calibration of "zero" and "span" possible
- Local indication of the process variable (PV) on a digital display.
- Configurable via HART protocol

Fuel oil instruments shall have a remote seal with a capillary in the impulse line. Tees shall be used to close and assemble the seal. The distance between the process outlet and the sealing tee shall be minimized. Double-distilled glycerin shall be used as sealing fluid. The use of the sealing or condensate pot shall be restricted to specific cases and submitted to the BUYER.

Instrument connections cannot be installed in the lower part of the pipe, due to the possibility of debris obstructing the impulse line in this condition.

Instruments installed in systems with pulsating pressure or subject to "water hammer" shall be fitted with a snubber in the impulse line.

API RP 501 shall be adopted as the installation standard.

### **Temperature Instruments**

Bulb-capillary thermometers, temperature switches, transmitters, etc. shall have the sensing bulb mounted in a stainless steel well with a threaded connection.

The wells for pipe-mounted sensors shall be installed perpendicular to the flow of the fluid being monitored and during the pipe manufacturing phase.

Sensors installed in systems that may experience rapid temperature variations shall have the well filled with an appropriate liquid to improve heat exchange with the instrument.

Bulb-capillary thermometers with adjustable second pointer and alarm contact shall be mounted on a suitable base with anti-vibration dampers.

API RP 501 shall be adopted as the installation standard.

### **Level Instruments**

Level switches shall be of the capacitive or float type with a totally watertight magnetic coupling.

The level switches shall have devices for testing their functionality, without requiring access to the electrical contacts.

Vertical mounted level switches ("displacer" type) shall be easy to dismantle, with adequate access and space for removing the instrument.

Indirect liquid column pressure level transmitters shall be installed with a valve that allows them to be removed for maintenance without having to empty the tank. API RP 501 shall be adopted as the installation standard. Top mounting switches shall be used to monitor void spaces, manholes, cofferdams and tanks located below the platform of the engine room, where access is limited, avoiding the need to enter confined spaces for maintenance.

## 8 SHIP COMMON

### Pipe line systems - general

- All pipe systems shall be according to system drawings, approved by the Owner, Classification Society and to the satisfaction of possibly involved Sub-contractors.
- National Authority's approval shall be obtained on systems where it is required.
- Thickness of all penetration pipes connected to ship's side, bottom, main deck as well as deck scuppers pipes are to be Sch.160.
- The materials used in piping systems shall be certified and documented according to Classification Society.

### Material (Piping and armature)

All requirements related to piping materials, workmanship, valves, marking and color coding shall refer to 7 System for Main Engine Components

## 80 Ballast and bilge system, drain system outside accommodation

### General

The Ballast and the Bilge systems shall be separate systems

### Ballast system

The ballast system shall consist of:

- Two (2) variable speed Ballast pumps, back-up for each other. Capacity 500 m<sup>3</sup>/h each
- Two(2) Ballast ejectors for stripping of ballast tanks and main lines to be provided. Drive water to be supplied by ballast pumps.
- Valves and pumps shall be remote operated from IAS.
- Alarms and variables of cargo and ballast pumps (tank pressure, discharge pressure, bearing temperature, etc.)
- One (1) Ballast Water Treatment Plant (BWTP) with a total capacity of 1000 m<sup>3</sup>/h, suitable for operation with two ballast pumps running simultaneously. Type approved according to requirements of IMO resolution MEPC 125(53) as amended. Separate control system with interface for monitoring (status running/stop) from the IAS.

### Bilge system

The bilge system shall consist of:

- Three (3) bilge wells in Engine Room (PS forward, SB forward and Center aft);
- Two (2) pumps for General Services, Bilge and Fire;
- One (1) sea water pump for the central cooling system
- One (1) bilge pump
- Final number and capacities shall be according to SOLAS and Classification Society requirements
- The Bilge main pumps of eccentric screw type
- Valves and pumps, locally operated
- One (1) Bilge ejector for chain lockers
- One (1) Bilge water holding tank
- One (1) Bilge water separator, centrifugal type, capacity 2,5 m<sup>3</sup>/h with 5ppm ODM system, in compliance with IMO Resolution MEPC 107(49) and certified by the USCG.

- One (1) Bilge water separator supply pump
- One (1) Bilge water settling tank with heating coils. Tank arrangement in accordance with Marpol guidance note for IBTS bilge primary tank
- One (1) Oil tank
- One (1) overflow tank
- One (1) Sludge pump
- One (1) FO/LO drain tank
- One (1) FO/LO sludge tank
- One (1) clean water drain tank (air conditioning condensate, etc.)
- One (1) Incinerator
- Piping, filters and accessories.

#### **Drain system outside accommodation**

A sufficient number of pipes and drain collectors shall be laid from the decks.

### **801 Ballast system, solid ballast**

#### **General**

- Two (2) sea chests shall be provided for the ballast system, one in each side ballast tank near the pumps. Each sea chest shall have double isolation valves.
- The ballast system shall be designed with two (2) ballast pumps operating in parallel.
- Each ballast pump shall be installed inside a separate side ballast tank (port and starboard). Each pump shall be connected to a dedicated sea chest located inside the ballast tank, next to the ballast pump. Isolation valves shall be installed near the ballast pumps to allow them to be removed for maintenance.
- The system shall be designed in such a way that any ballast pump can be connected to any ballast tank and the Fore Peak Tank.
- Ballasting and de-ballasting of the Aft Peak Tank shall be carried out by the general services and fire pumps located in the Engine Room.
- The ballast piping system shall be arranged as a ring line, with a longitudinal branch passing through the Port ballast tanks and a longitudinal branch passing through the Starboard ballast tanks. These branches will be interconnected by transverse piping equipped with shut-off valves, allowing flexible operation and transfer of ballast water between the tanks.
- A branch shall be arranged for filling the Starboard slop tank, connected to the ballast piping by means of a removable spool piece.
- The system shall allow deballasting of the ballast tanks by port and starboard through a high discharge side connection.
- All ballast piping made of steel shall be coated with polyethylene and externally painted according to the painting scheme for the region as defined in section 7 System for Main Engine Components.
- **Material of penetration pieces to be according to ballast piping outside tanks.**
- Piping inside the ballast tanks will be made from GRP (Glass Reinforced Plastic), ensuring resistance to corrosion and hydraulic hammering.
- Arranged for pumping from sea inlet via BWTS to tanks and from the tanks via BWTS to overboard.

- Arranged to prevent gravity filling or discharge of tanks by-passing the BWTS. The by-pass of the BWTS shall be in compliance with BWM Convention.
- Sea inlet, ref. [72 Cooling systems](#).

### Technical particulars for the Ballast water pump

- Two (2) vertical centrifugal ballast pumps, self-priming by built-on automatic air ejector, "deep well" type with electric drive.
- Each pump will have a capacity of 500 m<sup>3</sup>/h. Maximum 3600 rpm, electric driven - Variabel speed (VFD converter).
- Pump Construction and Materials:
  - Volute casing: Bronze (ASTM B-584)
  - Impeller: Aluminum Bronze (ASTM B-148)
  - Wear ring: Aluminum Bronze (ASTM B-148)
  - Shaft: Stainless Steel (ASTM A-276)
- Zinc sacrificial anodes shall be fitted, either integrated or externally mounted, for seawater service.

### Monitoring and Remote Control:

Ballast system shall be remote operated and monitored from IAS.

The following equipment to be monitored:

- Level in tanks. See [822 Sounding system](#)
- Ballast water pumps discharge line shall be arranged with pressure transmitter for remote reading.

The following equipment to be controlled and monitored:

- Valves for ballast water system as defined above. See also [792 Alarm and monitoring system](#)
- Ballast water pump control shall be Local and remote from IAS.
- Remote control from IAS shall be manual Start/ Stop, Running indication and discharge pressure to IAS.

### Ballast Water Treatment System (BWTS)

The Ballast Water Treatment Plant (BWTP) shall be approved in accordance with IMO Resolution MEPC.125(53) as amended, and comply with USCG regulations and Classification Society requirements. The system shall allow compliance with the D-2 standard under all operational modes, including stripping and fallback operation.

The Ballast Water Treatment Plant shall be sized for a total flow capacity of 1000 m<sup>3</sup>/h, suitable for operation with two ballast pumps running simultaneously.

General system description

- The treatment technology shall be electrochlorination with filtration.
- Two (2) filters shall be provided, each capable of handling 100% of the ballast pump flow rate.
- The system shall serve all ballast tanks, including the Fore Peak and Aft Peak tanks.
- The system shall allow simultaneous ballasting during cargo unloading via elevated piping.
- Certificates and documentation shall be provided as per applicable regulatory and class requirements.

Filtration and disinfection

- Filters shall be automatic backwash type.

- The system shall be suitable for operation in seawater and freshwater.
- The treatment system shall operate effectively at water temperatures down to 0°C. If required, arrangements shall be made for water heating.
- The system shall be able to treat water with salinity ≥ 0.1 PSU.
- If salinity is below system limits, the system shall use stored seawater for electrochlorination. A dedicated seawater tank shall be provided, with sufficient capacity to treat the full ballast capacity under normal operating conditions with minimum water salinity.
- The holding time of ballast water after treatment shall be in compliance with applicable IMO and USCG regulations, with requirements as defined in the Requirement Specification (if specified), and shall be confirmed and approved by the Owner.

#### Electrochlorination system components (for side-stream systems)

- Two (2) seawater booster pumps shall be provided, each with 100% capacity.
- Automatic changeover shall be arranged in case of low pressure.
- A basket-type filter shall be fitted upstream of each booster pump.
- Differential pressure sensors shall be installed and connected to IAS with alarm signal.
- A chemical cleaning system shall be provided for the electrolysis cell electrodes.
- All tools, reagents and chemicals required for 10 ballasting and 10 deballasting operations shall be supplied.
- If neutralizer is used, a neutralizer tank shall be provided with minimum capacity for 10 deballasting operations.
- Each seawater booster pump for the electrochlorination unit shall be provided with a basket-type filter upstream, with a differential pressure sensor and alarm connected to IAS.
- The Ballast Water Treatment System shall be arranged so that each ballast pump can operate with any treatment unit.

#### Monitoring, control and interface

- The system shall be fully operated from a dedicated panel in the CCR.
- The control panel shall include graphic synoptic display, alarm handling, data logging, and real-time status.
- A local control panel shall be installed near the BWTS equipment for testing and maintenance.
- The system shall be interfaced with IAS for status, alarms and running indication.
- The system shall provide remote monitoring of operational variables and alarms via a serial communication channel using an open industrial network protocol.
- If available, the control system shall support remote access to operating data and alarms via internet.
- Differential pressure across filters shall be monitored with alarms in CCR.
- Sampling devices shall be installed for each ballast tank to enable compliance checks.

#### Redundancy and fallback mode

- In case of BWTS malfunction or failure, the vessel shall implement the "Sequential Ballast Exchange Method" in accordance with stability and strength criteria.

#### Spare parts and accessories

- A complete filter maintenance kit shall be delivered, including filter elements, gaskets, and other required parts.

## Ballast Discharge Monitoring and Control (ODME)

A monitoring and control system shall be provided for any discharge of oily water mixture from cargo tanks into the sea.

The system shall comply with applicable IMO MARPOL Annex I and USCG requirements.

It shall be installed downstream of the Ballast Water Treatment System, and shall be capable of interfacing with the IAS for status and alarm forwarding.

## 803 Bilge systems and oil/water separation

### General

Technical particulars for the pumps and ejectors:

- Eccentric screw type shall have casing of cast iron, rotor of stainless steel and stator of Perbunan. A solenoid valve for priming water and a safety valve shall be provided. (Priming water shall be supplied from the technical FW system, with back-up from fire main)
- Centrifugal type shall be of vertical design, self-priming type with housing of cast iron, impeller of Ni.Al.Bronze and shaft of stainless steel.
- Pumps shall be electric driven – one speed, where nothing else is described.
- Two (2) pumps for General Services, Bilge, and Fire duties shall be installed
- Each fire pump (including emergency), bilge pump and general services pump shall be able to attend the total capacity required from foam system (see 816 Fire fighting systems with foam (Low and High Expansion)).
- Maximum rpm in accordance with recommendation from the pump supplier.
- Ejector shall have bronze housing and drive water from fire main.

### 1. Bilge System

- Three (3) bilge wells in Engine Room (PS forward, SB forward and Center aft)
- One (1) bilge pump (spindle type)
- Two (2) General Services, Bilge and Fire pumps, with filters at bilge suction branch, serving as backup to bilge pump
- One (1) sea water pump for central cooling
- One (1) bilge water holding tank
- One (1) bilge water settling tank with heating coils
- Drainage from ER decks, platforms, cofferdams, sea chest, stern tube tank and steering gear/ emergency fire pump recess is collected via scuppers and pipes
- The Aft Peak Tank shall be filled and drained by the General Services, Bilge and Fire pump.
- Emergency bilge suction performed by the largest capacity, self-priming pump, with direct suction and no filters
- The sea water cooling pump arranged for emergency bilge suction shall be power supplied by ESB. Alternatively, an equivalent arrangement shall be provided.
- Bilge pump discharges to:
  - Bilge water holding tank
  - Separated oil tank
  - PS Slop tank (via check valve and removable spool piece)
  - International discharge connections on both forward sides of accommodation (with shut-off valve and blind flange)

### 2. Oily Water Separator (OWS) System

- One (1) oily water separator (OWS), USCG certified, complying with IMO MEPC.107(49)
- Capable of separating emulsions

- Equipped with oil content meter, direction valve, integrated discharge pump
- Sample and test lines installed vertically
- One (1) OWS supply pump
- Connected to bilge water holding tank and settling tank
- Discharges water overboard via oil content meter and oil to separated oil tank
- Used to empty clean bilge water tank
- Heating system provided for bilge and separated oil tanks and connected piping
- **Bilge water separator installations shall be provided with overboard sample cock, as per applicable rules.**

### 3. Sludge System

A system for handling sludge oil shall be arranged.

The sludge pump shall:

- Be of single-screw (eccentric/helical) type, electric driven, two-speed
- Have suction from the FO/LO sludge tank, FO/LO drain tank, separated oil tank and oily water separator filter, with discharge to the incinerator sludge tank, oily water separator, PS slop tank and international discharge connection (IMO standard flange in bunker station).
- Have local control only
- One (1) sludge pump shall serve as a backup supply pump for the oily water separator
- One (1) incinerator shall be provided for the treatment of sludge and oily residues
- The sludge pump shall have:
  - Volute casing: Cast iron (ASTM A-48), internally coated
  - Stator: Synthetic rubber
  - Shaft and impeller: Stainless steel (ASTM A-316L)
- The sludge pump and oily water separator shall have local control only.
- **The Bilge and Sludge pumps shall have remote stop push buttons located next to the international discharge connections on deck. The sludge pump shall also have a remote stop button located close to the Incinerator Sludge Tank.**

### 4. Drainage and Auxiliary Functions

- **One (1) clean water drain tank (e.g. A/C condensate) One (1) Drain Inspection Tank (Clean water drain tank, e.g. A/C condensate), fitted with instruments and accessories as specified in Section 822 Sounding system, Table 8.1.**
- One (1) FO/LO drain tank
- One (1) FO/LO sludge tank
- One (1) separated oil tank (not adjacent to hull boundaries)
- One (1) overflow tank
- Drain valves for bow compartments operable from exposed deck
- Eductor system for chain lockers, Bosun Store and access ducts (10 m<sup>3</sup>/h, operated by GS/Bilge/Fire pumps)
- Filter baskets at pump inlets and easy-clean mud boxes
- Interconnection between pumps to provide redundancy
- Priming of bilge and sludge pumps by water branches from hydrophore system
- Scuppers sized and located to prevent accumulation and ensure effective drainage to bilge wells

## 5. Deck Drainage in Cargo Area

Drain scuppers without bilge wells, fitted with SPILL VALVE, shall be installed to drain deck residues accumulated at the aft cargo area to the Slop Tanks.

### 804 Drain system outside accommodation

The vessel's possible trim shall be taken into consideration for routing and installation of drain pipes.

- Sufficient number of pipes shall be laid from the respective decks.
- Convex screwed drains shall be installed on exposed decks and platforms to prevent clogging.
- Waste water piping with siphoned scuppers shall be installed to drain the decks of galley, pantries, cold store, infirmary, toilets, changing rooms, laundry rooms and storerooms. Waste water discharges shall be taken to the Sanitary Sewage Treatment Unit or to the ship's side by means of a storm valve and shut-off valve.
- Drain collectors shall be arranged on wheelhouse top and other areas with large surfaces to be drained.
- Drain pipes from the wheelhouse top shall be laid on the inside down to the bridge deck.
- Drain pipes from the superstructure shall be fitted outside bulkheads.
- Scupper drain and side penetration pipes shall be built of steel pipes, Sch.160, to ensure durability and compliance with safety standards.
- Where possible, drains from one deck shall be routed directly above the drain down to the next level.
- Top of funnel(s) shall have drain pipe directly overboard.

Freeing ports, ref. [267 Gutter, bulwark, railings and cargo rails \(securing of deck cargo\), freeing ports](#).

### 807 Drainage from technical spaces

Drain pots shall be arranged in all corners in all technical rooms and spaces and have volume of minimum 20 litre.

Drain from technical rooms shall be led independently to bilge water drain tank, drain from same room can be combined.

Drain pipes from technical spaces shall be DN80.

In engine room caution should be taken to arrange drain notches so that all water will be drained to bilge wells.

### 808 Drainage from hazardous areas/spaces

#### General

Drain from hazardous spaces shall be contained and the extent of potential spills limited.

Drip trays and coaming bars shall be provided for equipment and tanks to collect oily waste, with drain piping leading to the fuel oil and lube oil drain tank.

Fuel Preparation Room for Methanol (FPR) shall be arranged with a sill height of minimum 300 mm.

### 809 Drain system interior spaces

The vessel's possible trim shall be taken into consideration for routing and installation of drain pipes from interior spaces.

- Sufficient number of pipes shall be laid from the respective decks
- Where possible, drains from one deck shall be routed directly above the drain down to the next level

- Drainage from all gutter ways in accommodation to work with fore and aft trim
- Inspection hatches for gutter ways shall be arranged in accommodation according to Yard standard
- Insulation shall be stopped 50 mm above deck in gutter ways. Stainless steel mesh insulation stoppers shall be installed.
- Gutter bars shall be provided at accommodation decks at the lower end of insulated bulkheads.
- Internal drains from accommodation can be led to bilge wells in processing area where feasible.

## 81 Fire and lifeboat alarm, fire fighting and wash down systems

### Fire fighting and alarm systems provided on board:

- **Fire detection and alarm system** (see [811 Fire detection, fire and lifeboat alarm systems](#))
- **Gas and oil mist detection and alarm system**
  - Gas detection system for the methanol fuel supply system (FSS) and other methanol based gas detectors.
  - Oil mist detector system shall be provided at assigned locations in the Engine Room for detection of airborne oil mixtures.
  - Gas detection system for vessel (gas detection system(s) as required for methanol fuel system is to be installed in accordance with Class and regulatory body requirements)
- **Fire line system** including emergency fire pump, hydrant system, fire posts and hoses (see [813 Fire line/deck washing system](#))
- **Fixed clean agent fire fighting system** (Novec™, Inergen™ or equivalent) for engine control room, paint store, and main engine scavenge air box (see [815 Fixed clean agent fire fighting system \(Novec/Inergen\)](#))
- **Fixed high-expansion foam fire fighting system** for Engine Room, workshops, storerooms, and purifier compartment (see [816 Fire fighting systems with foam \(Low and High Expansion\)](#))
- **Fixed low-expansion foam fire fighting system** for cargo deck and trunk area (see [816 Fire fighting systems with foam \(Low and High Expansion\)](#))
- **Portable fire extinguishing systems** (see [818 Fire fighting systems with powder](#))
- **Fixed water mist fire fighting system** for local protection of main engine, auxiliaries, thermal oil heater, incinerator and purifiers (see [819 Watermist fire-fighting system for local protection high risk areas](#))
- **Fixed detection and extinguishing system** in galley hood and deep fat fryer (see below in this section)
- **Pneumatically operated remote closing system** for ventilation dampers, fire doors and quick-closing valves on fuel/lube oil tanks (see below in this section)
- **Manual or remote closing system** for emergency generator fuel service tank (see below in this section)

The vessel shall be equipped with a complete fire-fighting system designed in accordance with applicable international rules and Classification Society requirements.

The fire-fighting system shall consist of the following main subsystems:

- Fixed sea water fire-fighting system with two (2) general service/bilge/fire pumps, each with 100% capacity;
- One (1) self-priming emergency fire pump with independent sea chest and dual power supply;

- Fixed foam fire-fighting system covering engine room and cargo area;
- Fixed clean agent fire-fighting system (Novec, Inergen or equivalent) for engine control room, paint store, and other designated spaces;
- Fixed high-pressure water mist fire-fighting system for local protection of main engine, auxiliaries, thermal oil heater, incinerator and purifiers;
- Portable fire extinguisher system in accordance with Class requirements;
- Fire detection and alarm system with repeaters;
- Fixed fire detection and extinguishing system in galley hood and deep fat fryer;
- Pneumatically operated remote closing system for ventilation dampers, fire doors and quickclosing valves on fuel/lube oil tanks;
- Manual or remote closing system for emergency generator fuel service tank;
- Gas detection system for ballast tanks and enclosed spaces, with panel in Fire Station and repeaters in CCR and Bridge.

A fixed gas detection system shall be installed to monitor hydrocarbon gases (CxHy), hydrogen sulphide (H<sub>2</sub>S), and oxygen (O<sub>2</sub>) in enclosed and hazardous areas. The system shall operate by sequential scanning of sampling points located at:

- Ballast tanks (one point per tank)
- Inert gas main line
- Forward peak tank
- Cofferdams
- Paint locker
- Chemical locker
- Gas locker
- Engine room
- Air intake to accommodation area

~~Each sampling point shall include a shut-off valve to protect the sensors from water ingress. The gas detection system shall be integrated with the fire detection and alarm system and with ICMS for status monitoring and failure alarms. Sampling points with sensors installed in tanks shall include a shut-off valve to protect the sensors from water ingress. The gas detection system shall be integrated with the fire detection and alarm system and with IAS for status monitoring and failure alarms.~~

Indications and alarms shall be displayed in the Cargo Control Room (CCR). At least 10% spare sensors and one test kit per sensor type shall be supplied. Preferably, the gas detection system shall be provided by the same supplier as the fire detection system.

All equipment and systems shall be certified in accordance with applicable international codes and regulations, including the EU Marine Equipment Directive (2014/90/EU) where applicable.

## 811 Fire detection, fire and lifeboat alarm systems

### Fire detection and alarm system

An addressable automatic fire detection system shall be installed in accordance with regulatory body requirements.

One (1) automatic addressable fire detection system shall be installed in accordance with Classification Society and National Authority requirements. ~~A central fire detection control panel, shall be mounted in the wheelhouse and with slave panel in the ECR and CCR.~~ Power supply and loops shall be arranged and segregated according to the main fire zones.

Fire detectors shall automatically lead to fire alarm when: The fire detection system shall have addressable detectors with multiple loops, a main control panel located in the Fire Station and repeater panels in the navigation bridge, ECR and CCR.

~~A heat detector reach a pre-set maximum temperature limit~~

~~A combustion gas has reached a smoke detector~~

~~A flame detector is activated by flames~~

~~A fire alarm push button (manual call point) is activated.~~

The installation All control panels shall be according able to Classification Society silence the alarm, acknowledge alarms and National Authority requirements, and include: indicate the location of triggered sensors.

~~Combined heat and smoke detectors in accommodation, including all cabins and HVAC room(s)~~

~~Heat detectors in Engine room and other machinery spaces~~

~~Smoke detector in Engine room and other machinery spaces, alternatively combined smoke/heat detectors.~~

~~Flame detector(s) for the water mist system in each designated area if not covered by a water mist system, ref. 819 Watermist fire fighting system for local protection high risk areas.~~

~~Manual call point (push button) detector in accommodation, corridors and in engine room exits~~

~~Smoke detectors in stores, laundry, corridors, etc.~~

~~Alarm bells installed in:~~

~~accommodation corridors, galley and mess room~~

~~steering gear room etc.~~

~~ECR, switchboard room, etc.~~

~~Alarm siren shall be installed in the engine room~~

~~Red flashing lights shall be installed in noisy areas where fire alarm bell(s)/siren(s) are installed~~

The line diagram of the fire detection system, together with its identification texts/messages displayed on the main and repeater control panels, shall be framed and displayed in the Fire Station.

Detectors and push buttons shall be installed as follows:

- Thermovelocimetric detectors: in confined spaces and directly above equipment subject to rapid and high heat generation (galley, engine room)
- Ion detectors: in individual cabins, control stations, corridors, collective spaces, engine rooms and locker/store
- Ultraviolet (UV) detectors: Engine Room
- Alarm push buttons: general use, where recommended and indicated in the firefighting plan.

The fire alarm shall sound primarily in the main panel and repeaters, and with a time delay in the various accommodation areas, in accordance with the Fire Station Integrator standard.

The fire detection system shall also have the following features

- Command and control the closing of accommodation doors and dampers in order to automatically isolate compartments
- Switching off the ventilation in the engine room and living quarters
- Powered by 220V and with a built-in UPS

- Interconnected to the VDR
- Interconnected to gas detection systems
- With reversible contact for IAS fault alarm

Fire detectors shall be easily accessible for testing.

Computer software for set up for spare sensors shall be supplied, if needed.

General Alarm push buttons to be provided as required by rules and at all control stations.

When activated, bells and sirens shall sound continuously for fire alarm and according to regulations  
~~(— for general alarm, —, repeated) for general alarm. Alarms shall be of adequate sound level throughout the vessel, and alarms shall be transmitted to the PA system.~~

As per Code of Alarms, General Alarm is to be 07 short blast + 01 long blast and Fire Alarm is to be consecutive 01 short + 01 long blast.

Alarms shall be of adequate sound level throughout the vessel, and alarms shall be transmitted to the PA system.

The panel for the fire detection central shall have built-in monitoring circuits intended to control that the equipment at any time is in satisfactory order and indicate faults which could prevent a fire alarm. Faults in the system shall be indicated on the central panel by means of visual and audible signals.

The Fire detection alarm plant shall:

- be prepared for an input from intercom/PA for muting of bells and sirens.
- be equipped with separate battery and battery charger, alternatively a built-in solution.
- have power supply from emergency switchboard.
- close fire doors automatically if fire doors are equipped with door holding magnets, ref. 512 Internal Doors. In addition local release button for each door and common manual release button on bridge on indication panel for fire doors.

## 812 Emergency shutdown system

Emergency push buttons to be provided at designated locations as requested by Class and at Owner'S convinience. Preferably Remote push buttons to be located at ECR, CCR and WH.

## 813 Fire line/deck washing system

### General Services, Bilge and Fire Pumps:

Two (2) General Services, Bilge and Fire pumps shall be provided to supply fire-fighting sea water and general services sea water to the main deck, casing, accommodation, engine room and other areas of the vessel as required by rules.

Two (2) seawater branches shall be provided on the main deck, one exclusively for firefighting and the other for general services.

The pumps shall be sized for 100% capacity each, including for feeding the foam systems, and shall be started at different rotational speeds depending on the demand of the system(s) to be served.

One of the pumps shall supply the Fresh Water Generator in the event of failure of the Fresh Water Generator ejector pump.

The general services seawater branch shall also supply:

- Bilge eductors in the bow compartments;
- Anchor chain washing system;
- Portable gas-freeing fans for tank degassing (see Section 374 Ventilation/gas freeing systems for cargo tanks).

Each fire pump (including emergency), bilge pump and general services pump shall be able to attend the total capacity required from foam system (see 816 Fire fighting systems with foam (Low and High Expansion))

**Emergency Fire Pump:** Technical particulars for the Fire / General Service / Deck Washing pumps:

- Vertical centrifugal type, self-priming by built-on automatic air ejector;
- Housing and impeller of Ni.Al.Bronze or Bronze, shaft of stainless steel;
- Maximum 3600 rpm;
- Electric driven – one speed.

**Emergency Fire Pump:**

One (1) centrifugal, vertical, self-priming, electric motor-driven emergency fire-fighting pump shall be supplied.

The pump shall be connected to a dedicated sea chest, located in such a way that it can supply water even when the vessel is in the lightest operational condition.

The emergency fire pump will be fed by main and emergency power supply and shall be located in a compartment aft of the Engine Room with access from the Steering Gear Compartment. The compartment shall be insulated with class A-60 insulation material on the bulkhead facing the Engine Room.

The pump shall be started locally and remotely (navigation bridge, Fire Station - "ECI" and foam compartment) without the need for any operational procedure to enable the pump to be primed, which shall be guaranteed by its self-priming system and by another independent method such as a seawater expansion tank and check valve near the sea chest or another method provided for in the design and approved by Class to keep the pump primed "ready for operation" at all times.

Main/emergency fire pumps and foam pump to have start/stop push buttons locally and at Fire Station and Wheelhouse.

**Fire Main Piping, Connections and Fire Hoses: Armatures**

Connections with a valve and quick coupling connection ("Storz") for a 2½"-(DN65) hose shall be provided in the following locations:

- 1 (one) at Bosun Store;
- 5 (five) on each side of the cargo area;
- 2 (two) on the Main Deck (or deckhouse), at stern;
- 2 (two) per deck, externally, on the accommodation, except navigation bridge deck;
- 1 (one) on the navigation bridge deck;
- 1 (one) in the Steering Gear Compartment;
- 2 (two) per floor and platforms in Engine Room.

~~Movements in the fire fighting seawater system pipes caused by thermal expansion or the vessel's structure shall be absorbed by expansion bends (loop). Fire connection with a valve and quick coupling connection for a 2½" (DN65) hose shall comply with ABNT standards.~~

~~Fire connection with a valve and quick coupling connection for a 2½" hose shall comply with ABNT standards.~~

~~A necessary number of fire posts shall be arranged in the engine room, in the accommodation, on deck and other places as required by the Movements in the fire-fighting seawater system pipes caused by thermal expansion or the vessel's structure shall be absorbed by expansion bends (loop). Classification Society and/or National Authorities.~~

From the fire main system the following lines shall be arranged:

- Distribution to fire posts
- Isolating valve for machinery space comprising fire main pumps shall be arranged readily available outside machinery space.
- Washing of anchor chain hawse pipes
- Drive water to ejector(s)
- [Flushing of Sewage/Grey water hull tank. Ref. 582](#)[Flushing of Sewage/Grey water hull tank. Ref. 582](#)[Sanitary discharge systems](#)
- [Supply to local water sprinkler systems for the following compartments:](#)
  - [Paint stores](#).

~~Local water sprinkler systems shall be supplied from fire main to the following compartments:~~

~~Paint stores~~

#### **Fire Stations (Hydrant Boxes)**

A necessary number of fire posts shall be arranged in the engine room, in the accommodation, on deck and other places as required by the Classification Society and/or National Authorities.

Each fire post shall include:

- Fire valve including hose connection
- Number, length and diameter of fire hoses shall be in accordance with Classification Society and/or National Authorities requirements.~~All fire hoses shall be stored in separate cabinets.~~
- [All fire hoses shall be stored in separate cabinets.](#)

~~Technical particulars for the Fire , Fire/ General service/ Deck washing pumps:~~

~~Vertical centrifugal type, self priming by built on automatic air ejector~~  
~~Housing and impeller of Ni-Al Bronze or Bronze, shaft of stainless steel~~  
~~Maximum 3600 rpm~~  
~~Electric driven—one speed~~

#### **Monitoring and Remote Control:**

The following equipment to be controlled and monitored:

- Control of Fire pump, Fire/Deck washing pump and Emergency fire pump shall be Local and remote from IAS
- Remote control from IAS shall be Auto/Manual, Start/Stop, Running indication to IAS.

## **816 Fire fighting systems with foam (Low and High Expansion)**

#### **General Description**

The vessel shall be equipped with a fixed foam fire-fighting system to protect the cargo deck and cargo trunk, as well as high-risk areas in the engine room and workshops. The system shall be designed to provide both low-expansion and high-expansion foam protection, ensuring rapid fire suppression in all designated areas.

The foam system shall be interconnected with the emergency fire pump discharge to ensure uninterrupted foam supply. All components of the system shall comply with the applicable Classification Society rules and international regulations.

#### **Foam Generation System**

The foam system shall consist of the following main components:

- One (1) Foam Forming Liquid Tank located in a dedicated foam compartment inside the

accommodation on the main deck. The tank shall be equipped with a sampling cock for testing purposes.

- One (1) Foam Forming Liquid Pump, capable of supplying foam to all protected areas.
- Proportioners, control valves, and diffusers for proper foam distribution.
- Foam concentrate shall be AFFF (Aqueous Film Forming Foam) at 3% concentration.
- The sealing joints on the flanges of the foam system piping shall be made of non-combustible material.
- Expansion bends (loops) shall be used to compensate for thermal expansion and vessel structural movements.

### **Low-Expansion Foam System**

The low-expansion foam system shall provide protection for the cargo deck and cargo trunk areas.

The system shall include:

- Foam Monitors:
  - Monitors shall be installed on the main deck above cargo tanks, arranged along the centerline of the vessel.
  - Additional monitors shall be placed on each side of the accommodation forward bulkhead.
  - Each monitor shall be fitted with a ball valve with an ASTM A-316L stainless steel seat.
  - The number and location of monitors shall ensure full coverage of the cargo deck area.
  - Isolation valves shall be installed immediately before the monitors for maintenance and removal purposes.
  - All sealing gaskets used in foam monitor connections shall be made of non-combustible material, as required.
- Foam Connections and Hoses:
  - Foam piping system shall be equipped with quick coupling connections for 2½" hoses.
  - Connections shall be distributed in such a way that all points of the deck can be reached by at least one portable nozzle.
  - Sets consisting of foam concentrate containers, foam applicators, and flexible hoses shall be provided in accordance with the applicable rules and regulations.
  - All valves, couplings, and foam hoses shall be certified in accordance with Classification Society and international standards.
- Each fire pump (including emergency), bilge and general services pump shall be able to attend the total capacity required from foam system.

### **High-Expansion Foam System**

A fixed high-expansion foam system shall be installed to protect the engine room, workshops, engine room storerooms, and purifier compartment. The system shall:

- Provide independent activation for each protected area.
- Be supplied with seawater from the fire, bilge, and general services pumps, as well as the emergency fire pump.
- Ensure the entire volume of the protected areas can be filled with high-expansion foam for effective fire suppression.
- Each fire pumps (including emergency), bilge and general services pump shall be able to attend the total capacity required from foam system.

The foam system shall be fully integrated with the vessel's fire-fighting alarm and control system. Activation and monitoring shall be available from the Fire Station (ECI) and other designated locations.

**References:**[803 Bilge systems and oil/water separation](#)[813 Fire line/deck washing system](#)**818 Fire fighting systems with powder**

Hand extinguishers shall be installed according to the requirements of the National Authorities. Ref.  
[505 Loose firefighting apparatuses and equipment, firemen's outfit.](#)

**819 Watermist fire-fighting system for local protection high risk areas****General Description**

A fixed watermist fire-fighting system shall be installed in the Engine Room for local protection of high-risk equipment, including:

- Main Engines
- Auxiliary Engines
- Thermal Oil Heater
- Incinerator
- Purifiers

The system shall be supplied with fresh (distilled) water from the technical freshwater tank. The piping connection on the tank bulkhead shall be located below other outlets to ensure minimum water level for fire-fighting. A low-level alarm shall be provided.

The distilled water tank shall have a capacity greater than the volume of the machinery cooling system and be connected via overflow to the general fresh water system. The lower part of the tank shall be reserved as spare volume for fire-fighting purposes.

The system shall operate by zone, with individual watermist nozzles and dedicated fire detectors for each protected equipment.

Activation shall occur in two stages:

- First detector: triggers alarm and starts the watermist pump
- Second detector: releases water to the relevant zone

Manual activation shall be possible locally (via call points) and from the Fire Station (ECI), including start/stop of the pump and manual actuation of the directing valves. Shut-off valves shall be arranged for testing.

The system shall be powered from the Emergency Switchboard (ESB) and fully integrated with the vessel's fire detection and alarm system. Components shall comply with Class and IMO requirements.

**815 Fixed clean agent fire fighting system (Novec/Inergen)****General Description**

A fixed clean agent fire-fighting system (Novec™, Inergen™ or equivalent) shall be installed to protect the following spaces:

- Engine Control Room (ECR)
- Main Engine Scavenge Air Box

The system shall be fully integrated with the fire detection and alarm system. Activation shall be automatic via fire detection and manual from the Fire Station (ECI).

Clean agent cylinders shall be located in a dedicated storage compartment.

A local clean agent system shall also be installed in the galley hood and deep fat fryer, integrated with the ventilation damper system.

If required by engine maker, alternative extinguishing media may be used for the scavenge air box, subject to Class approval.

All equipment shall be certified in accordance with applicable rules.

**Note:** Paint Store shall be protected by a fixed water sprinkler system (see [813 Fire line/deck washing system](#))

## 82 Air, overflow and sounding systems from tanks

### General

Tank vent and sounding pipes shall be clearly marked with numbers of the related tanks.

### Tank venting

Tank vents or overflow shall be arranged for all tanks.

- The FO bunker tanks shall be arranged with a common vent/ overflow system with drain to the FO overflow tank
- Common tank vent/overflow system for LO & HO stores tanks in engine room area to sludge or dirty oil tank. The overflow pipe shall have an air pipe to open deck.

### Sounding systems

The vessel is equipped with tank level measurement systems using different sensor types depending on the tank function.

- Ballast tanks, sea water tanks and draught measurement use pneumatic bubble-type systems.
- Fuel oil, fresh water, lubricating oil and sewage tanks are measured using either external pressure transmitters with isolation valves or bubble-type systems.
- Cargo and slop tanks are monitored by radar-type level sensors (see Section [381 Cargo control systems](#)).

Manual sounding is provided for tanks, as listed in Section [822 Sounding system](#).

All tank level sensors are integrated with the IAS and provide readouts in the CCR and engine control room.

For detailed specifications of all sounding systems, refer to Section [822 Sounding system](#).

## 821 Tank venting and overflow system

### Tank Venting

The tank venting system shall meet the following requirements:

- Air vents shall be arranged for all tanks, sea chests, and void spaces.
- Tank vent pipes for built-in tanks shall be routed to open deck and be self-draining.
- The height of the tank vent pipe opening shall be minimum 760 mm above main deck, unless otherwise required.
- Air vents shall be directed generally towards the exposed deck.
- The fuel oil tanks located in the Engine Room may have their air vents grouped in collectors; however, diesel oil tanks and heavy oil tanks shall have independent venting systems and shall not be interconnected.
- Air vents for the Main Engine LO Sump tank, Auxiliary Engine crankcases, and Intermediate LO

- tanks shall be independent and not interconnected with any other system.
- Air pipes from sewage treatment plants and sewage waste water tanks shall be routed above the top of the funnel, in accordance with Class requirements.

### **Overflow System**

- An overflow system shall be arranged for the sewage waste water tanks in accordance with sanitary discharge system requirements (ref. 582 Sanitary discharge system).
- For fuel oil cargo tanks (except combined tanks), a common air/overflow pipe system shall be arranged with drainage to an overflow tank.
- Overflow pipelines shall not promote progressive filling between damaged tanks or between tanks assumed to be intact.
  - For instance, overflow from a FO cargo tank on SB side shall be routed to a common overflow pipe on PS side, and vice versa.
- The overflow line and overflow tank shall be arranged with level alarms.

## **822 Sounding system**

### **General**

As an integrated part of the IAS, one (1) Remote tank sounding system shall be installed.

The Remote tank sounding system provides tank data for the pictures on the IAS operator stations defined in [792 Alarm and monitoring system](#).

In tanks with remote sounding sensor(s) at the same level, the liquid density has to be set manually. In the tanks with Two (2) remote sounding sensors at different level the difference in liquid pressures between the sensors enables “auto density” calculation for these tanks. Pressure transmitters for liquids that pose explosion hazards, required measures for these pressure transmitters shall be taken (i.e. barriers and Ex certification of equipment as required).

For pressure transmitter type remote tank sensors, constant reading of the liquid pressure.

Pressure transmitters shall be connected to the IAS Sub I/O cabinets, ref. [792 Alarm and monitoring system](#).

For remote sounding system with pressure transmitters, outside atmospheric pressure transmitter to be included.

A summary of all tanks with Remote, Manual and Local level indicators is provided in [Table 8.1](#).

### **Cargo and Slop Tanks Measurement System**

The cargo and slop tanks shall be monitored by a radar wave level measurement system, which is integrated with temperature measurement at three height levels in each tank and inert gas pressure measurement.

The system shall utilize microwave antennas, installed at the top of each tank, incorporating a pressure transducer for monitoring the tank's internal atmosphere and a special probe connection for additional measurement functions.

For slop tanks, the radar system shall be capable of detecting the oil-water interface level, ensuring accurate separation monitoring.

For more details regarding the cargo and slop tank measurement system and ullage equipment, see Section [381 Cargo control systems](#).

## **Independent Level Measurement System for Ballast Tanks, Consumables, and Draught Measurement**

The level of consumable tanks (fuel oil, fresh water, sewage, oily water, lubricating oil) shall be measured by either external pressure transmitters with isolation valves or a pneumatic bubble-type liquid column pressure system. The selected system shall be consistent throughout the vessel and integrated with IAS and the loading computer.

The measurement of draught and the level of ballast and sea water tanks shall be carried out using a pneumatic bubble-type system.

Draught measurement shall be taken from four (4) dedicated measuring points:

- Forward
- Aft
- Midship port side (PS)
- Midship starboard side (SB)

All sensors shall provide data to the IAS, with indication available in the CCR and engine control room.

Any tank used to store sea water shall have the measurement included in the ballast tank level measurement system.

The control panel(s) for measuring the level of ballast tanks, consumable tanks, and draught shall be installed in the CCR.

If the system uses individual pressure transmitters per tank, the sensors shall be installed outside the tanks and isolation valves shall be provided between the sensors and the tanks to facilitate maintenance.

Measurements and alarms from the level measurement systems of all ballast tanks, draught, and consumable tanks shall be supervised by the IAS and made available in synoptic diagrams of the vessel's tanks and hull (trim and list calculation). The measurements shall also be sent to the loading computer and trim optimization integrated system.

## **Closed Measurement and Sampling System for Cargo Tanks**

Two (2) UTI closed gauging measures shall be installed for manual probing and sampling of cargo tanks and interface measurement of slop tanks, with calibration certificates.

Each cargo tank shall have four (4) measurement connections:

- Three (3) with a diameter of 1"
- One (1) allowing sampling of 1 liter of product

Each slop tank shall have two (2) measurement connections:

- One (1) with a diameter of 1"
- One (1) allowing sampling of 1 liter of product

All connections shall be fitted with hermetic stainless steel valves for the following functions, performed with portable equipment:

- Ullage measurement
- 1-liter sampler
- Temperature measurement
- Measurement of O<sub>2</sub> content / H<sub>2</sub>S content / hydrocarbons in an inert atmosphere / explosimeter
- Interface detection

The portable equipment, two (2) of each type, required for these functions (Ullage System and Closed Sample) shall be provided.

System functions and interface details for closed ullage and sampling are described in Section 381 Cargo control systems.

#### **Additional Requirements:**

- Sounding pipes shall preferably allow sampling of tank contents. If not feasible, separate sampling pipes shall be arranged for Aft Peak Tank, Fore Peak Tank, Chain Locker, Ballast Tanks and Fuel Oil Storage Tanks.
- Sounding pipes in the Engine Room (mainly for double bottom tanks) shall be provided with a self-closing device (counterweight).
- All sounding pipes shall be fitted with galvanized striking plates at the lower end.
- Sounding pipes for oil tanks shall be equipped with test cocks.

Table 8.1 Sounding Type Summary Table

Tank Name	Qty	Remote	Manual	Local (Type)	Remarks					
Heavy Fuel Oil Storage Tank	2	✓	✓	Local indicator (KDG type or similar)	high level switch					
Heavy Fuel Oil Settling Tank	2	✓	✓	Local indicator (KDG type or similar)	high and low level switches. Overflow pipe with sight glass and bulb.					
Fuel Oil Service Tank	2	✓	✓	Local indicator (KDG type or similar)	high and low level switches and overflow to settling tank.					
Diesel Oil Storage Tank	1	✓	✓							
Diesel Oil Service Tank	1	✓	✓	Local indicator (KDG type or similar)	high and low level switch					
Fuel Oil Overflow Tank	1			Fuel oil / lubricating oil sludge Tank	1 ✓				✓	high level switch
Main Engine Lube Oil Sump Tank	1			Fuel oil and lubricating oil drain Tank	1 ✓				✓	high level switch

Tank Name	Qty	Remote	Manual	Local (Type)	<u>Remarks</u>					
Diesel Oil Emergency Generator Tank	1	Fuel Oil Overflow Tank	✓	1	✓	Sight glass indicator	✓		high level switch	
Thermal Oil Storage Tank	1	Main Engine Lube Oil Sump Tank	✓	1	✓		✓		high and low level switch and water detection alarm	
Thermal Oil Drain Tank	1	Diesel Fuel Oil for Emergency Generator		1	✓			Sight glass indicator	In the emergency generator compartment, with low level switch	
Fresh Water Storage Tank	1	Incinerator Diesel Oil (*)	✓	1	✓				Sight glass indicator	
Distilled Water Tank	1	Sludge for automatic fuel oil filter (*)	✓	1						
Bilge Tank	1	Thermal Oil Storage Tank	✓	1	✓		✓			
Grey Water-/ Sewage Holding Tank	1	Drain Inspection Tank (Clean water drain tank)		1	✓		Sight glass indicator	Sight glass indicator	Side windows with lamps, oil detector and low level alarm.	
Separated Oil Tank	1	Thermal Oil Drain Tank		1	✓			✓		
Sludge from Purifier Tank	1	Fresh Water Storage Tank		1	✓		✓			
TO-Drain / Cleaning Tank	1	Distilled Water Tank		1	✓		✓			
CPP Hydraulic Oil Tank	1	Bilge Tank		1		✓	Sight glass indicator	✓	high level switch	
Parts Cleaning Oil Tank	1	Grey Water / Sewage		1			Sight glass indicator	✓	Sight glass indicator	High level switch

Tank Name	Qty	Remote	Manual	Local (Type)	<u>Remarks</u>						
		Holding Tank									
Hydraulic Oil Steering Gear Tank	1	Separated Oil Tank		1			Sight glass indicator	✓			
ME Cylinders LO Storage Tank	1	Sludge from Purifier		1			Sight glass indicator	✓		high level switch	
ME Cylinders LO Service Tank	1	LO sludge from ME purifiers		1			Sight glass indicator	✓		high level switch	
ME Compressor LO Tank	1	LO sludge from AE's purifiers		1			Sight glass indicator	✓		high level switch	
ME Air Cooler Cleaning Tank	1	ME LO Settling		1	✓				Sight glass indicator	high and low level switch	
Sludge from Incinerator Tank	1	ME LO Drain Tank		1	✓			✓		high level switch	
Thermal Oil Heater Cleaning Tank	1	CPP Hydraulic Oil Reserve Tank		1	✓				Sight glass indicator		
Stern Tube Cooling Water Tank	1	ME lube oil reserve		1	✓				Sight glass indicator	High and low level switches	
Drain from Exhaust Gas Collection Tank	1	AEs Lube oil Storage		1	✓				Sight glass indicator	High and low level switches	
Cargo Tanks	12	LO Intermediate tank for AEs (*)	Radar	3					Sight glass indicator		
Slop Tanks	2	Parts Cleaning Oil Tank	Radar	1					Sight glass indicator		
Fresh water expansion of the	1			Sight glass indicator	With level switch and low						

Tank Name	Qty	Remote	Manual	Local (Type)	Remarks					
<u>high central cooling system</u>					<u>level alarm.</u>					
<u>Fresh water expansion of the low central cooling system</u>	1			<u>Sight glass indicator</u>	<u>With level switch and low level alarm.</u>					
<u>Freshwater hydrophore</u>	1			<u>Sight glass indicator</u>	<u>With pressure switch.</u>					
<u>Water heater tank for accommodation</u>	1			<u>Sight glass indicator</u>	<u>high and low thermostats.</u>					
<u>Hydraulic Oil Reserve for Steering Gear</u>	1			<u>Sight glass indicator</u>						
<u>ME Cylinders LO Storage Tank (*)</u>	1			<u>Sight glass indicator</u>						
<u>ME Cylinders LO Service Tank (*)</u>	1			<u>Sight glass indicator</u>	<u>Low level switch</u>					
<u>Lube oil for compressors</u>	1			<u>Sight glass indicator</u>						
<u>Lube oil for machinery in general</u>	1			<u>Sight glass indicator</u>						
<u>ME Air Cooler Cleaning Tank</u>	1			✓						
<u>Sludge from Incinerator Tank</u>	1			✓	<u>high level switch</u>					
<u>Thermal Oil Heater Cleaning Tank</u>	1			✓						

Tank Name	Qty	Remote	Manual	Local (Type)	Remarks						
<u>Stern Tube Cooling Water Tank (**)</u>	1		✓								
<u>Drain for Exhaust Gas Collection Tank</u>	1		✓								
<u>Kerosene</u>	1			<u>Sight glass indicator</u>							
<u>Cargo Tanks</u>	12	<u>Radar</u>									
<u>Slop Tanks</u>	2	<u>Radar</u>									

(\*) - According to the system manufacturer's recommendations

(\*\*) - This tank should be provided if deemed necessary by the manufacturer of the stern tube lubrication system

#### Notes:

- Fuel storage tanks shall be equipped with temperature transmitters for monitoring by the IAS and for correcting the level measurement by the loading computer.
- All tank level measurement sensors shall be integrated with the IAS. Readouts shall be available in the CCR and the engine control room.
- Sounding pipes shall be provided where required by Class or as backup to remote systems. ~~All sounding pipes shall be fitted with galvanized steel striking plates.~~
- Cargo and slop tanks are monitored by radar-type gauges (see Section 381 for full description).

## 84 Central heating systems

The vessel is equipped with a thermal oil heating system as the primary heat source for various consumers. The thermal oil heating system is described in detail in [845 Thermal Oil Heating System](#).

### 845 Thermal Oil Heating System

The vessel is equipped with a thermal oil heating system as the primary source of heat for various consumers, including hot water production, HVAC, and tank heating systems. The system shall recover heat from the exhaust gas economizers of the main engine and auxiliary engines, with oil-fired thermal oil heaters serving as a backup when heat recovery is insufficient. Thermal oil shall be used to supply heat to the following systems:

#### Hot Water System:

- One (1) fresh water heater (calorifier), with a capacity of 500 liters and a nominal flow rate of 2000 liters per hour, capable of raising the water temperature from 10°C to 70°C, using thermal oil as the primary heating source and electric resistors as backup.
- Two (2) hot water circulation pumps, each rated at 100% capacity.
- The hot water piping in the accommodation shall be thermally insulated.

**Tank Heating System:**

- Heating coils for tanks shall be supplied with thermal oil through heat exchangers, ensuring the tanks' contents are maintained at required temperatures.
- Tank heating consumers include fuel oil storage, settling and service tanks, slop tanks, sludge tanks, separate oil tank, incinerator sludge tank, and any other designated tanks as required.

**HVAC Heating System:**

- The accommodation and wheelhouse HVAC systems shall be heated via thermal oil-to-water heat exchangers, ensuring comfortable ambient temperatures in all relevant areas.

**Other Heating Consumers:**

- Additional heating consumers may be connected to the thermal oil system, including main and auxiliary engine pre-heaters, if applicable.
- The system shall include heating of:
  - Fuel oil purifier heaters
  - Lube oil purifier heaters
  - Fuel oil heaters for Main and Auxiliary Engines
  - Fresh water preheater for Main Engine jackets
  - Circulating fresh water preheater for Auxiliary Engines
  - Oil/water separator
  - Fuel oil mixing and deaerator tanks
  - Fuel oil pipes
  - Scavenge air system drain tank
  - Separate oil tank
  - Bilge tank
  - Inert gas system seal water
  - Fresh water generator
  - Air conditioning

**Control System:**

- The entire thermal oil heating system shall be integrated into the vessel's automation system, with monitoring and control capabilities to optimize heat distribution based on demand.
- ~~Temperature shall be controlled via the ICMS. Temperature shall be controlled via the IAS.~~
- Each consumer shall have its own independent display/by-pass assembly.
- Temperature control valves shall be supplied for the following consumers:
  - Direct-acting thermostatic type:
    - Main Engine jacket fresh water preheater,
    - Hot water tank,
    - Lube oil settling tank for the Main Engine.
  - Pneumatic type with electronic actuator:
    - Fuel oil heaters for the Main Engine,
    - Fuel oil purifier heaters,
    - Fuel oil heaters for the oil fired thermal oil heater,
    - Lube oil purifier heaters,
    - Fuel oil service and settling tanks.

### Heating Coil Configuration:

- A minimum of two (2) independent heating coil sections per tank shall be provided for fuel oil storage, settling and service tanks.
- The heating coil capacity shall be dimensioned based on tank geometry and medium temperature.

### Design Criteria for Tank Heating Calculation

- Outside air temperature: 2° C;
- Sea water temperature: 4° C;
- Air temperature in the Engine Room: 20° C;
- Temperature and heating time for each tank according to the following table, considering an initial temperature of 25°C:

Table 8.2 Tank heating system

Tanks	Tank temperature [°C]	Time (Hours)
Fuel oil storage	40	48
Fuel oil settling	70	8
Fuel oil service	90	8
Main Engine LO Sump Tank (@ suction)	30	8
FO/LO Drain	40	12
FO Drains/ Overflow	50	12
Sludge	40	12
Slop tanks	40	12
Freshwater expansion	45	6
ME Scavenge cooler cleaning	60	12
Separated oil	50	12

### Thermal Oil Heating System Equipment:

The following equipment shall be supplied:

- Five (5) thermal oil heaters: one oil-fired unit, four exhaust gas economizers (Main and Auxiliary Engines)
- Two (2) thermal oil circulation pumps (100% capacity each)
- One (1) expansion tank
- One (1) thermal oil cooler
- Two (2) thermal oil transfer pumps
- One (1) storage tank
- One (1) drain tank
- Equipment and accessories for heaters cleaning
- Automatic electronic control for combustion, level and fluid pressure
- Piping and fittings

The burner shall be of the "Low NOx" and low particulate emission type and certified according to Marpol Annex VI.

Simultaneous operation of the oil-fired heater with the economizers shall be provided. The oil-fired heater and exhaust gas heaters (economizers) shall meet the vessel's operating conditions. The oil-fired heater will be designed to consume fuel oil as defined in item 2.2.7 and diesel oil only for cold starting and for igniting the pilot burner.

The oil-fired heater shall be equipped with automatic combustion/thermal oil temperature controls and a cleaning system, consisting of a soot blower and relevant controls.

The Main Engine economizer shall be designed to withstand the condition of no oil in the pipes (dry economizer) and shall have an automatic "flap" system or flow control valve to regulate thermal oil temperature. The Auxiliary Engine economizers shall be designed similarly but without the flap.

Two (2) thermal oil supply connections shall be provided, one on each side of the exposed deck, in the accommodation/casing area.

The heat balance shall be approved in advance by the Owner.

The oil-fired thermal oil heater shall be sized to cover the total heating demand of the vessel, including all equipment, tanks, and systems, in the event of failure of all exhaust gas economizers (Main Engine and Auxiliary Engines).

For **Operational Modes** of the thermal oil heating system (Mode A/B/C), see section [64 Boilers](#).

#### **General/ references:**

Thermal oil boiler, ref. [648 Thermal oil boilers](#)

Control system, ref. [648 Thermal oil boilers](#)

Pipe material, ref. [7 System for Main Engine Components](#). Hot water pipes to be insulated.

Heating coils in fuel oil tanks, ref. [704 Heating coils in fuel oil tanks](#)

## 85 Common electrical and electronic systems

### **General**

The ship shall have alternating current systems as defined below, and shall be according to [Figure 0.1](#), Classification Society and relevant IEC norms.

The Main power system shall be a redundant 3 phase 450V AC/ 60Hz system.

The ship's alternating current systems shall be insulated towards hull throughout the vessel except grounding detecting circuits, necessary circuits of electronic equipment, etc.

All AC systems shall be equipped with earth failure instrument with alarm output, and 24 V DC systems shall have an earth failure relay with alarm output to the IAS.

Each power distribution system shall be equipped with a insulation measurement and low insulation locator system, installed in the system's main distribution panel (panel fed directly by generators, transformers, UPS or batteries, for example: MSB, ESB etc.).The system shall have an electrical system insulation resistance indicator and a low insulation feeder locator with individual fixed meters for each output feeder of these distribution panels and a monitoring and alarm device

The arrangement of the electrical equipment throughout the vessel shall as far as practical provide ready and safe access to parts requiring inspection, maintenance and repair.

All electrical equipment shall be located such that, as far as practicable, they are not exposed to risk of breakdown or damage caused by water, steam, oil or excessive heat. Where unavoidable exposed to such risks, the equipment shall be suitably protected or enclosed.

The design of the electric plant including generators, motors and controllers shall be coordinated to insure that the voltage drop when starting the motor with highest inrush current shall not exceed 15% of the rated voltage.

In no case the voltage drop during start-up shall be greater than 15% at the starter panel, 20% at the motor terminals (or a more restrictive requirement demanded by the classification society) or 20% at the other panels in the electrical system

Generators reactance shall be matched with consideration given to short circuit fault level and level of voltage distortion in the network.

Calculation for line harmonics / voltage and current distortion for main bus-bar shall be worked out. The total harmonic distortion in voltage waveform shall normally not exceed 8%, nor shall any single order harmonics exceed 5%. The total harmonic distortion may however exceed the given levels provided that equipment subjected to the increased distortion levels are documented to withstand the actual levels. i.e. A declaration or guarantee from the system responsible may be an acceptable level of documentation.

All electrical equipment shall be of the latest design employing reliable components and shall be selected to provide maximum availability of spare parts and service on a worldwide basis.

All electrical equipment shall be protected from vibration under normal operating services by mounting equipment with sufficient structure and hardware, sway bracing etc. All Electric cabinets, frequency converters and sub- switchboard in all rooms aft of engine room shall be mounted with vibration dampers. All electrical equipment exposed to the weather shall be designed considering wind and salt-water spray.

All electrical and control panels shall be installed with vibration dampers on their respective supports.

The maximum permissible continuous load on a generator, in any service condition, using any fuel in the engines and other combustion equipment (HFO/LFO, MDO/MGO or alcohol based fuels), will be 85% of the rated power. This condition shall be demonstrated in the design documentation.

In any service condition, it shall be possible to start any consumer without having to start an additional DG, unless the total electrical load after starting the consumer exceeds 85% of the generated power.

Table 8.3 DGs running in operation modes

<u>Condition of service</u>	<u>Generators in Operation</u>
<u>Normal seagoing</u>	<u>1</u>
<u>Voyage with Tank cleaning</u>	<u>1</u>
<u>Departure or arrival manoeuvring</u>	<u>1 (*)</u>
<u>Offloading at terminal with ballast water treatment</u>	<u>2</u>
<u>Monobuoy offloading with ballast water treatment</u>	<u>2</u>
<u>In port (anchored) + degassing/inertization/ventilation</u>	<u>1</u>
<u>Voyage with ballast renewal</u>	<u>2</u>

(\*) For operational safety reasons, two (2) DGs will operate in parallel.

The continuous powers (COP, according to ISO 8528-1) of the main generating sets and emergency generating sets shall be confirmed when the Main Electrical Load Analysis and the Emergency Electrical Load Analysis are submitted to the Owner for approval. The electrical load analysis shall show consumers grouped according to their simultaneity of operation.

All Electrical Systems shall comply with IEC 60092 Recommendations, as well as the Regulations, Standards and Conventions specified in section 2.4.1.

For the correct sizing and purchase of the equipment, at least the following electrical studies shall be carried out and the appropriate calculation reports submitted to the Owner for comments: load flow;

short-circuit (according to IEC 61363-1); voltage drop due to starting of large motors (with a power greater than 55 kW); coordination of electrical system protection; harmonic distortion in the system; incident energy from electrical panels (according to IEEE Std 1584).

The studies shall be specific to the vessel's electrical system as designed, and typical schemes will not be accepted. The loading conditions considered shall reflect all the service conditions defined in section 6.7, with a specific condition for maximum short-circuit, which shall consider the service condition of maximum loading and operation of 3 DGs. The short-circuit study shall indicate the minimum and maximum short-circuit current level allowed for the connection point with the terminal's Onshore Power Supply system. For the incident energy study, the respective maximum and minimum short-circuit level service conditions for each panel shall be taken into account.

### **Earthing**

Generally shall all metal parts of the electrical installation, other than current carrying parts, be earthed.

Earthing may however be omitted for double-insulated equipment, bearing housings, low voltage equipment, etc. Metal enclosures which are installed directly on parts of the steel hull or steel constructions which are welded to the hull, may be earthed by means of the fixing devices, provided reliable contact is made. The connection of earth conductors to the parts that shall be earthed and to the hull shall be made by corrosion-resistant screws or clamps. The cross section of the cables shall correspond to the earth conductor. Earthing screws and clamps shall not be used for other purposes.

### **Marking of electric systems**

All electrical equipment shall be clearly and durably labelled with necessary information for easy identifying. All cables (in both ends), conductors and terminals shall be clearly labelled for easy reference to documentation.

The marking signs shall be of durable type and easy to read, markings shall be as follows:

- Marking at the outside of the equipment shall be engraved signs, black text on white bottom.
- Inside switchboards and similar the marking can be more simple, but shall be durable.
- All emergency signs shall have white letters on a red background.

The labels/marking system shall be approved by the Owner.

### **Load Analysis**

The Designer shall prepare an electrical load analysis.

The main generating sets shall be sized to meet the service conditions shown in the table below:  
Normal seagoing, Voyage with Tank cleaning, Departure or arrival manoeuvring, Offloading at terminal with ballast water treatment, Monobuoy offloading with ballast water treatment, In port (anchored) with degassing/inertization/ventilation, Voyage with ballast renewal.

The electrical load analysis shall include the calculation for all service conditions, considering both the scenarios for using conventional fuels (HFO/LFO and MDO/MGO) and the scenarios for using alcohol based fuels, in accordance with the conceptual design in "ready for" class notation to be developed.

### **Short Circuit Analysis**

The Power systems supplier shall provide short circuit and selectivity analysis each of the voltage systems defined below as required from the Classification Society and regulatory bodies.

### **System setup**

The Main Power system shall be arranged according to Figure 0.1 and as follows:

## Power sources, power systems and equipment voltages

### Power sources

The ships electrical power sources shall be:

Table 8.4 Electrical Power sources

Description	Quantity	Capacity kW	Voltage VAC	Phase	Power factor	Frequency
Auxiliary generator sets, ref. <u>652</u> <u>Auxiliary generator set for electric production</u>	3	750	450V	3	0,8	60Hz
Emergency generator set, ref. <u>665</u> <u>Emergency Generator set</u>	1	200	450V	3	0,8	60Hz
Shore Connection Yard stay/ Dry docking, ref. <u>868 Shore connection</u>	1	300	450V	3	0,8	60Hz

### Power systems

The ships electrical power systems shall be:

Table 8.5 Electrical power systems

Description	Quantity	Switchboard (s)/ Distribution (s)	Separation/ Busties	Main Feeds	Network type	Phase	Voltage	Frequency
Main AC power system	1 (2-split)	One (1) Switchboard	One (1)	According to <u>Figure 0.1</u>	IT	3	450V	60Hz
Sub AC power system	1 (2-split)	One (1) Switchboard	One (1)	Two (2) via transformers	IT	3	220V	60Hz
<u>Sub 440V Distr. panels</u> <u>Sub 450V Distr. panels</u>	N/A	N/A	N/A	Redundant feed	IT	3	450V	60Hz
<u>Sub 440V Starters</u> <u>Sub 450V Starters</u>	N/A	N/A	N/A	Redundant feed	IT	3	450V	60Hz
Emergency AC power system	1 (Single)	One (1) Switchboard combined with Sub Emergency switchboard	-/ NA	One (1)	IT	3	450V	60Hz

Description	Quantity	Switchboard(s)/ Distribution(s)	Separation/ Busties	Main Feeds	Network type	Phase	Voltage	Frequency
Sub Emergency AC power system	1 (2-split)	One (1) Switchboard combined with Main Emergency switchboard	-/ NA	Two (2) via transformer	IT	3	220V	60Hz
Main DC systems	2 (independent)	Distribution panels, ref. <a href="#">866 DC systems</a>	-/ NA		IT	NA	24V	NA

### Equipment Voltages:

Equipment shall have voltages as listed below:

Table 8.6 Equipment Voltages

Voltage	System/equipment
450V/60Hz	Auxiliary generators Emergency generator Transformers 450V/220V Electrical motors in general Electrical heating fans heavy galley machinery heavy laundry machinery 250kVA Shore connection
220V/ 60Hz	Illumination receptacles Minor heaters Heating panels and heating cable Minor electrical motors (below 1 kW) Galley - and laundry equipment Remote control equipment Control Voltage Rectifiers/ battery charges Electronic equipment Communication systems.
24 V DC	Electronic equipment (Navigational, monitoring, governors etc.) Remote control Start batteries for emergency engine Start batteries for auxiliary engines

All 1-phase consumers shall be distributed as equally as possible on the 3 phases.

**855**

### Common computer systems

#### Local area network

An infrastructure shall be installed for broadband satellite communication systems and Ethernet data networks for computers, smart devices, routers, access points and automation systems, in accordance with the requirements described in I-ET-4800.00-9990-000-PTD-002. The data network shall be physically segregated between the administrative computer network, the access point network and the telemetry data network. The telemetry data network shall include 3 switches to be installed in the ship's control centers (ECR, CCR and navigation bridge) interconnected in a loop.

The on-board data network shall be connected to the broadband satellite communication system (supplied by the Owner), in accordance with I-ET-4800.00-9990-000-PTD-002. The antenna supports and cable penetration pieces between the antennas and the satellite communication system transmitters shall be manufactured and installed by the Yard, in accordance with the equipment manufacturers' guidelines to be informed by the Owner during the vessel's design phase.

## 86 Electrical motors, transformers etc.

### Motors

Motors < 500 kW as far as practical shall be ~~of Efficiency Class F insulation, with maximum temperature rise not exceeding class (IE2) or more and with insulation class/rise temperature "F/F"~~. However, where a motor is specially designed to suit the driven machinery (e.g. galley or workshop machinery etc.) the maker's standards may be followed.

### Transformers

All required transformers shall be included and shall be of the dry, natural, air cooled or FW cooled marine type, temperature Class F.

### Clean Power plants and UPS systems

Uninterrupted Power System(s) (UPS) for equipment and systems shall be arranged according to Classification Society and equipment suppliers requirements.

### Shore connection

A shore connection ~~440V450V~~/60Hz- 250 kVA for Dry dock/ Yard stay shall be installed and connected to one the ~~440V450V~~/60Hz Main AC systems as per Figure 0.1.

## 861 Electrical motors

Motors generally shall be of the induction marine type generally having squirrel cage rotors. Each drive shall be carefully considered in conjunction with the manufacturers of the motor and the driven unit and the most suitable characteristics selected. The nominal output of a motor shall be determined by the characteristics of the associated driven unit and shall be such that it cannot be exceeded. Rating for motors shall generally be for continuous full load duty (S1), but for motors where other ratings are widely accepted other ratings may be used.

Major motors in general shall have bearings in both DE and NDE.

Electric motors shall have the following characteristics, unless otherwise specified:

- ~~Marine use, induction, squirrel cage rotor, 440 VAC or 220 VAC, 60 Hz, 3 phases, power factor at least 0,8 inductive~~  
~~Marine use, induction, squirrel cage rotor, 450V or 220V, 60 Hz, 3 phases, power factor at least 0,8 inductive~~
- Minimum performance in accordance with current INMETRO regulations
- Locked rotor current of no more than 6 (six) times the rated current, for motors greater than 55 kW with direct start or compensated start (soft starter, autotransformer, star delta)
- Bearings, pre-lubricated and sealed in accordance with IEC recommendations and the specific use of the motor; if this is not possible, prior approval shall be obtained from the Owner
- Housing with lifting eye, for electric motors over 20 kg
- Fully enclosed, with external ventilation (IC411), connection box with cable glands and connection terminals mounted on an insulating block
- Minimum degree of protection: IP44 when located in accommodation compartments, IP55 when located in machinery spaces and similar spaces; IP56 in open areas

- Heating resistor, powered at 220 VAC, for electric motors installed in damp or open areas, steering gear room, fire pumps, thermal oil heater fans, inert gas fans, Heating resistor, powered at 220V, for electric motors installed in damp or open areas, steering gear room, fire pumps, thermal oil heater fans, inert gas fans,  
compressors, deck equipment, and motors weighing more than 500 kg. The "Heating on" indication shall be provided by means of a relay that detects the current in the heating resistors.
- The protective paint system of the motors shall be suitable for corrosivity category C5-M in accordance with ISO 12944-2. The durability range shall meet the "H" (High) durability requirements set out in ISO 12944-5, which refers to a minimum durability time of more than 15 years.
- Grounding connector on the base, on the same side as the junction box. Motors powered by a frequency converter shall have an additional grounding connector inside the junction box. The connectors shall be identified with grounding symbols.
- RTD or PTC (2 per phase) in motors with a rated power above 150 kW or driven by frequency converters, for over-temperature protection.
- Electric motors shall be sized to meet the design point of the loads being driven, with the following oversize factors
  - a) motor with a rated power of less than 22 kW - 25% oversize;
  - b) motor with a rated power of 22 kW up to and including 55 kW - 15% oversize;
  - c) motor with rated power greater than 55 kW - 10% oversize
- The speed (rpm), duty type and starting performance of each electric motor shall meet the needs of the driven equipment, under the most critical working conditions envisaged for the operation.

Two-speed electric motors shall have independent windings for each speed. Electric motors with a power rating of less than 75 kW shall have a direct starter and electric motors with a power rating of 75 kW or more shall have a compensated starter (soft starter, autotransformer, star-delta).

In no case the voltage drop during start-up shall be greater than 15% at the starter panel, 20% at the motor terminals (or a more restrictive requirement demanded by the classification society) or 20% at the other panels in the electrical system, according to the motor start-up study.

Electric motors for large consumers, as indicated in the specific items for each system in this Technical Requirement, shall be equipped with variable speed drives (VSD). VSD-driven electric motors shall meet the requirements of IEC TS 60034-25.

VSD-driven Ex electric motors shall be certified in conjunction with the VSD, in accordance with the requirements of IEC 60079-14. The technical characteristics of the VSD used for motor certification shall be described in the certificate of conformity or in the manufacturer's technical documentation, referenced in the motor certificate.

The certification of conformity of the motor shall cover the actual operating conditions regarding the speed variation range, torque characteristics and technical characteristics of the VSD used in the type tests for the certification of the motor.

Electric motors for specific use, such as for galley, laundry and workshop equipment, shall be in accordance with the manufacturer's standard for the equipment used.

Table 8.7 Minimum ingress protection for electric motors

Equipment	IP rating
• Electric motors in stores, technical rooms etc.	IP 44
• Electric motors in Engine room	IP 55
• Electric motors on open deck	IP 56

- Electric motors in accommodation IP 44
- Electric motors in ventilation ducts IP 44

Electrical motors for the following shall have automatic stand still (space) heating of adequate size:

#### Deck machinery

- Deck cranes
- Machinery mounted on open deck or in wet atmosphere
- Machinery mounted in room without insulation adjacent to open deck or to ship's side (excluding engine room)
- All Cargo pumps and HPU's
- Fi-Fi pumps
- Motors in Steering gear room
- Motors for thermal oil heaters
- Inert gas fans
- Compressors
- Motors more than 500kg

Heating element shall be monitored (i.e. with A-meter).

## 865 Transformers

### General

All transformers to be fully compatible with the remainder of the electrical system.

Transformers for electrical power supply to lighting, small power equipment, communication, etc. to be provided as follows:

### **Main transformers – 440V / 230V Main transformers - 450V / 220V**

Two (2) of marine type (one set as spare) transformers to be installed near the main switchboard for regular lighting, small power equipment, internal communication equipment, navigation equipment, radio equipment, etc.

The two tran working in parallel. In case of failure in one of the transformers, the other one to automatically take over the whole load.

Table 8.8 Main transformer

Type	Drip proof natural air cooled dry type
Capacity, each	According to electrical load calculation, each with 120 % of electrical load balance calculation.
Phase	3 phase
Frequency	60 Hz
Voltage	<u>Primary voltage 440V</u> <u>Primary voltage 450V</u> <u>Secondary voltage 230V</u> <u>Secondary voltage 220V</u>
Insulation	Class F, with a maximum temperature rise corresponding to class B.
Connection	Banks of single-phase transformers connected in delta-delta shall be used.
Protection	IP 44
Remarks	Transformers to be self ventilated

### Emergency transformers

Two (2) (redundant) transformers shall be installed to supply the 220V distribution panel of the ESB. Each transformer shall be able to support 100% of the load of the ESB 220V panel.

Table 8.9 Emergency transformer

Type	Drip proof natural air cooled dry type
Capacity, each	According to electrical load calculation
Phase	3 phase
Frequency	60 Hz
Voltage	<del>Primary voltage 440V</del> Primary voltage 450V <del>Secondary voltage 230V</del> Secondary voltage 220V
Insulation	Class F
Connection	Banks of single-phase transformers connected in delta-delta shall be used.
Protection	IP 44
Remarks	Transformers to be self ventilated

Banks of single-phase transformers connected in delta-delta shall be used.

The transformers shall have the following characteristics:

- ~~Marine use, 440 / 230 Vac, 60 Hz, with primary taps (+/- 2,5% and +/- 5%)~~ Marine use, 450V / 220V, 60 Hz, with primary taps (+/- 2,5% and +/- 5%)
- Voltage Regulation: better than 2,5%
- Dry type, air-cooled, natural ventilation, continuous duty
- Class F insulation, with a maximum temperature rise corresponding to class B
- Flame-retardant, self-extinguishing insulation resin with a low content of toxic gases on combustion, in accordance with IEC 60076-11 fire behavior class F1.
- Degree of protection IP23 for the transformer and IP44 for the terminal box.
- Silver connection terminals
- Lifting and lateral movement eyes

The magnetizing current (inrush) of the transformers shall be informed in the equipment data sheet for protection settings. Facilities shall be installed for temporary earthing using earthing cables and

screwed connectors. The Electrical Load Analysis of the Transformers shall be submitted to the Owner for approval.

## 866 DC systems

### 24V Battery System

24V DC battery systems for equipment and systems shall be installed as required by Classification Society National authorities and equipment suppliers requirements.

Two (2) 24 VDC uninterruptible power supply systems shall be installed, consisting of a rectifier, charger, battery group and distribution panels, fed by the ESB, as follows:

- System 1, for GMDSS consumers, according to the GMDSS manufacturer's standard.
- System 2, for general use (ECR console, CCR console, navigation bridge chart console, MSB, ESB, navigation lights, temporary lighting, etc), with the following characteristics:
  - Certified for marine use
  - Sealed batteries (VRLA - valve-regulated lead-acid), AGM type, certified in accordance with

- Anatel Resolution 570, with a 20% oversize factor (over the entire life time of the batteries)
- Autonomy of 30 minutes for the installed load (including the 20% oversize factor)
  - Output regulation: - 5% / + 10% (maximum)
  - Modular construction, with a minimum of 3 (three) rectifier modules (the failure of a module cannot cause system failure, unless of a capacity reduction) a spare rectifier module shall be provided
- Readout instruments: batteries current and voltage, charger output current and voltage, insulation measurement of the 24 Vdc system
- Insulation fault locator capable of identifying the faulty output feeder (this system may be installed in the distribution panel fed by the rectifier)
  - Alarms: 220 Vac fault, 24 Vdc fault, internal fault, low insulation in the 24 Vdc system, overcurrent, undervoltage and overvoltage
  - Reversible contacts for 24 Vdc system low insulation alarm and group alarm.
  - The installation of battery groups and their respective rectifiers/chargers shall follow the recommendations of the respective manufacturers.

## 867 Clean power plant and Uninterruptible Power supply systems

### Uninterruptible power supply system – UPS

UPS systems for equipment and systems shall be installed as required by Classification Society National authorities and equipment suppliers requirements.

The design philosophy shall take into account that UPS (Uninterrupted Power Supplies) will only be used for equipment powered by alternating current that suffers serious disturbance in case ~~of a momentary power failure, or that needs to be restarted or data re-entered. Dedicated UPSs (220/220 Vac) shall be installed for the following systems and equipment, among others:~~ of a momentary power failure, or that needs to be restarted or data re-entered. Dedicated UPSs (220V/220V AC) shall be installed for the following systems and equipment, among others:

- Fire detection system (alternatively, "built-in" UPS can be installed)
- IAS workstations
- Measurement system for cargo and ballast tanks
- Integrated load computer and trim optimizer system
- Radars (display only)
- Navigation and ECDIS/ENC system workstations
- Broadband satellite communication systems
- Server, routers, access points and other data network components
- CCTV

The UPSs shall have characteristics in accordance with the standard of the Integrator responsible for the system or equipment served by the respective UPS, in addition to the following:

- Certificate of conformity with IEC 62040-3
- Certified for marine use
- Sealed batteries (VRLA - valve-regulated lead-acid), AGM type, certified in accordance with Anatel Resolution 570, with a 20% oversize factor (over the entire life time of the batteries)
- Blackout operating time: 30 (thirty) minutes at full load
- Isolated distribution
- Alarms: input power failure, internal failure, low insulation in the output

- Reversible output contact for group alarm
- Automatic bypass in the event of a fault.

## 868 Shore connection

### Shore connection

The shore power connection box shall be located in the Emergency DG compartment, with provision for weathertight cable entry through the bulkhead, with a cable tray inside and shall have the following characteristics:

- ~~440 Vac, 3 phases, 60 Hz~~  
~~450V, 3 phases, 60 Hz~~
- 500 A capacity
- Connection terminals for the external cable
- Plug-in molded case thermomagnetic circuit breakers
- Internal heating element
- Phase sequence verification device
- Ammeter
- Dual voltmeters for all phases with voltage measurement before and after the circuit breaker

### Future Shore connection

The vessel's design shall consider the future installation of a Shore connection system- (at 6,6 kV) sized to supply 100% of the electrical power of 2 DGs, meeting the requirements of IMO circular MSC.1/Circ.1675, IEC/IEEE 80005-1, IEC/IEEE 80005-2, IEC 62613-1, IEC 62613-2 and classification society standards. The design for the installation of this system shall be submitted for the issuance of a Statement of Compliance by the classification society.

The design of the future installation of the Shore connection system shall describe at preliminary design level the technical characteristics of the Shore connection system and all the interventions in the

existing infrastructure and systems necessary for the installation and integration of the future system. Spaces reserved for the installation of new equipment, materials and the construction of rooms shall be clearly identified in the design documentation.

The design shall consider the future installation of connectors for the power and control cables (port terminal cables) of the port Shore connection system on both sides of the vessel (portside and starboard), in the midships region, aft of the cargo manifold , in a position that allows the onshore power cables to be lifted and moved using the vessel's cargo crane. A representative drawing of this movement shall be included in the technical design documentation.

The number of connectors for the power cables to be used for each vessel shall be calculated to meet the rated power of the system, according to the standard power per cable established in IEC/IEEE 80005-1 for onshore power cables on oil tankers. The system shall provide interlocks to prevent cables from being disconnected while energized.

The design shall take into account the future installation of supports for the port terminal cables during system operation.

The design shall take into account access control to the high-voltage equipment and remote closing of the Shore connection incoming circuit breaker on the vessel (without the presence of people in the compartment housing the high-voltage panels).

The future Shore connection system shall be equipped with automatic tripping in the event of emergencies, such as loss of hull grounding , high mechanical voltage on the connecting electrical cable, imminent failure of the cable connection, emergency stop triggers, etc .

Emergency stop buttons for the port Shore connection system shall be provided in the ECR and in the high voltage equipment compartment. The future 6,6 / 0,44 kV transformer for the OPS system shall meet the characteristics specified for the other transformers on the vessel, as per item 865 Transformers of this Building Specification.

The future Shore connection system, the vessel's PMS and the installation design shall make it possible to temporarily connect the on-board generators to the shore system in parallel.

The vessel's distribution system shall remain isolated after connection to shore power. The Shore connection system shall measure the energy received from shore and display this measurement on the receiving panel. The Shore connection system shall provide the status of circuit breakers, operational indications, measurements and alarms to the IAS.

## 87 Electrical distribution systems

### Main distribution system

The vessel shall have an electric distribution system setup and switchboards according to 85 Common electrical and electronic systems, and shall include "Power Management" and "Blackout Prevention" Systems.

### Distribution panels/ Electrical utility stations

Distribution panels shall be installed for all relevant voltage levels.

## 871 Main low voltage switchboards

### General

The vessel shall be equipped with the necessary switchboards according to Table 8.5.

The switchboards shall be designed for free standing mounting on a common base frame. Each cubicle shall consist of a framework built up of zinc plated squared tubes. The top, the sides and the rear (except wall mounted sections) shall be covered with detachable steel panels, while the front shall be fitted with hinged doors. The switchboard shall be of dead front type and have enclosure according to Classification Society requirements. Handrails of insulating material shall be provided at the front.

### Remote control of main electric generators to be provided in ECR.

The circuit breakers shall be operated from outside the panel, with no need to open the compartment door, and shall have a safety lock that can be fitted with a padlock for maintenance.

Bus bars and other conductors shall be of copper. Bus-bars and other conductors with their supports shall be mechanically and thermally dimensioned and fixed such that they can withstand the forces occurring by the maximum short-circuit which can occur without detrimental effect. Flame-retardant partitions shall be provided between compartments which shall prevent spreading of arc and minimize spreading of ionised gases in case of fault.

The switchboards shall be mounted with vibration dampers (below and on top).

The main busbar should preferably be located at the top of the panel, without splices, silver plated at the contact points and equipped with disconnecting links where necessary to guarantee the vessel's operation in emergency situations.

~~the vessel's operation in emergency situations.~~

The busbars shall be made of electrolytic copper, insulated (sheathed) and fitted with silver plated contacts/terminations.

The switchboard shall be equipped with

- Internal electrolytic copper ground bar
- Acrylic protection to prevent contact with live parts
- Door locks in the open position
- Heating resistors for panels installed in damp areas or on open decks
- Lifting eyes for panels weighing more than 20 kg
- Made from 316L stainless steel or painted carbon steel.

Certificates of compliance with the short-circuit currents indicated by the study shall be provided for each panel. In the case of a short-circuit current of less than 10 kA, certification may be waived. Electrical panels shall have an incident energy level lower than the 'CAT-2' arc rating clothing (up to 8 cal/cm<sup>2</sup>).

The panels shall be painted in accordance with the requirements of ABNT NBR 16680 for environments with a very high corrosivity category (C5-M).

The panels shall be fitted with a nameplate on the front door identifying the panel (tag) and the main electrical characteristics of the equipment, including the calculated incident energy levels and the required arc rating for clothing used on the panel.

The height of manual control devices in relation to the floor shall be limited to 1750 mm. Indications of heating element operation shall be controlled by current relays, i.e. they shall indicate the actual operation of the heating element.

Cable entrance shall generally be from below.

Space in conduit for future cabling shall be prepared.

Necessary converters/signal outputs shall be provided for the propulsion plant, etc.

All switchboards shall have available space for circuit breakers for future installation, with 2 – 3 circuit breakers for each main busbar section.

The 440V450V and 220V main switchboards shall be installed in the switchboard room ECR.

450V and 220V emergency switchboard shall be installed in the emergency generator room.

Switchboards shall be laid out and built in accordance with Table 8.5 and Classification Society requirements.

The panels shall be painted in accordance with the requirements of ABNT NBR 16680 for environments with a very high corrosivity category (C5-M).

The panels shall be fitted with a nameplate on the front door identifying the panel (tag) and the main electrical characteristics of the equipment, including the calculated incident energy levels and the required arc rating for clothing used on the panel.

The height of manual control devices in relation to the floor shall be limited to 1750 mm.

Indications of heating element operation shall be controlled by current relays, i.e. they shall indicate the actual operation of the heating element.

The following color standard shall be adopted:

- Internal and external color: gray RAL7030
- Identification of busbars and phases:
  - AC systems: R phase - red, S phase - white, T phase - blue
  - DC systems: positive - red, negative - black
- Signaling of operating functions:

- powered: white or colorless
- normal, circuit breaker open, stopped: green
- circuit breaker closed, working: red
- stand-by, fault, attention, reversing, preheating: yellow

The electrical panel feeders shall be fitted with a safety device to lock them for maintenance.

Switchboards, starter panels and electrical panels in general shall make available, for external use (monitoring by the IAS), all the signals considered relevant to the operation of the respective electrical equipment.

The electrical panel supplied as part of other equipment will follow the equipment manufacturer's standard, while respecting the color standard indicated in this document. All electrical and control panels shall be installed with vibration dampers on their respective supports.

The internal diagram of each electrical or control panel shall be printed, laminated and positioned firmly on a support inside the panel.

#### **450V switchboard**

The switchboard shall be dimensioned for all power sources except shore connection and Emergency Generator in Table 8.4 in continuous parallel operation.

The MSB shall consist of at least:

- 3 (three) DG input columns
- 1 (one) synchronization column
- 1 (one) bus tie breaker column
- 2 (two) group starter panels
- 2 (two) transformer feeder columns
- 2 (two) 440Vac distribution columns
- 2 (two) 450V distribution columns
- 1 (one) 220Vac distribution column
- 1 (one) 220V distribution column

The MSB design shall consider the future installation of one (1) input column to receive power from a future onshore power supply system.

The MSB columns shall be certified against short-circuit and arc flash. They shall be made up of individual cubicles, separated by steel plates, in order to confine electrical faults.

The MSB shall be designed and sized to continuously support the operation of 3 (three) generators in parallel at 100% of their rated power.

The main busbar of the MSB shall be divided into two sections, interconnected by an extractable tie breaker (ACB).

The main busbar shall be provided with cold busbar links between every two generators and between the generators and the distribution sections.

~~Duplicate consumers shall be divided between the two group starters and between the two 440 Vac distribution columns. Each Duplicate consumers shall be divided between the two group starters and between the two 450V distribution columns. Each 450V and 220V distribution column shall have at least three spare circuits equipped with circuit breakers.~~

The circuit breakers for the DGs and the bus tie breaker shall be of the same model, of withdrawable air circuit breaker (ACB) type, with features for testing in the withdrawn position and protection functions in an "intelligent" electronic module.

The MSB shall be equipped with optical arc detection sensors to trip the busbar's power circuit breakers.

The DG circuit-breakers shall be interlocked with the shore power circuit-breaker in the MSB.

The design shall consider temporally parallelism between the DGs and the Emergency DG during the transition from the emergency supply to the main supply. Consumer loads circuit breakers shall be thermomagnetic plug-in moulded case circuit breakers.

The MSB shall have a power management system (PMS) as well as analog meters for the system's electrical variables (bus voltage and frequency, generator voltage and frequency), manual controls and indications for opening and closing ACBs and manual controls for AE's rotation.

The automatic and manual controls shall be located in the MSB synchronization column, which shall be equipped with synchronizing relays (ANSI 25) to interlock the closing of the circuit breaker at unsynchronized condition.

The front and rear doors of electrical panels shall be fitted with handrails made of insulating material along the entire length of the panel. The panel shall be built in such a way as to allow safe thermographic inspections with the circuits energized at cable and busbar connections.

Shore power shall be fed to the 450V switchboard as defined in 868 Shore connection.

### Main generator panels

There shall be one generator panel for each generator.

This panel shall contain equipment for control and protection of the generator:

The control equipment installed in front of the panel shall be:

- 3 ammeters (scale min. 130% of the rated full load)
- 1 frequency meter (scale min.  $\pm 8\%$  of the nominal frequency)
- 1 voltmeter (scale min. 120% of the rated voltage)
- 1 wattmeter (scale min.  $\pm 15\%/130\%$  of the rated full load)

One (1) voltmeter switch for connection the voltmeter between the different phases and the different phases and earth.

All meters to have red mark for normal value/upper limit.

The protection equipment installed inside the panel shall be:

- 1 Air-Circuit breaker, motor operated.
- 1 generator guard, if not built-into circuit breaker or instrument, for protection against over-current, reverse power. The limits shall be adjustable.
- 1 Differential protection unit if generators are above 1500kVA
- 1 selector switch (normal/manual operation)

In front of panel shall be mounted control equipment for the generator breaker, etc.:

- 2 push-buttons for opening/closing of breaker
- 1 signal lamp (open)
- 1 signal lamp (closed)
- 1 Signal lamp (manual operation)
- 1 switch (on/off) and indication lamp for generator heating
- 1 signal lamp indicating over current/reverse power
- 1 push button for reset of over current/reverse power

- 1 hour counter up to 99.999 hr (no reset type)
- 1 speed control.

Necessary synchronising device and lamps for manual synchronising shall be installed.

#### Main bus instrument / Common equipment

- Voltage guard
- Frequency guard
- Insulation guards
- Power quality monitoring shall be included for the main busbars; 2 x 450V, and 3 x 220V. THD and single harmonics < 63. harm. for 450V bus-bars, and THD and < 21. harm. 220V busbars. Indication on IAS PMS/switchboard picture.
- Mimic diagram in front including:
  - Running indicator emergency diesel
  - Emergency switchboard supplied from emergency generator
  - Emergency switchboard supplied from main switchboard

#### 220V Switchboard

The 220V switchboards downstream of Main switchboards PS/SB shall be supplied by a 3-phase transformer each. Each transformer shall be sufficient for supplying the vessels normal 220V consumption during transit mode. The switchboard shall be divided into two parts by means of a circuit breaker, the load shall be connected to the two switchboards, according to separation requirements and equalisation of load.

The two parts will normally be running in split mode. Upon failure on one of the feeder circuits the feeder breaker can be disconnected and the bus-tie breakers engaged, thus the remaining transformer can supply both 220V switchboards.

The vessel's 220V consumers shall be supplied from these switchboards, important consumers shall be supplied directly from the switchboard, consumers of minor importance in general shall be supplied via locally installed distribution panels.

Moulded Case Circuit Breakers (MCCB) shall be applied. Consumer loads circuit breakers shall be thermomagnetic plug-in moulded case circuit breakers.

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#### Emergency switchboards

An emergency switchboard (IT), 450V, shall be installed close to the emergency generator. The switchboard will be normally supplied from the 450V main switchboard. A failure in the normal power system will start the emergency generator automatically and connect it to the emergency switchboard. The emergency switchboard will be equipped similar to the standard for the main switchboard.

The emergency system shall have the necessary facilities to feed the main switchboard for dead ship recovery.

A 220V emergency switchboard (IT) shall be provided. The switchboard shall be supplied by separate 450V/220V, 3-phase emergency transformer(s), ref. [865 Transformers](#).

Emergency light according to rules, shall be integrated in the ordinary light installation, bed lights in all cabins shall have power supply from emergency system. Additionally, emergency light to be installed in captain's cabin, master's cabin and cabins with alarm panel for UMS.

The ESB shall normally be fed by the MSB or, in an emergency, directly by the Emergency DG.

The ESB shall consist of at least:

- 1 (one) Emergency DG input column
- 1 (one) input column for MSB supply and transformer feeder
- ~~1 (one) 440 Vac distribution column~~  
1 (one) 450V distribution column
- ~~1 (one) 220 Vac distribution column.~~  
1 (one) 220V distribution column.

Moulded Case Circuit Breakers (MCCB) shall be applied.

The ESB columns shall be short-circuit and arc flash certified.

They shall be made up of individual cubicles, separated by steel plates, in order to confine electrical faults.

~~Each 440 Vac and 220 Vac distribution column shall have at least two spare circuits equipped with circuit breakers. Each 450V and 220V distribution column shall have at least two spare circuits equipped with circuit breakers.~~

The Emergency circuit breaker shall be of withdrawable "air circuit breaker" (ACB) type, with features for testing in the withdrawn position and protection functions in an "intelligent" electronic module. Consumer loads circuit breakers shall be thermomagnetic plug-in moulded case circuit breakers.

The front and rear doors of electrical panels shall be fitted with handrails made of insulating material along the entire length of the panel.

The panel shall be built in such a way as to allow safe thermographic inspections with the circuits energized at cable and busbar connections.

In addition to the consumers provided for in SOLAS, the Emergency DG shall feed:

- DGs pre-lubrication systems
- Heating resistor for the main generators
- Any equipment needed to provide the starting conditions for the DGs and Emergency DG
- Refrigerated Provision System
- Galley equipment
- UPS
- Fire detection and fire fighting systems
- Diesel oil transfer pump for the Emergency DG tank
- 1 (one) reversible fan of engine room
- 1 (one) main air compressor
- Electrical test panel
- Electrical and mechanical workshop, ECR, CCR, Navigation Bridge and infirmary sockets
- Charging sockets for lifeboat batteries
- Emergency lighting (around 30% of normal lighting and part of the deck floodlights)
- Emergency sea water pump, responsible for emergency draining of the engine room.

## 874 Starters and emergency stop system

### Group Starter panels

Group starter panels shall be made up of individual cubicles, separated by steel plates, in order to confine electrical faults.

The group starter panels shall have the following resources:

- Common busbar for grouped starters
- Manual controls for power, start, stop, "local/remote" selection (\*), "manual/automatic" selection and other necessary controls

- Indications of "powered", "running", "stand-by", "local", "remote", "manual", "automatic", "heating on", faults (individualized) and other necessary information
- Ammeter, for motors with a power rating of 10 kW or more, with marking of the rated current of the equipment being driven
- Safety device for attaching a padlock for maintenance.
- The local control pushbutton, with a "de-energized" lockout feature, shall be installed next to the driven equipment, whenever the respective starter panel is located more than 5 (five) meters from it. The local control buttons will have "start", "stop" commands and "running" indication when it is not possible to identify the operation of the equipment. The "stop" pushbutton shall be "fail safe", have a latch in the actuated position and be protected against accidental actuation by means of a tilting cover
- Input and output interface signals with the IAS, according to the application (running, local / remote, fault alarm, among others)

(\*) Local control means control from the field button next to the equipment, and remote control means control from the starter panel or IAS.

Starter panels for specific use, such as for galley, laundry and workshop equipment, shall be in accordance with the manufacturer's standard for the driven equipment.

All circuit-breakers shall be supplied with locking devices for blocking and signaling during maintenance work on the equipment.

Power supply circuits for electric motors driven by VSD to improve energy efficiency shall include VSD by-pass contactors or circuit breakers and a direct or compensated start operating mode depending on the motor's power. VSD shall have an input reactance to reduce the harmonic distortion at the electrical system and prevent damage to the VSD due to system voltage transients. Each group starter panel shall have at least two spare starters or 20% spare starters (whichever is greater), equipped with circuit breakers and a complete control circuit.

Copies of the respective connection diagrams for each starter panel shall be prepared, supplied and confirmed available after the installation has been completed.

### **Unlinear loads**

The amount of various unlinear loads on the various busbars to be limited according to what is required to keep within the harmonic distortion levels given in 85 Common electrical and electronic systems.

During the engineering period, preliminary THD calculations at each separate system (450V/~~440V~~/220V) for the vessel's various normal operation modes to be worked out, and based on the system capability and known unlinear loads in the system an availabl rest capability for 6-pulse drives to be calculated and documented.

If the THD calculation for a busbar section gives levels that exceeds the limits given in 85 Common electrical and electronic systems, Yard to supply means to reduce the harmonic distortion on the given busbar.

Means to lower the harmonic distortion:

- Replacing 6-pulse drives with higher pulse numbers
- Using pulse drives with active filters
- Replacing pulse drives with AFE drives
- Installing separate filters to reduce the THD

Transformers in the systems shall be designed to minimise harmonics back to source.

### Emergency Stop

Emergency stop push buttons shall be arranged in groups. Generally these shall be based on shunt trips in the main switchboard covering several fans/pumps etc. by one push-button. The push buttons shall be protected against accidental operation by cover or breakable glass.

Emergency stops shall be automatically triggered by the fixed fire-fighting systems in those areas.

Further emergency stops for sludge pump etc. shall be arranged according to Classification Society requirements.

All emergency stop locations shall be agreed by the Owner during the approval stage.

Emergency stop push buttons shall be arranged in groups previously agreed with the Owner.

## 875 Distribution panels

### General

Local distribution panels (fuse lockers) shall be arranged for minor machinery, illumination and heating.

All distribution panel cabinets shall be made of aluminium or primed steel with a painted surface. The cabinets shall have hinged door(s) with catch and lock complete with key or similar. All panels shall be keyed alike. A directory frame and card shall be provided inside the doors.

Distribution panels shall have a common power supply bus and individual circuits for consumers, protected by plug-in thermomagnetic circuit breakers.

Each distribution panel shall have at least two spare circuits or 10% of the total number of circuits (whichever is greater), equipped with circuit breakers.

Cable entrance for distribution panels in machinery spaces shall generally be from below.

### **Distribution panels for 440V**

Distribution panels\_The degree of protection shall be IP23 in control rooms and similar spaces, IP44 in machine and similar spaces and IP56 in open areas\_440V for galley-laundry equipment, heating fans, illumination etc.

### **Distribution panels for 450V**

Distribution panels 450V for galley-laundry equipment, heating fans, illumination etc.

Earth failure indication shall be provided for this cabinet.

Miniature circuit breakers (MCB) shall be used.

### **Distribution panels for 220V**

Distribution panel for 220V equipment.

Miniature circuit breakers (MCB) shall be used.

This 220V distributions shall be supplied directly from the 220V main switchboards which are supplied via transformers 450V/220V

### **Distribution panels for 24 V**

Distribution panels for electronic equipment, remote control etc.

Miniature circuit breakers (MCB) shall be used.

## 88 Cable installation and cable support

### General

All power supply cables throughout the vessel shall be of minimum 1,0 kV or 250 V grade insulation and meet the voltage which they are subjected to. Minimum 1,0 kV grade cables shall be used for all cables above 1 mm<sup>2</sup> installation and minimum 250 V grade cables shall be used for all pair cables. Special attention shall be paid during selection of cables to power supply connection to three-phase drives from pulse-controlled converters.

Cables shall not be painted.

All cables shall be installed in compliance with the rules of the Classification Society.

All cables except co-axial cables, shall in general have multicore and multistranded construction.

Cables in general shall have copper conductor and XLPE or EPR conductor insulation.

Special cables such as compensating cables, data network cables, shielded cables, coaxial cables etc. shall be used where necessary, ref. [886 Special cables](#).

General-purpose electrical cables for marine use shall be made of stranded copper, with insulation and outer jacket made of completely halogen-free materials, "flame retardant", "low smoke emission" in accordance with IEC 60332 parts 2 and 3, smoke density in accordance with IEC 61034-2, and low toxic smoke emission in accordance with IEC 60754. Cables installed in areas likely to come into contact with hydrocarbons shall have an oil-resistant sheath.

Fire-resistant cables shall comply with IEC 60331-21.

Three core power cables (single or multiple in parallel) shall be used to and from frequency converters. Multiple single core cables in parallel may be used for other high power equipment provided the cables are arranged to limit the difference in impedance between the cables for one component.

For multiple single core cables this means that cables shall be arranged with three or six cables in one bundle and configured according to normal ship building standards. The cables shall be revolved two (2) times with equal distance if over 30 m long. If over 80 m long, cables shall be revolved five (5) times with equal distance.

Instrumentation and control cables shall be kept away from power cables to avoid electromagnetic induced currents. All cables shall be installed taking into account the segregation requirements set out in IEC-60533 regarding electromagnetic interference. In addition, a minimum spacing of 300 mm between trays is required for maintenance.

Electrical cables in areas exposed to the weather shall be installed in cable trays. These shall be made of 316L stainless steel and the cables shall be armored, with a PVC outer jacket. In load handling equipment areas, covers shall be installed over cable trays.

Control and power cables between the DGs and the MSB and between the Emergency DG and the ESB, cables installed in or passing through hazardous areas classified as zone 0 or zone 1 and cables passing through areas subject to mechanical damage (cargo handling areas, permanent maintenance areas, main deck, submerged areas) shall be armored. Multicore cables shall have a galvanized steel wire mesh armor and single-core cables shall have a copper armor or other non-magnetic material protected by an anti-corrosion coating.

Flexible electrical cables for remote control pushbuttons shall have a spare pair of conductors and a minimum flexibility class of 5.

The outer cover of cables exposed to sunlight shall be protected against degradation by UV radiation and comply with UL 1581 section 1200. Equivalent certification can be submitted for evaluation to Owner.

All electrical, instrumentation, automation and communication cables connected to Ex equipment

shall be circular and compact, with an extruded, non-hygroscopic jacket and filling material, and shall be subjected to restricted breathing tests in accordance with the requirements of IEC 60079-14.

The outer cover of the cables/conductors shall be:

- For grounding/equipotential cables: green and yellow
- For intrinsically safe circuit cables: light blue
- For AC or DC power cables: black
- For phase conductors in three-phase cables: black, brown and gray
- For phase conductors in two-phase cables: black and brown
- For DC cable conductors: red (positive) and black (negative)

### Cable support

Cable trays for major cable runs shall be of the Z-profile type for effective installation, and to enable cables to be installed on both sides of the cable tray.

Space for future additional cables shall be provided in major cable runs (Approx. 10%).

### EMC plan

An EMC plan for cable installation shall be provided.

The plan shall as a minimum contain:

- A philosophy for use of screened cables
- Classification of cables into different EMI generation and susceptibility levels
- Rules for separation, routing and bunching of cables.
- Description of earth and cable screen connections.

The EMC plan shall be accepted by the Owner before installation work starts.

### Fixing of single core cables

In order to guard against the effects of electro dynamic forces developing on the occurrence of a short circuit or earth fault, single core cables shall be firmly fixed, using supports of strength adequate to withstand the dynamic forces corresponding to the prospective fault current at that point of the installation. The fixing clamps of the cables should not damage the cable when the forces affect the cables during a 1 s short circuit period.

### Screened cables

All 24 V cabling shall be of the screened type (except cables from battery to main distribution). All cables outside and in the wheelhouse shall be screened type. All cables to a hazardous area (Ex) shall be screened or armoured. This is also valid for cables passing through a Hazardous area (Ex).

## 881

### Cable installation

Cable runs shall be located as far as possible away from spaces exposed to excessive heat, steam, exhaust gas and moisture.

Cabling shall be avoided in spaces exposed to drip or accumulation of water or oil vapour as far as possible.

Cables liable to be exposed to mechanical damage shall be protected by suitable means e.g. by using galvanized steel pipes, steel conduits, flexible steel pipes etc.

Cable installation on open deck shall be minimised.

For protection of vertical single cable penetration to open deck, galvanised pipe with cable gland on top shall be provided. The pipe shall have a height of 900 mm above deck with a swan neck where possible. The pipe shall be fully welded to deck.

Wiring throughout the vessel shall be carefully arranged to eliminate fire risks.

The voltage drop from the main switchboard bus-bar to any point in the installation when cables are carrying maximum current under normal service conditions shall not exceed the Classification Society rules (AC=6%, DC=10%).

The cabling throughout the vessel shall be done in such a way that various instruments/meters on the bridge, instrument room, engine room etc. do not get affected due to radio frequency interference when the radio station is in operation.

The minimum bending radius for multipole armored cables shall not exceed ten times their nominal diameter and for single-pole armored cables shall not exceed twelve times their nominal diameter. No cable splices will be accepted. When strictly necessary, the connection of two sections of cable shall be made inside panels or junction boxes, using appropriate terminals fixed to the base plate. The use of splicing connectors or similar will not be accepted.

The electrical cables shall be identified at both ends in accordance with the respective codes ("tags") of the electrical diagrams. The conductors in use shall be identified at both ends according to the codes of the terminals to which they are connected.

Electrical cable junction boxes shall be shown on the electrical diagrams and shall be visibly identified at the installation site.

Electrical cables installed on masts shall have mechanical protection up to a height of 3 m (three meters).

Independent separate earthing cable shall generally be applied for earthing of metallic enclosures. Earthing by means of the fixing devices shall be limited to special cases and is only acceptable in internal areas and provided the electric contact is made firm through metal to metal contact without paint with corrosion resistant screws, nuts and star washers.

## 882 Cable support

Cables shall be effectively supported and secured without damaging their outer coverings.

Cable groups shall be supported on metal trays/ hangers placed clear off steel hull structure to permit painting on surrounding structures.

Cables may be installed directly on wooden walls or other non-rusting materials where frequent painting is not required.

Cable trays/ hangers shall be made of galvanized steel. On trays and flat bars, they shall be fixed with AISI 316L stainless steel clamps coated with plastic

material, so as not to damage the cables. Cable outlets in cable trays shall be protected with thermoplastic material.

The support of the trays in the exposed area shall be made of 316L stainless steel or painted galvanized steel. In branch sections where the use of cable pipes is necessary, these shall be made from ASTM A-53 or ASTM A-106 schedule 80 welded steel pipes.

Cable pipe bodies and cable pipe fittings shall be hot-dip galvanized and painted externally. Fastening screws for conduits, trays or rails shall be 316L stainless steel.

Independent trays or conduits shall be provided on the main deck for each of the following groups of electrical cables:

- Power and lighting cables;
- Intrinsically safe system cables;
- Communication, navigation and automation system cables.

The electrical continuity of the cable trays shall be ensured with jumpers or bonding cables fixed using welded AISI 316L stainless steel bolts, lock washers and hexagonal nuts, designed exclusively for this purpose.

A total of maximum 6 single core power cables may be bunched by one clamp.

Cables exposed to weather shall be secured with stainless steel hoops and buckles.

Where cables pass through watertight bulkheads or decks, watertight stuffing glands, or boxes for multi-transit arrangement, shall be used. The multi-transits shall have additional space for future installation.

Where cables pass through non-watertight bulkheads, beams or girders, the cables shall be protected in the penetration.

Cable sealing schemes with sealing compound or MCTs installed below the worst-case waterline shall withstand the expected hydrostatic pressure column (provided with watertight certification). These sealing schemes shall be certified with a minimum hydrostatic pressure of 4 bar. Sealing compound schemes and MCTs applied in hazardous areas shall have a certificate issued by a certifying body or official laboratory attesting the compliance with the requirements of IEC 60079 and Brazilian legislation (INMETRO).

Each MCT shall have at least 20% reserve blocks. MCTs shall have type certificates approved by an IACS member classification society, for use in A-60 penetrations and do not require the use of fire retardant compounds on the blocks.

The sealants used shall be of the flexible type and shall allow the laying of new cables by easy removal and subsequent replacement of the sealant. Rigid sealing compound will not be accepted.

Coamings for cables shall be provided at places where cables pass through non-watertight decks.

In accommodation where panel work is done over hull structure, cables shall be concealed as far as practical.

Panel-work in accommodation covering cable runs, shall be easy dismountable.

Cable trays between bridge deck, instrument room and main deck shall be easy accessible for future installation.

The cables in engine room spaces, lockers, stores etc. may be exposed.

For installation of temporary electrical equipment on wheelhouse top, an easy accessible and easy dismountable multi cable penetration - tube or similar - shall be provided from the wheelhouse to open deck. The penetration shall go through the inside lining in the wheelhouse and shall be easily sealed when not in use (e.g. with screwed cap or similar in both ends). If this penetration is arranged on the wheelhouse top, a swan neck arrangement shall be applied.

Edges of cable support/ trays to be provided with protection against cable chafing/ damage.

Cable metallic bands to be provided in machinery spaces and elsewhere applicable.

**885 Spare cables**

Electrical control cables, with a minimum capacity of 20 pairs of conductors, shall be installed as a reserve for future extensions, between: navigation bridge and CCR; navigation bridge and ECR; ECR and CCR.

Types and number of spare cables to be installed between the different locations shall be agreed with the Owner, but shall be a combination of power cables (1,5 mm<sup>2</sup> and 2,5 mm<sup>2</sup> (various numbers), signal cables (twisted pair) and Cat7 network cables.

**886 Special cables****Ethernet (twisted pair)**

Ethernet LAN cable shall support Class D performance characteristics as a minimum. This is achieved by using ISO/ IEC Category 6. The reason for this is to ensure network reliability and immunity against background noise (EMC).

**Ethernet (fibre optical)**

According to standards, multimode cable plants shall maintain uniform fibertypes in each link including jumpers and patch cords. Many suppliers equipment comprises 62.5 µm patch cords internally and recommends compliance with standards by maintaining consistent core sizes within the plant.

Special electrical or fiber optic cables shall be installed in accordance with the recommendations of the manufacturers of the equipment they serve.

Fiber optic cables shall meet the requirements of IEC 60793, IEC 60794, IEC 60332-1-2, IEC 60332-1-3, IEC 60332-3-10 and IEC 60332-3-22, including the maximum operating temperature of 85°C (IEC 60793-1-52). The laying of fiber optic cables shall comply with the tensile limits and bending radius of the respective cable, according to the manufacturer's information.

**Can bus**

A high level protocol, CANopen (ref. ISO11898), shall be used for administrating the bus communication and for interface to application and system software.

CANopen networks run at high data rates, and require cable specifically designed to carry high frequency signals. Low quality cable will attenuate the signals, and may render the signal unreadable for the other nodes in the network.

To ensure network reliability and immunity against background noise (EMC) a proper cable suitable for CAN-Bus communication shall be selected.

**Instrumentation**

Instrumentation cables for permanently installation in ships shall comply with IEC 60092-350 and IEC 60092-376.

Instrumentation cables shall be shielded by pair or 3 core. Instrumentation and communication network cables shall have a general copper shield and outer jacket, and shall meet the requirements of IEC TS 60034-25.

All instrumentations cables should be stranded type. Attention shall be paid to cable length and calculations regarding voltage drop shall be made in order to choose a cable with suitable wire cross-section.

**Serial data transmission (RS422/485 including Modbus)**

TIA-422 and TIA-485, commonly known as RS422 and RS485, are two independent standards for balanced and differential serial communication.

The standard does not give any recommendations regarding cable types or cable impedance. However, many equipment suppliers recommend to use a twisted pair shielded cable with characteristic impedance of 120 Ohm and low capacitance.

### **Serial data transmission (RS-232)**

TIA-232, commonly known as RS232, is a point-to point, full duplex, not galvanic isolated and unbalanced serial communication method.

The standard does not give any recommendations regarding cable types to be used for transmitting RS232 signals, so most twisted pair cables can be used. On the other hand, the transmission range will increase if a cable with lower capacitance and larger diameter is used. Shielded twisted pair cables with low capacitance is recommended.

### **Coaxial (Antennas)**

Flexible, coaxial single conductor cable types are recommended. The coax characteristic impedance should be  $50\ \Omega$  to ensure both relatively high power handling capability and low signal loss per unit length.

In order to assure the best performance in permanent installations it is recommended to choose both cable and connectors according to equipment manufacturer's recommendations in actual application.

### **Profibus**

For profibus communication a special screened twisted pair cable suitable for profibusDP is required. The requirements are:

- Impedance:  $135..165\ \Omega$  3-20 MHz
- Capacitance:  $<30\ pF/m$
- Resistance (line resistance):  $<110\ \Omega/km$
- Core/wire diameter:  $\geq 0,64\ mm$
- Core/wire size:  $\geq 0,32\ mm^2$

Multi core conductor, single core are not allowed.

### **Low Voltage power distribution (220V AC/24 V DC)**

Power cables for permanently installation in ships shall comply with IEC 60092- 353 and IEC 60092-354. Depending on application, power cables shall be either braid screened or unscreened.

Attention should be paid to cable length and calculations regarding voltage drop shall be made in order to choose a cable with suitable wire cross-section. This is especially important for 24 V power cables.

### **Power cables for variable frequency drive**

The power supply cables for VFD-driven motors shall be multi-core, with a copper shield concentric to the phase conductors and an outer jacket.

#### **General**

The accommodation, workspaces and outside decks shall have sufficient lighting and emergency lighting, meeting the requirements of the National Authorities and emergency lights shall be approx. 30% of the normal lighting.

These lights shall cover requirements and areas like Floodlights on work decks, Life raft -/ Lifeboat lights, ISPS lights, Searchlights and illumination of Vessel's name and Owners logo.

Generally there shall be mounted marine type LED light fittings. Incandescent lamps may be used for decorative purposes in accommodation and where fluorescent fixtures are impractical. Downlights shall be applied throughout the accommodation to the largest possible extent.

Emergency lighting shall be arranged in workspaces and accommodation and be according to National Authorities' requirements.

Low location lighting and supplementary lighting shall be arranged for cabins and escape ways in corridors and stairways according to Class, rules and regulations. ref. F Class and H Rules and regulations, tonnage regulations

The switches used in the lighting circuits shall be bipolar. Residual current devices (RCD) shall be installed on all lighting terminal circuits.

The lighting systems (main and emergency) shall be designed to reduce the possibility of total lighting failure in any area of the vessel, always using two different circuits per area.

Illumination level (Lux) shall be according to class and authorities requirements if nothing else is specified.

The lighting systems (main and emergency) shall be designed so that there is a maximum of 15% current unbalance between phases.

The emergency lighting (powered by the ESB) will meet the minimum areas required by SOLAS and will also make up 50% of the infirmary lighting and (around) 30% of the main lighting, and shall be properly identified.

Lighting equipment and fittings powered by emergency/temporary lighting systems shall be clearly identified. In distribution panels, the luminaire circuits shall be independent of the socket circuits.

Lighting fixtures shall only use replacement materials (lamps, power modules, etc.) available on the Brazilian market. Otherwise, the Yard shall supply at least 5% of the total number of components of the respective model used in the vessel as spare.

In addition to the main lamp powered by alternating current, some of the vessel's luminaires shall also have a lamp powered by 24 Vdc. Luminaires of this type shall be provided in the following areas:

- 12 (twelve) in the engine room;
- 3 (three) in the ECR;
- 2 (two) in the staircase trunk;
- 1 (one) in the galley;
- 1 (one) in the accommodation corridor adjacent to the messroom;
- 2 (two) in the Emergency DG compartment.
- 1 (one) in the CCR;
- 1 (one) in the inert gas generator compartment;
- 1 (one) in the Engine Room Emergency Exit Trunk.

Enclosures shall have IP ratings as mentioned in Table 8.10.

To minimise THD issues on the 220V systems, special attention shall be paid to drivers for lights (HP, fluorescent and LED) throughout the vessel. Drivers (LED drivers, Electronic ballasts, uncompensated ballasts) shall be selected to minimise the impact these have on the THD on the electric power system.

The lighting in the engine room is to be provided by LED floodlights, controlled from the site. The supply hatch will be illuminated by LED floodlights, controlled from the site.

The lighting in the Main Engine top area shall be provided by LED floodlights, controlled from the site. The lighting on the Navigation Bridge shall be equipped with dimmers and controlled individually by area of operation.

Table 8.10 Minimum IP rating for electrical lighting enclosures

Equipment	minimum IP rating
Light fixtures in dry accommodation	IP 20
Light fixtures in galley, laundry, etc.	IP 44
Light fixtures in engine room, etc.	IP 54
Light fixtures in stores, garbage room, etc.	IP 44
Light fixtures on open deck	IP 66

### Service supply/ Service receptacles

Service sockets from various voltage systems, 1 and 3 ph shall be installed throughout the vessel as normal for the ship type and trade.

The maximum current of the lighting/ socket circuits shall not exceed 20 A.

Residual current devices (RCD) shall be installed on all socket terminal circuits.

Industrial sockets for general use, watertight (IP-56), two-pole, universal type with grounding pin, shall be installed in the engine room (at least four sockets per floor), engine compartments, engine storerooms, deck storerooms, bosun store, lifeboat area, rescue boat area, external area of the main deck (portside and starboard) and in a safe area to serve the hatchway, funnel, workshops, galley, pantry, laundry, near the radar mast and forward masts.

Sockets installed in hazardous areas shall be manufactured in fiberglass-reinforced plastic enclosures and have Ex-de type protection.

ESB-powered sockets shall be available on the lifeboat's launch platform (for charging its battery) and make up 50% of the sockets installed in the workshops (electrical and mechanical), the infirmary, the ECR, CCR and navigation bridge.

In addition to the general-purpose sockets, specific-purpose sockets shall be installed for each washing machine, iron, refrigerator, dishwasher, ice machine, microwave oven, coffee maker, toaster, copy machines, microcomputer, television, DVD player, stereo set, etc.

~~Three-pole sockets, with grounding pin, 440 Vac / 50 A, shall be installed to supply the electric welding machine, in the electrical workshop, steering gear compartment, engine room casing and~~ Three-pole sockets, with grounding pin, 450V / 50 A, shall be installed to supply the electric welding machine, in the electrical workshop, steering gear compartment, engine room casing and bosun store.

The sockets in the workshops shall be powered by the ESB.

The plugs and sockets shall follow the usual Brazilian market standards.

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### Electrical installations in engine room, stores, workshops, etc.

#### Installation in engine room, stores, workshop etc.

Tank level gauges and pipeline flow gauges shall be equipped with local lighting using LED lamps.

Light fittings below decks exposed for high vibrations or shock loads (e.g. cargo deck/ work deck) shall be mounted with rubber suspension.

#### Heating of compartments outside accommodation

Rooms without air supply from an air handling unit shall be equipped with Electrical heating being able to keep the inside temperature well above freezing i.e. minimum room temperature according to

57 Ventilation, air-conditioning & heating systems. If a room/ area requires more than 3 kW heating capacity the heating shall be by heating circuits from the hot water boiler system. Ref.845 Thermal Oil Heating System and 577 Central heating systems for accommodation.

## 892 Electrical installations in accommodation

### General

All lamps shall be provided with double poled switches.

Spotlights shall have step-less dimmers.

The light fittings in accomodations shall be of the recessed type with tubular LED lamps or LED lamps with E27 sockets.

Sufficient number of double poled switches shall be installed for each room and area throughout the accommodation as normal for the ship type and trade.

General-purpose, non-static, two-pole, universal sockets with a grounding pin shall be installed in the superstructure corridors (with a spacing of 15 m between sockets), cabins (2 (two) next to the bed, 4 (four) on the work table and 2 (two) on the bedside table), working and training areas, control rooms, dry storerooms and in electrical equipment compartments.

Heating of accomodation shall be of electrical type.

~~All showers, wardrobes, bathroom / bathrooms modules shall have electrical heating cable in concrete floor below tiles.~~

Power socket in accommodation to be 20A.

## 893 External light, deck light etc.

### Outside lighting

Sufficient LED lighting and LED emergency lighting shall be provided for all outside decks meeting the requirements of the National Authorities.

All outside lights shall be suitable for operation in the environmental conditions (ref. Table 0.6) of which they are exposed.

General lighting outside shall be Stainless steel or Brass light fittings (LED).

Lighting on the main deck and other external working areas, including the funnel, shall be provided by LED spotlights, controlled from the navigation bridge by a control panel or equivalent resource.

The accomodation ladders will be illuminated by LED spotlights installed on a folding base in the navigation bridge wings, controlled from the navigation bridge. Signal lights and searchlights can also be used to illuminate the accomodation ladders, provided their installation arrangement is suitable.

Lighting of the provision crane operation area at hull side area shall be provided by LED spotlights installed on a retractable base, with site socket, plug and switch.

Lighting of the hull side area used for rescue boat launching shall be provided by an LED spotlight installed on a retractable base, site controlled.

Lighting of the hull side area used for all inflatable raft launching (aft and forward) shall be provided by an LED spotlight installed on a retractable base, locally controlled and powered by ESB.

Two (2) portable bulbous bow warning lights (white) and two (2) portable propeller warning lights (red) shall be supplied.

Ten (10) portable 20 W LED luminaires shall be supplied, watertight, increased safety (Ex-e"), encapsulated (Ex-m) or non-sparking (Ex-n), with a protective grid, with 15 m of flexible cable combined with a steel guide cable.

External lights forward and on the sides of the superstructure shall be switched on in the forward bridge console. External lights astern shall be switched on in the aft bridge console.

All luminaires or spotlights installed in a hazardous area shall have Ex protection of the increased safety type Ex-e, encapsulated Ex-m or non-incendive Ex-n.

All luminaires or floodlights installed outdoors shall have an AISI 316L stainless steel or fiberglass reinforced plastic housing.

In addition to the standard fixing of each model to the vessel support, all floodlights and spotlights installed in open areas shall be fixed to the vessel's structure by AISI 316L stainless steel chains or cables.

A floodlight in each of the following deck areas shall be powered by the ESB: bow, stern, cargo manifolds (one per side).

Lighting fixtures/ luminaries to be provided with shox for vibration purposes.

## 9 ENERGY EFFICIENCY

### 9.1 General

The vessel will be designed, built and operated with a view to excellence in mitigating environmental impacts in order to minimize air emissions, discharges into the sea and underwater noise.

The vessel's design shall take into account the concept of energy efficiency and management laid down in IMO rules, regulations and recommendations, MARPOL Convention Annex VI and related documents, with a reduction in emissions to the sea, air and optimization of fuel consumption, fully complying with the Energy Efficiency Design Index (EEDI) phase 3, without compromising design characteristics such as speed, draft (summer load line), cruising range and minimum deadweight.

During the concept design, the following technologies characterized as "Category A" (MEPC.1/Circ.896 - 2021 GUIDANCE ON TREATMENT OF INNOVATIVE ENERGY EFFICIENCY TECHNOLOGIES FOR CALCULATION AND VERIFICATION OF THE ATTAINED EEDI AND EEXI), non-exhaustive, shall be considered where not already specified in parts 1 to 7 of this Technical Requirement:

- Optimized fuel consumption for the vessel's operational profile;
- Optimization of hull lines;
- Optimization of the propulsion system;
- Rudder optimization;
- Use of hydrodynamic appendages "Energy Saving Devices" (hull, rudder, propeller).

Other technologies that might be implemented in the project:

- Use of alternative fuel (minimum preparation);
- Engines designed and equipped with improvements that allow reduced fuel consumption at low loads, engine performance monitoring and automatic adjustment system, with the ability to provide troubleshooting and economic torque control;
- Variable speed drive (VSD) electric motors, not limited to cooling system pumps and fans in the engine room;
- Use of a high-performance anti-fouling system ("low friction coating");
- LED lighting;
- Trim optimization system (+optimal trim table) integrated with loading software;
- Course control system;
- Speed control system;

~~Shaft power measurement system (torsiometer) with display connected to the ICMS; Shaft power measurement system (torsiometer) with display connected to the IAS;~~

~~Fuel consumption measurement system, using a mass flow meter (Coriolis), independent for each consumer group, integrated with the ICMS and enabled for external data transfer. Fuel consumption measurement system, using a mass flow meter (Coriolis), independent for each consumer group, integrated with the IAS and enabled for external data transfer.~~

In addition to the Category A technologies and others mentioned above, Category B technologies ("Air Lubrication System; Wind Assisted Propulsion System") and Category C technologies ("Waste Heat Recovery System, DC grids, photovoltaic cells") as defined in document MEPC.1/Circ.896, shall be assessed and proposed, where not already specified in parts 1 to 7 of this Technical Requirement, in compliance with the design assumptions as a means of improving the vessel's performance, energy and environmental efficiency, with a view to meeting the regulatory indicators (EEDI/ CII).

#### 9.1.1 Optimized Fuel Consumption

##### Kongsberg AutoChief Propulsion Control System

- Fuel pilot function
- Speed pilot function

The vessel have implemented functionalities in the AutoChief Propulsion Control System, like fuel- and speed pilot functions to keep fixed speed, or fixed fuel consumption.

### **K-Chief PMS - Power Management System**

The Kongsberg integrated K-Chief Power Management System will cover all basic functionalities for safe and efficient operation. It can be part of a total Energy Control architecture, which again contains several layers and strategies for optimal efficiency, the Energy Management System.

#### **9.1.2 Optimized Hull Lines**

Hull design is based on extensive iterations by CFD on hull resistance and propulsion efficiency, for design draught without compromising ballast draught conditions.

Marin Model Basin was engaged to used their best experience data in speed prognosis.

Information from Marin studies in combination with iteration from propeller supplier, was used in further optimizations by CFD.

#### **9.1.3 Optimized Propulsion System**

The vessel is equipped with an optimized propulsion system designed to maximize efficiency across the entire operating profile. A key feature of this system is the use of a large-diameter controllable pitch propeller (CPP) operating at low revolutions per minute (RPM). This configuration ensures high propeller efficiency by reducing losses due to cavitation and slip, while also enhancing thrust at lower speeds.

The large CPP is specifically engineered for efficient operation in combinator mode, where both pitch and RPM are continuously adjusted by the vessel's power management system. This enables the propulsion system to follow the optimal propeller efficiency curve throughout the speed range, ensuring minimal fuel consumption and reduced emissions during varying operational conditions.

#### **9.1.4 Rudder Optimization**

##### **Promas - integrated twisted rudder- propeller solution**

- The Promas system integrates the propeller, hub cap, bulb, and rudder into one propulsive unit, increasing propulsive efficiency and improving manoeuvrability. This results in significant fuel savings without power losses.

The hub cap in combination with the "Costa bulb" reduce/take away the hub vortex behind the propeller. With reduced/no hub vortex, the load on the propeller are moved from the propeller tip and closer to the hub.

This gives more efficient propeller and reduce pressure pulses from propeller tip to hull, and by that reduce conditions for potential noise and vibration.

The twisted rudder recovers rotation energy from the propeller water and gives a lift in forward direction.

##### **K-Steering remote-control system**

- Safe and energy efficient steering.

K-Steering is the latest generation of control systems for Steering Gears. The Kongsberg K-Steering combines control system for the steering gear unit into one system for mode selection and command transfer for stable, safe and efficient steering.

## 9.2 Other technologies

The vessel is designed with a "System Integration Philosophy", which makes sure the technical interphase and technical logistics are designed to optimize vessel operation and maintenance.

### K-Chief Integrated Automation System IAS

- Seamless Integration between Kongsberg Systems
- Optimized configuration - Saving space and weight
- Shared spare parts minimize crew training and maintenance

Our K-Chief solution is the ultimate choice for shipowners and operators seeking seamless integration and enhanced operational safety when using multiple Kongsberg systems.

Our cutting-edge, redundant bus network maximizes system reliability, while interchangeable operator stations and shared spare parts minimize crew training and maintenance.

### The vessel will be prepared for an Shaft Generator option

The gear box will be prepared with a PTO shaft for Shaft Generator.

In addition there will be arranged an open section in switchboard for potential Shaft Generator.

The decision on providing a Shaft Generator will not be taken before the Model Test Performance is concluded.

The reason for an optional Shaft Generator is to provide further margins on EEDI Index, if margins on estimated speed are reduced after Model Test.

## 10     OPTIONS



**NVC 615 PT**  
Epoxy Coated Product Tanker

KONGSBERG

