TECHNICAL SPECIFICATION

67M DP-2 ANCHOR HANDLING / OFFSHORE SUPPORT VESSEL

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BUYER

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SECTION 1 – GENERAL

100. Intent & Definition

The vessel shall be designed and build as twin screw with controllable pitch propeller, two (2) bow/ two (2) stern tunnel thrusters and two (2) station controls in wheelhouse.

As described in this Specification the vessel outfitted and equipped for offshore support, Fire Fighting c/w Anti-pollution and other related duties in offshore operation condition. It will be classed to DET NORSKE VERITAS (DNV) as an offshore support vessel for Unrestricted Services and will comply with the regulations of both the Classification and Registration Country Government.

Any item required by Classification Society and Regulation Bodies, currently in force or resolutions passed at time of signing of contract coming into force before delivery of the vessels, deemed necessary for first class and safe operation of the vessels, even if not expressively called for in the Specification, shall be furnished by the Builder.

The vessel shall be built to first class standard, with first class materials and equipment, first class workmanship, all defined as the best standard obtainable for offshore ships in the world and as approved by Buyers.

Spare parts/special tools to be supplied according to the guidelines of Class (DNV) for unrestricted service and per maker standard supply.

The Vessel is designed in such a way that the following roles can be obtained:

- (a) Transport liquid cargo, bulk cement, liquid mud, stores, materials & equipment
- (b) External fire fighting
- (c) Move men and materials between platforms
- (d) Operation to be 24 hours/day continuous operation, capable of remaining on station for a minimum of 25 days.
- (e) Towing & anchor handling duties
- (f) Dynamic positioning

101. General Description

The vessel is to be all welded steel construction. The vessel's accommodation is to be located in the upper/ lower, forecastle and fwd deck house. The main hull is to be divided by nos. of transverse WT bulkheads into the following compartments:

- 1) Forepeak SWB/FW/DW tank and chain locker
- 2) Bow Thruster Compartment, double bottom sewage tank, FW double bottom tank and P & S F.W. tank

- Cement Tank compartment, P & S Brine/ DW/ SWB tank (or Rig chain locker) and F.O tank P & S wing & double bottom tank.
- 4) Engine room with double bottom FO, double bottom FW/SWB, double bottom dirty oil tank, day tanks P&S, double bottom L.O. storage/ bilge holding tank, foam tank, detergent tank, P & S Fuel oil tanks and P & S Hydraulic/ L. O storage Oil Tank etc.
- 5) P & S FW/ DW/ SWB Tank, Center liquid mud/ Brine/ DW tank, and double bottom FW/ DW/ SWB tank.
- Steering Gear/ stern thruster compartment and FW/ DW/SW ballast tanks P & S & Center.

The tween deck compartment is to consist of:

- 1) Bow thruster compartment
- 2) Engine room with engine control room

The main deck accommodation is to consist of:

- 1) One (1) 2-man sickbay c/w attached WC shower unit
- 2) One (1) changing room
- 3) One (1) Smoking room
- 4) One (1) Mess Room
- 5) One (1) Galley
- 6) One (1) Laundry
- 7) CO^2 Room
- 8) Two (2) Deck/ Fwd Stores
- 9) One (1) Paint Store
- 10) One (1) Engine Room Store & Workshop
- 11) Provision Store/ Cold and Cool Room
- 12) One (1) AHU room
- 13) Emergency Gen set room
- 14) Machinery / Hydraulic pump room
- 15) A.H/ Towing winch compartment

The forecastle deck accommodation is to consist of:

- 1) Eight (8) 4-men cabins c/w attached WC shower unit (For special personnel)
- 2) One (1) Store
- 3) One (1) Office

The deckhouse deck accommodation is to consist of:

- 1) One (1) 1-man cabin c/w attached WC shower unit
- 2) Five (5) 2-men cabin c/w attached WC shower unit
- 3) Three (3) 4-men cabins c/w attached WC shower unit (For special personnel)

The Captain's deck accommodation is to consist of:

- 1) One (1) Captain cabin c/w attached WC shower unit
- 2) One (1) Chief Engineer cabin c/w attached WC shower unit
- 3) Three (3) 1-man cabins c/w attached WC shower unit
- 4) Two (2) ship office

102. Principal Particulars

Length overall	: 67.20M
Length W.L.	: 63.00M
Beam moulded	: 16.00M
Depth moulded	: 6.50M
Draft scantling	5.50M
Draft designed	: 5.10M (to be confirmed)
Deck area	: 435 M ² approx.
Deck Heights (Mean)	
Raised Deck	: 1.30M
Main Deck	: 3.00M
Forecastle Deck	: 2.80M
Deckhouse	: 2.80M
Captain's deck	: 2.80M
Wheelhouse	: 2.90M
Accommodation	
6 x 1-berth cabins	: 5 men
5 x 2-berth cabins	: 25 men
11 x 4-berth cabins	: 24 men
Total	: <u>54 men</u>
<u> Tankage – approx (100% full)</u>	
FW/ DW/ SWB tank	: 762M ³ approx.
FW tank	: 351.6M ³ approx.
F.O. tank	: 368.7M ³ approx.
F.O. Overflow tank	: 18M ³ approx.
Cement tank	: 215M ³ .approx.
Liquid mud/ Brine/ DW tank	: 318.5 M ³ approx.

Brine/ DW/ SWB tank (or Rig chain	:	150 M ³ approx.
Locker)		
Lub oil	:	11 M ³ approx.
Foam tank	:	15 M ³ approx.
Dispersant tank	:	19.8M ³ approx.
Sewage Holding tank	:	16 M ³ approx.
Bilge Holding tank	:	5.8M ³ approx.
Dirty Oil tank	:	12.6M ³ approx.
Hydraulic Oil tank	:	7.2 M ³ approx.
Engines	:	2 x 2660kW c/w CPP reduction gear box,
Performance Speed	:	Minimum 13 knots at 100% MCR
Bollard pull	:	Min. 80t with main engine at 100% MCR
Endurance	:	Min. 25 days
ERN number	:	99,99,96,96

Design Condition

The vessel plant, machinery and equipment components and related system shall be designed for following condition.

Ambient air temperature	: max. +45°C, min20 °C
Sea water temperature	: max. +32°C, min. 0 °C
Relative humidity	: max. 90%
Wind speed	: 35 knots
Current speed	: 1.5 knots
Significant wave height	: 3.0 m
Period	: 10 s

[Note: The maximum sea conditions that the vessel is capable of operating shall be determined by the DP plot generated by the DP system supplier.]

103. Classification

The vessel is to be constructed, machinery installed and equipment and spare gear provided in accordance with the latest Rules for Building & Classing of Steel Vessel to DET NORSKE VERITAS (DNV) (hereinafter referred to as classification) and to their special survey to hull and machinery for class DNV, Maltese Cross + 1A1, Offshore Service Vessel, AHTS, SPS, Clean, DYNPOS-AUTR, E0, Fire Fighter 2, COMF-V(rating 3),TMON, Recycable, BIS for unrestricted service.

104. Registry

The buyers are responsible for the registration of the vessel. The Port of Registry to be Marshall Islands.

105. Regulations

The vessel is to comply with:

- a) International Loadline Convention 1966
- b) Radio Communication Regulation to Government regulations
- c) GMDSS regulations for Area A3
- d) IMO Intact and Damage stability SPS Code 2008.
- e) Dynamic positioning systems (DYNPOS-AUTR)
- f) International Convention of Prevention of Collisions at Sea 1972 including Amendment of 1981 and latest Amendments
- g) International Tonnage Admeasurement Convention 1969
- Safety equipment to comply with Government Authority & SOLAS 1974 consolidated Edition 1988, 1992, 2004 etc. and including latest Amendments for this type of vessel.
- i) Marpol 1973/ 78 including latest Amendments for Annex I, II, IV, V & VI
- j) Maritime Laws and Regulations of Marshall Islands port authorities.
- k) Noise level Guideline as per IMO Resolution A. 468 (XII)
- I) Maritime Labour Convention 2006
- m) Shipboard marine pollution emergency plan (SMPEP/SOPEP) Buyer
- n) Garbage disposal management plan Buyer
- o) Cargo securing manual Buyer
- p) Fire fighting class I operating manual Buyer
- q) International safety management manual (ISM) Buyer
- r) SPS Code for special personnel not more than 60
- s) Ship security alert system manual Buyer
- t) International Ballast Water Management convention, BWM
- u) Performance Standards for Protective Coating (in Ballast tanks), PSPC
- v) P & A Manual Buyer
- x) DP Operation Manual Buyer

These regulations shall be applied with all amendments in force or adopted by the relevant bodies at the date of signing the shipbuilding contract.

106. Certificates

All necessary certificates, including classification reports shall be delivered with the Vessel, without any remarks. Certificates shall be final or provisional according to standard from issuer.

All certificates required shall be delivered, such as, but not limited to:

1) Builder's certificate

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- 2) Classification Certificate (Hull and Machinery)
- 3) Cargo Ship Safety Equipment Certificate
- 4) International Tonnage Certificate
- 5) International Loadline Certificate
- 6) Cargo Ship Safety Radio Certificate
- 7) Deratisation Certificate
- 8) Cargo Ship Safety Construction Certificate
- 9) Marpol Certificate For Annex I, II, IV, V & VI
- 10) Fi-Fi one certificate (issued by Class)
- 11) Launching certificate (issued by Builder)
- 12) Asbestos-free and CFC-free certificate (issued by Builder)
- 13) International IOPP Certificate (Refer item 9 Marpol Annex I)
- 14) Other certificate required by the classification and port authority.
- 15) Davit and deck crane load test certificate (issued by Builder)
- 16) Compass Adjustments (Deviation) Card
- 17) Special Purpose Ship Safety Certificate
- 18) Certificate of fitness to carry noxious liquid substances in limited quantity (NLS Certificate)
- 19) IAPP Certificate, Including EIAPP certificates for each and all engines
- 20) ISPP Sewage Certificate
- 21) Certificate of fitness to carry IMDG
- 22) Cargo securing manual, -Buyer
- 23) IAFS Certificate
- 24) BWM documentation/Certificate
- 25) IGPP Certificate/Statement of Compliance
- 26) Bollard Pull Certificate (issued by Class)
- 27) Noise, Vibration and No Asbestos certificate issued by Class.

The cost of all fees and charges incurred for survey, classification, FMEA and issue of certificates are to be borne by the Builders.

107. Materials & Workmanship

a) All material, machinery and equipment used in the construction of the Vessel are to be new and unused, of the first class commercial shipbuilding quality, suitable for the intended service, and approved by the Buyer and the Classification Society. All major items of equipment and all items on the makers list, including items omitted from plans or Specifications, but which nevertheless are necessary for efficient operation of the Vessel in its proposed service, are to be from suppliers with world-wide service network and acceptable to the Buyer.

Building procedure prepared by Builder is to be submitted to Buyer for approval. All workmanship is to be of Japanese Industrial Standards or agreed equivalent, and is

to be to the satisfaction of the Buyer. Welding to comply with AWS Standard. All welders to be duly qualified by IACS classification society, and be able to present proof of same upon request.

- b) All woods used to be suitable for the intended purpose and of first class international shipbuilding quality. All timber to be free from knots and well seasoned.
- c) All smith work or fabricated fittings to be of neat design, strong, smooth & free from defects.
- All castings to be of the first class international shipbuilding quality, close grained and complied with Classification related rules/standard and JIS..
 Steel castings to be manufactured to classification requirements and approval where required.
- e) No asbestos to be used throughout the vessel

108. Welding

Vessel to be of all welded construction, in accordance with contract plans, specifications, classification. Automatic welding to be used as far as possible.

Welding to be in accordance with classification requirements and the specified standard, all WPS to be class approved. All steel used to be of the first class welding quality, free from laminations or other harmful defects and be class approved. All structural welders to carry id/proof of qualifications, to be presented upon request

Electrodes to be selected from classification approved lists. Welding schedules to meet classification and AWS.. High standards of up-to-date welding practice and procedures are to be applied, associated with accurate alignment, fairness, edge preparation and gap widths.

All structures to be pre-fabricated in assemblies and sub-assemblies, where all piping, cable trays and any other fitting to be preinstalled except those between blocks and other which are impractical to pre-install during block stage due to the design before the structures are sandblasted to SA 2.5, primed and painted before the structures are assembled at the dock. This in order to minimise any hand welding.

109. Tests

Prior to the delivery, the hull, all machinery, electrical, piping, all equipment installed, machinery and deck fittings, domestic equipment, etc. are to be thoroughly tested in accordance with the classification rules & regulations in the presence of the classification's attending surveyor, Buyer and/or their representative.

Detailed Inspection and Test Plan (ITP) and Shipyard standard practise to be submitted to Buyers representatives for approval in connection with drawing approval. All test results are to be to the satisfaction of the Buyer.

110. Inclining Experiment

Lightship survey and/or inclining experiment if require by classification to ascertain the lightship weight and the center of gravity at lightship condition is to be carried out by the Builders with the presence of classification survey and Buyers and/or their representatives. Basing on these results, a stability report is to be prepared by the consultants, Ship Design Singapore Pte Ltd. Booklet must be approved by Class.

111. Mooring Trials

Upon the completion of the vessel, the following trials are to be carried out:

1) All piping systems are to be fully tested, including the checking of valve name plates

- 2) Bow & stern thrusters
- 3) External fire fighting pump with fire monitor
- 4) Electrical power plants together with all lights
- 5) Main engine with propulsion system
- 6) Auxiliary machinery
- 7) Heating, ventilation & air-conditioning and refrigeration machinery
- 8) All deck machinery
- 9) Airconditioning machinery
- 10) All pumps, filters etc
- 11) DPS2 System interface check and function & simulation testing
- 12) Automation test for unattended machinery spaces

The detailed items to be follow the Mooring Trial Scheme approved by Class Society and Buyer.

112. Sea Trials

Sea trials is to be arranged and carried out in accordance with a program/ procedure approved by the classification and the Buyer to be submitted minimum two months in advance of commencement of trial. The Builder is to supply a master, crews and all victuals and necessary equipment and arrange the catering. The compass is to be adjusted during sea trial. Manoeuvring chart is to be provided.

The sea trial to include, but not be limited to:

a) Speed Trials

Speed trials shall be conducted over a recognized measured mile. Two (2) double runs are to be made with engines running at maximum continuous revolutions 100% MCR, 85% MCR, 75% MCR, 50% MCR. Records of main engine operating

parameters like pressure, cooling water temperature, fuel consumption, engine revolution etc. are to be taken.

b) <u>Endurance Trials</u>

Endurance trials of 4 hours with the engines developing 100% MCR output is to be carried out in conjunction with speed trials.

c) <u>Steering Trials</u>

Steering trials are to be carried out with engines at 100% MCR. The diameter of the turning circle and the time taken to complete a full circle are to be recorded. The times taken to complete rudder movements from amidships to "hardover' 35° Port and from 35° port to 'hardover' 30° starboard are to be taken. A similar trial is to be made by moving the rudder from amidships to 'hardover' starboard 35° to port 30°.

Manoeuvring trial are to be carried out as follows:

With the vessel proceeding at full power on a straight course, a rudder angle of 35° port is to be applied and held until the vessel has turned 35° to port of the original course. At this point the helm is to be immediately reversed and held at 35° starboard rudder angle until the vessel has turned 35° to starboard of the original course.

At this point the helm is again to be reversed and held at 35° port angle until the ship's head reaches the original straight course. A total time taken to complete the manoeuvre: from straight course to 35 degrees port to 35 degrees starboard to straight course, is to be recorded.

d) <u>Stopping & Astern Trials</u>

With the vessel proceeding ahead at full power the main engine controls are to be moved from 'full ahead' to 'full astern' and the following records taken:

- 1) Time to move controls from 'full ahead' to 'full astern
- 2) Time to bring the vessel to a stop
- 3) Estimate of distance run between initiation of order and stopping of vessel
- 4) Time to a steady astern condition

During the astern trial the vessel is to be inspected for occurrence of superstructure and local vibration and the hazardous vibration with damages to the vessel's structure or equipment which to be rectified to ensure safe and good working condition of the vessel and approved by Class.

This testing is for first vessel only unless required by Classification.

e) <u>Bollard Pull Trial</u>

Bollard pull test procedure to be followed DNV Class bollard pull test procedure.(Refer to DNV rules, Part5, Chapter 7)

f) <u>Dynamic Positioning System Trial (function & simulation)</u>

DPS Trials are to be carried out with engine, c/w main propulsion, rudder, bow and stern thruster units, etc. system, at 100% MCR condition and/or maker's recommendation. The failure mode & effects analysis (FMEA) shall be completed and approved by Buyer.

g) Noise and Vibration Test see 117.

113. Delivery

Delivery of the vessel is to be taken afloat adjacent to the builder's yard and all tanks, compartments, bilge, accommodation, open space and other machinery space area etc. shall be free from corrosion, painted/ cleaned, looking like a brand new ship and free of all debris, corrosion and dirt and accepted by the Buyer. No paint to be applied on top of corroded steel. If delivery of Vessel is effected more than four (4) months after launching, the vessel's underwater parts and area to be inspected. If the bottom/under water area is not looking like a new and clean ship as per Buyer's requirement, the vessel shall be dry-docked to facilitate cleaning work and repainting. All cost for inspection and dry docking shall be borne by shipyard

114. Drawings

On completion, soft copy in CD, four (4) sets of the following "as built" drawings in paper prints and two (2) sets as approved or noted by the classification, are to be supplied. As fitted drawing list to be prepared by yard and approved by Buyer. Following are for guidance only.:

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- 1) General Arrangement
- 2) Hydrostatic Curves
- 3) Cross Curves
- 4) Stability Report
- 5) Docking Plan
- 6) Tank Calibration/ capacity plan
- 7) Structural Profile & Deck
- 8) Engine Seating Detail
- 9) Forward Sections & Bulkheads
- 10) Aft Sections & Bulkheads
- 11) Shell Expansion
- 12) Superstructure Detail
- 13) Shafting Arrangement and Sterntube Detail
- 14) Engine Room Layout
- 15) Rudder Assembly and Detail

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- 16) Bilge, Ballast & Firemain System
- 17) Ship's Fuel System
- 18) Engine Cooling System
- 19) Domestic FW & Sanitary System
- 20) Position of Tank Vent, Sounding & Filling Pipes
- 21) External Fire Fighting System
- 22) Schematic Wiring Diagram and Reference to Fittings
- 23) Main Switchboard Wiring & Short Circuit Calculations etc
- 24) 24V DC Radio Battery Charging Panel & 24V DC Switchboard
- 25) Ventilation Arrangement
- 26) LSA & F.F. A. Arrangement
- 27) Outfitting Detail
- 28) Other Construction / Engineering Drawing etc.
- 29) Any other reasonably required drawing

115. Manuals of Machinery & Equipment

Four (4) sets of manual of all machinery and equipment in the English language are to be supplied by the Builders/ suppliers.

116. Change of Equipment/Material and Equal of Brand

a) Any mentioned of the brand on the equipment or materials in the Marker's List, the Builder is required to follow strictly accordingly as per requirement. If for any reason the Builder should want to change any maker or brand of equipment, components or materials, any proposed change shall be presented to the Buyer for their written pre approval prior to purchase. In such case, the proposed equipment or materials must have an equal or better technical specification, quality and reliability as well as the supplier of the equipment must have an equally good worldwide service network as the existing supplier. Any price difference to be at actual documented cost and any difference in prices are to be adjusted accordingly to the contract price.

117. Vibration and Noise

Special attention should 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, will not cause damage to the main propulsion system or damage or malfunction of other shipboard machinery and equipment.

Noise and vibration analysis shall be undertaken prior to vessel's construction.

This Vessel shall comply with the DNV Rules for Classification of Ships, giving the following Class Notation: COMF-V (rating 3).

The noise and vibration criteria as specified in the COMF-V Class shall be met in the test condition as per DNV rule.

The DNV COMF-V includes the recommendations and requirements as given in the ISO Standard 6954: "Guideline for the overall evaluation of vibration in merchant ships", as well as

the IMO Resolution A468 (XII): "Code on noise levels on board ships". This is to be measured during the Vessel Trials.

The Builder to engage a noise and vibration consultant. The consultant shall be involved during the design and construction phase.

The noise and vibration criteria as specified in the Class are to be met for all power settings of the main propulsion machinery up to 85 % MCR during a normal transit condition. The specified criteria should also be met during manoeuvring /dynamic positioning (DP) with at least 40 % load on the thrusters.

The following criteria to noise and vibration shall be met :

Noise : As per DNV COMF-V Class Standard.

Vibration: Limitation values to be in accordance with ISO Standard 6954-1984 version "Mechanical vibration and shock - Guidelines for the overall evaluation of vibration in merchant ships"

Special attention shall also be taken to avoid that machinery and equipment will have local vibrations causing risks for malfunction or damages when the ship is in service. The vibration levels of machinery, equipment, radars, structure etc.

*For frequencies below 5 Hz the requirements follow constant acceleration curves corresponding to the acceleration at 5 Hz.

VIBRATION AND NOISE ANALYSIS

In order to demonstrate that the Class' specified limits to noise and vibration will be met, noise and vibration analyses should be carried out at the basic design stage. The analysis should at least include :

Vibration analysis of local structure in order to avoid magnification of vibration due to resonance with main excitation sources.

Analysis of the expected noise levels during transit and manoeuvring condition to determine the necessary noise control measures to meet the given specified noise limits.

Based upon this report, the actual extent and quality of the floating accommodation arrangement may be adjusted, as agreed between Buyer and Builder, in order to achieve the required standards.

Further, the recommended structural and arrangement modifications to be incorporated into the design, as agreed between Buyer and Builder, as required to meet the specified vibration criteria.

Funnel and air vent duct casings, and air condition AHU room as well as room for emergency generator to be well sound insulated towards the accommodation.

Special attention shall be made to noise reduction between access duct to forward thrusters room and living quarters.

Noise and vibration precautions

Floating floor in accommodation on Main deck and forecastle deck and anywhere if necessary subject to Noise & Vibration analysis

Also for bathroom, no connection to steel bulkhead.

Special precautions shall be made for ceiling fastening to avoid noise and vibration.

Combustion machinery and hydraulic aggregates shall be installed on flexible mounting joints and shall have flexible pipe connections.

Special attention shall be made for the thruster installations.

MEASUREMENTS

Full scale measurements in accordance with measuring-, certification and test conditions as given in the Class Rules, including the operating conditions during transit and maneuvering as specified above, are to be carried out after completion of the ship, in order to determine the adequacy of the design relative to the design requirements and specifications.

In accordance with the Class requirements, a detailed noise/vibration measuring program indicating the measuring positions, shall be submitted for approval in due time prior to the trial.

If the vibration or noise levels exceed the requirements given in the specification, corrective measures are to be carried out by the Builder.

118 Unit of measure

ISO standard to be followed generally.

SI units to be adopted and construction of hull, machinery, equipment, etc., in general.

All measuring units such as power, pressure gauge, thermometer, volume gauge, tank scales, etc. to be in accordance with SI system.

The unit of power to be of KW and the pressure to be expressed in gauge pressure unless otherwise described.

119 Standards

JIS standard shall be used unless Buyer agreed standards, for example:

- 1) ISO Standard;
- 2) Builder's practise upon approval;
- 3) Chinese industrial standards (GB, CB, CSQS,etc.)

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SECTION 2 - STRUCTURE

200. General

The Builder shall construct the vessel using all welded steel as specified in the sections that follows. All structures shall meet Classification Society requirements based on scantling draft 5.50m and all steel plates shall be Classification Society certified and stamped.

The steel hull and deck erections are of all welded construction. Transverse framing system is used throughout. The size mentioned below are subject to class approval. All Steel sheets and stiffeners to be GB standard and Class approved if necessary.

201. Keel

A plate keel 16mm thick is to be fitted, connected throughout the length to be center girder. It is to be tapered at the forward end to the stem bar and connected to the aft centerline skeg.

202. Stem

The stem below the waterline is to be formed by curvature plate. It is to be well shaped at the end to the keel plate and the upper stem plating.

Above the waterline, the stem is to be formed by a raked and radiuses plate. The stem plate is to be stiffened by webs and breasthooks.

203. Skeg

A fuel efficient, box shaped skeg is to be fitted at the centerline. The bottom of the skeg is to be 16mm thick with sides 12mm thick and set forward of the propellers as shown on the General Arrangement.

204. Bottom Construction

The bottom is to be of double bottom except part of steering gear compartment. In order to give a structural continuity in the bottom and to meet with classification/ SOLAS requirement, two engine girders P/S are to be extended as far as possible and are to be linked with longitudinal bottom girders.

205. Double bottom and Skin

Double bottom and skin is to be fitted as shown on the General Arrangement Plan.

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206. Shell Plating

The bottom (including bilge strake) and side plating are to be longitudinally plated, to have welded butts and seams and except in way of openings for sea water inlets, "Y" brackets, hawse pipes and forefoot, etc. where heavy plates are to be fitted and having the following thickness:

Aft Main Deckplate	:	12mm
Bottom plate in general	:	12mm
Side shell in general	:	12mm
Shell plating in way of rudder and nozzle	:	16mm
Shell plating in way of Stern corners to Aft transom	:	20mm
Deck plating in way of anchor handling working deck space	:	20mm

207. Frames/ Beams

Frames for main hull are to be $150 \times 90 \times 12$ mm O.A. & $125 \times 75 \times 10$ O.A respectively spaced at 600mm throughout and to be welded to the shell plating. Strong longitudinal girders and transverse ring frame (or web) is to be provided.

Beams for main deck are to be $100 \times 75 \times 9$ mm O.A. $125 \times 75 \times 10$ O.A & $150 \times 90 \times 12$ O.A. respectively and fitted at every frame. They are to incorporate with strong beams of plate fabricated section fitted in way of deck openings c/w other longitudinal girders and transverse web is to be provided.

208. Sheerstrake

Sheerstrake of 25mm thick and about 600mm wide to be fitted in between main deck, lower/ upper forecastle deck level. Sheerstrake should be inserted IWO defined location and the welding joint to be appropriately shape for welding to be arranged as shown on General Arrangement.

209. Deck Girder & Pillars

Deck girders of fabricated sections are to be fitted in engine room, steering gear and cement/ liquid mud/ brine tanks, etc. compartments in association with pipe pillars.

210. Engine/ Winch etc. Girders

Engine/ winch etc. girders of vertical plate with horizontal rider plate are to be fitted. Vibracon adjustable chock shall be provided for main propulsion (main engine, gearbox and lineshaft, plummer block bearings) and steering gear units. Orange chock-fast of approx. 30 ~ 45mm thickness epoxy resin chocking compounds to be used for fire pump, winch, shaft alternator, thruster motor mountings etc. Details of dimension to be as per engine/ equipment maker's recommendation and classification & Buyer approval.

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211. Main Decks

The main deck is to be longitudinally framed abaft the collision bulkhead, and supported by deck girders and web transverses.

The deck plating aft of the superstructure is to be 12mm thick and to take uniformly distributed load of 7.0 tonnes/m2.

Elsewhere the deck plating is to be according to Classification requirements. The deck plating is to be welded direct to the shell. Extra thick insert plates to be fitted at deck machinery areas, fwd and aft, and at anchor pockets, etc.

Cargo-rails (aft) to be carefully faired down to main deck.

Stowage fittings are to be arranged for the rig discharge hoses as required.

Freeing ports to be arranged in main deck bulwarks with area to Classification requirements. All transitions in the bulwark top are to be made as smooth as possible to avoid snagging the towline. Freeing ports to be lined with 16mm round bars.

Forecastle deck bulwark plating to be 8mm thick with 200 x 12mm bulb plate on top with bulwark stays welded to deck with doubler. Scupper pipes to be installed at forward forecastle deck and anchor windlass area.

Doubling plates to be fitted under bulwarks stanchion feet and in way of mooring pipes, etc.

Mooring pipes, chain stoppers, roller fairlead, etc. are to be fitted as shown on General Arrangement and to be of cast steel.

The cargo deck, inside the line of the cargo rails, to be covered with 75mm thick hardwood. The timber to be retained by steel bars in between spaced approximately 3000mm apart and a mild steel sheathing 3600mm wide x 12mm thick shall be fitted/ laid on the wooden deck at the center area with 4" NB x Sch 80 x 1500mm H slot in type portable pipe stanchions (storage for pipe to be provided) on the P&S main deck from aft to forward to be arranged as shown on General Arrangement drawing.

212. Water Tight/ Oil Tight Bulkheads

The W.T/ O.T bulkheads as shown on the General Arrangement are to be plated horizontally with two different thickness. The vertical stiffeners are to be spaced approximately 500mm ~ 600 mm (Refer to construction condition).

213. Deckhouse

The deckhouse's front plate is to be 8mm. The top, sides and aft end bulkhead are to be 8mm or 6.35mm. The vertical stiffeners and deck beam are to be 75 x 50 x 8 O.A or 100 x 75 x 7 O.A.

214. Wheelhouse

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The wheelhouse is to have 8mm plate for the front, 8mm for sides and top with 75 x 50 x 8 O.A, 100 x 75 x 10 O.A or 100 x 12 F.B. for vertical / horizontal stiffeners and beams / web respectively. Aft side windows to be full sized with 12mm steel plate. Extra sound reducing acoustics to be installed in way of funnel. Aft side windows to be full sized with 12mm steel plate.

215. Bilge Keels

One (1) bilge keel made of 350×12 bulb plate to be fitted on the bilge strake P&S on doublers.

216. Bulwarks

Bulwarks to be 1000mm high. Plating to be 8mm thick with 200 x 12mm bulb plate on top and half round section on outboard edge. Bulwark stays welded to deck with doublers.

217. Funnels

Twin funnel uptakes to be arranged as shown on the General Arrangement Plan to accommodate the exhausts. Funnels to serve as engine room hot air exhausts. Funnel to carry Buyer's insignias (Buyer's approved insignias)

A hinged water tight access door or portable panel is to be fitted on the funnel for maintenance accessibility. A cross piece is to be fitted on top, joining the funnels together and act as platform for mounting and operating the fire monitors. Inclined ladder is to be arranged from wheel house top to this platform.

218. Cargo Rails

Two (2) longitudinal bax shaped cargo rails to be fitted longitudinally along the top of the deck. Stanchions at 2400mm apart. to be arranged and fitted out in accordance with G.A. plan.

The height of cargo rails shall be about 2800mm with steel plate of 12mm thick c/w stiffeners shall be welded from the main deck to the top of cargo rails and in between cargo rails stanchions in two spacing each to be arranged access openings and freeing ports at appropriate interval. 4 x 25 tons and 20 x 10 tons SWL eye lug to be fitted on below freeing ports for deck cargo lashing. (Construction drawing shall be submitted to the Buyer for approval before construction work)

219. Rudder and Rudder Stocks

Two (2) off high lift flap rudder c/w flap mechanism are to be fitted behind the nozzles and each with an approved area for flap with rudder blade. The rudderstocks are to be forged steel with Bronze/ stainless steel liner in way of neck bearing c/w lifting eye at the top.

The rudder trunk is to be tubular steel with a heavy top plate to take the steering gear and for welding to the ship's structure. A heavy steel boss to be incorporated at the lower end of the

trunk and fitted with approved type bearing. The bearing and stock to be designed to take the full side load of rudder. The rudder bearing to be oil type lubricated. Scaling arrangement shall be as per Maker's standard. Detail of information/ system to be as per Maker's recommendation and to meet with DP-2 operation requirement.

220. Nozzles and Shaft Brackets

Two fixed mild steel nozzles, suitable for controllable pitch propeller to be fitted. Each nozzle is to be supported by a headbox and two streamlined side brackets. The bottom structure of the hull in way of the nozzles will be stiffened by additional transverse and longitudinal members. Wear rings in way of propeller tips to be of stainless steel material.

Two shaft brackets are to be fitted each to support the stern-tube/ shaft with propeller. Propeller shaft brackets are to be the "Y" type of fabricated mild steel construction, upper part of support shaft aft bossing and lower part to prevent wires entering nozzle thus protecting propellers and rudder.

221. Gob Eye

One (1) off recessed gob eye to be fitted with chain at the forward of lock jaw on main deck.

222. Reinforcement for Future Installed Deck Machinery

Necessary under deck reinforcement for future installed deck machinery to be provided by Builder. The future installed deck machinery including AHC crane. Buyer should provide detail information of future installed deck machinery before related structural drawings completed. These drawings to be approved by Buyer.

SECTION 3 – ACCOMMODATION, WHEELHOUSE & STORE

300. General

The accommodation is to be arranged and fitted out in accordance with the General Arrangement drawing built to first class international shipbuilding practice. Scheme of decoration together with colour scheme and samples of all decorative materials and finishes such as furnishing fabrics, plastic laminates, deck covering, paints etc are to be submitted to the Buyers for approval prior to purchase.

All fixed and loose furniture, curtain, 150mm thick spring mattresses, Bedding sheet, pillows and pillow cases etc. as described in the following specification are to be supplied and fitted by the Builder. All kit lockers in accommodation to be limited full height lockable and in wood for crew's personal effects & clothing.

Clear height throughout accommodation area, included cabin/ living space/ passageway/ public area, etc. to be not less than 2100 mm and wheelhouse not less than 2200 mm.

All internal doors are to meet with SOLAS requirement and hung on brass hinges and fitted with satin chromed door fixtures with louvers at the bottom for return air ventilation. All materials used must be of asbestos free material.

First class quality locks with three labelled keys each are to be fitted to doors of all cabins, stores and other compartments throughout the accommodation. Brass locks are to be fitted to drawers, cupboards, lockers, refrigerator and stores as necessary. Also Five(5) master keys to be provided.

301. **Deck Coverings**

Steel decks are to be thoroughly cleaned and mastic coated before the installation of deck coverings which are to be laid under all furniture including the built-in.

Safety treads of brass with wooden steps are to be fitted on all ladder footings c/w stainless steel hand rail on the deck inside of accommodation passage way and step ladder area c/w ECR / Wheelhouse control console, etc.

Schedule of Deck Coverings

Wheelhouse top & wheelhouse deck interior/ exterior & main deck etc. : non skid deck paint Wheelhouse interior, Mess, lobby, crew's cabins, smoking/ mess room, office/ instrumentation room,

- : heavy duty type vinyl on about 10 mm Dynamix deck composition.

Washrooms, laundry, changing room and galley	:	non-skid ceramic tiles on cement with curves at corners
Engine room, steering gear/ bow	:	4.5mm aluminium chequer plate on tank/ thruster
and cement compartment		top of floor bearers (Escape passageway to
		be M.S chequer plate as per SOLAS require- ment)
Winch compartment and hydraulic	:	Galvanised grating
power pack room		
Deck/ paint stores, deck and A.C	:	non skid deck paint
machinery space, AHU room &		
CO2 room, etc.		
Stores	:	wood gratings on painted steel
Engine Control Room	:	3 mm Rubber stud mat on Dynamix deck
		Composition c/w floating floor (A60
		material).
Wheelhouse interior (Raised deck)	:	25mm waterboil plywood (WBP) with 2mm (About
400mm from wheelhouse deck)		Marley or Mipolam sheet (Butt joint to be
		welded)
Wheelhouse Console Platform	:	3mm Rubber stud mat

302. Minor Bulkheads & Lining

All steel minor bulkheads are to be lined with fire retardant rockwool panel and door in the wheelhouse, engine control room, sickbay, office/ instrumentation, smoking/ recreation room and all the accommodation cabin/ living/ public space and area etc.

Divisional Bhd to be on metal welded frame works and double skin panel construction for passageways, cabins and other accommodation Area, etc. and to meet/ comply with SOLAS requirement.

Insulation against ship side, outer walls and exposed deck shall be of fireproof mineral wool. The insulation shall be calculated for an inside temperature of +22°C and an outside temperature of +45°C & -20°C.

All exposed steel work is to be insulated on the inside with 75 mm fireproof mineral wool and retained behind the linings in accommodation area. (20+20)mm thick ceramic wool (A60 & sound proof insulation) for funnel area and in between wheelhouse, forecastle deck, main deck in way of accommodation, cabins/ public space, engine room/ engine control room & bow thruster compartment area, etc. for noise level limited condition and other area to meet/ comply with IMO and SOLAS requirement. Floor gutters with drain to be arranged inside all exposed walls/bulkheads for drainage of condensate.

- 1) Wheelhouse & deckhouse : exposed deckhead, sides and under deck
- 2) Forecastle deck : exposed deckhead, bulkheads and sides cabins

 Main deck cabins/ public space: exposed deckhead, bulkheads and ship sides & cool/ cold room

- Remarks: a) In addition, in mess room, sickbay, smoking/ recreation room, and passageway on the main deck area to be arranged 1 ~ 2 mm thk viscoetastic lay with 25mm thk. Hi-heat board with Floating floor material.
 - A60 or sound proof insulation area to be covered by fibre cloth CFC free material with perforated galvanized sheets (for exposed space only).
 - c) Underdeck insulation in accommodation cabins/ public space, etc. area for floor temperature to be checked and limited condition. If heat or cooling temperature is transferred from machinery space.

Sound insulation:

In order to minimize noise transmission, the accommodation areas on main deck, lower forecastle deck and anywhere if necessary to be fitted with a floating accommodation system of suitable type. Also see 117.

Engine control room to have resiliently mounted raised flooring system of approved type.

Sound trap to be installed in trunk from forward side thruster room if necessary.

304. Windows & Scuttles

All windows are to be welded type with tempered glass and Side scuttles are to be welded type or bolted M.S type with tampered glass and deadlight and to meet/ comply with classification requirement. All the scuttle below forecastle/ main deck Accommodation Area to be of insert type.

305. Steel Hatch/ Doors

All watertight/weathertight Hatch and doors on the below/ above main, forecastle and deckhouse deck to be of mild steel complemented and coaming heights according to the loadline requirement.

Single handle control operable on both sides are to be fitted with clips and grease fittings. The hatch/ doors to be channel-framed tightened to gaskets of soft neoprene or similar. Hatch/ doors to be fitted with sturdy padlocks and hold-back arrangement to retain them in open positions.

Wheelhouse side doors to be mild steel weathertight Door c/w BO type Joiner door complete with self closing device.

306. Carpenter's Work

All internal doors to be provided with rubber stoppers and hold-back hooks to retain the doors in open position. Hardware to be of stainless. Hinged steel doors with large windows in wheelhouse. Store rooms to be provided with steel shelves with retaining bars and wooden grating.

Arrangement of shelves, etc to be sufficient for the intent of each store room. Side lining and ceiling in wheelhouse, engine control room, accommodation area/ living/ public spaces etc. fitted with fire-retardant type material.

Accommodation to be well renovated according to Europe high standard.

The shape of furniture and solid type of material are to be of quality high standard type and the final arrangement of furniture is to be in accordance with accommodation plan and approved by Buyer's before the work is started.

307. Wheelhouse

The bridge is to be located on wheelhouse deck with raised deck of 400mm for cable-routing. The whole area is designed for all navigation/ communication purpose and other control equipment as specified below. The helmsman's chair position at the center or in operation area and between the console fitted at forward and aft of the wheelhouse. Wheelhouse windows are to be arranged to give maximum visibility all round providing a panoramic view and forward/ aft view to be fitted for large full height window at forward/ aft console operation area. The compass is to be located above the forward steering position. The layout of the bridge to be approved by Buyer.

Control stations shall be arranged in wheelhouse for aft main propellers, rudders and all tunnel thrusters, all in accordance with class regulation etc. The arrangement shall be according to the Wheelhouse arrangement drawing.

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The maneuvering system shall be electric.

The DP main operation consoles shall be placed adjacent to aft centre navigation console in accordance with class regulation.

- One (1) OS in SB aft console and
- One (1) OS in PS aft console

Change over of control of all main propellers, thrusters and rudders shall be able to be carried out by one (1) common switch, not push-buttons. The arrangement shall be made such that it is possible to take command from all manoeuvring consoles, using just one (1) switch.

The wheelhouse fwd control console of prefabricated (steel) to be fitted with:

- 1) Main propulsion/ engine remote controls c/w indication panel and shaft indicators.
- 2) Main engine/ gear box alarm indication panel
- 3) Electric Non & follow-up steering lever c/w rudder indicators and alarm indication panel.
- 4) Horn(air operated) button (mounted on console)
- 5) Gyro repeater (flush mounted table top type)
- 6) Two (2) searchlight with remote control, 2000W
- 7) Three (3) marine type horizontal wiper c/w FW spray and one (1) 350 mm clear view screen at both end.
- 8) Bow/ stern thruster unit/ motor remote controls and indication panel/ alarms
- 9) Engine remote control c/w indication panel/ alarm
- 10) Electric Engine Telegraph
- 11) Sound power telephone, direct line and common type SPT.
- 12) One (1) VHF (GMDSS unit) & one VHF non GMDSS type
- 13) One (1) off. docking station for portable joystick control unit, etc.

Other equipment in wheelhouse to be fitted out as follows:

- Navigation equipment Radars, echo sounder, gyrocompass/ repeater c/w Autopilot, DGPS, AIS, SSAS, Navtex Receiver, Weather facsimile, speed log, navigation lights and shapes, etc.
- 2) Communication equipment MF/HF & VHF radio telephones, flags, loudhailer, PA/intercom system, bell and morse lamp etc.
- 3) Mechanical plunger horn
- 4) Navigation light switches and alarm panel
- 5) Francis Aldis signaling lamp c/w battery in a box
- 6) Eight (8) each spare power points, 230/1/50 and Four (4) 24 volt DC in addition to those required for equipment specified.

- 7) One (1) Chart table with lockers and drawers under and flexible type table lamp with dimmer c/w emergency light and curtain all round
- Three (3) Helmsman chair c/w foot/ arm/ head Rest: Norsap 1000 comfort (sliding track/ swing seating type for forward/ aft console)
- 9) Wooden platform for wheelhouse Fwd & Aft control console area
- 10) Side board
- 11) Barometer 1 off
- 12) Thermometer 1 off
- 13) One (1) computer table with table lamp (modern design) with drawers and one chair
- 14) One (1) table with drawers and one chair for survey equipment (and goose leading from wheelhouse top)
- 15) One (1) radio table with drawers under and table lamp with dimmer c/w emergency light.
- 16) One (1) pocket to be provided at aft console for DP system remote console
- 17) Flag locker with complete signaling flags
- 18) GMT Radio clock
- 19) Clinometer
- 20) Marine Battery Clock
- 21) Settee with coffee table and 1 domestic type hot water urn
- 22) Ceiling light with separately on/ off switch to be provided
- 23) Emergency stop button for air conditioner, fuel oil and fans
- 24) Chronometer
- 25) Fleet Broadband and LAN system cable for wheelhouse, office, ECR and one man cabin
- 26) Pilot plug and socket for Inmarsat Fleet Board Band
- 27) Wind indicator
- 28) Panoramic Rudder Angle indicator Round View , 2 nos at port and stbd
- 29) Emergency Fire PUMP, Fire PUMP on/off Button

Aft Control Station

Aft control console (steel) will be arranged on the aft wheelhouse fitted as follows:

- 1) Main propulsion/ engine remote controls c/w indication panel and shaft indicators
- 2) Electric Non/ follow up steering lever c/w Rudder indicators
- 3) Bow/ stern thruster unit remote control and indication panel/ alarms
- 4) Five (5) Marine type horizontal wipers c/w F.W. spray
- 5) Horn push button
- 6) Electric Engine Telegraph
- 7) Two (2) searchlight with remote control, 2000W.

- 8) Bulk tanks system control panel
- 9) One (1) VHF Radiotelephone (independent unit)
- 10) Gyro repeater (flush mounted table top type)
- 11) Dynamic positioning system (DPS-2) equipment/ system control console
- 12) One (1) Echo Sounder Repeater
- 13) Sound power telephone
- 14) Emergency stop button for FW, FO, DW, BW and mud cargo pump and deck machinery
- 15) Stand type Microphone for P.A./ intercom system (system linkage to main station control panel Fwd console)
- 16) Two (2) off. docking station with one (1) portable joystick control unit, etc.
- 17) One 1 (1) Operator station with one (1) off monitoring units shall be installed. This unit shall include one (1) off colour monitor, one (1) off PC with keyboard, one (1) offpointing device and an alarm buzzer.
- 18) Wind indicator repeater
- 19) FIFI Control Panel
- 20) TUGGER And Capstan control button

One special single operator chair to be provided in the wheelhouse. This chair is for integration of navigation, control and manoeuvring functions for the aft bridge. The unique access to all major control systems within easy reach from the seated operator ensures complete awareness in all situations. Model and details to be accepted by Buyer.

General remarks for Cabins, Messroom & Galley : To be fitted with Common Telephone. Each crew cabin to be fitted with internet LAN connection, telephone and TV set. TV size is 32" LED TV except individual indicated.

308 Furniture for Crew and Passenger

All furniture shall have first class marine standard, they shall be made of plywood covered with veneer, wood and plastic laminate.

Bedsides shall be thick plywood, with wooden list on edge. 2 drawers shall be arranged underneath lower bed.

Drawers and cupboards shall be covered by veneer/laminate. Doors and drawer panels shall be in veneer or laminate

All cupboards and shelves shall have lighting list and cornice.

All tables shall be in plastic laminate/veneer with wooden profile lists on edge.

All wooden details in the ship shall be in the same stain colour.

The edges on furniture shall be rounded.

The curtain board shall be in laminate/veneer with decorating wooden list on edge.

The length of curtain board shall be mounted minimum 500mm from windows list, for parking curtain. Curtain board shall be mounted close to the ceiling.

The chairs and sofa benches in dayrooms, mess rooms, state and crew cabins shall have cover in IMO approved leather all over.

The curtains and bed curtains shall have lining.

All cabins shall have for each bed:

One (1) lockable locker for clothes,

One (1) lockable drawer.

All cabins with portholes shall have "blackout curtains".

The upper bed in two men cabins shall be fixed bed w/ladders and bed horse.

Free-standing furniture shall have means of securing.

Furniture shall be built with table-tops of plastic laminate.

All beds shall have 150 mm thick spring mattress of first class quality with fire-resistant covers, and 60 mm over-mattresses.

Between furniture and where necessary, there will be fillings.

Tables and locker doors will have core of plywood, and plasticlaminate/wooden list on top. Plywood material will consist of min. five (5) layers.

The Vessel shall be fitted with bathroom modules size according to accommodation drawings.

The equipment in bathrooms shall be in stainless steel (including fastening equipment).

309. Captain's Cabin c/w attached WC shower unit

The captain's cabin is to be situated forward of captain's deck as shown on the drawing and fitted out as follows:-

- 1 2000 x 1000 built-in high berth with drawers under and bunklight c/w curtain
- 1 desk with drawers and light
- 1 built-in upholstered settees c/w coffee table

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- Page 34
- 1 built-in locker c/w drawer shelf, hanger rod and hooks with lifejackets stowaged on

top.

- 1 upholstered chair
 - 4 coat hooks on back of door
- 2 x window (600 x 600) c/w curtain
- 1 PC w/keyboard
- 5 spare power points 230/1/60
- 1 marine battery clock
- 1 4-tier book shelf and 1 mirror
- 1 100-litre domestic type refrigerator (Freon gas R404a or equal)
- 1 4- drawer steel filing cabinet with locks
- 1 sound power telephone
- 1 sideboard & 2 lockers
- 1 40" colour television set and DVD player
- 1 domestic type auto hot water urn
- 1 VHF repeater
- 1 gyro repeater
- 1 safe box

310. Chief Engineer's Cabin c/w Attached WC shower unit

The Chief Engineer's cabin is to be situated forward of captain's deck as shown on the drawing and fitted out as follows:

- 1 2000 x 900 built-in high berth with drawers under and bunklight c/w curtain
- 1 deck with drawers and light
- 1 built-in upholstered settees c/w coffee table
- built-in locker c/w shelf, hanger rod and hooks with lifejackets stowage on top.
- 1 upholstered chair
- 4 coat hooks on back of door
- 2 window (600x 600) c/w curtain
- 1 PC w/keyboard
- 5 spare power points, 230/1/60
- 1 marine battery clock
- 1 4-tier book shelf and 1 mirror
- 1 100-litre domestic type refrigerator (Freon gas R404a or equal)
- 1 4- drawer steel filing cabinet with locks
- 1 sound power telephone
- 1 sideboard & 2 lockers

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1 40" colour television set c/w antenna and DVD player

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- 1 domestic type auto hot water urn
- 1 Alarm monitoring station as per E0 requirement.

311. 1 Sick Bay

The cabin is situated on the main deck as shown on the drawing is to be fitted out as follows:

- 2 2100 x 920 built-in berth with drawers under (or standard stainless steel bed) and bunklights c/w curtain
- 1 desk with drawers under and desk light
- 1 built-in lockers c/w shelf, hanger rod and hooks with life-jackets stowage on top
- 2 upholstered chair
- 4 coat hooks on back of door
- 4 spare power points, 230/1/60
- 1 300mm diameter portlight c/w deadlight cover and curtain
- 1 book shelf and locker with double locking wooden cupboard
- 1 sideboard and 1 locker and 1 mirror
- 1 marine battery clock
- 1 alarm call
- 1 100 litre domestic type refrigerator (Freon 404a or equal)
- Exhaust ventilation (Ducting connection to changing room and non-return flap to be installed)

The hospital bathroom shall have:

- 1 Toilet
- 1 Washbasin with hot and cold water
- Bathtub with hot and cold water and with shower
- 1 Handle
- 1 Soap dispenser
- 1 Paper dispensers 5
- 1 Double hook for cloth
- 1 Mirror
- 1 Shower set

Hospital alarm

A hospital alarm shall be fitted with buzzer and indication light in mess room and on bridge. Push-buttons shall be fitted at each bed and in toilet. The buzzer and indication light shall be clearly labelled. The system shall be supplied from 24V DC system.

312. 1-Berth Cabin c/w Attached WC shower unit - 4 off

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These cabins are situated on the deckhouse deck as shown on the drawing and fitted out as follows:

- 1 2000 x 800 built-in berth with drawers under and bunklights. Curtains for each bunk.
- 1 desk with drawers under and desk light
- 1 built-in locker c/w shelf, hanger rod and hooks with life-jackets stowage on top
- 1 upholstered chair
- 2 coat hooks on back of door
- 1 400x600 window c/w curtain
- 3 spare power points, 230/1/60
- 1 book shelf and locker and 1 mirror

313. 2 Berth cabin c/w Attached WC shower unit – 5 off

These cabins are situated on the deck house deck as shown on the drawing and fitted out as follows:

- 1 2-tier 2000 x 900 built-in berth with drawers under and bunklights with ladder for upper berth. Curtains for each bunk.
- 1 desk with drawers under and desk light
- 2 built-in lockers c/w shelf, hanger rod and hooks with life-jackets stowage on top
- 1 upholstered chair
- 4 coat hooks on back of door
- 1 400x600 window c/w curtain
- 2 spare power points, 230/1/60
- 1 book case and 1 mirror

314. 4 Berth cabin c/w Attached WC shower unit – 11 off

These cabins are situated on the forecastle deck and deckhouse deck as shown on the drawing and fitted out as follows:

- 2 2-tier 2000 x 900 built-in berth with drawers under and bunklights with ladder for upper berth. Curtains for each bunk.
- 1 desk with drawers under and desk light
- 4 built-in lockers c/w shelf, hanger rod and hooks with life-jackets stowage on top
- 1 upholstered chair
- 8 coat hooks on back of door
- 1 400x600 window c/w curtain
- 4 spare power points, 220/1/60
- 1 book case and 1 mirror

315. Attached WC shower unit – 22 off (wet/ modular unit)

These WC shower unit attached to Captain & Chief Engineer's cabins and 1,2 & 4 berths cabins as shown on the drawing and fitted out as follows:

- 1 shower fitted with curtain, soap dish and grabrail (without in wheelhouse)
- 1 ceramic washbasin with hot/cold water supplies
- 1 pedestal WC (European type) with seat, lid, toilet roll holder & grabrail
- extractor fan
- 2 coat hooks(for each person)
- 1 mirror with Cabinet
 - 1 toilet roll holder
 - 1 garbage bin

Outer edge of shower recess in module floor shall be sloped in order to drain water back to the recess.

316. Laundry – 1 Off

The laundry situated on the main deck as shown on the drawing and fitted out as follows:

- 1 washbasin with cold and hot freshwater tap and soap dish
- 1 worktable with mirrors
- 1 250mm diameter portlight with deadlight
- 2 spare power points, 230/1/60
- 2 5kg spin dryer (heavy duty type)
- 2 5kg washing machine (heavy duty type)
- 10 coat hooks
- 1 extractor fan and natural ventilation (Details of information to be as per equipment maker's recommendation and approved by Buyer)

317. Mess Room

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Both mess room situated on the main deck as shown on the drawing and fitted out as follows:

The mess room situated on the main deck as shown on the drawing and fitted out as follows:

ollows:

- 2 "L" shape built-in settee c/w back rest with stowage under
- 5 dining table c/w formica top and edge fiddles
- 6 spare power points, 230/1/60
- 23 uphostered chairs
- 1 200 litre domestic type fridge (Freon R404a)
- 1 marine battery clock
- 3 250 dia portlight with deadlight cover and curtain
- 1 42" colour television set c/w Antenna and DVD player
- 1 side board and white notice board
- 1 AO Serving hatch (in between Galley & mess)
- wall and ceiling light with separately on/ off switch with dimmer (wall light)

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to be provided.

- 1 Alarm monitoring station in officer mess as per E0 requirement.
- 1 antenna system for satellite television
- 1 bain marie (food warmer)
- 1 water boiler
- 1 working table with 1 sink

318. Linen Store

The linen store on main/ lower forecastle deck are to be fitted with wooden locker as shown on the drawing.

319. Changing Room c/w Attached WC Shower Unit

The changing room is situated on the main deck as shown on the drawing and fitted out as follows:

This changing room on the main deck is to be fitted as follows and as per General Arrangement Plan:

- 7 steel cabinet lockers c/w doors locks
- 1 water coolers c/w U.V filter
- 1 ceramic washbasins with hot/cold water supply c/w mirrors
- 1 extractor fan
- 1 spare power point, 230/1/60
- 2 WC pedestal with seat (European type). Lid, toilet roll holder and grabrail
- 8 coat hooks

320. Smoking room/ Duty mess & Recreation room

The smoking/duty mess room situated on the main deck as shown on the drawing and fitted out as follows:

- "L" shape built-in settee c/w back rest with stowage under
- 1 sideboard
- 1 table

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- 2 chair
- 1 exhaust ventilation (Ducting connection to common changing room)
- 2 spare power points, 230/1/60
- 1 white notice board
- 1 locker with bookshelf
- 1 Quartz battery clock
- 1 Hi-Fi system
- 1 microwave oven
- 1 coffee machine
- 321. Office Room
- The office situated on the forecastle deck shown on the drawing and fitted as follows:

- 2 bigger size, 800 (w) x 1200 (h) window at after end to be provided
- 3 lockable desk
- 2 each book/ equipment shelves
- 1 white notice board
- 3 upholstered chairs
- 1 coffee table
- 1 4-drawer file cabinets
- -
 - 8 spare power points. 230/1/60
- 1 100 litres domestic type refrigerator (Freon R404a or equal)
- RSS system cable
- LAN connection
- 1 Copy machine (A4 size)

322. Galley

The galley situated on main deck as shown on the drawing is to be fitted out as follows:

- 2 6 pce square hotplate marine type electric stove c/w oven & retainer bars with S.S vent hood and 250mm (min) extractor fan above stove.
 - 1 twin bowl stainless steel sink with workbench c/w hot and cold FW supplies with hanging cabinets/ plate racks over
- 7 spare power points, 230/1/60
- 2 spare power points, 440/3/60
- stainless steel side boards c/w with drawers and shelvings below and hanging cupboards above
- 1 500 litres min. stainless steel commercial type freezer/fridge, ((Freon R404a or equal))
- 1 waste food grinder c/w table and stand (to meet with Marpol Annex V requirement c/w certificate)
- 1 15 kg stainless steel deep fryer (to meet with SOLAS requirement c/w certificate)
- 1 Mixing machine
- 1 Frying pan
- 1 induction oven
- 1 water filter for F.W. supply line
- 1 total 18 ltrs twin deck type rice cooker c/w stainless steel stand
- 1 20-litre auto hot water urn
- 2 300 dia portlight with deadlight cover
- 2 stainless steel dish racks

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- Sufficient storage space for plates, cups, glasses, knives, forks, spoons etc
- working table with chopping board
- 1 dishwasher marine type

323. Freezer & Chiller Room

These compartments are to be fitted with internal shelf lined with stainless sheet, stainless steel shelves to be provided c/w wooden grating is to be fitted on floor. (refer Item 512).

324. Provision Store (Spot Cooling)

This compartment is to be fitted with steel shelves with plywood c/w retaining battens wooden grating is to be fitted on the floor.

325. Forward Store

The forward store incorporated with the chain lockers is to be situated aft of the collision bulkhead on main deck and fitted out with steel shelvings c/w mild steel Hatch.

326. CO₂ Room

This compartment is to install CO_2 bottles. Force exhaust and natural ventilation to be arranged.

327. Paint Store

The paint store located on main deck with security gates, shelving, adequate ventilation. Lighting and forced ventilation shall be of explosion proof type and the fan shall have a remote emergency stop outside the Paint Store. Water spraying (from G. S pump and S.W pressure set) or CO2 gas flooding system is to be provided and to meet with SOLAS requirement.

328. Deck store

This store on main deck are to be fitted with steel shelving. Door is to be mild steel watertight c/w adequate ventilation to be provided.

329. Engine Store/ Workshop

The engine store/ workshop located on main deck is to be fitted out as follows:

- 1 work benches
- 1 pedestal grinder
- 1 standing drill,
- 1 x 6 inch vices
- One (1) 300 Amp welding set (440/3/60)
- Two (2) spare/ power points, (440/3/60)
- Two (2) spare/ power points, (230/1/60)
- Running air supply and steel shelvings

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Forced supply/ natural ventilation

One engine work shop space located in the forward of engine room starboard to be fitted out:

- 1 work benches
- 1 pedestal grinder
- 1 x 6 inch vices
- Two (2) spare/ power points, (440/3/60)
- Two (2) spare/ power points, (230/1/60)

330. Steering Gear Compartment

This compartment is to be fitted out with Electric hydraulic steering gear and stern thruster. The flooring is to be of steel chequer plate with stainless steel self trapping screw to steel bearers and fitted with handrail as necessary. Watertight sound power telephone c/w 10m length cable with headset, on/ off switch and siren and yellow beacon is to be fitted.

331. Bulk Tanks Compartment

This compartment is to be fitted with Bulk Tanks as shown on the G.A plan. The flooring is to be of steel chequer plate with stainless steel self trapping screws to steel bearers and fitted with handrail as necessary. Siren and yellow beacon shall be linkage to Engine Room sound power telephone system is to be fitted in this compartment.

332. Bow Thruster Compartment

This compartment is to be fitted with bow thruster machinery. The flooring is to be of aluminum chequer plate except in way of escape way to be of steel chequer plate and secured with stainless steel self trapping screws to steel bearers and fitted with handrail as necessary.

All moving parts to be provided with guards or rails or both. Portable handrails to be provided in strategic positions for protection of crew safety. Watertight sound power telephone c/w 10m length cable with headset, on/ off switch and 2 siren and 2 yellow beacon is to be fitted.

333. Emergency Generator Room

This compartment is to be fitted out as follows:

- 1) Emergency Generator (running on low sulphur MGO)
- 2) Ventilation Fan (Auto-start c/w emergency stop button)
- 3) Emergency Switchboard w/space heater
- 4) Low sulphur MGO Tank
- 3) Battery Charger
- 4) Spare power point, 230/1/60 and 440/3/60
- 5) Shore connection box
- 6) fitted with wooden grating on the floor

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7) to fit rubber stud mat at the switchboard

334. Engine Room

The engine room is to house all machinery and equipment at convenient locations described elsewhere. Aluminium chequer plates (escape passageway to be M.S chequer plate) are to be used for flooring secured with stainless steel self trapping screws to steel bearers and fitted with handrail as necessary.

All moving parts to be provided with guards or rails or both. Portable handrails to be provided in strategic positions for protection of crew's safety. Workbench to be fitted at suitable location.

Clinometer to be suitably positioned.

335. Engine Control Room

The engine control room is located at the second deck forward of the engine room as shown on the drawing, and is an air conditioned room to house the main switchboard, spare power point, DPS-2 power management system/ panel, engine/ CPP controls & instrument panel, steering system alarm and auxiliary engine instrument panel etc.

The engine control room / centralized control and monitoring station shall be equipped with adequate controls, monitoring and alarm systems to maintain the safe operation of the propulsion machinery and associated ship's service systems and power generating machinery to the requirements of the E0 notation.

The air conditioning system (Freon R407a or equal) for this room is fresh water cooling independent package type c/w compressor unit, F.W cooling pump and air conditioning ducting. Rubber mats to be placed in front of the switchboard.

One (1) sound power telephone and 10m length cable with headset, on/ off switch (outside of ECR) c/w Nine (9) siren and yellow beacon and system (alarm & indicator light) linkage to Engine Room, Bulk Tank and Bow Thruster compartment, one (1) Quartz battery clock and one (1) clinometer are to be fixed.

336. AH/Towing winch compartment

This compartment is to be fitted with AH/Towing winch and to be arranged on main deck. The compartment shall have sufficient eye lugs for handling of chains and wires. Ladder with safety cage (chain pipe) for access for rid chain to be arranged. Closed circuit TV system (in wheelhouse) with 2 cameras (in winch compartment) shall be installed to monitor the operation of the winch.

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SECTION 4 – PAINTING & CATHODIC PROTECTION

400. Painting General

Descaling, shop priming, derusting and painting works to be carried out as outlined below and in accordance with the maker's recommendation and the Builder's practice.

The finish colour for hull to be in accordance with the Buyer's colour scheme.

The steel structure surfaces including welded beads to be painted before leak test, in general. However, fillet welding joint and erection seams/butts forming tank boundary to be painted after the joint has been examined either by compressed air test, vacuum test or tank air test as appropriate.

The adhesive tape may be used to protect the fillet joint and erection seams/butts waiting for leak test from contamination by surrounding painting.

The surface of materials other than steel and permanently enclosed space not to be painted.

Machinery, electrical equipment, fittings, valves, navigation equipment and furniture to be painted in accordance with the maker's standards unless otherwise specified.

The damaged parts of above machinery, equipment and outfitting after installation to be touched up with one (1) coat of finish paint of compatible kind.

In general, the steel outfittings including pipes to be painted with one(1) coat of the Builder's standard epoxy primer (exposed part : 100 micr. and enclosed part : 75 micr.) and one(1) coat of finish paint same as surroundings unless otherwise specified in these Specifications.

The paint not to be applied during the periods of rain, snow, fog or mist in the open air and also not to be applied when the weather conditions may cause condensation i.e., when the relative humidity is above 85% and the steel temperature is lower than 3 oC above dew point except the case that paint maker has confirmed that a particular paint can be applied at such weather conditions.

In case of the application of epoxy paint during the winter season, the Builder may use the winter type paint recommended by the paint maker.

The paint products for machinery space, accommodation inside and F.O./G.O./L.O. tanks to be applied with the Builder's standard maker.

401. Treatment of steel surface

401.1. Primary surface preparation

The hull structural steel of 6.0 mm thickness and above to be shot-blasted to SIS Sa 2 1/2 and immediately coated with one(1) coat of 15 microns inorganic zinc silicate type shop primer.

Grit-blasting to SIS Sa 2 1/2 may be applied instead of the shot-blasting for the hull structural steel when the shot-blasting is considered impracticable.

The hull structural steel below 6.0 mm thickness to be grit-blasted to SIS Sa 2 1/2.

The steel surface of fittings such as pipes, masts, pipe supports, grating supports and auxiliary machinery seats to be generally power tool cleaned with the wire brush or disc sander or pickled prior to main coating in accordance with the Builder's practice.

401.2. Secondary surface preparation

Before the first coat is applied, damaged area of shop primer due to welding, burning, rubbing and the rusted steel surface to be treated in accordance with the following table.

Area		Block Stage	Pre-Erection/ Dock/Quay Stage
Underwater hull		SIS Sa 2 1/2	SIS St 3
Topside		SIS Sa 2 1/2	SIS St 3
Weather deck		SIS Sa 2 1/2	SIS St 3
Deckhouse	Exterior	SIS Sa 2 1/2	SIS St 3
Decknouse	Interior	SIS Sa 2	SIS St 2
E/R interior		SIS Sa 2	SIS St 2
Water ballast tanks		SIS Sa 2 1/2	SIS St 3
Fresh water tanks		SIS Sa 2 1/2	SIS St 3
Other tanks	F.O., G.O. and L.O. tanks	Builder's practice (Dry and cleaning)	Builder's practice (Dry and cleaning)
	The others	SIS St 3	SIS St 3
Others		SIS Sa 2	SIS St 2

The visible zinc salt on intact shop primed surface to be removed bu sweep blasting for the area of which apply shot blasting at block stage and by disc sander, wire brush, or other appropriate methods for other area.

Condition of secondary surface preparation and cleaning prior to first coat shall be inspected by the Builders, Paint Maker and Buyer's representative.

All rough edges and metal burr on cut or burnt steel, slots, drain holes, scallops, etc. except Deck house interior, E/R interior, FO/DO Tanks and other interior area of dry spaces shall comply with the Builder's standard for before blast cleaning operations. The following shall be performed prior to paint application:

Thorough removal of welding and gas cutting slag and spatter

Smooth grinding of irregular welding bead Repair of surface damage such as pitting, undercut etc. by welding and grinding, such repairs to always comply with class requirements.

401.3. Surface cleaning before overcoating

The surfaces to be cleaned of oil, moisture, dust and other foreign materials with thinner, fresh water, wire brush or compressed air prior to coating.

402. APPLICATION OF PAINTING

Painting work to be carried out by airless spray generally. However the brush or roller to be used where it is impracticable and/or difficult to use spray.

Mixing and thinning of the paint material and interval of painting to be in accordance with the maker's recommendation.

The painting schedule specified hereunder may have alteration in number of coats and the dry film thickness in accordance with the recommendation of the paint maker selected. And the painting specification to be submitted to the Buyer for approval

In the edges of small holes such as slots, scallops, drain holes, air holes, and corners of flame burnt free edge of structural members, the dry film thickness may not always be the specified one. However one (1) stripe coat to be applied after first coat on such edges for underwater hull, exposed weather part and fresh water tank by roller or brush according to the Builder's practice, and stripe coats for water ballast tanks to be applied two(2) stripe coat.

After the specified coating is applied, the damaged parts of paint film to be repaired at proper time. When such a damage reaches to the steel surface and rust occurs, the surface to be cleaned by the wire brush and/or disc sander and to be coated same as surrounding hull.

When such a damage does not reach to the steel surface, the surface to be touched up with same as surrounding hull.

The damaged parts of galvanized steel surface to be touched up with one(1) coat of Builder's standard zinc-rich primer, in general. However, in case of the galvanized steel specified to be coated in these specifications, the damaged parts to be touched up with same as surrounding.

The dry film thickness specified in Section 2.1.4 Painting Schedule to be attained on at least 85% of the measuring points and at least 85% thickness of specified one to be attained on remaining 15% measuring points.

Dry film thickness to be measured after completion of anti-corrosive coating or final coating in accordance with the Builder's practice.

No measurement of dry film thickness to be made for machinery, equipment, outfitting, pipes with nominal diameter of 250 mm and below, pipe supports, machinery seats, small fittings and plate edges.

Small outfitting and fittings may be galvanized instead of painting as per the Builder's own discretion.

403. PAINTING SCHEDULE

Location	(Coat(s)	Total D.F.T.(micr.)
воттом			, , ,
1) Flat bottom (up	to bilge k	eel level)	
, , , , , , , , , , , , , , , , , , , ,	Ū	,	
Epoxy primer		1	150
Epoxy tie coat		1	100
Tin free S.P.C. A/F	Total	2	190 440
2) Side bottom (up	to scantl	ing draft)	
Epoxy primer		1	150
Epoxy fie coat		1	100
Tin free S.P.C. A/F	3	3	300
	Total	-	550
(Service life time of	A/F paint	; five (5) years)
TOPSIDE			
Epoxy primer		1	150
Tie coat		1	75
Polyurethane finish		1	50
	Total		275
EXPOSED ARE	A		
1) Weather deck			
Epoxy primer		1	100
Epoxy finish		1	100
	Total		200
2) Deckhouse			
(1) Wall an	d overhea	ad	
Epoxy primer		1	100

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Tie coat Polyurethane finish	1 1 Total		75 50 225	
(2) Deck Epoxy primer Epoxy finish	1 1 Total		100 100 200	
3) Funnel				
 (1) Outside Epoxy primer Tie coat Polyurethane finish Total (2) Inside Epoxy primer 	1 1 1		100 75 50 225 70	
Heat resistant type epoxy	2		50	
Tota	I		120	
 4) Platform, mooring fitting, deck machinery, handrail, stanchion and outside of pipe / ventilator / mast / post (bare steel) Builder's standard epoxy primer 1 100 Same as surrounding finish coat 				
5) Inside of ventilator				
Builder's standard epoxy primer 1 125				
6) Inside of mast and post (accessible part)				
Builder's standard epoxy primer 1 100				
ACCOMMODATION AREAS				
1) Accommodation and Store				
(1) Wall overhead and deck (Bare steel)				

(1) wall, overnead and deck	(Bare steel)	
Alkyd primer	1	70
Alkyd finish	1	50
	Total	120
(2) Behind Lining		
Alkyd primer	1	70

(3) Behind Sprayed type in Alkyd primer	sulation 1	70	
(4) Under deck covering (ir No paint	ncluding cement	ing area)	
2) refrigerated provision c	hamber / Gutter	way	
Epoxy primer	1	125	
ENGINE ROOM AND STE	ERING GEAR F	ROOM	
1) Wall, overhead and dea	ck		
Alkyd primer Alkyd finish	1 1 Total	70 50 120	
2) Tank top (below lowest stringer)			
epoxy primer	2 Total	200 200	
 Behind lining / insulatio Alkyd primer 	n 1	70	
4) Behind insulation (E/Room ceiling part only)Alkyd primer170			
5) Oil / Water coaming compartment			
epoxy primer	2	250	
CARGO AND SLOP TANK			
epoxy primer	<mark>2</mark> Total	300 300	

TANKS

 Water ballast tanks Tar free epoxy 	2 Total		320 320	
2) Fresh water tanks				
Holding primer Solvent free epoxy (Paint maker ; Builder's sta	1 1 ndard m	aker)	50 300 Total	350
 Fuel oil, Gas oil and Lu Anti-rust oil 	b. oil tan	iks		
4) Bilge tanks in Engine ro epoxy primer	oom 2		250	
5) Stern tube cooling wate	er tank			
epoxy primer	<mark>2</mark> Total		<mark>250</mark> 250	
MACHINERY AND EQ	UIPMEN	IT		
- Engine room machinery and Electric equipment ; According to maker's standard,				;
MISCELLANEOUS				
1) Void space and cofferd epoxy primer	am	1	150	
2) Chain locker epoxy primer		2 Total	300 300	
3) Rudder(1) OutsideSame coating system as Be	ottom			
(2) Inside Volatile corrosion inhibitors	powder			
 Rudder trunk Epoxy primer Epoxy tie coat 		1 1	150 100	

Tin free S.P.C. A/F	1	125
	Total	375

5) Sea chest inside Same coating system as surrounding hull

6) Other store and v	Other store and workshop			
Alkyd primer	1	70		
Alkyd finish	1	50		
	Total	120		

7) Anchor and anchor chain According to maker's standard.

PAINTING FOR GALVANIZED PIPES / OUTFITTING ITEMS

1) Inside the enclosed space No paint

2) On the exposed weather deck
(1) Pipe (Including stainless steel pipe), platforms, handrails and stanchions
Epoxy primer
1
75
Same as surrounding finish coat
1
50

(2) Outfitting

No paint

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404. Pipework Colouring

All exposed piping systems are to be identified with colour bands in accordance with the following colour schemes:

1)	Bilge & ballast	:	black
2)	Firemain	:	bright red
3)	FW Systems Cold	:	blue
	Hot	:	blue with red bends
4)	Fuel oil	:	brown
5)	Lub oil	:	yellow
6)	Hydraulic oil	:	purple

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7)	Sea Water System	:	green
8)	Brine Water	:	grey with green bends
9)	Compressed air	•	white
10)	Liquid mud	:	Grey with brown bends
11)	Bulk cement	:	Grey
12)	Drill water	:	Blue with green bends
13)	Air duck (machine space & compartment)	:	White

405. Cathodic Protection

Appropriate numbers and sizes of zinc anodes are to be bolted type to the immersed loaded hull, nozzles, rudder and inside of the ballast tanks, seachests area, etc. for five (5) years life span. Type and make to be Buyer's approval.

NGAPORE

SECTION 5 – PLUMBING & PIPING

500. General

All pipes are to be arranged according to first class international marine practice with sufficient bore and thickness for the purpose intended. They are to be well clamped to the ship's structure and to have minimum number of bends.

Approved type of bulkhead fitting to be used where piping penetrates a watertight or oil tight bulkhead, deck or tank top. Expansion elbow or bends only are to be fitted where necessary to avoid damage due to expansion or movement of the structure. Piping on hot service is to be insulated and is to be clammed to the structure after insulation has been fitted. Oil fuel and lube oil, compressed air and exhaust piping are to be black steel, other pipes to be galvanized, actual schematic diagrams of piping systems shall be provided and approved before installation. Pipes and pipe fittings can be GB measurement size and fulfill the Class requirement, the flanges and valves shall be ISO/DIN standard. Pipes system are to be fitted with cleaning plugs and drain cocks, where necessary.

All suction lines connected from Main Sea Chest lines will have individual strainers and valves apart from the common Sea Suction Strainer or valve. All tanks having a positive head for any of penetrations/opening to that tank should have a tank mounted valve. The Sea Main Line connecting both sea chest to be SCH 80 including the branches up to the first valve. Tank

Suction lines to be of same size as per the pump capacity. Manifolds to be sized accordingly. All valves will be marked with appropriate name plates. Bunker station (P & S) will be arranged on deck with common filling of diesel oil. All pipes of 15mm and over to have flanged connections except in accommodation and inside tanks where sleeves to be used. Those below 15 mm are to be screwed with unions or similar except for the air piping where butt-welded with flanged connection is to be adopted. Threaded pipes are to be avoided wherever possible except in fresh water supply system for domestic use. Where screwed connections are used, exposed and uncovered threads are to be treated with an approved anti-corrosive compound. All bare steel pipelines to be painted with primer prior to final finish coat as per paint specification.

All air vent pipes for tanks and voids to be carried above exposed decks and terminated in tank vent check valve as required. Float balls to be PVC. All ballast and freshwater tank vent to have insect screens. Vents are to be fitted to all under deck store spaces. All sound pipes to be fitted to each tank and to extend above exposed deck, as necessary and fitted with brass cap and brass keep chain. Flush deck sounding pipe to be avoided on exposed deck, to the extent possible.

Short sounding pipes to be fitted to double bottom tanks in engine room, F.O. double bottom's sounding pipes to have self closing weighted cock. All filling connections for F.W. tanks to be fitted on main deck complete with brass screw cap and keep chain.

Filling pipes to be clearly marked with engraved brass tally plates.

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Colour code is to be advised by Buyer. Bilge, scupper, fresh water, cargo lines and fire lines to be hot-dipped galvanized to a thickness of at least Microns.

Fluid pipes are not allowed to be laid above switchboard or distribution board. Screens to be arrangement where fuel oil and lube oil pipes are laid on hot area.

All steel pipelines to be painted with coats of primer prior to final finish coat. Shipside valve to be classification approved marine type.

Pipes situated in the assumed extent of damages are to be provided / arranged to prevent progressive flooding as per SPS code 2008.

The flow speeds in pipes must not exceed the values below if not otherwise stated in this specification:

System	Velocity
Seawater pressure side	3.5 m/s
Seawater suction side	1.5 m/s
Fresh cooling water suction	2.0 m/s
Fresh cooling water discharge	3.0 m/s
Hot water circulation discharge	2.0 m/s
Hot water circulation suction	1.5 m/s
Compressed air	25 m/s
Lube- / hydraulic oil suction	1.0 m/s
Lube- / hydraulic oil discharge	2.5 m/s
Marine diesel oil pressure side	2.5 m/s
Marine diesel oil suction side	1.5 m/s
Bilge suction	2.5 m/s
Bilge discharge and ballast	3.0 m/s
Fuel oil pressure side	2.5 m/s
Fuel oil suction side	1.5 m/s
Mud/Brine pressure side	3.5 m/s
Mud/Brine suction side	2 m/s
Methanol suction side	2 m/s
Bulk pressure side	3.5 m/s
Bulk suction side	2 m/s

501. Pipe and Valve Material

Hull pipes to JIS or equivalent. For pipe passing through tanks, pipe scantlings may be increased to be to Classification requirement.

<u>System</u>	<u>Material</u>	<u>Remarks</u>
Sea Main Line	Galvanized steel	Seamless sch 80
Bilge & Ballast	Galvanized steel	Seamless sch.80
Fire & Wash Deck	Galvanized steel	Seamless sch.80
S.W. Cooling	Galvanized steel	Seamless sch. 80
F.W. Cooling	Black steel	Seamless sch 40
Lube Oil	Black steel	Seamless sch 40
Fuel Oil	Black steel	Seamless sch 40

Sanitary (FW)	main line PVC(approv	main line PVC(approved type)			
	/copper(applied) in ac	commodation)/			
	Galv. Steel Under dec	ck)			
Soil Pipe	UPVC(approved type)/Stainless Steel	Seamless sch 40		
Air & Sounding	Galv. steel /Black stee	Galv. steel /Black steel			
	(to suit tank)				
Control	copper	tubing			
Compressed Air	Black steel	Seaml	ess sch 80		
Exhaust	Black steel	ERW	sch 20 main engine sch 40 Aux, engine		
Bulk	Black steel	Black steel Seamless sch 80			
Mud/Brine	Galvanized steel	Salvanized steel Seamless sch 80			

Where galvanizing is specified, this is to be hot dipped and to be carried out after fabrication as far as practicable and rectification of the damaged coating to be done in any case. Piping is not to be led through tanks as far as practicable.

Valve:

Shipside valves are to have cast steel or bronze body and bronze trim with class approval .Valve on bilge, ballast, cooling water(S.W. and F.W.),fire and wash deck may be cast iron body with bronze trim. Fire main system valves to be type approved. Valves on compressed air system to be steel or bronze. Valves on fuel oil and lube oil systems can be of cast iron/bronze.

502. Bilge & Ballast System

Bilge and ballast pipes of hot-dipped seamless galvanised steel Sch. 80 are to be arranged in accordance with the classification's requirements and SPS Code 2008. Mud or Strum boxes are to be fitted in the system where applicable in accordance to Rules requirement. Mud and strum boxes to be galvanized. Valves to be provided on either side of the mud boxes on the main sea suction to facilitate cleaning. Filling, suction and discharge pipes to be fitted to all tanks. Suctions to be fitted as required by Classifications. Upon completion, the systems are to be pressure tested to Classification requirement. Care is to be taken to ensure drainage to bilge suctions and scuppers. High level bilge alarms to be provided and connected to alarm panel, All main tanks, including the Skeg to have 40mm diameter screw fittings, stainless steel docking plugs fitted at their lowest point as far as practicable.

Suctions are to be fitted to the following compartments:

- Bulk tank compartment
- Bow thrusters compartment
- Engine room
- Steering gear compartment, etc.

Filling, suction and sounding pipes are to be fitted to all tanks. Drain plugs of 38mm (1½") diameter stainless steel screw fittings are to be fitted in double bottom drill /ballast water,

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potable water and foam , dirty, sewage and bilge holding, void tanks, and all deep tanks. Two docking plug spanners are to be supplied.

High level bilge alarm is to be provided in engine room, steering gear, bulk tank and bow thrusters compartment, and indicators to be installed in engine control room and wheelhouse.

A separate bilge pump shall be provided for handling the dangerous spill(brineresidue) Means to be carried out to separate the bilge systems in steering gear compartment with other normal bilge when the vessel carry Brine.

A non-return valve shall be fitted on the pipe in the compartment containing the open end, the bilge valve shall be operatable from above bulkhead deck.

503. Air & Sounding Pipe

Sounding pipes are to be fitted to tanks, cofferdams and drain well, as required by Classification. Sounding pipes are to be removable for the part inside the tank. Double bottom tanks are be sounded from the engine room. Self-acting weighted cocks to be fitted. Nameplates of brass engraved with the tank number and purpose to be fitted. Striking plates or equivalent to be fitted at bottom of sounding pipes. Air pipes terminating on deck to have vent heads with ball float valves. Air pipe for loose tanks to be terminated on top of the respective tanks.

All air and sounding pipes except for oil tanks shall be galvanized. Ventilation head for fresh water and ballast water to be provided with S.S./brass insect screen and oil tanks to have with S.S. flame arresters.

Filling connection is to be with flange closures. Additionally sounding pipes shall be of welded typed with closure device .All filling connections, on deck, for fresh water, fuel oil and lube oil shall have stainless steel CAMLOCK coupling.

504. Fuel Oil System (DPS-2)

Fuel oil pipes of seamless black mild steel of Sch. 40 are to be arranged with valves, filters, manifolds, pumps and tanks in accordance with piping drawing and to meet classification's requirements.

The ship's oil fuel bunkers are to be arranged with one of the bunker tank arranged as an overflow tank, which is fitted with suitable level alarms. Oil fuel bunkering connections are to be arranged port and starboard on the main deck with 5" CAMLOCK fittings for quick filling/discharge for all bunkers, suitable spill trays. Sampling cocks and pressure gauges are to be provided. A relief valve shall be provided on the main bunker line in the E/R.A high-pressure alarm is also to be provided on the main bunker line. Save-all trays are to be provided on all filling, vent, sounding connection of fuel and oil. The oil fuel piping is to be arranged so that the transfer pump may draw from any of the bunkers and discharge to either the daily service tanks or the settling tanks. A spring loaded draw-off cock is to be fitted to each daily service tanks and the settling tanks.

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Each oil fuel bunker and settling tanks to be fitted with an overflow pipe led into a common main, as far as practicable, which is to discharge into the overflow tank, The service tanks or day tanks to have overflow to the settling tanks, A single air pipe is to be arranged from the overflow tank and is to be terminated under the forecastle deck bulwark with appropriate ball float vent head and flame arrestor screen. The over flow line is to be fitted with illuminated sight glass and audio visual alarm.

Drip trays of minimum 150mm coming height are to be fitted in way of pumps. Drain from drip trays to be drained to dirty oil tank. Emergency shut-off valves to be fitted on fuel oil and lube oil tanks subjected to static head.

quick closing devices for fuel oil valves are to be provided as per Rules and Regulation.

Vessel shall be equipped with an accurate & easily operated sounding or gauging system. This system should indicate true quantities of fuel in each tank. This system should have remote display(s) together with a paper printer or other hard copy recorder in the Bridge.

The diesel fuel discharge & intake pipes shall be fitted with gauges or flow meters which can accurately measure quantity of fuel taken on board & discharged.

Fresh water & Diesel fuel discharge & intake pipes or lines shall be fitted with pressure gauges and sampling cocks for monitoring quantity at periodic intervals during discharge and intake of diesel fuel.

Each day tank and settling tank is to be provided with supply, auto filling and overflow pipes, drain valves, low and high level alarm, heat resisting flat sight glass c/w self-closing cocks at top & bottom ends as per classification and E0 requirement. Fuel over flow main line with sight glass in between fuel oil daily tanks and fuel overflow tank is to be arranged. Emergency stop button for FO transfer pump to be installed in the emergency generator room. Tamper –proof flow meter (calibration certificate to be provided) to be fitted before the engine and return to the day tank c/w strainers to be provided for independent monitoring fuel consumption for each generators engines.

Separate Fuel oil flow meters and valves to be provided from the daily tank to each generator engine so as to calculate the fuel oil consumption for the generator Engines.

F.O. Purifierx1 no. of about 2300 Litres/hour capacity to be provided for the purifying the fuel oil ,Trolley beam or lug to be provided near purifier for cleaning of bowls .Fuel oil purifier to be self cleaning type .The settling tanks are to be located at a higher level.

505. Lube Oil System

Lube oil pipes of seamless black mild steel of Sch. 40 (internals to be acid cleaned) are to be arranged in accordance with engine manufacturer's recommendation and to meet classification's requirements.

Lube oil storage tank is to be provided in engine room with filling pipe and air vents with suitable save all trays, fitted on the main deck and level gauge with volume indication for the tank . The generator engines are supplied with built-in lube oil pumps. The lube oil/hydraulic oil tanks are to be located in the bottom and wings.

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L.O. Purifier x 2 no. Of about 700 Litres/hour capacity each 2-stage heater is to be installed and connected to the system, purification as required. The purifiers to be self cleaning type.

506. Engine Cooling System (DPS-2 Central cooling system)

General:

Deck machinery and air-conditioning shall be freshwater-cooled. The cooling system shall provide necessary cooling for connected equipment. Calculations to be based on S.W. inlet temperature + 32 °C, Seawater discharge velocity in pipes generally not to exceed 3.5 m/s when fully utilized. Freshwater velocity in pipes generally not to exceed 3.0 m/s.

Number and capacities of pumps, heat exchangers and the dividing of the systems shall be in accordance with the different modes and supplier's recommendations. The coolers/heat exchangers shall be of plate type with plates of titan material, Min. 20% fouling to be included. All coolers shall be arranged with possibility for back-flushing on the sea water side. Piping and valve materials refer 501

506.1 Main propulsion diesel engine Cooling

Shipyard shall provide all components for the main propulsion diesel engine and main generator diesel engine cooling

Each main propulsion diesel engine shall have attached fresh water pump(s), and coolant thermostatic valve(s), as required. Each main propulsion diesel engine shall have jacket water expansion tank(s) (with water level indicator and low level alarm switch) and plate heat exchanger(s). Flexible piping connections shall be provided at engine connections. Shutoff valves shall be provided at heat exchangers to minimize coolant loss when servicing heat exchangers. Schedule 40 Fresh water coolant piping shall be provided between the engines and remote components and shall include low point drains and high point vents.

Each main propulsion diesel engine shall provide a sea water cooling pump, a sea water strainer. One unit SW cooling pump shall be installed as standby for automatic starting in case of duty pump failure for either engine. Sea water cooling piping shall be seamless galv. and shall include low point drains and high point vents.

Two off F.W.. cooling pump to be provided for cooling of gear boxes ,intermediate shaft bearings etc.. The shafting generator /motor self shall be cooled according to manufacturer's requirements.

Each main propulsion diesel engine shall have monitoring and alarm instrumentation as required by CLASS for E0 and DPS-2 notations which shall include: Water inlet, pressure-low or flow-low; Water outlet, temperature-high; Cooling water in expansion tank, level-low.

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Each heat exchanger shall have local temperature indication on each inlet and outlet.

506.2 Auxiliary Machinery Cooling

Main Generator Cooling

The main generator engine shall be cooled with attached heat exchanger(s), fresh water circulating pump(s), fresh water thermostatic valve(s), and sea water cooling pump, final is according to maker's recommendation. Sea water cooling piping shall be of seamless galvanized steel pipe. Instrumentation and monitoring shall be as required by CLASS for E0 notation.

The generator self shall be cooled according to manufacturers requirements.

Emergency Generator Cooling

The emergency generator shall be radiator cooled with attached jacket water pump, thermostatic valve, belt driven radiator fan and radiator.

The radiator hot air discharge shall be suitable for fitting to a flexible connection and a discharge duct with fire damper and louver.

Bow/Stern Thruster Motor and Drives Cooling

Each bow thruster motor shall be fresh-cooled or according to manufacturer's requirements. Piping shall include low point drains and high point vents. Instrumentation and monitoring shall be provided as required for CLASS DPS-2 notations.

Fresh Water Cooling Treatment

The Shipyard shall provide a corrosion inhibiting antifreeze for all engine fresh water circuits in sufficient concentration to protect against freezing.

The shipyard will be responsible for proper sizing of all cooling system components required for specific equipment included in the vessel.

507. Compressed Air System (DPS-2)

The main engines are to be air started. The compressed air pipes of solid drawn black mild steel are to be arranged with air bottles, valves, pressure gauges in accordance with manufacturer's recommendations and to meet classification requirements.

-There are two (2) air bottles of suitable size for the starting air purpose

- Two (2) electric air compressors are capable of charging the air bottles within one hour

Air compressor are to have automatic stat / stop, Intermittent auto drain, running hour meters, ammeters and lead lag switches. One (1) of the compressor to be supplied with alternate source of power from emergency generator.

Emergency shut off valve to have independent air bottle station located outside the Engine room

-Service of air of 7 Bar to be available in Engine Room(2 Locations), Workshop, Aft Thrusters Room, Bow Thrusters Room, Bulk Tank room, Emergency generator room, All decks external area in the fwd and aft,

An alarm is to be provided in the main control station and the navigation bridge to indicate a low level starting air pressure condition, which is to be set at a level where further main engine starting operation is possible.

Auxiliary air bottles and air dryer shall be provided.

508. Hydraulic Systems

The hydraulic pipings of solid drawn steel (internals to be acid cleaned) and high pressure flexible hose of approved type for steering gear, anchor handling winch, rope reel, towing pin/ lock jaw, tugger winch, anchor windlass and capstan, etc and detail of system/ material to be followed in accordance with the manufacturer's recommendations and to meet classification requirements. Adequate strainers to be provided.

509. Fire & Deck Wash Service

Salt water for the fire fighting and wash deck service are to be supplied from fire fighting/ general service pump in engine room and from the emergency fire pump to a fore and aft main run under deck with branch line of 65mm and with 2-1/2" instantaneous hydrants valve as per applicable rule. The fire hydrant coupling to be John Morris instantaneous coupling with twin twist lock or equal.

Hose reel, hose nozzle and lever for opening of valve to be stowed in boxes adjacent to each hydrant.

Each pump discharge is to connect to the system through an accessible isolating valve and each main deck branch is to have a shut-off valve and cap at the main .Drain plugs to be fitted at low points in the system.

Hoses with standard approved type of instantaneous coupling are to be supplied with nozzles. As far as possible hydrants are not to be located in accommodation area.

510. Fresh Water System-cold

A potable water pressure system is to be fitted for drinking and washing purposes .One FW line complete with UV sterilizer or equivalent filtering system to remove sediments ect. is to be provided and supply to drinking water fountains, one tap in the galley (to be distinct) are to be supplied from this line .

Fresh water system is to consist of a pressure tank (500 Litres) and one pump.One (1) additional pump is also to be fitted to act as standby for both fresh water and sanitary water pumps.

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Domestic fresh water system shall draw water through separated (independent) suction pipes from forward fresh tanks port & stbd. The fresh water maker outlet to be directed to these tanks.

Vessel shall have a completely separate clean FW (potable water) system together pipes/lines & pumps, which are not used for pumping bilges, ballast or fuel, The tanks are to be de-odorized before putting into use.

A hot & cold water dispenser is to be arranged in the mess room.

Sufficient storage tanks for domestic FW shall be provided together with the necessary equipment for filling from a deck manifold, venting lines with insect screens, level gauging by sight glasses, sounding facility, drain facilities etc. The clean FW discharge pipes or lines shall be fitted with flow meter and sampling cock for monitoring quality at periodic interval during intake & discharge of F.W.

An emergency hand pump to be the freshwater tank shall be fitted in the galley as a standby to the main pressure system. Foot valve to be fitted for each suction of fresh water tank.

All fresh (hot and cold) and seawater service piping shall be of U-PVC (class approved type)/copper tube.

Cold & hot freshwater shall to be led to all sinks and basins. Hot & cold freshwater supply to showers shall be led through mixing valves of the anti-scale type. Taps for cold freshwater supply to wash basins shall be spring-loaded.

One (1) each service points for fresh water to be available on Main deck and all exposed decks and also in Engine room.

511. Fresh Water System- Hot

One (1) fresh water calorifiers with adequate capacity (approximately 500 litters) shall be provided for supply of hot water throughout the vessel. The hot water heater shall be electrically heated by two immersion heaters and be thermostatically controlled to cut-in and cut-out in sequence. The calorifiers to have safety valve, thermometer and other safety devices.

The calorifiers is to be adequately lagged. A thermometer is to be fitted to the heater. One hot water circulation pump shall be installed for forced circulation to circulate the hot water throughout the vessel.

Forced circulation to be provided by electric driven centrifugal pump having Cast Iron casing, bronze impeller and stainless steel shaft.

Hot fresh water and cold fresh water system shall be equipped with dedicate pump. One spare pump with electric motor shall be provided in store .The necessary controls for automatic operation, as well as monitoring and safety features shall be provided.

One (1)10-litre electric how water heater, with automatic filling and thermostatic controls, is to be provided for the Mess room.

The hot water pipes to be lagged (insulated) using Armaflex pipe insulation.

Hot water service point to be available in Engine Room and Workshop.

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512. Sanitary water System

A pressure system identical to the fresh water system is to be fitted. Fresh water system shall be used for toilet flushing. System to supply sanitary water to water closets and taps for washing down purpose .The pumps in sanitary is to have bronze casings, bronze impeller and Stainless steel shaft. The piping in accommodation area behind panelling shall be of copper (except mainline).

The FW hydrophone and pump should have identical capacity as that of the FW hydrophore system.

The FW sanitary pump shall be provided a suction line from the freshwater tanks/system, through isolating valves and spectacle blanks to provide flexibility for using either fresh or sea water for the sanitary system. Similarly, the outlet from the pressure tanks shall be interconnected through isolating valves spectacle blanks to facilitate only one pump supplying the sanitary and domestic freshwater system when using freshwater for both systems. F.W and sanitary pumps shall be identical

Sanitary Fittings

Washbasins	:	white vitreous China, 500mm x 400mm with 12mm
		cold/hot water supply.
Showers	:	12mm cold and hot water screw down taps and mixing
		valves.
WC	•	white vitreous China with plastic seats and lids.25mm
		FW supply with flush valve and F.W supply for cleaning.
	:	White ceramic urinals c/w F.W supply with flush valve.
Galley sink unit	:	Deep type stainless steel twin bowl unit 12mm
supply c/w filter		hot & cold FW
	Washbasins Showers WC Galley sink unit supply c/w filter	Washbasins : Showers : WC : Galley sink unit : supply c/w filter

513. Scupper & Discharges

Discharges from washbasins, showers, sinks are to be grouped into common cross main(s) to discharge overboard through storm valve(s).Internal scuppers from accommodation are to be taken separately. Discharge from W.C. is to be led to a sewage treatment plant adequate for 60 persons.

Scuppers from the refrigeration spaces are to be led to the bilges. Scupper from AHU drain is to be led to deck scupper.

50mm scuppers to be fitted in toilers. Laundry and galley scuppers to be 80mm.All internal scuppers are to be sloped, and fitted with portable gratings. Scuppers to be of JIS standard or similar.

Discharges and taps generally to be as follows:

Showers: 50mm with P-trap

Wash basins: 32mm with deep seal bottle trap

Galley sink: 65mm with water and grease trap, strainer to be fitted W.C.S:100mm

Cleaning plugs to be fitted as may be required.

Open superstructure/deckhouse decks to be drained by 50mm scuppers.

Moisture condensate drainage has to be provided from behind accommodation panelling above main deck.

All scupper and drainage pipes shall be galvanized steel pipes. Inside scuppers shall be provided with water seals and shut off device. Overboard- discharge shell penetrations are to be of galvanized steel with stop valve and non-return flaps. All scuppers gratings on the Main deck to be easily removable type for Plugging in case of fuel leakage

Necessary wooden or Rubber plugs to be provided.

514. Refrigeration System

One (1) Refrigeration plant R404A system direct expansion type, water-cooled, electrically driven, direct coupled, to be installed on vibration-free mountings, complete with all necessary accessories, such as dryers, oil separators, liquid level sight glasses on the condenser, liquid flow sight glass on the refrigerant line, oil and refrigerant charging connections with proper isolating valves. For charging of refrigerant a hose set with pressure gauges shall be provided. Ratchet spanners shall be provided for opening/closing of valves. Major components of the system shall be as follows.

-Two (2) condensers, each with 100% capacity.

- Two (2) fresh water cooling pump, one acting as 100% standby.

The plant is to maintain temperature of (-)5 °C and (+)4 °C in refrigeration store spaces.

Dial type thermometers to be supplied and fitted for each chamber with dial mounted on outside of chambers.

Refrigerant pipes to be seamless copper and to be lagged. The plant shall be skid mounted and located to adjacent to refrigerated rooms minimize length of refrigeration gas piping. Belt drive will not be used for driving the compressors. The motor for the compressor are to be of totally enclosed fan cooled type with Class H insulation, IP 54 and S1 Continuous rated. Refrigerating system shall be of the fan /coil blower type and to be automatically controlled. Scupper pipes to be fitted draining to main scupper lines and led to overboard. Except refrigerant line no other pipes to pass through cold rooms. Drain from tray to the scupper is to be provided with defrosting arrangement, Door gasket in freezer room is to have heater.

The built-in walk-in chiller and freezer shall be furnished and installed as shown on the drawings.

Two (2) complete sets refrigeration compressor units shall be fitted in the engine room with easy accessibility.

Each compartment shall be accessible through a proper stainless steel insulated door with 150mm minimum polyurethane to preserve temperature. Each compartment shall be

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thermostatically controlled. In addition, each compartment shall be fitted with a drain for condensate and water accumulation.

Provision for latching access door from inside the freezer and chiller room is to be provided. Extra precaution shall be taken to ensure that a vapour seal be maintained. The chiller and freezer will be fitted with deep shelves and sea rails all around for storing food.

The refrigeration compressors will be Bitzer c/w water cooled copper nickel condensers and F.W Cooling pump for the system.

The refrigeration compressor units will be identical, each sized to 100% capacity. One unit is running and the other serving as a standby unit. The units are fitted with proper sealed refrigeration valves so either unit can be isolated for service. The operating unit will service both the chiller and freezer fan/evaporator units, with pressure/temperature controlled expansion valves. Chiller and freezer have its own thermostat, controlling the compressor operation and regulate the flow of Freon to each fan/evaporator unit.

A remote temperature gauge will be installed outside the chiller and freezer, and door alarm/bell with indication light to be installed in the bridge/ galley. Suction & pressure gauges (permanent) will be provided for each refrigeration compressor.

The floors of the chiller and freezer will be finished in stainless steel sheets covered with wood grating, the sides and overhead will be stainless steel sheet metal over non-flammable, oil resistant type of insulation. Shelves will be stainless steel frames with stainless steel bottoms and raise three and four tiers high, and approx. of 200mm above floor level.

515. Heating, Ventilation & Air-Conditioning

The air-conditioning system's design should have 100% redundancy. The air-conditioning plant shall be R404A high pressure system direct expansion type, water-cooled, electrically driven, to be installed on vibration-free mountings, complete with all necessary accessories, such as dryers, oil separators, liquid level sight glasses on the condenser, liquid flow sight glass on the refrigerant line, oil refrigerant a hose set with pressure gauges shall be provided. Ratchet spanners shall be provided for opening/closing of valves.

Air handling unit (AHU) blower unit and return ventilation are to be designed and installed with low noise insulation material for minimum noise level. The air-conditioning plant is designed in accordance with marine type standard system. The system is to meet the IMO and SOLAS requirements.

All vent outlets are to be fitted with adjustable dampers capable of closing completely or as necessary for air balancing. Cooled air through mechanical ventilation system is to be thermostatically controlled from one central location, near the air handling unit return.

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Fire dampers with indicators and/or fusible links are to be provided as per SOLAS requirements. Dampers are to close automatically in the event of fan failure, fire or shut down. Dampers are to be fitted with manual over-ride feature.

Air-conditioning plant is a single duct, high velocity air conditioning system, comprising a central air handling unit and a spiro-duct type air duct system. This high pressure system is to be installed to serve all cabins, living & public spaces & stores in the accommodation area, etc. The central air handling unit consists of:

- Filtering section with dry-type filter
- Fan section with V-belt driven high pressure fan
- Cooling section with air coolers for direct expansion of freon R404a or equal
- Heating section with electric heaters
- Oil/gas separator

The branch duct serving the sickbay exhaust and air-conditioning ducting is equipped with a non-return flap. The plant is to maintain the inside climate conditions as described under this section.

Ceiling air-grilles of pan type diffuser or punkah louver with noise attenuation box are to be provided as necessary for supplying of the conditioned air. Grilles to be equipped with air volume control dampers.

A high pressure duct are joined by means of rubber rings mounted on the fittings ensuring an airtight and durable assembly. Exhaust return air is drawn from mess rooms and passageways through the exhaust units with low noise insulation material and travel through the ducting to the mixing chamber on the central air handling unit.

Spiro-duct and return duct are to be insulated and system must be follow the manufacturer's standard and to meet with SOLAS requirement.

All Freon gas system for refrigerating and air conditioning equipments shall be CFC-free and made of environment friendly materials.

Major components of the system shall be as follows. Each plant should have

-Two compressors, each capable of meeting 100% of area served by that plant to be cooled,

One (1) working, one (1) standby

-One Air handling unit with twin fans.

Two (2) fresh water cooling pump, one acting as 100% standby .Spot cooling shall be provided in Galley, All Stores, Laundry, Common Toilets, and Change Room ect. Design Conditions as follows:

Outside Temperature	45°C, 90% RH (summer);	-20°C	(winter)
Inside Temperature	+22°C, 50% RH(summer);	+20°C	(winter)
50% Return air and 50 % Fresh	Air with facility to take 100% Fre	sh air.	

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Ducts to be spiral type (High pressure duct) and insulated by minimum 25 mm thick glass wool to ensure that the condensation will not occur on the outer side. Each space to have cabin attenuator units – silencers for volume /velocity control. The ducts to be concealed behind deck head lining. Fire dampers to be fitted where necessary.

Exhaust from cabin or compartment to be through louvered grilled in lower part of the door.

The coolers/ condensers shall be designed for 25% fouling factor. Belt drive will not used for driving the compressors. The motors for compressor drive shall be S1 continuous rated IP55, Class H insulation and TEFC. The air-conditioning plants shall be skid mounted on vibration free mountings and located in the AHU room to minimize length of piping.

ECR and workshop each to have floor mounted water cool (5 Ton Minimum) packaged unit of sufficient capacity .The conditioned air to be ducted for proper distribution. Additional Ail cool Split A/C of 3 Tons each to be provided in Wheel House x 2 nos. Outdoor unit to be explosion proof type (Total no. of air cooled units 3Ton x 2 nos.)

Ventilation:

Following spaces to have forced supply and /or forced exhaust :

Engine Room: Two (2) forced supply fan dual speed reversible type

The temperature in the Engine Room shall not exceed 55 °C

Capacity: minimum according to diesel engine ship and auxiliary machinery .

The reversible fan shall be fed from the emergency switchboard

Thruster Rooms (Bow & Steering gear) : One (1) forced supply and one (1) forced Exhaust Cargo space, Galley, Toilet, Hospital, Stores and all spot cooling area without recirculation : One (1) forced exhaust and natural supply

thruster motor to have interlock with the respective ventilation fans.

Space	Air Chang	jed Per HR
	Supply	Exhaust
Galley	20	40
Toilets		15
Laundry/drying room	-	15
Dry provision	10	-

Natural ventilation is to be provided for cofferdams, and tanks.

516. Exhaust Pipes & Silencers

Exhaust pipes (external pipes to use stainless steel (316) of Sch. 20 seamless and Sch. 40 for generator are to be led to top and out of funnels. Exhaust pipes and silencers are to be insulated with heat resisting insulating material (non asbestos type) and covered with metal cladding (aluminium or galvanized sheeting). To provide vertical ladder internally for inspection purposes.

The number of expansion pieces (bellows), fixed resilient supports and anchor supports for engines exhaust pipes shall be arranged, where all mountings and supports to be noise absorbing and flexible mountings to minimise any noise and vibration.

All exhaust silencers to be fitted with spark arrestors c/w water drains to be fitted to all lower part exhaust pipes. Silencers are to be certified if so required by classification.

To help ensure the emission control solution is correctly designed , sutible space to be reserved for the future 's installation of catalytic converters before exhaust silence .

517. Dispersant System

An anti-pollution oil dispersant system can be provided, complete with the following:

- a) One (1) detergent proportioner of between 3% to 6%.
- b) Two (2) spray booms, one each at P & S, 6m long aluminium, each fitted with 3 nozzles of 125 litres/min at 5 kg/ cm². Booms to be hinged such that these can be swiveled in for storage and secured perpendicularly out when in use.
- c) One (1) detergent pump at $45 \text{ m}^3/\text{hr}$ at 50m head.

518. Bulk Tank for Dry Bulk Material

a) Bulk Tank and System

The system is designed for transporting cargo of cement, barite and bentonite with a maximum specific gravity of 2.5.

Filling / discharge / vent line for the outlet station arranged on the main deck at port & starboard side amidships. 5 inch dia. discharge pipe line c/w female kamlock coupling shall be along the port & starboard side crash rails and discharge point at the stern.

Discharge and purge air system c/w compressor emergency stop button to be operated / controlled from central control panel and located in the wheelhouse. The bulk system shall be remote operated with the exception of the butterfly valves (manual operated) located on the main deck. Deck connection for filling / discharge / vent line shall be of 5 inch dia. quick disconnect type female kamlock coupling.

External and internal surface of bulk tanks shall be blasted to SA $2\frac{1}{2}$ and primed with one (1) coat of intersink epoxy primer and two (2) coat of epoxy paint for external surface area.

Capacity of bulk tanks	:	3 nos. x 1900 Cu. ft. approx.
Type of bulk tanks	:	vertical double Dome type
Tank to be classification:		DNV

Working / operation pressure : 82 psi (5.6 bar)

All the bulk tanks to be complete with aeration system, air nozzle, quick release manway, sounding point, lifting lugs, legs and pipe connection for dicharge, Filling and vent links c/w air inlet, high level indicators / alarm, safety valves and pressure gauge with transmitter. A pressure equalization system shall be provided to assure minimum pressure differential between the upper and lower spaces within the tank.

The four (4) nos. bulk tanks shall be individual remote operated system for filling, discharge and vent line before inlet tank and main deck to be individual manual operated.

b) <u>Bulk tank compressor</u>

Two (2) nos. rotary screw type or equal electrically driven compressor (each 19.3 m^3 /min approx.) or equal air compressor with slipring type motor (one unit in serving and one unit in 100% standby) to be provided and free air delivery of suitable capacity at 5.6 bar (82 psi) for bulk tank operation c/w soft starter panel.

The system consisting of One (1) complete set refrigerated air dryers and capacity to suit Two (2) unit compressor operation condition. The system included cyclone water separator, sea water cooling pump c/w starter, oil / after sea water cooled and moisture separator c/w auto drain trap etc. and all the system to follow the manufacturer's recommendation.

Air piping system from compressor to bulk tanks must be as straight as practicable to eliminate condensation collection points.

All the pipe line for the bulk system to be hot-dipped seamless galvanised steel Sch 40. For filling, discharge and vent pipe-line to be 5 inch dia. and shall be flange connected in lengths no longer than 3 metre and victualic couplings are fitted before and after bends in discharge line. (if necessary)

519. Liguid Mud/ Brine

Liquid mud(include oil base mud)/brine pipe of hot-dipped seamless galvanized steel sch 80 are to be arranged with valve, pumps and tank in accordance with piping system drawing and circulating of liquid mud and drill water by-pass line for washing system in the mud tank to be arranged.

4" dia. female kamlock deck fitting to be installed for common filling and discharge on main deck port and starboard side at the amidship, and 4 inch dia. discharge pipe line

c/w

female kamlock coupling shall be along the port and starboard crash rails and dischargers point at the stern.

520. Fuel Oil Transfer System

The fuel oil system shall be arranged with manifold for transfer between group of tanks in addition to discharge/supply to deck.

The fuel transfer system shall be fitted with a printout metering system. The fuel transfer flow meter(s) shall be provided with calibration certificates upon delivery of the vessel. The piping arrangement shall permit using the flow meter (s) for filling, discharge and tank to tank transfer. In addition to local reading/display of flow meter, remote display shall be provided at the aft console in wheelhouse. Meters shall be of first class quality (Liquid Controls Model M75-C-1 with mechanical local display and digital remote display with reset facility) and built for 'radio interference suppression', The local indicator shall be mechanical with tamper proof sealing and remote shall be digital display. The pipe line to have relief valve leading to the overflow tank so to avoid over pressure on line. The discharge point to have pressure gauge and sampling cock. Also by pass arrangement to be provided from the discharge to the suction of pump with valve. The system shall have two (2) pumps and capacity of transfer of each pump shall not be less than 150M3/Hour at 80 meter head. The pumps shall be interconnected so as to provide 100% redundancy.

Pump start/stop switch with running/stop indication & safety cap for cargo fuel oil pump shall be provided at aft console in wheelhouse and near main deck bunker stations. Selector switch shall be provided at local and remote control station (wheelhouse)

521. Freshwater Cargo System

The FW cargo system to be arranged with manifold for transfer between tanks in addition to discharge/supply to deck through flow meter. The water transfer system shall be fitted with a printout metering system. The water transfer meter(s) shall be provided with calibration certificates upon delivery of the vessel. The piping arrangement shall permit using the flow meter (s) for filling and discharge. In addition to local reading/display, remote display shall be provided at the aft console in wheelhouse, Meters shall be first class quality (Liquid Control) and built for 'radio interference suppression'. The local indicator shall be mechanical with tamper sealing and remote shall be digital display. The discharge point to have sampling cock.

The system shall have two (2) pumps and capacity of transfer of each pump shall not less than 150m3/hour at 80 meters head. The pumps shall be interconnected so as to provide 100% redundancy.

Pump start/stop switch with running/stop indication & safety caps for cargo fresh water pump shall be provided on aft console in wheelhouse and local start/stop switch shall be provided near the pump. Selector switch shall be provided at local and remote control station (wheelhouse).

523. Deck Fitting/Cargo Piping System

The Kamlock deck fitting (female type quick coupling) to be installed for filling and discharge (or common) lines on main deck, port and starboard side at the amidships, port at after. Butterfly valve (S.S.) to be fitted adjacent to the quick coupling. In addition, discharge pipe line c/w female Kamlock coupling shall be along the port and starboard crash rails and discharge point at the stern to be arranged.

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600. General

All deck machinery and equipment are to be supplied and installed to meet classification approval for DNV notation and towing service. Following info are for guidance only and subject to class acceptance & approval equipment number for this class of vessel. Protective guards to be provided in way of deck machinery equipment at local control panel area if necessary.

601. Anchors, Chain Cables & Mooring Lines

The anchors, chain cables and mooring lines are to be supplied in accordance with the classification's requirements. For guidance, they are as follows:-

Anchor	:	Two (2) A	C-14	high l	holding pov	ver anc	hors,	each min.18	345 k	g	
Chain cables	:	467.5M to	otal le	ngth,	44mm dia,	Grade	2 hig	h strength st	ud lir	ık ch	ains
Mooring lines	:	4 X 170	m l	ong	mooring	rope	of	minimum	186	kN	breaking
		strength									
Towing wire	:	1 X 190m	@ 4	79kN	breaking st	rength					

602. Anchor Windlass/ Mooring Winch

One (1) unit hydraulic anchor windlass/ mooring Winch suitable for 44mm dia. (subject to final confirmation) high strength Stud link U2 chain c/w two warping drums, two mooring drum and two roller type chain stoppers is to be provided.

The cable lifters, mooring drum and warping drums are to be independently clutched and variable speed local hydraulic control on forward of forecastle deck, the chain pipes, cable stoppers roller type and hawse pipes are to be arranged at site.

a)	Anchor Windlass:-		
	Duty pull	:	11 t at 0 to 12m/min
	Gypsy size	:	suitable for 44mm dia. U2 high strength stud line chain.
	Chain stopper	:	suitable for 44mm dia. U2 high strength stud line chain.
	Brake control	:	manual operated band brake
	Gypsy clutch	:	manual operated jaw clutch
b)	Mooring Storage Drum	<u>.:-</u>	
	Drum capacity	:	220m x 64mm P. P rope approx.
	Duty Pull	:	12 T at 0 to 12 m/min (1 st layer)
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	:	slack rope at 0 to 40 m/min
Brake control	:	manual operated band brake
Drum clutch	:	manual operated jaw clutch

603. Mast

The main and fore navigation mast is to be completely fitted out with necessary brackets and stays for navigation lights and shapes. Climbing rungs to be provided. (Fore mast subject to approval from marine department)

604. Manholes

All manholes are to be elongated shape with stainless steel studs, washer and nuts. In way of main deck, they are to be of raised type with flush steel covers to wooden deck level. In engine room and other machinery space manholes are to be of "standard" type.

605. Draft Marks

Draft marks are to be in metric P&S forward, amidship and aft as per the relevant regulations.

606. National Colours

"Staff" to be installed at mast for national colours.

607. Escape Hatch

Mild steel hatch cover c/w counter balance weight and 2 step stopper to be provided for engine room, accommodation and store.

608. Storm Rails (Grab Rails)

Storm rails to be fitted all round deckhouse and on exterior bulkheads. Storm rails also to be fitted in convenient positions in toilets, bulk tank / steering gear/Bow Thruster compartment and engine room.

609. Drainage for Decks

Suitable scupper pipes to be positioned in funnels, along the main deck, deckhouse forecastle deck and wheelhouse top etc. to facilitate deck drainage.

610. Towing Bollard

One (1) pipe 'H' bollard fitted aft anchor handling/towing winch.

611. Doors

Doors to be fitted as shown on the General Arrangement drawing. All watertight/weathertight doors to be in steel. Aluminium BO Type Joining doors to be fitted at Wheelhouse sides c/w

self-closing. Accommodation weathertight doors to outside, are complemented with fire rated doors with and door self closing.

Internal fire rated doors in accommodation spaces to be of flush type and submitted to the Buyers for approval prior to purchase.

612. Handrails & Stanchions

Stanchions are to be 65 x 16 FB x 1000mm high with short backstays and spaced not more than 1200mm spaces apart. Top rails of 42 mm dia galvanised pipe and the lower rails of 20mm round bar. At access points, pipes substituted by 1/2" short link galvanised chain with hook and eyes.

613. Ventilators

Four (4) axial low rpm flow fans of adequate capacity are to be provided for ventilation of engine room. Ventilation deflectors will provide circulation to engine room fore and aft. Natural exhaust through funnel casing. Ventilators and location of ventilators to be considered to minimize noise, also on the deck.

Changing room, smoking room, sickbay, paint store, deck machinery room, deck workshop, bulk tank & B/T & S/T compartment, CO2 room, WC shower unit and galley to be provided with axial flow extractor fans and natural ventilation to be arranged for store, machinery space or other compartment.

Emergency Generator set room is equipped one (1) reversible circulation fan and natural fan.

614. Covers for Deck Equipment

Sailcloth covers for deck equipment such as compass, anchor windlass, capstan, tugger winch and control panel etc. are to be provided.

615. Handrails & Grabrails

Handrails and grabrails are to be fitted at strategic positions for maximum safety and to meet rule requirements.

616. Bulwarks

See Section 2.

617. Ladders

All ladders to be steel construction. Tread to be non-slip, made of chequer plate or similar construction. Vertical ladder to be constructed with 20mm square bar rungs welded to steel flat bar and to be clear of steel bulkheads.

Hand grips to be fitted as necessary.

618. Floodlights

6 x 1000W & 2 x 500W Aqua Signal Metal Halide Floodlights with Narrow/ Wide Angle Reflector Tungsten Halogen (6 Aft & 2 Fwd)

619. Searchlights

2 x 2000W, Imax or equal Searchlights c/w remote controls (1 fwd & 1 aft)

620. Mooring Bollards

a) Bollards

Ten (10) heavy pipe double bollards are to be fitted on four (4) aft main deck and six (6) on ford of forecastle deck as shown on the G.A plan.

b) Mooring Posts / Closed Chocks

Six (6) mooring pipes and three (3) closed chocks, size: 300mm and 400mm for the above bollards are to be fitted to the bulwark as shown on the G.A plan.

c) Stand Roller

Six (6) 250 mm dia. and two (2) 200mm dia. fair lead-open type stand roller are to be fitted to the main deck and forward forecastle deck.

621. Hawse Pipes & Anchor Recesses

Two (2) hawse pipes and chain pipes welded to 14mm anchor recesses.

622. Deck Sheathing

75mm thick hardwood planking to be arranged on the main deck. The timbers to be retained by angle bars or flat bars with steel boundary plates at edges and plank ends as shown on the G.A. plan.

623. Fenders & padeyes

1) Rubber fenders : 400mm width x 300mm height "n" type, 4 (four) sets of rubber fenders to be fitted at ship side port & starboard as shown on the GA drawing.

2) Padeye : 20 x 10 Tons S.W.L. padeye spaced 1.80m and 4 x 25 Tons S.W.L. padeye to be fitted at side of main deck.

624. Anchor Handling cum Towing Winch

One (1) Min. 160 tonnes SWL hydraulic low or high pressure winch of waterfall type (double drum) with two declutchable drums with band brake c/w emergency quick release system and transmission would be from a low speed high torque low pressure hydraulic motor c/w manually operated hydraulic spooling device common for two drums and remote operated from bridge.

Below description to be confirmed by manufacturer.

The anchor handling/ towing winch would comprise a lower anchor handling drum and an upper towing drum mounted in a waterfall configuration. Both drums would be fabricated construction with fixed high tensile steel main shafts. All mainshafts would be supported on the fabricated steel base plate by heavy duty roller type bearings mounted in steel housings, bolted to the structure.

The drums are each fitted with a wrap up type band brake, which is hydraulically released/ applied from a hydraulic cylinder, operating through mechanical linkages to provide the required braking torque.

All brake straps are lined with a marine high grade non asbestos material that is bolted/ riveted to position

Specification

Type : Twin drums in waterfall configuration

Drum capacity : 1545m of 64mm diameter wire rope or 2150m of 56mm diameter wire Brake and clutch control: manual/ remote controlled.

Brake holding load : Min. 200 tonnes on towing drum @ 1st layer

Min. 200 tonnes on anchor handling drum @ 1st layer

Cable lifters : Two fixed cable lifters of steel,one 76mm-Port side and one 76mm-STB side .

b) Performance on Either Drum:

Winch driven by two pumps.

Details to be in accordance with manufacturer's recommendations.

c) One off colour T.V monitor c/w camera and line/ tension indicator meter/ panel to be provided and to suit the above equipment operation condition.

d) Two off chain rollers adjustable type for rig chain (Capacity to be confirmed by vendor and Buyer)

625. Stern Roller

Min. 2.0m dia. x 4m length approx. refer to hull condition (maximum @ SWL 300 tonnes) stern roller c/w shafts, bearing and supporting bracket to be fitted at stern.

626. Deck Connection (1P & 1S)

1)	FW water	-	Female (125mm)
2)	Fuel oil	-	Female (125mm)
3)	Drill Water	-	Female (125mm),
4)	Brine water	-	Female (100mm)
5)	Liquid mud	-	Female (100mm)
6)	Recovery Oil		Female (100mm)
7)	Cement	-	Female (125mm)
8)	Dirty oil	-	Connection to meet Marpol 73/78
9)	Sewage	-	Connection to meet Marpol 73/78

627. Logo

Logo is to be steel plate and welded on the funnel.

628. Gangway/ Bulwark Gates

One (1) 6 mL x 0.6 mw portable aluminium gangway complete with handrail and net is to be provided. Two (2) hinges steel gates to be fitted, 1 P & 1 S c/w overhead support 3" dia pipe & manila swing ropes.

629.

630. Crane

One (1) electro-hydraulic telescopic & luffing deck crane. Capacity 3 ton @ 10m radius. 440/3/60 with the following options, crane assumed suitable for provisions as well as engine room service :

- a) Load chart
- b) Load / radius indicator plus clearly marked SWL
- c) Overload alarm
- d) Approved safety catch fitted to hook
- e) Appropriate carne warning and working lights
- f) Control levers should have dead man's handle
- g) An operation maintenance manual with checklist for pre-use inspection must be provided by makers.

631. Towing Pins/ Lock Jaws:

One (1) set towing pins/ lock jaws to be placed in the steering gear compartment c/w Remote Control in the wheelhouse aft console and main deck.

a) Towing Pin Type : 160 tonnes SWL Number off : 2

Towing Pin are equipped with rotating liners c/w turnable top flapses/ locking plate or closed tip angular type. Hydraulic cylinders for lifting and lowering are double acting and built into the pins.

b) Lock Jaws: Two (2) off lock jaws to be installed in centerline on the aft main deck.
The stopper to be able to take 1 ¼" to 4" dia wire and chain and SWL to be 300 tonnes.
Hydraulic power pack for towing pins and lock jaws to be according to the maker's standard.

632. Capstan

Two (2) sets variable speed hydraulic capstan c/w local hydraulic control unit.

Duty pull	:	10 tonnes @ 0 to 18 m/min
	:	light line @ 0 to 19 m/min
Drum dia.	:	380 mm Approx.

633. Tugger Winch

Two (2) sets variable speed hydraulic Tugger c/w local hydraulic control system.

Duty Pull	:	10 tonnes @ 0 to 24 m/min
	:	light line @ 0 to 97 m/min
	:	3tonnes @ 0 to 75 m/min
Drum capacity	:	min. 250m x 22mm dia. steel wire rope
Brake	:	manual operated brand brake

634. Storage Rope Reel

One (1) variable sp	eed storage	e rope reel c/w local hydraulic control system.
Duty Pull	:	7 tonnes @ 0 to 35 m/min ,1 to 9 tonnes @ 0 to 404m/min
:	light lin	e @ 0 to 127 m/min
Drum Capacity	:	1800 mL x 64mm dia steel wire rope

635. Electric-Hydraulic power pack for Deck Machinery

Three (3) complete sets of electric hydraulic power pack to be provided for the anchor windlass/ mooring winch, tugger winch, towing winch/lock jaws, storage rope reel and capstan.

The power pack to consist of one pumps with motors c/w starter for the system. Star-delta or auto-trans starter panel and other necessary fittings and accessories items to be as per maker's standard and recommendation.

Hydraulic power pack to be resiliently mounted

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637. External Firefighting

External fire fighting system is to be as generally stated below and is required to meet Class FiFi 1 requirement.

a) <u>Fire Pumps</u>

Two (2) seawater pumps each 1600m3/hr at 14 Bar. The pumps to be driven from the front PTO of the main engines via gearbox (increaser) with built-in clutch c/w plummer block bearing local manual and remote control panel in the wheelhouse.

Independent sea suction and piping system for each pump. The pump casing to be NIAI Bronze, shaft acid proof stainless steel impeller of NIAI-Bronze c/w mechanical seal with fluid barrier.

Capacity	: 1600 M ³ /hr (400 M ³ /hr for exposed deck water
	curtain spray nozzle to meet with classification
	requirement)
Total Head	:140 mlc
Power consumption	:740 kW approx. @ 1800 Rpm

b) <u>Fire Monitors</u> (Water/ Foam)

Two (2) - units double long barrel stainless/ bronze for water/ foam monitors. Electro-Hydraulic remote control water/ foam monitor c/w spray deflector for straight jet stream/ spray remote joystick control in the wheel house.

Two (2) hand wheels for emergency manual control also built on the monitors.

Water apacity	:1200 m3/hr
Inlet pressure	:12 bar
Throw length	:120m
Foam capacity	:300 m3/hr
Inlet pressure	:12 Bar
Throw length	:75 ~ 80 m approx.
Reaction force	:about 16000 N
Swivels and swivel	:Bronze
Body, gear & barrel :	AI-Bronze housing

Throw height : 50m measured vertically from sea level assuming a mean impact are located at a horizontal distance not less than 120m from monitor outlet.

The MA

Horizontal and vertical movement with limit switch restricting monitor discharge on any part of the vessel.

c) <u>Control Panel</u>

The control panel for installation in wheel house with the following remote functions.

- i) elevation and rotation of monitors by Joystick
- ii) clutch in/off for fire pump to main engine
- iii) inlet valve on/off for fire pump suction line
- iv) change over switch in between water/ foam monitor
- v) start/ stop push button for hydraulic motor c/w power available lamp
- vi) push button for jet/ spray monitor
- vii) system interlock and interface to main engine and suction valve to be provided.

d) Deck delivery head

Two (2) 4-way 65mm delivery heads c/w brass flanged 90° valve for storz C coupling with cap with instantaneous hose connections are to be fitted on main deck. Inlet pipe 100A N.B. and eight (8) hoses each 65mm dia x 30ml complete with variable nozzles (jet/fog) for capacity each 350 ltr/min @ 4 kg/cm² c/w shut-off & 65mm dia. Storz C coupling or equal to be provided.

e) <u>Fixed Water-Spraying System</u>

The vessel is to be protected by a permanently installed water-spraying system consisting of a number nozzles fitted on all deck levels.

The fixed water-spraying system is to provide protection for all outside vertical areas of hull, superstructures, deck houses and wheelhouse including foundations for water monitors and jet/ fog nozzle for coverage of Aft main deck and other equipment.

The arrangement for the water-spraying system is to be such that necessary visibility from wheelhouse and the control station for remote control of the fire fighting water monitors can be maintained during the water-spraying.

The pipelines and nozzles are to be so arranged and protected that they will not be exposed to damage during the operations. The fixed water-spraying system is to have a capacity not less than 125 litres/min @ 10kg/cm² of the are to be protected.

<u>Sea Chest</u>

f)

g)

Two (2) independent sea chest for external fire fighting is to be fitted.

Foam System

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i)

- One proportioner eductor with a mixing ratio of 5%
- One metering valve
- One pressure gauge
- One foam tank c/w valves and foam pump with mechanical seal for capacity 14.5 m³/hr @ 15 bar
- One compound gauge with cock and copper pipe.

Oil Pollution Control System

An anti-pollution oil dispersant system can be provided, complete with the following:

- a) One (1) detergent proportioner of between 3% to 6%.
- b) Two (2) spray booms, one each at P & S, 6m long aluminium, each fitted with 3 nozzles of 125 litres/min at 5 kg/ cm². Booms to be hinged such that these can be swiveled in for storage and secured perpendicularly out when in use.
- c) One (1) detergent pump at 45 m³/hr at 50m head.

SECTION 7 - SAFETY, COMMUNICATION AND NAVIGATION EQUIPMENT

700. Life Saving Equipment

Life saving equipment is to be in accordance with the requirements of the Government authority and Solas meeting with SPS code for Ocean Going vessel with a total complement of sixth (60).

- Liferafts: : Four (4) twenty-five men & Four (4) twenty men inflatable liferafts with fullemergency pack in rigid fiberglass container conforming to SOLAS 74 latest amend convention. The liferafts are tobe stowed on the forecastle deck in hinged type cradles c/w automatic hydrostatic release or quick sideway launching.
- 2) Lifebuoys : Total Ten (10) lifebuoys to be supplied: Four (4) c/w 90ft buoyancy lines
 - Two (2) c/w 90ft buoyancy line & self-igniting electric lights and smoke signals (quick release type)
 - Four (4) c/w 90ft buoyancy line & self-igniting electric lights
 - lifebuoys to be fitted with retro-reflective tape

seconds discharge time and be waterproof.

- Lifejackets : Sixty (72) approved type lifejackets to be supplied and stowed adjacent to each berth, six (6) child's lifejacket's,six max lifejacket's. and to meet with SOLAS requirement.
- 4) Pyrotechnics : One (1) line throwing apparatus (4 projectiles & 4 lines)
 Six (6) hand flare
 Twelve (12) parachute distress rockets
 Two (2) orange smoke signals each to have 120
- 5) Retro Reflective Tapes : To be fitted to all life saving items.
- 6)

7)

Rescue/Workboat : One (1) semi rigid type rescue boat c/w 40HP long shaft motor capable of carrying 6 persons and remote operated davit for lifting and slewing/ launching

			SOLAS requirements).
8)			
9)			
10)			
11)	Stretcher	:	1 rescue stretcher c/w carrying case and 4 points lifting handle.
12)	Oxygen Resuscitator	:	1 set of sharp or equal oxygen resuscitator c/w oxygen cylinders and 2 spare cylinder.
13)	First Aid Kit	:	4 x 25 men first aid kit
14)	Signboards	:	Emergency procedures, signboards, etc shall be placed at various locations and to be written in English Language.
15)	Work Vest	:	Eight (8) work vests of self uprighting type and approved by U.S. coast guard offshore life jacket type I PFD.
16)	Rescue Zone	:	Each side of the vessel marked with 6mm steel plate rescue zone which is painted in bright yellow with diagonal black stripes. The area located at the center part of the main deck c/w 2 nos. scrambling net to be provided.
17)	Immersion Suit &		
	Thermal protective Aid	:	To follow and comply with SOLAS requirement. Or
		see	king Government authority for exemption
18)	Emergency escape		
	breathing /devices set	:	Emergency escape breathing devices 10.
			Emergency escape breathing devices (spare) 2.
			Emergency escape breathing devices (training) 1.

over one side (both the boat and davit must comply with SOLAS requirements).

701. Firefighting Equipment

Firefighting equipment is to be provided to meet classification, government and Solas regulations and generally in accordance with the following:

1) <u>Firemain</u>

A firemain and twelve (12) 2" bronze hydrants are to be installed, nine (9) on various deck levels and three (3) in engine room/ bow thruster compartment. 15M fire hose c/w brass coupling and jet/ spray type nozzle is to be supplied and stowed alongside each hydrant in a protective box.

- All hose fitting, nozzles and hydrants to be gunmetal BSS336 or marine standard.
- All hoses to be Angus' Flame Fighter or marine standard
- All hose nozzle to be Pyrex T B 25 type or marine standard
- International shore connection is to be fitted 2 off.
- 2) <u>Fireman's Outfit</u>

Six (6) complete fireman's outfit to comply with SOLAS requirement is to be provided: (4 sets for class FiFi One)

- a) One (1) aluminium asbestos protective clothing.
- b) One (1) complete set of Drager premier model : 90 1 breathing apparatus with one (1) spare bottle & safety line
- c) One (1) fireman's axe
- d) One (1) safety lamp of portable battery type
- e) One (1) set of gloves & boots & helmet
- f)

Remarks: One (1) set air compressor capable of recharging the air bottle used in breathing apparatus to be provided and to meet/ comply with classification/ requirement.

3) Portable Fire Extinguishers

Fire extinguishers as required by the classification with Solas latest requirement/government authority. They are as per related approval drawings:

4) <u>Fire Bucket</u>

2 x 3 nos. buckets painted in red c/w seating and marked ' fire' to be supplied in stands.

5) <u>Fixed CO₂ System</u>

A fixed CO_2 flooding system to be installed in paint store, engine room and bow thruster compartment with CO_2 bottles stored in compartment on the main deck and system to meet with Classification/ SOLAS requirement.

6) Flexi-fog water mist extinguishing system

The flexifog water mist local protection system extinguishes or controls fires by cooling, oxygen displacement by water vapour and radiant heat attenuation. And fixed water-based local application fire-fighting system for use in category A machinery space. And all the system must be follow/ comply with SOLAS and Classification requirement.

702. Navigation & Communication Equipment

The following navigation and communication equipment are to be fitted and to comply with GMDSS for sea area: "A3" and IMO/ SOLAS latest requirement and all the equipment are to be submitted to the Buyer for Approval prior to purchase.

1) <u>GMDSS A3 Radio Communication Equipment</u>

The communication equipment to be supplied in accordance with registered country Maritime Safety Authority requirements, Classification requirements to meet GMDSS A3 requirements and to consist of at least the following:

One (1) unit of compact radio console for operation in area A3 containing the following systems: MF/HF radio station 250 W for telephony, telex, DSC and NBDP functions, VHF radio telephone semi-duplex with DSC, Immarsat-C satellite communication for telex and EGC, LRIT.

1)

The console is completely assembled and pre-wired. Equipped with all necessary equipment and components e.g. Emergency light, voltage alarm system, AC/DC distribution and also includes GPS position data with data distribution.

- Comprising of 1 MF/HF Radio with transmitter 250 W (PEP) 1.6 27.5 MHz, main receiver 0.03 – 30 MHz, distress/safety DSC receiver operation terminal with display unit and keyboard and handset Printer for 24 V, Power supply 220 V and 24 V (auto switch-over)
 - 2 VHF Radio Telephone Transceiver with handset and holder, Power supply 220 V and 24 V in, 12 V out, (auto switch-over)
 - 1 Immarsat-C Satellite Communication with Operation terminal/ transceiver unit with EGC/GPS and display unit, keyboard Printer for 24 V, Power supply 220 V and 24 V, (auto switch-over)

2) <u>Navtex Receiver Equipment</u>

One (1) unit of IMO type approved Navtex receiver, receiving SAR messages on dedicated 518 KHz, navigational and meteorological warnings, operates on 24 VDC comprising of receiver-recorder unit and antenna, Weather Fascimile

3) DGPS Navigator Equipment

One (1) unit of IMO type approved DGPS navigator equipment for indication of vessel's position, planning of routes via waypoints plotting, mob position, anchor watch alarm, waypoint arrival alarm, cross-track error alarm, at 4 NMEA outputs for interface to radar, gyro compass, autopilot, GMDSS equipment comprising of display unit, DGPS antenna, standard accessories and connection cable and one repeater for the Forward console.

4) <u>DGPS Equipment</u> (item supplied by DP System Supplier)

Two (2) units of approved type DGPS equipment. System including sub-meter accuracy, 12 channel GPS receiver, L-Band satellite differential correction receiver, dual channel digital MF beacon receiver (IALA), WAAS & EGNOS capable and c/w

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combined L1 GPS, satellite differential beacon antenna and system for interfacing to DP system.

5) <u>SART</u>

Two (2) units of IMO type approved SART (9GHZ) with 96 hrs standby time and at least 8 hrs of continuous operation, constantly interrogated by radar signals.

6) <u>406MHz EPIRB</u>

One (1) unit COSPAS-SARSAT 406mhZ EPIRB, homing on 121.5MHz, ship's particulars programmed internally with automatic float-free hydrostatic release and operation manual.

7) <u>GMDSS type-approved Walkie-Talkie</u>

Three (3) units GMDSS type approved walkie-talkie, 55 INT/US channels with channel 16, lithium battery pack, rechargeable battery pack, charger and antenna.

7a) Six (6) units of UHF band type approved walkie-talkie for crew use.

8) <u>Echo Sounder Equipment</u>

One (1) unit of IMO type approved navigation echo sounder with depth range from 0 to 800m, bottom alarm, depth alarm, interface with DGPS, and NMEA and other navigation data equipment comprising of 1 unit depth graphic LCD display with integral keypad, transducer of 200 KHz, junction box, printer and one repeater for the aft control station.

9)

Radars Equipment

Two (2) radars 96 NM x-band daylight table mounting type radar to be provided (IMO approved type, GRT above 1000) and 220V AC and suitable for 24DC operation and system to interface to Gyrocompass, GPS, time and speed, etc.

Remarks: Two (2) radars of IMO type approved with ATA/ ARPA radar, x-band upmounted transceiver c/w performance monitor (min 21") and 6 ft antenna compromising of 1 radar display, electronic cabinet, keyboard, RPU with control panel, 10 kW x-band pedestal with up-mounted modulator-receiver-transmitter, 6 ft xband antenna array, 1 set of spare parts, user and technical manual.

10) Magnetic Compasses

One (1) reflector type compass c/w Azimuth circle and spare compass bowl.

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11) Automatic Identification System (AIS)

One (1) unit Automatic Identification System (AIS), with GPS antenna, DSC and mounting cassette and Gyro compass, GPS Signals are to be interfaced to the AIS system in according to the IMO/ SOLAS requirement.

12) Ship Security Alert System (SSAS)

One (1) set ship security alert system to be installed on-board and alert shall consist of basic alert functions via e-mail to CSO and security agencies at least three alert button is to be situated at wheelhouse, ECR and captain's cabin and the system must be follow/ comply with IMO/ SOLAS requirement/

13) Speed Log Equipment

One (1) unit of IMO type approved electromagnetic speed log for indication of vessel's speed from 0 to 20 knots and system interface to radar, GPS, gyro compass or autopilot comprising of 1 electronics cabinet with compensation adjustment unit. 1 speed indicator with dimmer for installation in wheelhouse, and 1 transducer, 24 VDC.

14) Gyro Compass c/w Auto-pilot

Three (3) IMO approved type Gyro-compass c/w one (1) auto-pilot system and (two sets Auto-pilot feedback unit c/w in between change over switch and system linkage to the P&S rudder indicator to be provided) P & S wing repeaters with bearing sight and 3 nos. repeater in the wheelhouse Fwd/ aft console and steering gear compartment and to meet with IMO requirement and interfacing as follows:-

- 2 Display unit in radar
 - DGPS Navigator
- 1 Satcom

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- Portable joystick system
- 1 Independent joystick system
- DP consoles, etc.

15) Portable & Independent Joystick Control and DP System

An integrated joystick control system is installed providing full interface between the following:

- i. Two Main engines c/w CP propellers system
- ii. Two steering gear system
- iii. Bow and thruster unit system
 - iv. Stern thruster unit system

Controls to be fitted in both forward and aft wheel house stations.

The Duplex dynamic positioning system shall interface with the vessel main propulsion system, bow & stern thrusters, steering gear, bus tie breaker and main switchboard system allowing to maintain position or to maintain a desired heading. An automatic and a manual control system are to be provided and arranged to operate independently, so that failure in one system will not render the other system inoperative. The numbers of sensors and environmental references shall be according to the requirements of DYNPOS AUTR..

The system shall comprise the following main equipments c/w sensors and position references:

- 2 DP Control computer(s) with console
- 1 independent joystick unit
- 1 portable joystick unit c/w 3 docking station
- 1 laser reference system
- 2 DGPS
- 1 notebook computer
- 2 high speed events printer
- 3 motion (vertical) reference units
- 2 uninterruptible power supply units
- 2 anemometers c/w display units
- Remarks: The system in between manual/ joystick/ DPS control change-over switch shall be installed on wheelhouse aft console.

Necessary prepapration for future installation of HIPAP system along with Hull transponder needs to be done.

16) <u>Anemometer and Anemoscope Equipment</u> (item supplied by DP system supplier) Two (2) units of Wind Speed & Direction Indication equipment c/w display unit with digital signal outputs interface to DP system.

Each comprising of 1 solid state ultrasonic wind speed and direction sensor, 1 wind speed indicator in knots and beaufort scale, 1 wind direction indicator in cardinal scale, 24VDC operation.

17) <u>Laser Reference System</u> (item supplied by DP system supplier)

One (1) unit of high precision laser positioning and tracking system and system interface to DP system.

- 18) <u>Differential Receiver/ Demodulator</u> (Optional:- Item supplied by DP system supplier) One (1) unit x Fugro Sea-star 3000 LRS differential receiver c/w spot-beam antenna or equal and system interface to DP system.
- 19) <u>Horn</u> One (1) mechanical plunger horn

One (1) electrical marine air whistle

20) <u>Ship's Bell</u>

One (1) 300mm brass bell, engraved with the name and year of completion of the vessel.

21) Flag Locker etc.

- One (1) complete set of International signaling flags
- National Ensign
- Two (2) International signal code manual (one for visual, one for radio)
- Flag of country of Builder

PA/Intercom System

One (1) intercom/public address system (PA) consisting of built-in facility for talkback and paging with 10 stations intercom and 13 stations speakers c/w amplifier, microphone, etc. to be provided and system must comply with SOLAS requirement.

23) Sound Powered Phones

Seven (7) Sound powered phones to be fitted and system must comply with SOLAS requirement.

- * Wheelhouse (Fwd and Aft)
- * Captain and Chief Engineer Cabins
- * Engine Room c/w headset and siren and rotating light
- * Steering gear and B/Thruster compartment c/w headset and siren & rotating light

24) <u>Portable Transistorised Loud Hailer</u> One Unit battery type

25) Charts & Publication

One set of relevant charts for International Water Area and publications and tide table.(Buyer's item)

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	ar ne el Aleman en la constanta en la constant	ECDIS System (Buyer to provide) One (1) Electronic Chart Display and Information System (ECDIS) with 19 inch display, IMO approve type shall be installed. Buyers should provide detailed information of future installation before related drawings are completed.
	25a)	<u>Loading Computer</u> A class approved Loading computer with necessary software to be installed.
	26)	<u>Electrical Navigation Lights & Shapes</u> A Single or complete set of dual lens, 24V DC supply navigation lights is to be supplied and fitted as specified in electrical section. In addition to this, the following is to be supplied:
		Two (2) black circular shapes of 600 mm diameter One (1) black diamond shape of 600 mm
	27)	<u>_Clinometer</u> Three (3) units, wall mounted (one in wheelhouse, two in engine room).
	28)	<u>Chart Table</u> Chart table to be fitted with chart drawers & table light with dimmer.
	29)	<u>Clock</u> Fourteen (14) marine battery clocks One (1) radio clock
	30)	<u>Aldis Lamp</u> One unit, Francis Aldis lamp c/w battery in a box, 24 D.C.
	31)	<u>Vertical Wiper</u> Eight (8) vertical wipers c/w spray nozzle on forward and aft of wheelhouse windows.
	32)	<u>Barometer</u> One (1) Barometer
	33)	<u>Thermometer</u> Three (3) Thermometers (Wet & Dry type)
	34)	<u>Binoculars</u> Two (2) Binoculars with wooden box, Marine type.
	35)	Sextant

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One (1) sextant

36) <u>Chronometer</u> One (1) chronometer

37) <u>Manuals</u>

All navigational equipment shall be provided with operation manual in English.

38) <u>VHF</u>
 One (1) independent VHF Radiotelephone in the wheelhouse Aft console, 24V. DC.

39) <u>Engine Telegraphs</u>

Three (3) sets electric push button telegraphs operating on 24 volt DC for twin screw propulsion in the wheelhouse and engine control room.

40) Morse Signal Lamp

One (1) Morse signal lamp system and two (2) Morse key switch to be provided.

41) <u>Television (TV) Receiver Set (Buyers to provide)</u>

One (1) TV receiver of world wide multi system and television antenna system to be provided in accommodation area. The TV terminal to be installed in all cabins and mess room. Buyer should provide detail information of future installed equipment before related drawings completed.

42) Voyage Data Recorder (VDR)

One (1) VDR in compliance with IMO and IEC regulation for recording required

interfaced data and events

43) Local Area Network (LAN) System

One (1) set of local area network system shall be provided with hub unit, cables and sockets, etc. to be installed in wheelhouse, ship offices, ECR and all cabins

44) Automatic Telephone System

One (1) set internal auto telephone communication system with capacity of minimum 50 lines with interface to the PA-system shall be installed. The telephone to be provide in all cabins, mess room, ship office and wheelhouse

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SECTION 8 - ELECTRICAL

800. General Installation

All electrical installation, systems, equipment, switch gear etc. to fully comply with Class and Authority and be of first class marine standard. All main equipment shall be supplied with Class certificate, according to Class and Authority requirement.

The diesel electric power frequency drive system shall be based on - Active front end (AFE) technology

Harmonic distortion

Harmonic Distortion on 440V bus to be below recommended from Class, but maximum 5% THD, and less than 3% for any single harmonic.

If the total harmonic distortion above are exceeded, proper harmonics filter to be installed on the consumers causing the distortion (variable frequency drives, rectifier, UPS's, switched mode power supplies, etc).

Electrical design requirements and standards.

The electrical system, equipment, components and materials shall be designed, produced and installed in accordance with specification, proven marine practice, Class requirements and furthermore with rules and regulations as stated in the general section.

The electrical installations shall be compatible with the recommendations of the International Electro technical Commission (IEC), in particular publication No. 60092. Consideration shall be given in the design of all equipment to the environmental conditions of shipboard service, and proven marine components shall be employed.

All electrical equipment shall be suitable rated for marine use under continuous tropical condition. Particular emphasis shall be placed on corrosion, temperatures, vibrations, power supplies and electrical interference effects.

Requirements in IEC 60533 concerning EMC, "Electromagnetic Compatibility of Electrical and Electronic Installations in Ships", shall be fulfilled as a minimum.

Special attention shall be given to prevent equipment from being affected by harmonics, transients or distortions imposed on the main supply by thyristor controlled units.

All Electrical equipment, instruments, regulators etc. should not be interfered by induced current or radiation from other electrical or electronic equipment fitted onboard.

In general, all main electrical equipment shall be supplied through one (1) subcontractor, as far as practical, e.g. main switchboards, motor control centre, motor starters, generators, auxiliary motors, transformers, etc. to ensure that the equipment is of the same approved type and make.

All electrical equipment shall be so located that, as far as practical, they are not exposed to risk of mechanical injury or damage from water, steam, oil or excessive heat. Where unavoidable exposed to such risks, the equipment shall be suitably protected or enclosed.

All electrical equipment shall be clearly and durably labelled for easy identifying with necessary information. All cables (in both ends), conductors and terminals shall be clearly labelled for easy reference to drawings, etc.

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.

As far as practical, the electrical equipment/component shall be the product of Europestandard.

Electrical equipment and measuring instruments shall be scaled in metric units. To the extent practicable, electrical equipment shall be designed and located shall be readily accessible for operation and maintenance and to provide access to all relevant parts that require inspection, repair, removal, and maintenance without the removal of structure or other equipment.

All instruction manuals, drawings, diagrams, name plates, etc. shall be written in English.

All switchboards and distribution panels shall have each circuit permanently marked using durable materials in accordance with installation drawings and Builder's practice. Instruments, controls and equipment shall be permanently marked to show circuit or application. Stainless steel cable tags shall be provided to show cable designators at each cable termination. If both ends of the cable can be easily seen only one cable tag is required. Embossed Nylon cable tags shall be substituted for aluminium tags for cables on weather deck.

Bare metal surfaces of electrical equipment shall be painted in accordance with the painting schedule, except for equipment that is specially treated for corrosion resistance and does not require paint. Metal surfaces shall be protected by a painting system appropriate for use in a marine environment, not enamel alone. The finish colour for the electrical equipment shall be in accordance with the painting schedule.

All electrical equipment shall be protected from vibration under normal operating services by mounting equipment with sufficient structure and hardware, sway bracing etc. All electrical equipment exposed to the weather shall be designed considering wind and saltwater spray.

Feeder circuits shall be protected by moulded-case circuit breakers with both time-over current and instantaneous trip features. Moulded-case circuit breakers for motor circuits shall have a shunt trip coil or under voltage trip coil for preferential trip or emergency stop, where required by the Class Society.

A complete load analysis shall be prepared and submitted by the yard for the main and the ship's service plants for each of the Vessel's functional modes. The accuracy of the load analysis will be confirmed by observing and recording electrical loads at steady state conditions during sea trials. The Builder shall prepare voltage drop calculations in form and content to confirm adequacy of conductors.

The Builder shall provide short circuit calculation of the medium (if any) and low voltage electrical systems, and the adequacy and selectivity of the protective devices. The design of the electric plant including generators, motors and controllers shall be coordinated to insure that the voltage dip, when starting the motors with the highest inrush current shall not exceed 15 percent of the rated voltage.

Electrical and electronic equipment shall be designed, constructed and installed to tolerate transient AC voltage of $\pm 20\%$ and frequency variation of $\pm 10\%$.

Voltage transients shall stabilize to steady state conditions within 2 seconds. Frequency transients shall stabilize to steady state conditions within 5 seconds.

801 Electrical load analysis and Selectivity analysis

A preliminary electrical load balance shall be worked out to indicate the load at the following conditions:

- Transit mode max speed
- Transit mode, service speed.
- Cargo loading/discharge (DP at Platform)
- Cargo loading/discharge (harbour)
- Construction mode (Crane, ROV, DP operation)
- Harbour manoeuvring.
- Harbour resting.
- Emergency power.
- Worst Single Failure mode

Selectivity Analysis to choose circuit breakers, regarding selectivity through-out the whole electric network, shall be worked out.

802 Short circuit calculations

Short circuit analysis shall be worked out based on classification requirements, The three (3) diesel generators shall be arranged for continuous parallel operation while the shaft generators shall only operate in parallel with any other generator for a short period of time for load transfer purposes only.

Short circuit level on 440V/230V main switchboards as well as emergency switchboard and subswitchboards shall be worked out.

Circuit breakers shall be fitted, sized to overcome the short circuit currents without damages in the whole electrical network.

Generator reactance shall be matched with consideration given to short circuit fault level, and level of voltage distortion in the network.

803 Principle electrical diagrams

The electrical power generation and distribution system shall be designed, constructed and installed in principle as shown by the main electrical system supplier.

804 Emergency stops

Emergency stops shall be provided for all engine room and machinery space pumps, standby pumps, fans and other auxiliaries as required by Class.

Emergency switches shall be located in a safety station located outside engine room, preferably on the bridge. Emergency stop circuits for propulsion and other class specified equipments shall be fail safe and provided with loop monitoring.

Emergency stops for fuel oil pumps, lubrication oil pumps and ventilation for engine room shall also have emergency stop from a location close to engine room entrance. Sludge pumps shall have emergency stop at the IMO deck connection flange. Emergency stops shall also be fitted for all water pumps, which in an emergency situation might discharge into a lifeboat/raft. These emergency stop switches shall be located near muster stations.

For ventilation in accommodation, emergency stop switches shall be provided on the bridge.

805 Electrical power system

Electrical plan for this Vessel to consist of the following main equipment. Here after are given as guidance only:

• Two (2) Shaft generators, 2 x 1200kWe, 440V, 60Hz

• Three (3) Aux generators, 3 x 550kWe, 440V, 60Hz

- One (1) Emergency generator 1 x 150 kWe (approx), 440V, 60Hz
- Two (2) Fwd. Tunnel thruster motors(FPP), 2 x 950 kW, 440V
- Two (2) Stern Tunnel thruster motors(CPP), 2 x 500 kW, 440V
- Two (2) Frequency converters(AFE type) for fwd. tunnel thruster motors
- Two (2) Soft starters or Auto-Transformer starters for stern tunnel thruster motors
- One (1) Main switchboard, 440 V (in 4 sections)
- One (1) Main switchboard, ship's net 230 V (in 2 sections)

• Two (2) Transformers for light/small power, 440V/230V(capacity to be in accordance with Electrical Load Analysis.

• One (1) Emergency switchboard, 440V, 230V

• Two (2) Transformer for emergency light etc. 440V/230V(capacity to be in accordance with Electrical Load Analysis.

The sizes of generators and transformers and UPS' to be confirmed by Load analysis.

806 Active Front End Frequency Drives:

Two (2) class approved suitable variable frequency drives of Active Frond End technology to be used for the control of the two forward tunnel Fixed pitch thrusters.

The vendor of the drives to ensure the power quality complies with class rules with regards to maximum harmonic distortion level (THD).

The location of the drives should also be according to vendor recommendation.

The Vendor shall guarantee that the total harmonic distortion (THD) in voltage waveform in the power distribution system is not to exceed 5% and any single harmonic distortion in voltage waveform is not to exceed 3% on the Main SWBD.

807 Electrical supply system general

The electrical plant will be powered by three (3) diesel generators and two (2) shaft generators, or by the emergency generator, or by the shore connection.

1) Generating sets

Main generators:	440V, ·	- 60Hz
Emergency/harbour generator	: 440 V ,-	- 60Hz

2) Main Distribution

Main switchboard (general power consumers/ propulsion/ essential etc.) 440V/60Hz

Main switchboard (lighting / domestic equipment):......230V/60Hz (Obtained from transformers)

Battery systems (electronic / automation equipment):24V DC (Obtained from rectifiers)

3) 440V AC Main System

The main generators are controlled by a Power Management System. During "at sea" conditions, the 440V AC main generators shall serve as the source of power to the system thorough the 440V main switchboard and emergency switchboard. During normal (non-emergency) conditions, the main 440V MSB - and emergency switchboards will be connected via a bus tie. Distribution panels shall have one (1) spare breaker for each five (5) active breakers.

4) 230V AC Main System

The 230V AC main system shall be supplied from the 440V main switchboard via appropriate (440/230V AC) transformers. The 230V AC system shall serve all lighting circuits and other 230V AC power consumers.

Lighting distribution panels shall have one spare breaker for each ten (10).

5) 440V AC Emergency System

Normal power for the emergency switchboard is supplied from the 440V main switchboard through a bus tie breaker. Upon loss of normal power, the emergency generator shall be automatically started and shall open the bus tie breaker to the low voltage switchboard. Then the emergency generator breaker shall be engaged and supply power to the emergency consumers. The emergency generator circuit breakers shall be electrically interlocked in order to prevent damage to electrical systems.

6) 230V AC Emergency System

The 230V AC emergency system shall be supplied from the 440V emergency switchboard via appropriate (440V/230V AC) transformers. The 230V AC system shall serve all 230V AC emergency consumers.

Lighting distribution panels shall have one (1) spare breaker for each ten (10).

7) 24V DC System

The 24V DC supply for navigation aids is to be obtained from two (2) banks of 24V, 200 AH batteries and located in the wheelhouse top.

A 24V DC supply for GMDSS radio is to be obtained from two (2) banks of 24V, 200 AH batteries.

Static battery charger, Model Victron Energie 50 amp, 24V DC output is to be provided for charging the above batteries and located in the wheelhouse.

Batteries to be stored in two (2) fibre glass storage box c/w glands and ventilation for D.C. Wiring outlets and located on wheelhouse top.

808 Transformers

1) General

Transformers shall be located so as shall be protected from excess moisture or exposure to liquids and so that the ventilation is not impeded by other equipment, structure or protective shielding.

The transformers shall be of the 3-phase marine type having

Insulation class F and IP 23 enclosure. They shall be installed in dry, clean and well ventilated rooms. Mechanical ventilation with air cleaning filters shall be used if necessary. Heat from transformer shall not affect the main switchboards ventilation.

Each transformer to have capacity of 120% of the load indicated in the electrical load analysis.,

2) Transformer for 230V system, 440V/230V

Two (2) transformers 400/230V shall be installed, with sufficient capacity for supplying 230V ship load. The capacity of each shall be final decision by load analysis. The transformer shall have high reactance in order to reduce the short circuit capacity on the 230V distribution system.

3) Emergency lighting transformers, 440V / 230V

Two (2) transformers with sufficient capacity to supplying all 230V emergency power and lighting shall be installed in emergency generator room. The capacity of each shall be final decision by load analysis. The transformer shall have high resistance in order to reduce the short circuit capacity on the 230V distribution system.

809 Shore connection system

One (1) shore connection to designed for 440V, 250A, 60Hz shall be installed in combination with 440V Mains SWBD and shall be fitted with followings:

One (1) Phase sequence indication lamps

One (1) "POWER ON" indicating lamp

Two (2) 440V, 250A moulded case motorized circuit breaker or contactor for automatic phase shift

The shore supply circuit shall be interlocked with the ship main and emergency generator breakers to prevent parallel operation.

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The connection box shall be fitted with followings:

One (1) 250 A moulded case circuit breaker

One (1) Kilowatt-hour meter

A 100 meters length of shore power connecting cable with 250 A capacity shall be provided and stored. Cable shall be securely stowed in an area protected from weather and seas. A notice shall be provided to give information of the supply system and the procedure for carrying out the connection.

Cable entry shall be provided at the bottom of the box for the temporary connection of the shore power cable. Cable entry shall be designed to facilitate ease of cable connection and hook up. The shore power connecting box shall be permanently wired to the main 440V switchboard.

810. Electrical Cables and Installation

General

Cables supplying a single load, in general, shall have a continuous current carrying capacity of the connected load.

Cables supplying multiple loads, in general, shall have a current carrying capacity calculated without consideration of demand factor and/or diversity factor to the total connected loads.

The voltage drop on all power and lighting circuits from main bus bars to the final termination point shall not exceed 6% of the nominal voltage, except for DC circuits, where a maximum voltage drop of 10% of the nominal voltage is allowed.

The type of cables and installation inside switchboards, starters, panels, etc. shall be provided in compliance with the regulations of the Classification Society and the requirements of Section and its various subsections.

Cables to and from frequency converters shall be approved by frequency converter manufacturer.

Cable and wire marking

All electrical cables in both ends, conductors and terminals shall be clearly and durably labelled for easy indication and drawing reference.

Routing of cables

In general, cables shall be supported by continuous galvanized steel metal hangers, ladders or cable trays as far as possible. Indoors, zinc primed metal, or other approved non-metallic hangers, laddersor cable trays, may be used.

Metal hangers, ladders or cable trays shall also be provided in bends in order to get a continuous support. Expansion joints shall be provided where required. No cables shall be run on unpainted steel. Cables shall be protected by removable steel covering or steel conduit

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where exposed to hot water, oil, high temperature or mechanical damage. Horizontal mounted steel conduits used for cable protection to have 6mm holes for drainage for every 2m. Cables run under the lowest flooring in engine room shall be protected with cable tray or steel conduits with drain holes, for protection against mechanical damage. All cable runs shall be as continuous and straight as possible.

The minimum bending radius permitted by the manufacturer shall be followed. No cables shall be painted.

Separate labelled cable trays shall be installed for cables for communication, signalling and remote control with minimum 0,2m distance to power cables if parallel running more than 10m, in order to avoid electromagnetic interference.

Cables belonging to intrinsically safe circuits shall be marked specially and must be laid at a distance of 0,3m from cables of non-intrinsically safe circuits or laid in special protective conduit.

Where a system shall have duplicated supply and/or control cables, for safety reason, the cable routes shall be located as far apart as possible.

Cables for supply of important main and emergency consumers, lighting and important communications and signalling systems shall, whenever possible, not be run through galley, laundry, engine room and their casings and area of high fire risk.

Cable bundles

Power cable bundles of maximum six (6) cables shall be run on the cable trays and ladders/hangers, according to Class requirement.

Cable inlet and penetration

Cable inlets of electrical equipment outside the dry accommodation spaces shall be made from the bottom, or lower part of said equipment with drip proof installation. Cable inlets of main and emergency switchboard as well as group starter boards and similar equipment shall be made from the bottom only.

Watertight or gas tight cable penetrations through decks or bulkheads (A60 area) shall be of a Class approved multi cable transit type (MCT), with possibilities to open the transit for future additional cables. Where only one cable is passing through a deck or bulkhead, a Class approved single gland mounted on a pipe welded to the surface, can be used. Class approved sealing compound shall be used for other areas to the satisfaction of site surveyor.

Where cables pass through non-watertight stiffeners or bulkheads, the cables shall be protected by lead, rubber or plastic grommet to prevent sharp metal from damaging cable insulation, and fire resistant compound shall be used in order to prevent air circulation in the event of fire.

Where cables for lighting, switches, receptacles, clocks, alarms, instrumentation, etc. penetrates a joiner bulkhead, the hole in the jointer bulkhead shall be circular, of uniform size

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and suitably fitted with a rubber or plastic grommet to prevent sharp metal edges of the joiner panel from damaging cable insulation.

Earthing

All current carrying parts of the electrical equipment contained in metal enclosures shall be insulated so as to reduce the risk of electrical shock to personnel.

Non-current carrying metal parts of electrical equipment shall be effectively earthed by means of copper straps connected to the Vessels structure, according to Class requirement. Where applicable, screened cable shall be used.

Earthing of power cables and electrical equipment shall be done according to Class rules and regulations.

Earthing of instrumentation and communication cable screens shall be done according to makers' requirement. The screen/earthing wire shall be as short as possible, in order to prevent electromagnetic noise and interference. In general, to prevent EMC, special cable glands shall be used for earthing of cable screen outside the equipment (no cable screen inside enclosure for sensitive equipment).

Special attention shall be made when installing single core cables, for e.g. generators, thrusters, etc.

3 phase installation of single core cables shall be done in a trefoil formation, using the same length of cable, non-metallic penetration, etc.

For instrumentation/communication cables with only one screen, the cable screen shall be earthed in both ends (if accepted by equipment maker). If double-screened cables are used, the outer screen shall be connected to earth in both ends and the inner screen shall then be connected the shortest way to earth in one end.

Fixing of cables

Cables shall be properly fixed according to Class requirement.

Electric equipment enclosure

All electrical equipment in machinery or similar spaces shall have at least IP 23 enclosures unless otherwise specified.

Equipment under floors and other wet places shall have minimum IP 44 enclosure and equipment on deck shall be of minimum IP 56 enclosure.

Cable types

All cables shall be marine type weather resistant cables designed for 45°C ambient temperature and a temperature class of 85°C for propulsion, power and lighting cables.

All cables to have Class certificate and shall in general be constructed by use of stranded copper conductors, insulation of Cross linked Poly-Ethylene (XLPE) or Ethylene Propylene Rubber (EPR) and with outer sheet of EVA cross-linked rubber or polyolefin.

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All power cables shall be produced and tested in accordance with the following international standards: IEC 60092-352 (insulation material), IEC 60092-359 (sheathing material), IEC 60332-3

(fire retardant), IEC 61034 (low smoke), IEC 60754-1 (halogen free), IEC 60754-2 (no corrosivity).

All cables for services, required to be operable under fire conditions shall be of fire resistant type complying with the requirements of IEC 60331-, where they pass through machinery spaces of category A and other high fire risk areas other than those which they serve.

All control and signal cables shall be produced and tested in accordance with the following international standards: IEC 60092-352, IEC 60332-3 (fire retardant), IEC 61034 (low smoke), IEC 60754-1 (halogen free), IEC 60754-2 (no corrosivity).

Power cables, 440 V system

Approved ship's type cable (750V) of ample size minimum 1,5 mm2 shall be used throughout the Vessel. Cables with steel or copper braiding shall be used on deck and in hazardous areas.

All power cables for 440V and 230V shall be laid with 0,2m distance to all lower voltage cables, control cables and monitoring cables.

Lighting cables

Approved ship's type cables (250V) of ample size minimum 1,5 mm2 shall be used throughout the whole Vessel.

Communications, signalling and remote control cables

Approved ship's type copper screened cables, min. 0,75 mm2, shall be used for the low voltage, low current part.

Flexible cords

For portable or semi-portable appliances such as portable lamps, etc., cables shall be flexible ethylene propylene outer oil resistance, rubber insulated and polychloroprene sheeted (PCP), and for table lamps in accommodation, flexible vinyl cord.

Special requirements for cabling

Special low loss screened cables shall be supplied and installed on a dedicated tray away from other power cables(0,3m), where necessary.

Special high standard marine cables, such as coaxial cables, compensating cables, etc. shall be used where required by equipment manufacturer.

Cables for converters

Power cabling from frequency converters to motors shall all be 3-wire cable with copper braiding suitable and approved by the maker the actual frequency converters drives(e.g. IGBT). The cable type shall be designed for variable speed drives with maximum permissible periodic peak voltage as recommended by vendor of the frequency drive. The cables shall be laid with 0,5m distance to all other cables.

811. Installation of Cable Trays

1) Installation in engine room

Cables under flooring in engine rooms and other exposed places shall be properly protected against mechanical damages. All cable trays and cable ladders in areas exposed to water and moist shall be galvanised steel. Cable fasteners shall be made of stainless steel of Buyer approved type.

Separation of cable runs

Cable runs shall be routed well away from hot surfaces and at least 0,3m away from insulated exhaust pipes, etc.

Cable runs for cables for communication, signalling and remote control shall be separated from power cables by a distance of 0,2M.

Cable runs for special low loss screened cables shall be supplied and installed on a dedicated tray away from other power cables (0,5m), where necessary.

Cable runs for cables for high-voltage installations (above 1000V, if applicable) and cables between frequency converters and motors shall be run at a distance of at least 0,5m from low-voltage cables (440/230V).

2) Installation in accommodation

Cables in the whole accommodation shall be concealed in conduits behind ceiling and lining. Halogen free plastic conduits, wall boxes and ceiling boxes shall be used. Where it is impossible to run conduits behind linings, cable ducts with colour matching the wall shall be used.

Main cable trays shall mainly follow the corridors where the junction boxes for the concealed installation shall be placed, above removable ceiling.

Three (3) cable conduit between wheelhouse and monkey island shall be fitted for laying of survey Cables

3) Installation on deck and in cargo area below deck

All cables shall be effectively supported and secured without damaging the outer covering of the cables. Cable groups shall be supported on metal hangers, ladders or cable trays, located away from exhaust or hot pipes, and shall be installed clear of steel hull structure, in order to permit painting of the surrounding structures. Cable ladders shall preferably be fitted with "Z"-

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rungs for possibilities to run cables on both sides of the cable ladders. On all main cable ways a spare space of 10% shall be provided for future installation.

Accessibility of cable runs

Cable runs shall be accessible, except for cables carried in pipes.

Cable runs shall be accessible for later inspection. Free distance above trays, and cables laid on trays, shall be a minimum of 100 mm, for later maintenance and possibility for changing of cables.

Distance between cable trays, or towards adjacent structures shall be a minimum of 50 mm.

When cable runs are carried behind bulkhead lining in accommodation spaces (except when carried in pipes), the panels shall be hinged or fixed for example by screws, so that they can be removed for inspection without damaging the cable or the bulkhead. Exceptions can be made for cables to light fittings, switches, socket outlets etc. in dry accommodation spaces, when the deck head and bulkhead constructions are made of incombustible materials.

Routing of cables for emergency and essential equipment

Cables for power and control of thrusters shall preferably be routed in two different cable runs from propulsion compartment to switchboard room/Emergency generator room and to wheelhouse, respectively.

Cables for essential/ emergency power for lighting, internal communication or signals shall be routed clear of galley, laundry, machinery spaces and other area of high risk of fire. Separation of cable runs

Cable runs shall be routed well away from hot surfaces and at least 0,3m away from insulated exhaust pipes, etc.

Cables for important and essential equipment shall be routed away from the collision zone.

Cable runs for cables for communication, signalling and remote control shall be separated from power cables by a distance of 0,2M.

Cable runs for special low loss screened cables shall be supplied and installed on a dedicated tray away from other power cables (0,5m), where necessary.

Cable runs for cables for high-voltage installations (above 1000V, if applicable) and cables between frequency converters and motors shall be run at a distance of at least 0,5m from low-voltage cables (440/230V).

812 Electrical Common Distribution

1) Main and emergency switchboards

<u>General</u>

The switchboards shall be of self-supporting dead-front, drip-proof (IP23), box frame construction with a drip-cover over the top and shall have hinged front panels that can be opened without disturbing the meters, pilot lamps, etc. mounted on them. Each access panel shall be provided with stays to hold access panels open. The switchboard shall be provided with insulated handrails in front.

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Passage ways for main and emergency switchboards to meet class requirements: Passages in front of main switchboards shall have a height of minimum 2m. The same applies to passages behind switchboards having parts that require operation from the rear.

The width of the front passage of main switchboards shall be at least 0.92m. The width of the passage behind a switchboard where access for operation is necessary, shall be at least 0.61 m, except at frames where it can be reduced to 0.5 m. Doors in open position, or switchgear drawn out in position for service, shall not obstruct the passage, i.e. there shall be at least 0.4 m free passage left. Where switchgear needs passage behind for installation and maintenance work the free passage behind the switchgear shall not be less than 0.61 m, except at frames where it can be reduced to 0.5 m.

The free passageway in front of, or behind the switchboard, shall give unobstructed access to a door for easy escape in case of an emergency situation occurring in the switchgear room. Switchboards shall be protected from fire hazards and shall be capable of withstanding an explosion caused by a short circuit.

A simple mimic diagram indicating busbars, bus-tie breakers, air-circuit breakers for generators and transformers, shall be fitted on the front of the switchboards. Mian switchboard shall be designed so that they can be conveniently extended and to have at least 10% spare capacity.

All switchboards shall be controlled and monitored by the Power Management System (PMS). The arrangement of all main and emergency switchboards shall be approved by Buyer before purchasing. Automatic earth fault monitoring shall be provided for all primary and secondary distribution systems according to class.

<u>Meters</u>

Panel meters shall be a minimum of 88 mm with a 250° scale or greater and 2% accuracy or better.

The rated value shall be marked in red on meters, and the scale of meters shall have the following ranges:

Voltmeters 0 to approx. 120 % of rated voltage Ammeters 0 to approx. 130 % of rated current Wattmeters -15 % (reverse) to approx. 130 % rated wattage Frequency meters 55-65 Hz

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Terminals

Cable terminals shall be of the solder less type and clearly marked with the circuit served.

Fuses

Control and instrument circuits shall be protected by fuses except for circuits where the opening of the fuse could be hazardous. Current transformers for instrumentation shall not be fused.

Bus Bars

The bus bars shall have sufficient current-carrying capacity for continuous operation and provisions shall be made for withstanding mechanical strains created by electromagnetic forces by large motor starting currents or fault currents. The bus bars shall be made of copper. Bus bar supports shall be provided with sufficient strength to withstand a short circuit of bus bars, and shall be made of moisture resistant materials.

Labelling

Labels shall be provided in English and shall identify all switchboard components, such as circuit breakers, control switches, instruments, indicating lights, terminal blocks, transformers, etc.

The nameplate on feeder circuits shall indicate the feeder designation, name of application, cable cross-section and ampere rating.

2) 440V Main switchboard (To meet DYNPOS AUTR)

<u>General</u>

The main switchboard shall be constructed in accordance with the requirements of the Classification Society and arranged with link to allow the switchboard to be split into sections, according to the class approved Single Line drawing.

Spare space shall be provided for future installation of equipments like ROV/Crane/ A-Frame etc.

The generators shall be protected by draw-out type air circuit breakers of the drip free type and controlled by a control switch. In addition, a manual-operating handle shall be provided. The circuit breaker for the generators shall have an over current trip device with long time over current and short time delay trip action, and a magnetic coil for instantaneous and under voltage trip.

Generators shall be protected from reverse power by a reverse-power relay connected to the generator circuit breakers under-voltage trip device (only aux. generators). Each circuit breaker shall be capable of opening circuits carrying maximum rated

current at rated potential and shall be capable of interrupting short circuits within their rating. Steam, water or oil lines shall not be located over close to the switchboard. Air from ventilation ducts shall not be discharged directly on the switchboards. Switchboards and internal components shall be capable of withstanding shipboard vibration without damage or faulty operation.

Main and emergency switchboards shall be properly illuminated and part of these lighting shall be fed from the emergency supply system.

All circuit breakers on the switchboard shall be able to withstand the maximum short circuit capacity when all generators are running. In case of not fully type tested SWBD, arc detection equipment to be installed.

Generator breakers shall be motor operated Air Circuit Breakers (ACB) of draw-out type. Other feeder circuit breaker shall be manual operated Moulded Case Circuit Breakers (MCCB). The switchboards shall be controlled by "Power Management System" (PMS).

Parallel operation of generators

The aux. generators shall be arranged for parallel running with automatic load sharing. The shaft generators shall not run in continuous parallel with any other generator except for load transfer purposes. Automatic synchronizing shall be arranged for all generators.

Layout 440 VAC Main switchboard

Each generator panel shall be designed as an independent unit.

Non-conducting handrails shall be provided at the front of the switchboard.

Each generator panel at least shall be provided with the followings:

One (1) Draw out type air circuit breaker for generator

One (1) Voltmeter with a selector switch

Three (3) Ammeters(one for each phase)

One (1) Frequency meter

One (1) Wattmeter (aux. generators also with reverse power indication)

One (1) Reactive Power meter/guard

One (1) Short circuit guard

One (1) Over current guard

One (1) Reverse power guard

One (1) Under voltage guard

One (1) High/low voltage and frequency guard

One (1) Circuit breaker "ON" indicating lamp (green)

One (1) Circuit breaker "OFF" indicating lamp (red)

One (1) Space heater "ON" indicating lamp (blue)

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The list of consumers should be approved by Buyer.

Type and number of components fitted on the panels shall be in accordance with Class requirement, manufacturer's standard and subject to Buyer approval during plan review.

Emergency switchboard shall be connected to the switchboard.

The 440V feeder panel at least shall be provided with the following:

- Insulation level meter with earth indication lamp (for each busbar system)

- 10% Spare breakers of each type and size (for less than 400A circuit breaker)

- 10% Spare space for less than 400A circuit breaker

- Necessary number of triple pole moulded case circuit breakers

The list of consumers should be approved by Buyer.

3) 230V Main switchboard

The switchboard shall be supplied from two (2) transformers, fed from the 440V main Switch board. Circuit breaker shall be of moulded case type. The list of consumers should be approved by Buyer.

<u>Layout</u>

The 230V AC feeder panel shall be provided with following:

- One (1) Ammeter reading phase current of the transformer's secondary circuit.

- One (1) Voltmeter with a selector switch for reading each phase

- One (1) Insulation level meter with earth indication lamp (each busbar)

- 10% Spare breakers of each type and size

- Nécessary number of triple or two(2) pole moulded case circuit breakers

4) 440V/ 230V Emergency switchboard

The switchboard shall normally be supplied from 440V main switchboard. 230V section shall be fed from two (2) 440/230V transformers, supplied from the 440V section.

The list of consumers should be approved by Buyer.

Emergency switchboard.

In case of a black-out, the connection between main and emergency switchboard opens. The emergency generator will start automatically and connect the emergency generator breaker according to Class requirement. Emergency generator shall have possibilities to feed the 440V main switchboard in harbour condition. Selector switch "emerg. gen. – harb. Gen " to be mounted in emerg. switchboard. Alarm indication to be provided if selector switch is in harb. gen. position at sea. In "emerg. gen." mode, no external cables shall
have influence.

Layout

The generator and 440V AC feeder panel shall be provided with followings.

- One (1) Draw out type air circuit breaker for generator (motor operated)
- One (1) Moulded case circuit breaker (MCCB) for bus tie to main switchboard

Two (2) - MCCB for 440/230V transformer (manual operated)

One (1) - Voltmeter with a selector switch

One (1) - Ammeter with a selector switch

One (1) - Frequency meter

One (1) - Wattmeter

One (1) - Generator running indicating lamp (white)

One (1) - Circuit breaker "ON" indicating lamp (green)

One (1) - Circuit breaker "OFF" indicating lamp (red)

One (1) - Space heater "ON" indicating lamp (orange)

Necessary number of moulded case circuit breakers

Two (2) - Spare breakers

Space heaters

Should voltage failure of the 440V AC Emergency switchboard be detected, the emergency/harbour

generator will start automatically and feed the emergency switchboard.

The following consumers shall be fed from the 440V AC panel of the emergency switchboard:

Two (2) Emergency lighting transformers

One (1) Emergency air compressor

One (1) Emergency fire pump

Any other consumer required by the Rule and Regulation.

813 AC Motors & Motor starters

General

Motors in general to be AC 3 phase induction motors with nominal voltage of 440V and rated at 60Hz frequency. Exceptions to be approved by owner and accepted by class.

All motors which are to be located below main deck and in Engine room to be atleast IP 23. IP ratings to be according to deck area and class regulation.

All motors which are to be located in hazardous zones are to be explosion proof rated and the list of such motors to be sent to class for acceptance.

The specification described in this section shall be applied, in general, to motor starters. However, starters supplied as part of the following equipment shall be constructed in

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accordance with the relevant manufacturer's standards:

- Electric appliances provided in the galley, pantry, laundry
- Navigation equipment such as radar, gyrocompass, etc.
- Instrumentation and control equipment
- Package type air conditioning units
- Auxiliary machinery such as deck cranes, provision cranes, lifeboat davits, ventilating fans, workshop machinery, tools, etc.
- In general, starters shall be a drip-proof type and shall be of suitable construction for either deck or bulkhead mounting.
- Drawings of the starter circuit shall be provided and mounted in clear plastic envelopes inside the starter enclosure.
- Starters shall be of electro-magnetically operated type, except starters for nonessential motors of 0.5 kW and less, that may be manually operated with moulded case circuit breakers or protectively fused line switches.
- In general, starters shall be of direct-on-line starting type.
- Where excessively high starting current of the large motors could cause voltage drop of the switchboard bus bars more than 15 %, the starters for those motors shall be of star to delta or auto-transformer starting type.
- Generally, starter units for auxiliaries shall be included in group starter boards in the respective switchboards, except for some motors requiring special local controls, such as purifiers, machine tools, pumps connected to valve chests, etc.
- Under-voltage release and under-voltage protection shall be provided in accordance with regulatory requirements.

814 Emergency Stop System (also see 804)

All cargo pumps, ventilating fans, FO purifiers, FO pumps, LO pumps and the incinerator shall be stopped in case of fire and their stopping devices shall be divided as follows:

For ventilating fans in the engine room, FO purifiers, fuel oil pumps and LO pumps, the stop push button box shall be fitted in the fire control station and in the wheelhouse. For ventilating fans in the accommodation and all cargo pumps, the stop push button box shall be fitted in the wheelhouse.

The arrangement of emergency stop system shall be in accordance with the requirements of the Classification Society and other applicable rules and regulations.

815 Distribution boards and panels

1) General

Each distribution board shall be furnished with an engraved plastic nameplate on the front with all necessary information (name of consumer, location, main fuse rating and

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feeder cable size). Inside each distribution board a directory sheet in transparent plastic cover shall be fitted, with necessary information for all feeders (name of consumer, location, fuse rating and cable size).

Protection shall be provided against accidental contact with life parts.

All steel enclosures including doors shall be earthed.

A sufficient number of spare circuit breakers (20%) shall be left in each distribution panel when the Vessel is completed. All fuses up to 63 amps shall be of the automatic circuit breaker type, except where for technical reasons, the other type must be used. Fuses above 63 amps shall be avoided in distr. panels.

All switchboards/panels in accommodation spaces shall be fitted in lockable cabinets, near the cable duct room on the respective decks. All cable inlets/outlets for switchboard/panels throughout the Vessel shall be fitted with fire resistant compound. All distribution board shall be located for easy access. Distribution boards fitted on bridge shall flush-mounted type (recess mounted).

2) 440V distribution board

The 440 V distribution boards for supply of 440V power consumers shall be located where necessary around the vessel. 440V distribution boards shall be denominated "P1", "P2", etc., with numbering starting on the bridge.

3) 230V distribution board

The 230V distribution boards for supply of low consumption- and domestic equipment shall be located where necessary around the Vessel, with at least one 230V distribution board fitted on each deck level.

The 230V distribution boards shall be denominated "L1", "L2", etc., with numbering starting on the bridge. 230V distribution panels for accommodation shall be located in a central position on the deck served. To the extent possible, lighting distribution panels will be located in the same position on each deck served.

4) 230V Emergency distribution board

One (1) emergency switchboard denominated E1 shall be fitted on the bridge. More shall be located as deemed necessary during the design stage.

5) Navigation light panel

Signal light distribution panel shall be supplied from both the main switchboard and emergency switchboard

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6) Distribution board galley

Amp. meter shall be included in the galley equipment distribution panel for easy control and testing of the galley range, hot plates etc.

7) Test panel

Test panel for testing of motors, lights etc. with various voltages (440V, 230V, 24VDC) shall be fitted in el. workshop.

8) 24V DC distribution boards

Five (5) dead-front type battery switchboards shall be provided for the 24V battery

distribution systems (switchboards on bridge shall be recessed type).

The distribution boards shall be denominated as follows:

R1 –24V DC Distribution board for GMDSS console (if not a part of the console).

B1 - 24V DC Distribution board no. 1 for consumers on bridge

B2-24V DC Distribution board no. 2 for consumers on bridge

B3 - 24V DC Distribution board no. 1 for consumers in engine room

B4 - 24V DC Distribution board no. 2 for consumers in engine room

Normally, the battery charges/power supplies shall supply various distribution boards, and shall be designed for 100% capacity.

The charging rate shall be sufficient to replace 100% battery capacity within 10 hours at which point the unit shall automatically revert to the trickle charge rate.

Each battery charger/switchboard shall be fitted with the following instruments and devices:

One (1) - Voltage adjuster

One (1) - DC voltmeter

One (1) - DC ammeter with a selector switch

One (1) - Source pilot lamp

One (1) - Insulation level meter with earth indicating lamp

One (1) - Push button switch (quick charging or trickle charging)

Necessary numbers of feeder circuit breaker with fuses

Battery charging failure alarm

Low voltage alarm for on-line battery

Summary alarm for machinery monitoring system

816. Lightings

General

Emergency lighting shall be installed throughout the Vessel according to Class and Authority requirement.

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Emergency lighting shall normally be used as general illumination purpose and fed from the emergency switchboard via each emergency lighting distribution panel.

Around outside aft deck, in corridors at each deck, in each stairway and escape routes, some light fixtures with built-in chargeable batteries (1 hours capacity) shall be mounted as part of the emergency light system.

Arrangement

Emergency lighting circuits shall be provided as partial lighting in at least the following areas:

- Wheelhouse and communications spaces
- Fire/fire control stations
- Public Rooms
- Galley
- Alleyways
- Exits
- Staircases
- Engine Room
- Switchboard room
- Working deck
- Emergency generator room
- Steering Gear room
- Tunnel Thruster room
- Life raft stations
- MOB boat station

Elsewhere as required by Class and Authorities.

Chart lights, bunker lights, instrument lights, navigation and signal lights shall also be fed from the emergency switchboard.

Special lighting

Instrument Lights:

Instrument lamps shall be provided for the main engine revolution indicators, gearbox pitch/rpm indicators, azimuth thruster motor revolution indicators, azimuth thruster angle indicators, bow and stern thruster pitch/rpm indicators, switch panels and other control equipment, and all radio and nautical instruments in the wheelhouse.

The instrument lights for bridge controls shall be fed through dimmer switches, from one common dimmer switch in front console and one common dimmer switch in aft console. Instrument lighting for bridge wing controls shall be fitted with separate dimmers.

Chart lamps:

The following chart lamps, all provided with dimmer switches, shall be fitted over the chart table:

• One (1) 60W lamp with adjustable arms.

Instruction board:

Additional lamps shall be fitted above information and instruction boards.

Ship's name board lighting:

Four (4) Fluorescent lighting with special shades shall be fitted, with two (2) fittings on each ship's name board.

Light and signalling equipment (searchlights, navigation lights, horn, etc)

Portable lamps:

Ten (10) fluorescent portable lamps, shall be supplied, complete with lamp, guards and hooks.

Each lamp shall have 15m flexible cord and plug.

Illumination levels

In general, rooms and spaces shall be effectively illuminated according to the following standard. The figures given are the average horizontal illumination levels with a tolerance of 10% at the stated measuring points.

The measuring point for cabins and rooms in the accommodation space shall be at the centre of the space between the lamp and wall and/or between lamps in cabins and rooms. Measurements shall be taken at the height of 85 cm above the deck.

The measuring point for machinery spaces shall be at working and/or passage spaces as agreed between Builder and Buyer. Measurements shall be taken at the height of 85 cm above the deck or grating level.

No individual work area or significant portion of an individual work area in which machinery or equipment shall normally be operated or maintained, shall be illuminated at less than 90% of the specified average level.

Compartment/area	Illumination level in lux	Remarks
Engine room	300	
Thruster rooms	300	400 at control panels
Machinery rooms	300	-
Switchboard room	300	-
Engine Control Room	300	-
Workshops	500	-
Muster area	200	-
Paint shop	500	-
Stores	100	-
Galley	500	750 lux at working surfaces, food

Average illumination levels shall be:

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Compartment/area	Illumination level in lux	Remarks
	:	preparation counter and range tops
Pantry	300	-
Mess and day rooms	300	-
Offices	300	-
Cabins	150	500 lux at desk
Hospital	500	-
Interior corridors / stairways	200	-
Exterior corridors / stairways	150	-
Laundry	300	-
Wheelhouse	300	500 lux on chart table and radio equipment area
Refrigerated chambers and dry provision store	150	
Working deck area	250	-
Mooring stations	250	-
Toilets	200	-
Emergency generator room	300	-

The light installation shall be according to the lux levels indicated in the table above.

In addition to the general ordinary lighting, special attention shall be made for installation of local illumination of control panels, bilge wells, working bench, sign boards, etc., which is important for safe operation of the Vessel.

In general, machinery spaces, stores, engine room, thruster rooms, workshop, etc, shall be illuminated by two (2) x 40W or two (2) x 18W fluorescent light fittings. Other light fitting types may be used for special illumination purpose. For use of light switches in engine room, see 890.2.

Working light

A sufficient number of working light shall be fitted in engine work shop and other workshops. Flexible working lamps shall be fitted on all machine tools as well as on all working benches.

Lighting fixtures in machinery spaces, engine room, stores, etc.

Machinery space lighting shall be so arranged that failure of one branch circuit shall not cause complete darkness in the said space.

Engine room, thrusters rooms, store rooms, workshops etc. shall be provided with high quality fluorescent fixtures of the following types:

Two (2) x 18W with polycarbonate shade, IP 44 enclosure (IP 56 in cargo holds)

Light fixtures in bilge wells requires special incandescent light fixtures (IP 67).

Lighting ECR/switchboard room:

Flush mounted fluorescent fittings of 2x18W (IP22) shall be installed in the ceiling in engine control room and switchboard room.

Battery room, paint and chemical stores:

Battery rooms and paint store shall be fitted out with Explosion Proof equipment (also cablepenetration). Fluorescent light fittings shall be 2 x 18W.

Emergency lighting (AC and DC)

The emergency lighting shall be part of the ordinary lighting installation throughout the whole accommodation. Where rules and regulations require lighting fixtures supplied from two (2) separate circuits, one (1) of them shall be connected to the emergency power system. To include machinery space.

Arrangement

The following equipment shall be installed in each cabin as a minimum:

• Two (2) x Fluorescent fitting, 2x18W of recessed type shall be installed in each room (three(3) in each master and chief engineer cabin, 3rd unit fed from emergency source).

• One (1) x Fluorescent fitting, 2x18W of recessed type shall be installed in each bedroom.

• Sufficient numbers of 230V down-light may also be used as an alternative, if more appropriate.

• One (1) x Fluorescent berth light, 1 x 8W, with diffuser, shall be installed above each berth (head end), with on/off switch fitted on the front.

• One (1) x Wall lamp of ornamental type.

• Three (3) x Twin receptacles (230V) for radio, refrigerator, hair dryer etc., one of them installed above the table.

• One (1) x Fluorescent fitting, 1x18W, mounted above the desk (below book shelf), with switch fitted on the front.

The additional equipment shall be installed in the officers' cabins/clients cabins:

• Two (2) x Wall lamps of ornamental type.

• One (1) x Flexible table lamp, 1x18W.

• One (1) x Down-light, 1x13W (fed from the 230V emergency distribution board).

• One (1) x Twin receptacles (230V).

Mess room and day room lighting

Two (2) x18W or Two (2) x 40W recessed fluorescent lighting fixtures, with silver/aluminium metal screen shall be used as ceiling lights. In addition, down-light /low voltage illumination and sconces shall be arranged, for illumination of special area (Buyer to advice).

Necessary amount of ornamental type wall and/or table lamps shall be arranged to give a comfortable environment (depending of room size, design and arrangement).

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The lighting shall be so arranged that failure of one branch circuit shall not cause complete darkness in the room.

Fluorescent ceiling light, down lights and wall lamps shall have separate switches arranged at each entrance.

Offices

Two (2) x Fluorescent fitting, 2x18W of 2 x 18W recessed fluorescent lighting fixture type, with silver/aluminium metal screen shall be used as ceiling lights (Three (3) in large offices). One (1)x Light fixture with flexible arm shall be fitted above each writing desk.

Corridors and stairways

Lighting fixtures in corridors and stairways shall be supplied from two (2) separate circuits, one (1) of them shall be connected to the emergency supply system. This emergency lighting shall be used as

general illumination purpose and shall be fed from the emergency switchboard via each emergency lighting distribution panel.

Some of these emergency light fixtures shall be fitted with built-in chargeable batteries (3 hours capacity) and arranged with the philosophy that a blackout of the main system shall not cause complete darkness in the stairways and corridors during the time it takes to start and connect the emergency generator.

Hospital

Two (2) x 18W recessed fluorescent lighting fixtures, with silver/aluminium metal screen shall be used as ceiling lights. Necessary amount of ornamental type wall lamp (sconce) shall be arranged to give a comfortable environment (depending of room size, design and arrangement).

Fluorescent berth light, one (1) \times 8W, with diffuser, shall be installed above each berth (head end), with on/off switch fitted on the front.

One (1) light fitting shall be provided with a 3 hour built in back-up battery pack.

The lighting in the hospital shall be possible to regulate down to minimum (except berth light). Hospital alarm shall be installed according to requirements from class and authorities.

Bath rooms and toilet rooms

One (1) lighting fixture 1 x 18W including a socket outlet with isolating transformer (shaver outlet), shall be mounted above the mirror. Additional ceiling light of recessed type shall be fitted, if necessary (IP44).

Toilet on bridge shall in addition be provided with a red light, connected to the same switch as the red lights on bridge.

Refrigerated provision compartments shall be illuminated by a special sub-zero temperature waterproof 2x40W fluorescent fittings and controlled by switch with red pilot lamp outside of the compartments.

Wheelhouse lighting

General

Fluorescent light fittings shall be used as general lighting in the wheelhouse (2x18W). Half of these light fittings shall be fed from the emergency switchboard.

Down light fixtures of fluorescent type shall be installed above all control consoles with separate dimmer switches for each console.

Red lights

In addition to the ordinary lighting, special red lighting to preserve the night vision shall be installed for the wheelhouse, toilet in wheelhouse and at the chart space. Approx. ten (10) fluorescent light fittings, 1 x 18W, recessed type, shall be installed in the ceiling for this purpose evenly distributed around the wheelhouse. The red lighting shall be supplied from the emergency switchboard and shall be provided with dimmer switches, giving a variable red lighting.

Door switches

The door between wheelhouse and corridor below and door between wheelhouse and toilet in wheelhouse shall be provided with door switches for switching off the bright light in corridor/ toilet

while the door is open, preventing bright light from the said area to come into the wheelhouse.

Electrical lighting system for weather deck etc

General

Deck lighting in working deck area shall comply with Rules. The light installation shall be according to the lux levels indicated in the table above.

High-pressure sodium floodlights shall be fitted for lighting of fore-, side- and aft decks and other open deck areas.

All floodlights, searchlights and fluorescent fittings in the forecastle area must be given special protection against sea spray.

A switch control panel for all deck lighting shall be fitted in the wheelhouse.

Cables shall pass through accommodation with short cable pipe connections to the lighting fixtures.

Cables between lighting fixtures shall be protected by steel conduits. No bare cables shall be run on deck. Flexible/movable lamps shall be connected via junction boxes with flexible cable entering box through covered cable gland.



Searchlights

Four (4) Searchlights shall be fitted on the wheelhouse roof, two(2) located fore (port and stbd.), and two (2) located aft (port and stbd.), each with the following functions and accessories:

- Electrical remote controlled from inside bridge, fore and aft.
- 2.000 W.
- Variable focus.
- Capable of giving 360 deg total coverage.

Emergency lighting

Part of the deck light shall be fed from the emergency switchboard, and necessary light fittings shall be provided with built-in chargeable batteries (one (1) hours capacity).

Stairways

Lighting fixtures at external stairways shall be supplied from two (2) separate circuits, one (1) shall be connected to the emergency supply system. The emergency lighting shall be used as general illumination purpose. Some of the emergency light fixtures shall be fitted with built-in chargeable batteries (three (3) hours capacity) and arranged in such a way that a black-out of the main system

shall not cause complete darkness in the stairways during the time it takes to restore power supply.

General deck lighting

High quality two (2) x 18W and fluorescent lamps made of polycarbonate, seawater resistant aluminium or stainless steel shall be installed as general illumination on external decks. For exposed deck areas in front-, and on stbd./port sides of superstructure, fluorescent lighting shall be of brass

casting, type 2x7W, IP 67, and aft port & stbd. side deck area shall be explosion proof type 2 x 18W (IP 67) fluorescent lamp.

Life raft Embarkation Lights

Minimum one (1) 300 W, halogen floodlight with local switch shall be fitted at MOB boat and life raft stations. The light shall be fed from the 230 VAC emergency supply system.

One (1) 2x18 W, fluorescent fixture with built-in battery pack (3 hours), shall also be fitted at each life raft storage space, controlled from the wheelhouse light control panel. The light shall be fed from the 220 VAC emergency supply system.

Two (2) incandescent lights (40W) fed from the 24 VDC supply system (bridge) shall be provided for the MOB boat station.

Floodlights

High-pressure sodium and halogen floodlights shall be provided for deck illumination. Sodium vapour type floodlight shall be provided for ROV deck and cargo deck.

Generally, floodlights shall be fitted for lighting of fore-, side-, and aft decks and other area and shall be mounted on top of wheelhouse/aft part of accommodation in such a way that view from bridge or

crane/project operations will not be interrupted. Light in work deck area shall comply with rules and Buyer's requirements.

Lighting shall be controlled from the lighting control panels in the wheelhouse..

817. Switches, Sockets & Switched-Sockets

All switches, sockets and switched-sockets in the accommodation are to be flush mounted moulded cased type and in the engine room and other machinery and WT compartments are to be WT and metal moulded. Adequate numbers of switched-sockets are to be provided in accommodation, wheelhouse, galley, mess room, store and other machinery spaces and compartment, etc., for portable equipment.

818. Domestic Equipment

The domestic equipment is described in chapter 3.

819. Navigation and communication equipment

Navigation and communication equipment is described in section 702.

820. Navigation Lights

Dual lens navigation lights, 230V/1ph/60Hz or 24V DC are to be fitted unless otherwise stated.

All navigation lights are to be controlled by indicator panel fitted in the wheelhouse. Each navigation light is to be controlled and protected by double pole switch and fused on each conductor c/w dimmer switch. Visual and audible alarm indicators are to be fitted.

821. Fire & General Alarm

Fire and general alarm supply system is to be taken from 230V and 24V DC distribution boards. Alarm pushes and alarm bells are to be fitted in wheelhouse, below main deck, main deck forecastle deck, engine room and steering gear, bow thruster, bulk/liquid mud/brine tanks compartment and to meet with classification/SOLAS requirements/SPS Code 2008. Maker to advice power supplies.

Heat or smoke fire detectors to be provided in accommodation area, cabin, living, public space, machinery spaces and engine room, etc. Fire alarm indicator and siren are to meet with classification/ SOLAS requirements. The fire detection & alarm system and location of fire alarm panel to be approved by classification.

822. Automation Equipment for Machinery (Meet E0) and Cargo System

General

Construction and operation

Sufficient instrumentation alarms and control equipment for safe operation of the main engines and all auxiliaries shall be arranged in accordance with supplier's instrumentation list. The control and instrument plant shall also be in accordance with requirements regarding "Dead man alarm" (applicable to Vessels above 500 gr.reg.t.)

Sensors

The following items shall be given special attention;

All temperature sensors shall be installed in pockets of suitable material. Connections shall be arranged for draw-out for testing purposes.

All level switches shall have test level handle for function test of switch.

All sensors shall be installed in places where it is a minimum risk for damage during normal overhaul and maintenance.

Shut off and test valves with standard connection shall be fitted for all pressure regulating and measuring units as well as for local instruments.

The sensors' connections to consoles etc. shall be arranged for easy earth fault and cable fault location on the sensor side, i.e. separate wiring between each sensor and the alarm central or other terminating equipment shall be required.

Sensors and instruments shall be mounted in such way that shock and vibrations of the sensor body with connections are avoided.

Pressure sensors exposed to shocks and large vibrations in their working medium shall be protected by damping chambers.

Water pockets shall be avoided in the pressure sensor pipe connections.

All level switches in tanks shall have test level for function test of switch.

Test equipment for temperature and pressure shall be suitable for connection to the respective sensor types.

The arrangement of the instruments and alarms shall be worked out in close co-operation with the Buyer and in principle in accordance with the specified list of content.

All components and wires shall be clearly marked with number in accordance with the drawings. All name- and number-plates as well as reference shall be engraved laminated PVC unless otherwise specified.

Water and oil pipes inside the consoles shall be avoided. Necessary air pipes shall be separated or eventually shielded from electric and electronic equipment. Air ventilating pipes from pneumatic equipment shall be led outside of consoles.

Bridge consoles, general

On bridge there shall be installed two (2) manoeuvre consoles, one (1) forward and one (1) aft according to GA. All monitors shall be integrated to the consoles.

All door panels to be "lift off" type.

Bridge console / forward

Fwd bridge consoles shall have control and monitoring equipment for propulsion thrusters, tunnel thrusters, navigation equipment, VHF, wipers, alarm panels, communication systems and FiFi control panel etc.

Bridge console / aft

Aft bridge consoles shall have control and monitoring for propulsion thrusters, tunnel thrusters, navigation equipment, VHF, wipers, alarm panels, communication systems, cargo systems and dry bulk tank shut off valves etc.

Following equipment shall be separately installed in wheelhouse:

- Fire alarm panel
- Navigation lights (main /emergency)
- Signal lights
- Distribution panels
- Emergency stop system of aux.
- Panel for watertight doors
- Emergency stop with running lights for cargo pumps and dry bulk system
- Hospital alarm (also outside the hospital)
- Freezer & Chiller alarm

Engine control room and switchboard room

A control room with maneuvering stand, control cargo pumps, alarm panel and main switchboard shall be arranged. The control room shall be air- conditioned and insulated against noise and heat.

Engine control room console

Console shall have control and monitoring systems for main propulsion. aux. engine, electric system in accordance with supplier's delivery and required by the Classification Society.

All door panels to be "lift off" type.

Console shall have monitoring systems for tunnel thrusters, propulsion room, in accordance with supplier's delivery and required by the Classification Society.

Switchboard room

An insulated switchboard room shall be arranged according to GA-Plan. The switchboard room shallbe air-conditioned.

Common automation equipment, engine alarm, Monitoring etc

General alarm

One (1) Machinery alarm and monitoring system shall be installed to provide control, monitoring and alarm of all functions necessary for the safe and efficient operation of the main propulsion and auxiliary machinery.

The system shall be installed with one (1) workstation in ECR and two (2) work stations on the bridge.

The various alarms shall be arranged in two (2) separate groups for each main generator and it's auxiliaries. Earth fault detection with alarm shall be included.

The machinery alarm and monitoring system itself and the installation shall comply with the applicable requirements for IMO class 2 DP vessels of the listed classification society.

All alarms related to the propulsion and main machinery shall be analogous when relevant.

Instruments, sensors and control equipment shall be of simple, robust and standardised design.

Local instrumentation, such as thermometers, pressure gauges, etc., shall be provided as necessary for manual start up, control, and monitoring of equipment in the machinery spaces. Scale engraving shall be in metric units.

Pressure and temperature sensors shall be installed in locations where there is minimal risk for damage during normal overhaul and maintenance. Temperature sensors shall be installed in wells and be capable of being withdrawn for replacement or calibration.

All components and wires shall be marked with numbers in accordance with the instrumentation list and installation drawings.

MONITORING

System structure

One (1) system mimic and one (1) capacity mimic shall be provided for each system.

Mimics to include; Ship's FO, Cargo FO, Liquid mud, Brine, Base oil, Methanol/LDHI and PPD etc as applicable.

One (1) mimic (showing temperatures, pressures RPM's, loads, sumps, etc.) shall be provided for each of the following; each gen. azimuth thrusters and tunnel thrusters.

One (1) mimic showing loads electrical particulars (kW, A, V, Hz) for main electric power supplies and (A) for main distribution. Liquid densities shall be manual only.

The system shall feature the following functions:

Multi-user system

• Provide users with a simple and correct overview of the various systems using system pictures/diagrams

Shall be self-monitoring; i.e. it is equipped with alarms which monitor its own faults.

- Divides the Vessel's machinery into one System Failure group for internal watch and max fifteen different display groups; i.e.:

• Gen. Engines

Thruster system

Bilge system

• Etc.

- A simple and straightforward parameter adjustments; i.e. limit values, time delays, sensor calibration etc.

- Provide users with a simple and correct overview of the various systems using system pictures/diagrams

- Possibilities for inhibit of individual signals and listing of all inhibited signals.

- Possibility for off scanning of individual signals and listing of all off-scanned signals.

- Interlock function.

- Group status-, alarm summary and event lists.

- Bargraph presentation for a simple status presentation.

- Printer for different types of reports and listing.

- Action group function: i.e. input point status combinations give output action (open/close contracts).

- Trends of analogue signals, inhibited and off-scanned signals, past events, also running hour etc.

- Control, alarm and monitoring system shall interface following systems:

Monitoring of temperature, pressure level in tanks etc shall be with minimum storing of minimum two(2) months history to show trend. Presentation shall be with graphs.

System pictures / mimic diagrams

The system shall be provided with mimic diagrams/pictures for ballast system, cargo control system, propulsion plant, electrical power plant and for other relevant machinery.

Other installed pictures which shall be available as follows:

- Tank sounding separate tanks
- Tank sounding groups of tanks
- System alarms
- System configuration

Tank group picture

The alarm and monitoring system to receive tank data from sounding system.

This pictures display all information about the actual tanks, such as:

For each tank:

- Max. Cubic metres
- Alarm limits
- Density (Manually)
- Percentage of full tank

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- Level in metres
- Cubic metres

For the group:

- Max. Cubic metres
- Percentage of full group
- Cubic metres

The information shall be presented graphically and numerically.

Opérator station in wheelhouse

One (1) colour printer shall be installed

One (1) alarm buzzer shall be installed

Four (4) off monitoring units shall be installed (two (2) aft and two (2) fwd)

Each unit shall include one (1) off colour monitor, one (1) off PC with keyboard and one (1) off pointing device.

Opérator station in engine control room

One (1) colour printer shall be installed

One (1) alarm buzzer shall be installed

Three (3) off monitoring units shall be installed.

Each unit shall include one (1) off colour monitor, one (1) off PC with keyboard and one (1) off pointing device.

Watch and responsibility system to be combined into the common machinery alarm and monitoring system, according to class requirements.

Engineer's alarm

When the engine room is unattended, the alarms of the engine alarm system shall be extended to the following alarm panels, according to rules:

- bridge fwd
- bridge aft
- chief's cabin
- chief's bedroom
- 2nd engineer's cabin
- mess room

Machinery spaces alarm signals (Alarm tower)

The following visible /audible alarm signals shall be arranged as follows: in one (1) propulsion room, Three (3) in cargo room, three(3) in main engine room and one(1) in side thruster room etc. and shallbe easy to identify

- Life boat alarm
- Automatic telephone alarm
- Battery less telephone alarm
- Fire alarm



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• Engine alarm

• CO2 alarm

The engine alarm and telephones' alarm shall be given by means of high intensity flickering lights and a sufficient number of small low noise alarm horns.

Instruments

All instruments shall be of suitable construction for their maximum operating value. Scaling in ISO units, where suitable.

Local thermometers shall be of the liquid filled glass tube type.

Local pressure gauges shall be of the liquid filled type.

Automation equipment for propulsion machinery and transmission

Two (2) electronic remote control systems (one (1) for each Main Engine) for engine speed shall be installed.

Remote control operations for thrusters shall be fitted in the wheelhouse.

The engine control room manoeuvring shall be actuated electrically with the regulating handle.

The wheelhouse manoeuvring shall be actuated electrically with the regulating handle.

The wheelhouse, engine control room and local manoeuvring (if applicable) shall include functions as follows:

- Speed regulating
- Control of clutch (if applicable)

• Emergency stopping

Choice of remote control location shall be made in the Engine Control Room with confirmation from the wheelhouse. The control selection and confirmation procedure shall conform to the requirements of the Classification society.

Redundancy

The remote control systems shall be designed and installed as two (2) electrically and mechanically totally independent plants. One (1) failure in one (1) plant shall not put the other plant out of operation and vice versa.

Each plant shall have two (2) galvanic isolated power supplies.

823 Electric Generating Plant Control and operation of generator sets

Control and operation of generator sets

The diesel generator sets shall be started and stopped from the engine control room or locally on the engine. The diesel generator set shall be started and connected automatically to the swb.

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The diesel generator set shall automatically shut down in accordance with the manufacturer's design criteria. A shut-down condition shall be identified by an alarm connected to the Engine Room Control and Monitoring System.

The diesel generator set shall be fitted with its own electronic governor, with the speed setting remotely carried out by the governor control switch on the engine control room main switchboard.

Automatic synchronising, frequency control and preferential tripping shall be provided.

Blocking/interlocks of heavy consumers

An interlock system shall be arranged to prevent overload of generators.

Power Management System

The entire electrical power plant shall be automatically controlled by a Power Management System

(PMS). The power management system shall be provided with the following functions:

• Automatic power management of the generators depending on the necessary power demand and the generators ability and stand by situation. The correct and suitable combination should automatically be established.

•The PMS should never allow the shaft generators to operate in continuous parallel operation with any other generator on the grid.

• In case of starting of big consumers the available power should automatically be checked and if necessary the stand by diesel generator should be started automatically and connected to the switchboard. As soon as available power is accepted, the big consumers should start.

• An estimate of heavy consumers should be needed.

If the power consumption on the main switchboard has decreased and should be covered by smaller number of generator set, the generator of lowest priority should automatically be loaded off, disconnected from switchboard and stopped. The operations shall be provided with certain delays.

System structure, PMS

The power management system shall ensure consistency and maximum efficiency of power generation equipment. The system shall be controllable from the workstation located in the Engine Control Room.

The system shall perform at least, but not limited to the following functions:

• Automatic load dependent start and stop of diesel generating set (including black-out start of stand-by generator)

- Automatic speed/frequency control of diesel generating set
- Automatic operation of air circuit breakers for generators
- Automatic generator off-loading prior to load free disconnection of generator circuit breakers
- Automatic control and protection of generators

•Automatic control of emergency/harbour generator (function disconnected in emergency mode)

• Automatic control and protection of Main switchboard including operation of bus-tie breakers

Synchronizing of all motor operated breakers

• Automatic load sharing and load control with software for black-out prevention caused by sudden overloads due to stop of generators

· Heavy consumer control including start request and start accept of heavy consumers

- Critical alarm handling / shutdown
- Aux. pump control
- Automatic preferential tripping of non-essential load

• Mode selection; (Under Way, underway with economical running, Cargo load/ disch.-

Manual/Joystick DP, Cargo load/ disch. Harbour, Harbour resting (emerg./harbour gen.) and optional). Some of the mode may be combined if similar.

Indication (mimic diagram of all necessary parameters for electric power plant in Ship's alarm system.

The situation of working generators, standby generators, supply transformer power and thrusters motors shall be displayed on indicating all important data as:

- Supplied power for each generator
- Nominal power for each generator
- % loaded
- Bus bars voltage and frequency
- Position of main circuit breakers
- Total power
- Standby situation
- Generator set available or not available

Reduction in tunnel thrusters loads, speed reductions, must be introduced in the period it takes to start and bring a new generator set on the line. If this function is taken care of by the DP computer system, the effect shall be co-ordinated with the PMS system.

Each diesel generator set shall automatically shut down in accordance with the manufacturer's design criteria. A shut-down condition shall be identified by an alarm connected to the Integrated Automation System.

Each diesel generator set shall be fitted with its own electronic governor, with the speed setting remotely carried out by the PMS or manual by the governor control switch on main switchboard.

Preferential Trip

• When the running generator (s) is overloaded, non-essential consumers shall be automatically tripped to prevent the complete power failure of the Vessel. The preferential tripping system of non-essential consumers shall be arranged according to class and suppliers recommendations and subject to approval from Buyer.

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The following non-essential consumers shall be tripped:

- HVAC system (A/C compressors and heating element)
- Galley equipment
- Jacket water pre-heaters
- Welding machine etc.

Aux. Engine Safety System

A safety system for protection and control of the aux. engine shall be provided. The safety system shall control and protect the aux. engine in order to prevent faulty operation and/or major failure. The system shall automatic stop the engine upon critical failure that may lead to breakdown of the engines, so as very low lub. oil pressure, very high coolant temperature and overspeed, in addition to any further requirements according to the Class.

The safety system for the aux. engine shall include alarm and monitoring of the engines as well. The alarm shall be clearly indicated on the safety system panel / cabinet. In addition a common alarm for each engine shall be given to the central alarm plant.

The safety alarm system shall be a separate system.

Control and operation of emergency generator set

When the voltage of the main bus fails, the emergency generator set shall be automatically started

with time delay and the emergency switchboard shall be energized automatically.

Safety devices for over-speed or loss of lubricating oil pressure (very low pressure) shall be provided on the engine and arranged so that the engine shall automatically shut-down in the event of either occurrence.

824 Automation for other machinery equipment

Control of pumps

The following pumps shall be capable of being manually started and stopped from a remote operating station (ECR):

• Cargo System (such as liquid bulk cargo of Methanol/LDHI/PPD) shall be provided with remote control and monitoring system

Local manual control of equipment

The following systems shall be controlled from local (equipment supplied) systems:

- Hydrophore plant
- Air condition and ventilation
- Sewage plant
- Starting air system
- Lub oil system
- Fuel oil and lub oil purifiers
- Fresh water

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- Liquid Mud
- Fuel Oil
- Brine
- Drill water
- Base oil

Fuel oil transfer system

Starting DO transfer pumps shall be a manual operation. However, the transfer pumps shall be manually started and stopped.

Purifier control system

All purifiers shall be manually started and stopped.

However, the purifier control system shall provide automatic sludge discharging for all purifiers and by-pass the fuel oil to a selected tank upon detecting an abnormal condition.

Air compressor control system

All air compressors shall be stopped automatically at the following conditions:

- Discharge air temperature, high
- Lubricating Oil pressure, low

All air compressors shall have alarms at the following conditions:

- Sump level, low
- Oil pressure, low
- Oil temp, high

All air compressors shall be fitted with both automatic and manual controls. Manual stop/start buttons shall be provided for each air compressor and additionally, each compressor shall be automatically started and stopped by detecting the pressure of the air reservoirs.

Engine room bilge system

The engine room oil/water separator pump shall be manually started and stopped. If the separated water's oil content is higher than the set limit, the water shall automatically be returned to the bilge holding tank with alarm given.

High-level alarm shall be provided for bilge wells and bilge holding tank.

The engine room Oily water separator shall be locally manually operated.

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SECTION 9 - MACHINERY

900. General

All equipment, machinery, instruments, and installations shall be of the latest design and rugged construction and as per first class international shipbuilding practice. They shall be of the reputed make and suitable for tropical, humid marine climate. Similar machinery, equipment etc. shall be so selected as to have maximum inter-changeability of their parts.

Where applicable for machinery, equipment or components international standards shall be followed. the latest system, machinery, equipment shall be provided for fuel and energy efficiency and shall have adequate controls, gauges, alarms and safety measures.

The vessel is to be equipped with the latest remote control arrangement so that the maneuvering with the propulsion machinery can be controlled from the Bridge Deck.

The vessel shall be designed and constructed to have minimum noise and vibration levels.

The torsional vibrations shall be avoided within the working range of all machinery. Necessary TV calculations shall be carried out to the approval of Classification Society by the Yard.

The exhaust emissions of the diesel engines shall meet the MARPOL 73/78 Annex VI requirements, including Tier II compliance.

The machinery installation comprises of the following:-

Two (2) controllable pitch propeller installed in the Aft of ship.

Two (2) main diesel engines, each driving shaft with 2660 KW each.

Three auxiliary diesel engines with generator 550kw each.

All diesel engines are to be IMO approved type (NOx technical code mandatory guidelines relating to Regulation 13 of Annex VI to MARPOL \geq 130 kW) and supplied with certificates as required by the classification. They are to be supplied and fitted by the Builder.

All machinery outputs are to be rated for continuous duty under the following conditions:

Ambient temperature: 45 °C

Sea Water temperature 32 °C

Air pressure: 1 bar

Relative humidity: 90%

All the auxiliary engines will undergo shop test at the manufactures' shops and shall be witnessed by Buyers Representative and Classification Surveyor.

All exhaust pipe to have external spark arresters.

Electric motor to be explosion proof if it is located in hazardous area.

901. CP Propulsion System

Two CP propeller shall be installed, at the aft for propulsion and for station keeping of the Vessel. Each CP propeller shall be driven by engine through shafting.

Propeller type, CPP

Propeller diameter (approx.),..... TBA

Number of blades, 4

Speed of propeller, TBA

Output power (each approx): 2660KW

-Four bladed NiAl propellers with controllable pitch working in a flow accelerating nozzle.

-The nozzle is to be of mild steel with Stainless steel lining in way of propeller.

hydraulic power pack for CPP is to be F.W cooling.

-Steering and RPM control systems with main and secondary steering controls for two position controls in Bridge Deck.

-Local & Emergency control are to be provided.

-Monitoring and alarm systems for Bridge Deck consoles and engine room consoles -Flexible coupling.

Standby pumps are to be provided in accordance with classification requirements.

Special consideration shall be given to minimizing cavitations and maximizing efficiency at Vessel operational condition. The propulsion plants shall have electronic remote controlling from bridge, and shall be interfaced to Dynamic positioning system. In addition, system to be interfaced joystick control unit if applicable.

902. Tunnel Thrusters

Four (4) tunnel thrusters shall be installed. Two (2) of them located at bow with FPP, two (2) of them located at AFT with CPP. Thrusters motor to be resiliently mounted.

The tunnel thrusters shall be driven by an electric motor of fixed rpm. The motor rating shall be 950KW for bow thruster, 500kw for stern thrusters and to be rated for continuous operation of DP2. The tunnel inside shall be lined with stainless steel in way of propeller. The unit to be complete with hydraulic pump unit, header tank, alarms, electronic remote control system for pitch control etc. The control shall be provided complete with monitoring and alarm system at the Bridge Deck consoles. There should be local emergency control for start/stop and for pitch control and indication. The complete thrusters unit to be class approved.

The Motor should be as follows

Output power (each):950KW for bow thrusters, 500kw for stern thrusters.

Duty: S1-Continuous.

Voltage: 440V

Enclosure: IP44(Bow thruster)

IP56 (Stern thruster)

Cooling: manufacturer's recommendations

Insulation: Class H

Temperature Rise: Class H

Bearing: Sealed bearings to be provided at both ends.

Bearing and winding temperature monitoring to be provided and connected to central alarm.

Two (2) remote stations c/w instrument panels will be from both the forward and aft controls in the wheelhouse, and DP-2 system and joystick control unit.

Emergency starting and control should be available locally in the B/T compartment.

Special focus on Noise and vibration have to be given when installing the above bow thrusters.

903. Monitoring and Alarms (E0)

An integrated control monitoring and alarm system shall be provided. (followed by European standard & manufacturer)

Monitoring instrument panel in Engine Control room, Wheel house consoles (Aft & Fwd) and extension alarms in Mess room, Chief Engineer's cabin,2nd Engineer cabin to be provided Monitor and alarms as per Classification Society and SOLAS Requirements and to include for the following equipments.

- Propulsion System
- -Tunnel Thrusters
- -Diesel engine
- High and low level alarms for tanks and bilges.
- Aux machinery systems and equipment

904. Main engines

Two (2) units x 2660 kW at 750 Rpm marine diesel engine coupled to intermediate shafting and vertical offset CPP gearbox by flexible coupling. Engine front part are PTO to also drive the external fire pump with clutch and gear, main engine is to be resiliently mounted. Power Take-Off

Two (2) gearbox are to be provided with PTO at after end of the gearbox. It is used to drive a shaft alternator of 1200 kW, 440/3/60, 3 wire.

Power/ Pitch shedding devices in between the system are fitted to prevent overloading of engines.

The main engines shall be complete with:

1. Cooling System

The main and auxiliary engines are to be fresh water cooled via heat exchangers remote mounted from engines. Each main engine is equipped with engine driven LT, HT fresh water pumps, sea water pump and engine mounted charge air cooler & lub oil cooler. The cooling pipes are to be arranged in accordance with engine manufacturer's recommendations and to meet class requirement. The SW cooling pipes to be schedule 80 XS galvanized steel pipes.

One unit each electrically driven standby LT, HT, & SW cooling pumps to be installed for each main engine and ready piped to the respective circuits.

Main plate coolers should be of titanium plate type and designed for over capacity of 25%, back flush arrangement or built-in strainer arrangement and temperature and pressure gauges at inlet and outlet.

2. Lube Oil System

The following is to be supplied and fitted per ship:

	1	main engine driven lub oil pump, gear type c/w built-in relief valve.
		Capacity as per engine manufacturer's recommendation.

- * 1 Duplex lub oil filter
- 1 Duplex lub oil filter, mesh 150

Alarm device with audible and visual signals to be fitted for failure of lubricating oil system of the main engine, auxiliary engines and propulsion units.

Alarm device with audible and visual signals is to be fitted for failure of lubricating oil system of the main engine, auxiliary engines and propulsion units.

Two (2) main engine standby lub oil gear pump c/w gauge 440/3/50.

(To be supplied by Engine maker's identical to main lube oil pump as required by Class

3. fuel oil system with engine driven fuel oil pump

4. air starting equipment according to class requirements.

Engines Control and monitoring

The local control panel (LCP) shall consist of a display unit, backup instruments and control switches & buttons built on the engine. The LCP shall show all essential engine measurements (e.g. temperatures and pressures) and provide various engine status indications. Local control panel shall also be equipped with control switches and push buttons for start/stop and emergency stop functions. Following monitoring shall be arranged as a minimum for remote reading to monitoring system in control room.

- Lub.oil pressure

- Low lub.oil pressure, shut down

- Lube oil temperature

- Air temperature

- High fresh water temperature, shut down
- Exhaust temperature after turbo charger
- Fuel oil leaking alarm

- Over speed alarm

- PT 100 sensors in windings and bearings.

Electronic governor system with remote control shall be fitted. The electronic speed governor shall be capable of regulating the speed of each diesel engine.

Automatic stop of engine at very low lubrication oil pressure, very high water temperature

and over speed shall be provided, with alarm connected to the alarm system. Alarm and monitoring for low lubrication oil pressure, high cooling water temperature, low level in f.w. expansion tank, etc, according to Class and Manufacturers standard.

905. Diesel Generating Sets

The electric power is to be supplier by three (3) diesel-driven generators with 550kw each and two (2) shaft generator with 1200kw each. The diesel generator in the engine room shall be driven by three (3) water-cooled marine diesel engines. Shaft generator will be fresh water cooled. Starting of engine is to be by compressed air using air start motors coupled to flywheel. All accessories shall be in accordance with the Classification Society.

Generators are to be designed for parallel operation with each other. Provisions for auto start, auto load sharing and auto synchronization to be provided. The cooling of engines shall be done by individual heat exchangers cooled by sea water.

The diesel engines and generators are to be fitted on a common foundation, which is to be resiliently mounted. Alternators to have bearing at both ends.

Output power (each):550KW approx, 440V, 60Hz, 3 Phase each.

Duty: Continuous.

Enclosure: IP23

Cooling: Air cooled with dust filters

Insulation: Class H

Bearing: To be provided at both ends with Sealed bearings

Shipyard to submit power balance chart and electric load chart before placing order for DG sets

For alarms, safeguards and instrumentation see separate clauses.

The generator to be complete with anti-condensation heater and good AVR with drop Kit for parallel operation.

Generators engines systems

The diesel engines shall be complete with:

1. Cooling System

The generator engines are fitted with engine mounted HT, LT fresh water pump, charge air cooler & Lube oil cooler, are to be F.W. cooled via central coolers. Each generator engine is also supplied with the following,

- One (1) heat exchanger

- One (1) fresh water pump (engine mounted)

2. Lube Oil System

-One (1) engine driven lube oil pump, gear type c/w built-in relief valve

- One (1) Lube. oil cooler (engine mounted)

- One (1) Centrifugal filter & automatic filter (engine mounted)

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Alarm device with audible and visual signals is to be fitted for failure of lubricating oil system of the main engine, auxiliary engines and propulsion units.

- 3. fuel oil system with engine driven fuel oil pump
- 4. air starting equipment according to class requirements.

Generator Engines Control and monitoring

The local control panel (LCP) shall consist of a display unit, backup instruments and control switches & buttons built on the engine. The LCP shall show all essential engine measurements (e.g. temperatures and pressures) and provide various engine status indications. Local control panel shall also be equipped with control switches and push buttons for start/stop and emergency stop functions. Following monitoring shall be arranged for remote reading to monitoring system in control room (to be recommended by vendor).

- Lub.oil pressure
- Low lub.oil pressure, shut down
- Lube oil temperature
- Air temperature
- High fresh water temperature, shut down
- Exhaust temperature after turbo charger
- Fuel oil leaking alarm
- Over speed alarm
- PT 100 sensors in windings and bearings.

Electronic governor system with remote control from main switchboard/PMS shall be fitted. The electronic speed governor shall be capable of regulating the speed of each diesel engine such that the generator shall meet the Class and Authority's requirement of speed drop. Automatic stop of engine at very low lubrication oil pressure, very high water temperature and over speed shall be provided, with alarm connected to the alarm system.

Alarm and monitoring for low lubrication oil pressure, high cooling water temperature, low level in f.w. expansion tank, etc, according to Class and Manufacturers standard.

906. Remote Control (Manoeuvring and control equipment)

Control & Monitoring System

A control, monitoring and alarm system shall be provided in ECR and in Bridge (on both consoles). The control, CP propeller, Tunnel Thrusters, Main engine, etc displayed as minimum and also other parameters required by the class Extension alarm to be provided in Mess room, CE's cabin and 2nd. Engr's cabin with a selector switch in ECR for the extension alarms. All control positions of equipment to have emergency stop with indication if the emergency stop is engaged. The system is to be interfaced with machinery data logger and recording system.

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Forward and aft Manoeuvring control console to be installed at the bridge and fitted with all required instruments for control, monitoring and alarms of CP propeller, Tunnel Thrusters, main engine. CP propeller shall be controlled remotely by electronic device from the wheelhouse. The command, control, monitoring, alarm and communication systems will be completely duplicated on forward and aft consoles. All instruments used on the aft console shall be suitable for operating the vessel when looking aft. These shall be mirror images of the instruments fitted on forward console.

An integrated joystick and DP control system is to be provided at aft control station.

ECR console

ECR control console to be installed at the ECR and fitted with all required instruments for Control, Monitoring and alarms of Main engine .Emergency controls, monitoring and alarms of CP propeller to be provided.

907. Shafting & Stern Tube

Propeller shafting to be hollow type c/w push pull rod forged steel with split coupling type and to suit propeller boss and loose coupling which is coupled to gearbox output flange c/w in between intermediate shaft and to install min. one (1) LS or Dover plummer or equal block bearing in between inboard stern tube bearing and gear box.

Tail shaft to be oil lubrication with white metal bearing, operation condition monitoring to be provide, stern tube bearing temperature, lube oil content and level to be monitored according to the requirement of notation TMON.

Stern tube shall be of fabricated steel construction arranged for oil lubrication and cranepac lips seal type. Lubrication with white metal bearings. Alignment for the stern tube bossing must be by boring method before installing the bearings.

908. Steering Gear (Rotary Vane type)

Two (2) independent Electro-hydraulic type steering gear at 45 degrees rudder angle c/w emergency hand hydraulic steering and system to be interfaced with DP system and joystick control unit.

 Wheelhouse
 : a) electric non & follow-up steering lever joystick type remote control c/w two deck head mounted type (3 ways) with

 Two table mounting rudder indicators at forward console and two table mounting rudder indicators at aft console.

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S/G compartment

:

b) hand hydraulic for emergency

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The steering gear system to meet with classification/ SOLAS requirement.

Alarm and instrument panel shall be installed in the wheelhouse and engine control room and change over switch with interface system in between Auto-pilot/ steering gear to be provided.

909. Pumps

All centrifugal pumps shall preferably be of vertical type. for all seawater pumps (excluding the Fifi pump), the casing shall be of bronze, impeller of bronze, shafts of stainless steel with mechanical seals. Following spares shall be provided for each pump.

- 2. One Mechanical seal
- 3. One set of mouth rings

Builder shall provider numbers, capacities, NPSH chart and detailed specification of pumps for each system including standby pumps for main engine. All pumps to have pressure gauges on the suction and discharge sides.

The motors for the pumps to be totally enclosed fan cooled,IP55, Insulation class H, continuous rated. All pumps shall have locally mounted start/stop panel with running indication lights. The starter panel to be mounted in ECR. The start/stop and running indication to be provided on ECR console. Running hour meters to be installed

Remarks:

1)All pumps shall be provided with starter and suction & discharge pressure gauge c/w valves.

2) All SW cooling pumps with starter for deck machinery and other machinery equipment for system operation to be provided by Builder.

909.1 Fuel Oil Transfer Pump

Two (2) gear pumps are to be provided for fuel oil transfer. Pump is to have a cast iron body with alloy steel rotor and shaft. Pump to have a capacity 23.8m3 per hour against a discharge head of 25m and NPSH OF 3.1M. Pump to be directly coupled to a 3 Phase, 60 Hz, 440 V motor complete with locally mounted start/stop. The pump and motor are to be mounted on a combined base plate. Pump to have one remote stop outside engine room. The FO transfer pump shall be wired for auto start and stop.

909.2 Fuel oil cargo Pump

Two gear pumps are to be provided for pumping of diesel oil cargo. The pump shall have cast iron body with alloy steel rotor and shaft. Pump to have a capacity of 150 M3 (Minimum) per hour against a discharge head of about 80 M and NPSH of 4M.a local and remote reading flow meter capable of being used for filling and transfer is to be provided. Remote reading display shall be provided in ECR & Wheel House. Pump is to be directly coupled to a 3 Phase, 50 Hz, 440 V motor complete with locally mounted start/stop. The pump and motor are to be mounted on a combined base plate. Pump to have remote stop outside engine room and on main deck Remote Start & Stop panel with illuminated indication shall be provided at the Aft console in W/H.

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909.3 Bilge, Ballast, GS, Detergent & Fire pump

Two (2) centrifugal pump with self-priming function (one as bilge & ballast pump, another act as GS & Fire/Detergent Pump)to be provided for the above duty, being complete with 3 Phase, 60 Hz, 440 V motor complete with locally mounted start/stop with running indication. The pump is to have a capacity about 60M3/hr at about 60M head and is to be complete with suction and discharge pressure gauges. The pump casing and impeller are to be of Bronze and shaft stainless steel, the glands to be mechanical seal type. The bilge system to meet SPS 2008 requirements.

909.4 Bilge pump for dangerous spill

Locate in steering gear compartment, Capacity: Approx. 10 m3/h at 40 m Head

909.5 Mud & Brine

Two (2) twin screw pumps are to be provided for pumping of Mud and Brine. Pump to have a capacity 100m³/h (minimum) against a discharge head of about 75M (SG2.5). Pump is to be directly coupled to a 3 Phase, 60 Hz, 440 V The pump and motor are to be mounted on a combined base plate . The pump shall have cast iron hosing with stainless steel rotor & shaft, stator to be Perbunan or equal. Pump to have local start/ stop and remote stop on main deck Remote Start & Stop panel with illuminated indication shall be provided at the aft console in W/H.

Each mud tank to be fitted with electrically driven agitator and detailed information and system operation to be recommended by maker's.

909.6 Potable Water Cargo Pump

Two (2) centrifugal electric motor driven 3 Phase, 60 Hz, 440 V with locally mounted start/stop and capacity of about 150m3/h when discharging at about 80m and NPSH of 5M head to be provided for fresh water duties. The pump casing is to be of cast iron, shaft of stainless steel and Impeller of bronze. Mechanical seals and adjustable relief valves are to be provided. A local and remote reading flow meter capable of being used for filling and discharge is to be provided. Pump to have local start/ stop with running indication. Remote Start & Stop panel with illuminated indication shall be provided at the Aft console in W/H.

909.7 Drill Water Pump

One (1) centrifugal electric motor driven pump and capacity 150m³/hr at 80m total head of S.G 2.5, 440/3/60 with emergency stop in wheelhouse aft console. The designated drill water pump to have illuminated start/stop and running indication in W/H Aft console.

909.8. Sludge Transfer/Dirty oil/Slope Pump

One (1) electric driven horizontal positive displacement type screw pump, with rubber stator, installed in the engine room and shall deliver 8 m3/h @ 35m total head, 440V /3ph/60Hz.complete with electric heating coil for the tank and /suction line with recirculation arrangement. The bilge lines and sea

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suction lines shall be connected to this pump. The suction shall be led from bilge holding tank, Dirty Oil, Sludge and Slope tank to deck connection.

909.9. F.W Cooling pump

it is to be used for Air-conditioning, Refrigeration Plant and Aux machinery equipment.

Two (2) centrifugal pumps with self-priming function of suitable capacity, electrically driven is to be fitted to serve air-conditioning, refrigeration system and Aux M.C (Bulk Como, Dryers, Hydraulic Power Pack),Pump casing is to be of AL. bronze with AL bronze impeller and SS shaft. Total nos of pumps shall be six (6). Two (2) for air conditioning, Two (2) for reefer plant and Two (2) for Auxiliary Machinery. One (1) pump will be standby for the systems.

909.10.Sewage Pump

One (1) Macerator pump of 15m3/h at 20m total head, 440V/3ph/60Hz to be provided. The sewage discharge pump to take suction from sewage holding tank and to discharge to sewage treatment plant or to the deck discharge.

909.12. Pressure set FW. Pump

Capacity of each pump 3m³/hr at 45m.

910. Garbage Disposal

One (1) unit of garbage disposal (macerator) is to be provided and to meet with MARPOL requirement.

911. Mucking ejector for cleaning of dry bulk tanks

Free Air connection Approx. 300~400 M3/Hr, @ 5 meter head, driver water:100 m3/hr x 6 bar

912. Pressure Set-F.W.

Two (2) Fresh water pressure set complete with motor driven self-priming Hydrophore pump 3m³/h at 45m with pump casing, impeller to be bronze and shaft to be stainless steel. And one (1) diaphragm type pressure tank of about 500 litters with maximum working pressure 3-4 kg/cm2 with pressure relief valve.

913. Pressure Set Standby Pump

One (1) pressure set standby pump, identical to above shall be adjacently mounted to FW pressure pump for standby duties of both.

914. Hot Water Calorifier

One (1) 500 litre capacity approx. hot water calorifier c/w hot water circulating pump is to be provided, Electric heater to be from 440V /3ph/60Hz supply.

915. Fresh water maker

One (1) RO fresh maker of 20 Tonnes per day c/w independent UV steriliser unit, flow meter with sand filter for the system to be provided.

916. L.O. Purifier & Diesel Oil Purifier

two (2) electrical centrifugal lube oil purifier self cleaning type, each have capacity about 700 litres/hr, complete with electric heaters. L.O. Purification system shall be from Main Generator sumps and from L.O. Storage tank.

One (1) electrical centrifugal diesel oil purifier self cleaning type, capacity about 2300 litres/hr, M.D.O. shall be transfered from cargo tank to settling tank, futher purified and transfered to service tank.

Viscosity of MDO less than 11cSt at 40 degree Celcius and greater than 4cSt at 40 degree Celcius Both the LO & DO purifier shall be provided with appropriate controls for 'automatic' operation. The fault alarms of purifier shall be connected to central alarm and monitoring system. The sludge tanks for the purifier shall be located below in the DB tanks. The purifiers to be module type, complete items mounted on a single skid.

Scope of supply for oil purifiers as per manufacturer's standard.

917. Oily Bilge Water Separator

One (1) MARPOL standard centrifugal type oily bilge water separator complete with pump and oily water discharge alarm, automatic cut off valve or stopping arrangement etc. is to be fitted. Capacity 1.0m3/hr @ 2bar, single stage with 15 ppm bilge alarm as per latest MEPC107(49) requirement.

918. Electric motor driven Agitators for 1 Mud Tanks

<u>One (1) unit electric motor driven agitator per mud tank. Submerged agitator to be direct driven and</u> shall be designed for continuous mixing of mud at flowable/average 200 – 300 cSt apparent viscosity at max. S.G. 2.5.,

919. Air Compressors-Starting Air

Two (2) sets of starting -air compressors ,being air- cooled and electric driven, direct coupled type, shall be installed onboard. The capacity of each compressor is to be according to the regulations and the engine maker requirement. The compressors shall be direct driven by 440V, 3 Phase 60Hz electric motor through a flexible coupling. One (1) of the compressor to be supplied with alternate

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level alarm shall be provided. Washing arrangement from GS pump shall also be provided for this tank.

924. Emergency Fire Pump

One (1) electric motor driven emergency fire pump is to be provided, it is to be of self-priming, centrifugal type with capacity 40m³/h at 60m total head, 440V /3ph/60Hz .It is remote start/stop in the wheelhouse c/w local starter panel and system to meet with SOLAS requirement .pump to be located in either bow thrusters or steering gear compartment.

925. Running hour meters

Running hour meters shall be provided for engines, Tunnel Thrusters, All air compressors, Purifiers, Refrigeration units, Air conditioning Unit and all other equipment having power more than 5 KW.

926. <u>Tank level alarms (followed by European standard & manufacturer)</u>

Following tanks shall be provided with tan level alarms. The alarm shall be connected to ship central alarm system

Sewage holding tank-LAH(Also continuous level indication to be provided)

Dirty oil, Tanks- LAH Designated fuel oil overflow tank- LAH Bilge holding Tank- LAH All expansion Tank- LAL All header tanks- LAL

All fuel oil tanks- LAH

927. Generator – Emergency

One (1) SOLAS compliant, diesel-driven emergency generator with air-cooled radiator system and to be of electric-start type shall be provided. (In case the second start is of Electric, then battery charger, battery and starter motor to be duplicated. The changeover is to be well insulated and the generator is to be mounted on resilient foundations to minimize noise and vibration. The capacity of generator it to be sufficient to supply all Emergency loads as required. Output: 440v, 60Hz, 3 Phase, 0.8 Pf, 150 KW(e) (approximately). Should cater for the dead ship start arrangement, emergency steering, emergency lighting, and backup power supply for the search light and flood lights etc.

All necessary arrangement in accordance with Rule and Requirements are to be provided.

Diesel oil service tank for the emergency generator set shall be fitted with high & low level alarms. Tank shall be filled up by the FO transfer pump. FO overflow shall be taken to designated overflow tank.

The system shall be arranged to start the emergency diesel generator automatically when the main power supply fails. The capacity of the emergency diesel generator is subjected to the electrical load balance analysis. Fixed battery charger shall be fitted for continuous charging the starter batteries. 928. Tank Gauging (followed by European standard & manufacturer)

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All built in tank, cofferdams, void spaces, mud tanks to have manual sounding. Except bulk tanks all other tanks to have sounding pipes with striking plates. All portable tanks, Lub. oil/Hydraulic oil tanks, Fuel oil service tank to have gauge glass for indication of the levels.

Remote tank gauging with continuous level indication to be provided for all Fuel oil Tanks, Fresh Water Tanks, Drill Water Tanks, Mud/Brine Tanks, Bulk Tank, Remote tank gauging to be suitable to take care of the trim and heel corrections. All High and low level alarms to be independent of the remote tank gauging. The tank gauging system to have remote display at ECR and in Wheel House Aft console.

Magnetic type gauge glass indicators can be used for F.O service tanks which can be interfaced to the remote tank gauging.
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SECTION 10 - DYNAMIC POSITIONING SYSTEM (DYNPOS-AUTR)

1000. Dynamic position system

The D.P system shall enable the vessel to offshore/ perform safe and efficient operation and system shall comply with the requirements of DYNPOS-AUTR notation

Basic requirement not limited to the following:-

System	Component	DNV (DYNPOS-AUTR)
Power System	Generators and Prime Movers	Redundant
	Main Switchboard	1
	Bus Tie Breaker	1
	Distribution Systems	Redundant
	Power Management	Yes
Thrusters	Arrangement	Redundant
Control	Manual Control – Single lever for each thruster	Yes
	Independent Joystick – Combined Joystick	Yes
	DP Control computer(s)	2
Sensors	Position Reference	3
	Wind	2
	Gyro	3
	Vertical Reference Unit	3
UPS		2
Alternate Control Station for backup unit		No
Printer for alarm data log		2
FMEA		Yes
Loop monitoring for E-stop system		Yes

Remarks: 1) The failure mode & effects analysis (FMEA) shall be completed and submitted to Buyer's/ classification satisfaction.

- 2) All the supporting operation system and in operation equipment must be designed/ arranged and to meet/ comply with classification DYNPOS-AUTR requirement.
- 3)The equipment name and quantity listed in this chapter only to be used as reference.

For exact quantity please refer to previous section.

The table of system arrangement as shown above is provided herewith for the Builder to refer.

Weather condition to be based (to be confirmed):

: 35 knots
: 1.5 knots
: 3.0 m
: 10 s

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SECTION 11 - SPARES & TOOLS & INSTRUCTION MANUAL

1100. Spares

The following items will be provided by the Builder, and other spare part to be carried on board as per standard tools supplied by machinery/equipment supplier.

1101. Maintenance and Workshop Tools

- 1) Lifting lugs suitable for use of chain blocks are to be fitted in the following positions:
 - one length 4" dia. NB Sch. 80 Pipe above center of each main engine
 - one point about each rudder propeller
 - two points above each shaft
 - two points above each generating set
 - one point above each pump
 - two points on the outside of the hull and adjacent to each rudder propeller
- 2) Two (2) 1t chain blocks
- One (1) steel workbench with adjustable light and drawers and lockers with padlocks under the engine room
- 4) One (1) set oxy-acetylene burning equipment with bottles, regulators, gauges,

hoses, torch and nozzles. (Storage for bottles to be arranged on main deck)

- 5) One (1) electrical portable drill
- 6) One (1) set of assorted hand tools for general maintenance
- 7) Three (3) steel sounding tapes for F.O. & F.W.
- 8) One (1) electrical hand inspection lamp with 10M wandering leads
- 9) Two (2) keys for sounding pipes screws plugs
- 10) One (1) lot main engine standard tools
- 11) One (1) lot generator standards tools
- 12) One (1) lot standard tools

THE END