TECHNICAL SPECIFICATION

FOR

78M 12,000 HP ANCHOR HANDLING TUG

/ SUPPLY / OIL RECOVERY VESSEL

"FOCAL 512 LT"

(REV 2)

OWNER:

BUILDER: **WUHU SHIPYARD CO., LTD**

HULL NO.:

DESIGNER: **FOCAL MARINE & OFFSHORE**
(Project No. P-1798)

06 May, 2014

SECTION 1 - GENERAL

100. **Intent**

This specification together with the GA drawing is intended to describe the construction of an anchor handling tug / supply / oil recovery vessel completely outfitted and equipped for following duties.

1) Transportation of deck cargo and personnel between offshore platform and shore
2) Transport consumables - fresh water, diesel oil, bulk cement, liquid mud, drill water, brine, general materials and equipment etc. to offshore platform from shore base
3) External Fire-fighting
4) Rescue
5) Offshore platform towing / pushing
6) Anchor handling
7) Spilled oil recovery

The vessel will be registered as unrestricted service.

The Builder shall furnish all items required for the completion of the Vessel excepting items specifically stated herein as to be furnished and supplied by the Owner.

It is to be understood that anything not mentioned in the Specification but required by the Classification Society or Regulatory Bodies listed herein which are valid before and upon contract signing, shall be supplied and/or equipped by the Builder.

Even if any item is repeated twice or more in the Specification, it is to be understood that such item to be supplied and/or equipped once only.

101. **General Description**

The vessel is to be all welded steel construction with twin diesel engines, twin CP propellers. The vessel's accommodation is to be located on the forward decks.

Vessel design shall comply with MARPOL 12A concerning fuel tank double hull requirement, SPS code 2008 and MLC 2006.

102. **Principal Particulars**

Length overall	:	78.00 m
Length BP	:	69.30 m

Beam moulded	:	18.00 m
Depth moulded	:	8.00 m
Draft designed	:	5.20 m
Draft scantling	:	6.80 m

Max deadweight about 3,000 t.

Accommodation

6 x 1-berth cabins	:	6 men
12 x 2-berth cabins	:	24 men
5 x 4-berth cabins	:	20 men
Total	:	50 men

Tank capacity (approx)

Potable water	:	609 m^3
Fuel oil	:	999 m^3
Drill water / Water ballast	:	1,557 m^3
Dry bulk cargo tanks	:	250 m^3
Rec. oil / Mud / Brine	:	845 m^3 (SG 2.5)
Lub oil	:	17 m^3
Dirty oil	:	21 m^3
Foam	:	22.5 m^3
Dispersant	:	20.2 m^3

Rig chain locker	:	250 m^3

Deck cargo capacity	:	about 1,000 t, VCG about 0.8m above deck
Deck cargo space	:	about. 520 m^2
Cargo deck design load	:	7.5 t / m^2
Engines	:	2 x 6,120 BHP. Medium speed
Performance Speed	:	15.3 knots at trial condition, 100% MCR, design draft
Bollard pull	:	about 167 ton

Deck height : 3,400mm between main deck and forecastle deck.
2,700mm between forecastle deck / upper forecastle deck / officer deck / navigation bridge deck.
4,500mm between navigation bridge deck and compass deck (incl. 1,500mm high cofferdam).

103. **Major Equipment Particulars**

Propulsion system : 2 x MAN B&W marine diesel engine, 6,120BHP each, with Controllable pitch propeller or equivalent

Generating set : 3 x 550 KW diesel driven generators,
2 x 1920 KW shaft driven alternators

Tunnel thrusters : Bow 2 x 12t, stern 1 x 10t, controllable pitch type

Cargo Pumps : Fuel oil cargo pump 1 x 200 m^3/hr @ 90m head
Fresh water cargo pump 1 x 150 m^3/hr @ 75m head
Drill water pump 1 x 150 m^3/hr @ 75m head
Rec oil / Mud / Brine pump 2 x 75m^3/hr 20 bar at mud of SG 2.5 t / m^3, 100m^3/hr 5 bar at R.O of SG 1.0 t / m^3.

Anchor Windlass : 1 x 8.55 T x 10 m/min, with
Gypsy Size 44mm Diameter U3 Chain

Capstans : 2 x 10 Tonnes @ 15m/Min

Anchor Handling/Towing Winch: Double Drum, low pressure HPU, Drum Pull (First Layer) 305 T x 10 m/min
Braking Capacity 450 T
Upper Drum (Towing) capacity 76mm Dia. x 2,000 m Wire Rope
Lower Drum (Anchor Handling) capacity 76mm Dia. x 2,000 m Wire Rope. Constant tension towing facility provided.

Two cable lifters: For 76mm/84mm/90mm Stud link chaiun

Towing Pins : Two(2) sets pins for vessels with bollard pull up to 200 tonnes SWL in the top with 30° wrap: 386 tonnes

SWL on height 515mm above deck with 30° wrap: 480 tonnes

Shark Jaws: Two(2) sets, SWL 360 tonnes

Tugger Winches : 2 x 15 T @ 15m/min

Spare Towing Wire Reel : 2 x 10 T x 20 m/min, Reel Capacity 76mm Dia. x 2,000 m Wire Rope

Deck Crane : Marine Telescopic Type, 5 T @ 10 m Outreach

Stern Roller : 6.6m x 3m Diameter. 450 T SWL

104. **Classification & Flag**

Class notation: ABS +A1 (E) Offshore Support Vessel,
(AH, Tow,
Supply –HNLS,
FFV 1,
OSR-C1
SPS
+ AMS,
+ACCU
+ DPS-2
UWILD

The vessel to fly Singapore flag.

105. **Regulations**

The vessel is to comply with:-

1) Class Rules for Building and Classing of Steel Vessel, latest version.
2) Class Guide for shipbuilding and repair quality standard for hull structures during construction (latest version).
3) Marine Labor Convention 2006, with exemption from requirement on individual sleeping room for each seafarer.
4) International Telecommunication and Radio regulation of 1973/1976 and 1982 including latest GMDSS-rules for radio communication.

5) International Convention for the Prevention of Collision at Sea 1972 including amendments.
6) International Convention for the Prevention of Pollution from Ships (MARPOL) 1973/1978, including latest amendments.
7) IMO Resolution A>468 (XII) Code on noise levels on board ships and ISO6954 for vibration requirements.
8) IMO Resolution A719 (XVII) Prevention of Air Pollution on Ships.
9) International Convention on tonnage Measurements.
10) Maritime Laws and Regulation of Flag.
11) International Convention for the Safety of Life at Sea, 1974 including latest amendments (SOLAS).
12) IMO A673 (16) Guidelines for the transportation and handling of limited amount of hazardous and noxious liquid substances in bulk in offshore support vessels (For mud and brine containing pollution hazard only substances with FP above 60 degree C).
13) IMO Res. MSC 226(84) Code of Safety for Special Purpose Ships (SPS 2008).
14) IMCA Guideline for Dynamic Positioning Class 2
15) International Oil Pollution Prevention (1991) Act and Relevant Regulations where applicable.
16) Institute of Electrical & Electronics Engineer Applicable Marine Regulations (Code 45)
17) IMO ISPS Regulations
18) IMO regulation on ballast water management

106. **Certificates / Statements**

The following certificates / statements are to be supplied to the owners at the time of delivery of the vessel.

1) Builder's certificate
2) Classification Certificate (Hull and Machinery)
3) Safety Equipment Certificate
4) Safety Construction Certificate
5) Tonnage Certificate, including international tonnage, Suez & Panama Canal Tonnage

6) Loadline Certificate
7) Safety Radio Certificate
8) Marpol Statement of Fact Certificate & I.O.P.P.
9) Marpol Statement of Fact Certificate (Annex I, IV, V ,VI)
10) Safety Certificate as required by SOLAS 1974 and all amendments
11) Bollard Pull Test Certificate Issued by the Classification Society
12) Test certificate for Anchor and Chain Cable issued by the Classification Society
13) Other usual certificates including those for navigation light and magnetic compass issued by the assigned authority, and magnetic compass adjustment and direction finder calibration issued by recognized Authority.
14) Asbestos free statement
15) Spark Free Certificate for Main Engines and Diesel Generators Exhaust
16) Compass deviation card
17) Launching certificate
18) Deratization certificate
19) Statement of fact for complying with SPS 2008
20) SMPEP (By Owner)
21) Cargo securing manual (By yard)
22) COF by class for carrying limited amount of non-flammable hazardous and noxious liquid substances in bulk, with reference to IMO A673(16)
23) Oil recovery operation manual (By Owner)
24) Potable water tank certificate
25) Ballast Water Management Certificate. Class Approved manual supplied by Shipyard
26) Emergency Towing Manual (By Yard)
27) Fi-Fi Manual

    Ship Specific Manual to be submitted by Equipment Makers to ABS for approval. Approved copies to be delivered to Owners 2 months prior vessel delivery. Owner will prepare Operation Manual for Crew and submit to ABS if required
28) DPS Operation Manual (Ship Specific) to be prepared (and submitted for Class Approval) by FMEA contractor

29) Test certificate for Anchor and Chain Cable issued by the Classification Society

107. **Tests**

Prior to the delivery, the hull, all machinery, electrical, piping, all equipment installed, machinery and deck fittings, domestic equipment are to be thoroughly tested to class requirement in the presence of the classification's attending surveyor, owners and/or their representative. The Builder is to submit a program for dock and sea trials to the Owner and class two weeks before the start of the trials for their approval.

108. **Lightship Weight Measurement**

The lightship weight measurement shall be carried out by reading the draft of the Vessel, measuring the specific gravity of sea water and by investigation of weight to be added or to be deducted, in the presence of the Owner's representative.

The draft of the Vessel shall be measured at both sides of stem, stern and midship draft marks.

Displacement of the Vessel at this lightship weight measurement shall be determined by reading the draft-displacement table on the corresponding draft obtained from the measured draft. The correction for trim, heel and deflection of the Vessel and the specific gravity of seawater at the measurement shall be made also.

If any superfluous weight is on board the Vessel or any item belonging to the lightship weight is not on board the Vessel at the time of the light weight measurement, such a weight shall be corrected by calculation.

The calculation of the lightship weight and deadweight shall be made by the Builder and verified by the Owner and then "lightship weight" and "deadweight" shall be determined.

109. **Inclining Experiment**

The inclining test shall be carried out, after the light weight measurement, in the

presence of the Owner or the person authorized by the Owner and the Classification Society's Surveyor, and then the position of the center of gravity of the Vessel in light condition shall be determined by the Builder's calculation based on the test results.

The inclining test shall be conducted by shifting weight and by appropriate means. The test may be carried out in the Builder's dock, or in sheltered water near the Builder's yard.

110. **Bollard Pull Test**

A static bollard pull test shall be conducted at full power with the vessel securely fastened by a towline to a fixed point ashore. The trial shall be conducted in accordance with class requirement.

The strain gauge to be used for the test shall be properly calibrated before the test. The pulling from the stern shall be carried out and the steady pull shall be maintained for a minimum of 5 minutes.

Engine output shall be increased in steps of equal increment up to the maximum rating in a total of 3 steps and a steady pull shall be maintained at each step for a minimum of 5 minutes. The gauge reading, engine rpm, shall be recorded. The fuel rack and governor position shall be noted.

111. **Quayside 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) Electrical power plants together with all lights
3) Auxiliary machinery
4) All deck machinery
6) Air-conditioning machinery
7) All pumps etc.

112. **Sea Trial**

Sea trial is to be arranged and carried out in accordance with a program approved by the class/owners. The Builder is to supply a master, crew, all victuals and necessary equipment and arrange the catering. The compass is to be adjusted during sea trial.

Oil fuel, lubricating oil, hydraulic oil, fresh water, pilotage, tugs and dues for the trials are to be supplied by the builder .

Following as minimum to be carried during sea trial.

1) A full power continuous endurance trial in conjunction with speed trial is to be carried out for the period of four hours. Throughout the period readings of pressures and temperature are to be recorded as per engine manufactures recommendations. In additional to those parameters recorded, peak pressure reading and fuel pump rack setting are to be taken on all cylinders.
2) Speed trials are to be measured by GPS or other relevant equipment with recorder at 75%, 90% and 100 % MCR (100 % Lever at governor setting)
3) Crash stop from full ahead to astern to be carried out and the distance to be measured.
4) Steering gear trials to be carried out, in accordance with Classification requirement.
5) The bow and stern thruster are to be tested.
6) Fuel oil consumption is to be taken on both engines at 100%, 90% & 75% MCR and recorded/tabulated and included as part of official sea trial report.
7) Crash stop and turning circle diagrams to be produced and posted.
8) Noise level measurements shall be carried out on the sea trials when
   - vessel running ahead steadily at normal continuous rating of the main engine (90% MCR) without tunnel thrusters in operation.
   - vessel in DP mode when bow and stern thrusters are working at 40% load. (for recording only)
9) External fire fighting system to be tested.
10) DP system trial to be carried out to class / maker requirements.

113. **Environmental Conditions**

The vessel, plant, machinery and equipment, their components and related systems shall be entirely suitable for service under the following conditions:

Ambient air temperature : 45 ^{o}C (max), -1 ^{o}C (min)

Relative humidity	:	95 (max), 0% (min)
Sea water temperature	:	35 ^{o}C (max), 5 ^{o}C (min) (subject to confirmation by engine maker)

114. **Delivery**

Delivery of the vessel is to be taken afloat at Builder's quayside.

115. **Spare Parts**

Spare parts for all equipment as listed in maker list are to be provided according to Makers' recommendations for vessels on unrestricted service. (Maker to provide recommended spare parts list for one year unrestricted service prior to equipment order being placed.)

116. **Noise & Vibration**

The Builder is to ensure that objectionable noise and vibration levels do not arise on the Vessel during normal operation, particularly in accommodation and service spaces. Sound absorbent material to be applied wherever necessary. The Builder is to pay particular attention to avoiding resonance, noise and vibration.

Noise level as shown in the International Maritime Organization (IMO) Regulation A.468 (XII), 1981, entitled: 'Code on noise levels onboard ships" shall be complied with.

Noise level measurement in accordance with the BSRA method or equivalent standard.

The test procedure of noise level measurement shall be submitted to the Owner.

If the measured noise level exceeds the above values, the Builder shall take measures to reduce the noise in the areas where it is higher than acceptable levels to acceptable levels. Method of rectification shall be mutually agreed between the Builder and Owner.

117. **Supervision**

The Vessel shall be constructed and equipped in accordance to this specification and under the supervision of the Classification Society's Surveyor and the Owner's representative in compliance with the Builder's construction schedule.

Throughout the construction period and prior to delivery, the Owner's representative shall have free access to all premises of the yard or its subcontractor's where the Vessel or parts of it are being manufactured during normal working hours.

Shipyard shall always ensure and maintain permanent cleanliness and safety on board throughout the construction period. Spill oil shall be removed promptly. Garbage shall be removed daily. Smoking shall not be permitted on board. Lighted access shall be provided throughout.

118. **Plan for Approval**

Prior to starting work, the Builder shall submit the specified working drawings and documents to the Owner and/or the regulatory bodies for approval.

The list of the plans for approval shall be mutually agreed between the Owner and the Builder.

Plans for approval shall be submitted in electronic from the designer to the builder and builder will submit same to the Owner for comments and approval. Comments if any shall be returned to the builder from the Owner within 5 Singapore working days after receiving, with the Owner's approval stamps and signature on the plan.

The designer will amend/incorporate the owner, builder and class comments into the drawings.

When any other plans or technical information such as detailed working plans are requested by the Owner's representative in addition to the list of plans, the Builder shall show or submit them for reference.

The Builder's standard plans and the subcontractor's or the manufacturer's plans may be used as working plans for approval.

Builders to arrange for Class to give access to Owner's designated representative to view and download all Plan Approval Comments/Letters and Approved Drawings. Builders to also request Class to copy all Plan Approval e-mails to Owners designated representative.

119. **Finished Plan (As-built Drawing)**

All classification approved drawing to be stamped by class. All the drawing to be updated and stamped "As-built" by designer. Builder shall be provided one (1) CD of electronic copies of design documents. Builder to provide the list of the as-built

drawing and the minimum drawings should be as follows.

1) GA
2) Accommodation layout
3) Safety plan
4) Fire control plan
5) Fire protection plan
6) Air-conditioning & mechanical ventilation layout
7) Refrigeration system
8) CO2 bottles room arrangement
9) Tank capacity plan
10) Navigation light arrangement
11) Mast detail
12) W/T Door & Hatches layout
13) Deck machinery foundation
14) Stern roller details
15) Cargo rail detail
16) FIFI pump foundation
17) Bow fender detail
18) Nozzles & shaft bracket detail
19) Sea chest construction
20) Hull Cathodic protection
21) Ladder detail
22) Portable panel details
23) Wheel house Console Arrangement
24) Draft marks & ship Name detail
25) Docking plan
26) Painting specification
27) Lines plan
28) Principal structural sections
29) Profile and deck plans
30) Bulkhead and frames sections
31) shell expansion
32) Welding schedule

33) Superstructure construction
34) Funnel construction
35) Hawse pipe detail
36) Skeg detail
37) Engine room machinery arrangement
38) Bow thruster room machinery arrangement
39) Steering gear room machinery arrangement
40) Shafting arrangement
41) Schematic tank vent and sounding system
42) Schematic bilges piping system
43) Schematic ballast piping system
44) Schematic firemain & deck wash system
45) Schematic fuel oil system
46) Schematic main engine cooling system
47) Schematic Aux engine cooling system
48) Schematic fresh water / drill water system
49) Schematic Domestic F.W & S.W supply system
50) Schematic Drain system
51) Schematic liquid mud system
52) Schematic oily bilge water system
53) Schematic engine exhaust system
54) Schematic Quick closing valves system
55) Schematic lub oil system
56) Electrical single line
57) Schematic watertight door indication
58) Electrical load analysis

Following plans, one (1) copy each, mounted in the frames with glass shall be installed onboard the Vessel in location designated by the Owner's representative:

- General Arrangement
- Capacity Plan
- Fire Control Plan
- Diagram of Pipeline System for ballast, bilge & fire extinguishing etc.
- Safety Plan

- Fuel oil piping plan

120. **Manual**

Three (3) sets of all manufacturer's instruction manuals and maintenance books, service manuals, spare parts lists and lists of agents are to be supplied to the Owner by the time of delivery of the Vessel.

All such documents are to be in English Language, indexed and placed in box files.

121. **Standard, Material & Workmanship**

Materials, machinery and equipment to be generally in accordance with ISO standards, JIS standards, IEC Standards and DIN Standards, unless specifically agreed or stated herein.

All material, machinery and equipment used in the construction of the Vessel are to be new and unused, of acceptable shipbuilding quality, suitable for the intended service, and approved by the Owner and the Classification Society.

All workmanship is to be of acceptable shipbuilding standard, and is to be to the satisfaction of the Owner. Welding to comply with class requirements.

All equipment and major components are to carry permanent identification integrally cast-in, hard-stamped or engraved on a permanently secured non-corrodible plate. The identification is to show, at minimum, the manufacturer's name or trade name, model type, size and rating.

Associated instruments, gauges or metering devices must be of acceptable quality, fit for the intended purpose, non-corrodible and delineated in metric or S.I. units.

All temporary construction equipment such as mounting lugs etc. is to be carefully removed by flame-cutting, re-welding and grinding flush and coated in accordance with paint manufacturer's recommendations.

Temporary lugs are to be burnt off, the rags flushed, ground and smoothen. Any undercut found in way to be built up with welding.

Damage to galvanized pipe to be avoided as far as practicable. Minor Damage area of galv. part caused by welding, machinery damage, etc., to be touched-up by one coat of zinc paint as far as practicable.

Any equipment place in the Vessel, either permanently or temporarily, is to be protected from damage from all causes during the construction phase.

Any item accidentally and physically damaged is to be removed and renewed in its entirety.

The Builder is to ensure that all material, equipment and components delivered to his premises for use in construction or outfitting of the Vessel, and forming part of his Contract with the Owner, are to be officially logged into his premises and clearly identified. The material and components are to be stored under cover and properly protected from direct sunlight, rain, dust, insects or rodent attack, and during cold weather to be properly heated and ventilated to prevent deterioration of equipment or its components.

All material and equipment are to be always accessible for inspection by Owner and, if considered necessary, to be moved to more secure or a better-protected environment shall any deterioration be apparent or considered likely to occur.

Stainless steel fitting on exposed area to be SUS316 or 304.

122. **Welding**

Vessel to be of all welded construction, in accordance with contract plans, specifications, classification.

Welding to be in accordance with classification requirements. All steel used to be of good welding quality, free from laminations or other harmful defects and be class approved. Electrodes to be selected from classification approved lists. Welding schedules to meet classification requirement/standard. High standards of up-to-date welding practice and procedures are to be applied, associated with accurate alignment, fairness, edge preparation and gap widths.

Where possible, structure should be pre-fabricated in assemblies and sub-assemblies to give the maximum possible amount of down hand welding.

All welds which are liable to be exposed to sea water including all deck fittings, external ladders and treads, bulwark stays, load line and draft marks etc. are to be of continuous type.

123. **Tests & Trials For Subsequent Vessels**

Above-mentioned tests and trials to be conducted for each subsequent vessel, except inclining test is for first vessel only, provided there is no substantial change in subsequent vessels.

124. **DP Operating Conditions At Sea**

The maximum sea conditions that the vessel is capable to operate with DP mode shall be determined by the DP plot generated by the DP system supplier, basing on the thrusters capacity as mentioned in this specification. This must be done as soon as possible after contract signing and before the bow thrusters and main switchboard are ordered.

SECTION 2 – HULL STRUCTURE

200. **General**

The hull including the deckhouse, shall be built from mild steel of shipbuilding quality. The steel shall be according to Specification and furnished with test certificate as required by Classification Society. The hull scantlings shall be designed to scantling draft and deck load as specified in previous section.

The steel hull and deckhouse are to be of all welded construction. Longitudinal framing system is to be used throughout except certain location may be transverse framing upon builder's choice.

201. **Keel**

A flat plate keel is to be fitted, connected throughout the length to the centre girder. It is to be tapered at the forward end to the stem and connected to the aft centreline skeg.

202. **Bow Section**

The fore body shall have bulbous bow / stem and be built of steel plates with thick steel bar stem in way of waterline. The fore body including stem shall be well stiffened.

Wash bulkhead with lightening holes shall be provided in part of the fore peak if needed. Chain locker in fore body is to be divided into two compartments by a thick non-watertight bulkhead on the centre line and stiffened with solid half-round stiffeners with cut-in-steps.

Perforated steel plates of 20mm thick shall be arranged inside of the chain lockers and to have a minimum height of 600 mm above the bottom of the chain locker for good drainage. The Chain lockers shall be arranged with bilge piping. Bitter ends to be fitted for securing cable ends.

203. **Engine Room Foundations**

Foundation of main engines shall have ample strengthening and good connection to

the Vessel's hull. Foundations of main engines are forming a part of the bottom construction in way of the engine room. Foundations for main diesel generator units, pumps, separators, deck machinery etc. shall be provided with sufficient strength in order to suppress vibrations.

204. **Aft Section**

The aft body shall have a well-stiffened transom stern. Floor plates shall be arranged at every frame with lightening holes for sufficient access to all spaces. Non-tight wash bulkheads with lightening and access shall be provided as necessary.

205. **Skeg**

A box shape skeg is to be fitted at the centreline. Upon completion, the skeg is to be filled with bitumen solution or equal and drained.

206. **Bottom Construction**

The bottom is to be of double bottom except in forward and aft hull where single bottom construction is to be adopted. In order to give a structural continuity in the bottom, two engine girders P&S, together with the centre girder are to be extended as far as possible and are to be linked with the longitudinal bulkheads of the aft tanks.

207. **Shell Plating**

Bottom and side shell plating, including bilge radius and frames, are to be in accordance with Classification Society regulations. In way of hawse pipes, propeller area, shafts, thruster units and sea chest plating and openings, the plate thickness is to be increased as necessary.

208. **Frames**

Frames for main hull are to be bulb plate spaced at 600mm throughout and to be toe welded to the shell plating. Strong transverse ring frame (or web) is to be fitted where necessary.

209. **Beams / Longitudinals**

Beams or longitudinals for main deck are to be bulb plate. They are to incorporate with

strong beams of fabricated section fitted in way of deck openings and other locations. Beams for superstructure decks are to be angle bar.

210. **Girder & Pillars**

Girders of fabricated sections together with pipe pillars are to be fitted in engine room.

211. **Decks**

Deck plate thickness is to class requirement. Insert plate is to be fitted in way of heavy equipment foundation.

Doubling plates are to be fitted under bollards and forward bulwark stays.

An Engine Room flush panel shall be fitted as per shown on GA.

212. **Watertight / Oiltight Bulkheads & Steel Walls**

The W.T. / O.T. bulkheads are to be plated horizontally.

All bulkheads shall be fitted according to Classification Society rules and stiffened with profiles.

Steel walls, being well stiffened by profiles, shall be arranged for subdivision of cabins, stores and workshops as well as stair casings in lower compartments of hull.

213. **Bulwarks**

Bulwarks are to be in 1,100mm height. Bulwark is to be fitted with 3" Sch 80 top rail and flanged plate stays. In way of rubber D fenders, bulwark plate thickness to be increased by min. 50% and stays must be provided.

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 tow line. Freeing ports to be lined with 14mm round bars.

Hinged Rescue Zone gate are to be fitted on bulwark port and starboard, in way of the Rescue Zone as shown on GA.

214. **Wheelhouse**

The wheelhouse is to have 8mm plate for the front, 8mm for sides and top with angle bar for vertical stiffeners and beams.

215. **Deckhouse**

The deckhouse's front plate is to be 8mm. The top, sides and aft end bulkhead are to be 8mm. The front vertical stiffeners, side and aft bulkhead vertical stiffeners are to be to class requirement.

216. **Funnel**

Funnel to be made of 8mm plate with stiffeners.

217. **Bilge Keels**

Two (2) bilge keels made of 350 x 12 plate Bulb plate are to be fitted about one-third ship length.

218. **Fenders**

15mm thick x 450mm wide doubler plates are to be welded in side shell as shown on the G.A.

Rubber fender see Section 6.

219. **Cargo Rails**

Cargo rails made of 10" N.B., Sch. 80 pipes are to be fitted longitudinally along the main deck, height 2700m, stanchions of I beam at 2400mm apart. Top of rail at outboard side shall be fitted with pipe support.

Rail to be covered with steel plates from inboard side with safe-heaven access openings at short intervals. Outboard surface of the cover plates to be used for storage of cargo hoses and tools. Sufficient lightings to be provided at this sheltered area.

220. **Rudder / Rudder Trunk**

Two (2) high lift type flap rudders with bottom pintle are to be fitted. The rudders are to be watertight streamlined, double plate type, fabricated of mild steel, with internal horizontal plate frames.

Suitable lifting arrangements are to be incorporated and filling / drain plugs fitted.

The plate frames to have limber holes to ensure internal drainage.

After testing, the rudders are to be filled with bituminous or equal solution and drained.

A lifting eye and a jumping ring to be fitted to each rudder stock.

The rudder stock is to be of forged steel.

The rudder trunk is to be tubular steel, with a heavy top plate to take the steering gear and watertight gland. 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 the rudder.

The rudder bearing is to be water lubricated.

221. **Steering Gear**

Two (2) electro-hydraulic independent type steering gears of 2 x 130 KNm torque capacity (subject to vendor verification and class approval) at 2 x 45 deg. rudder angle. Bedplates, actuator, locking valve, solenoid valve, filter, motor, starter, steering column, steering switch and other necessary fittings are to be provided. One (1) rudder indicator of panorama type to be fitted. Structural stoppers to be provided at the side of each tiller. Rudder turning speed 10 sec/35deg with two pumps, 20 sec/35 deg with one pump.

Steering gear control to be from forward and aft consoles in wheelhouse. Rudder angle indicators to be mounted at both forward and aft steering positions.

222. **Nozzles & Shaft Brackets**

Two (2) fixed mild steel nozzles, with diameter suitable for Controllable Pitch Propellers, are to be fitted. Each nozzle is to be supported by 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 to be sheathed with 316 stainless steel. Width of the wear ring to be 25% in excess of propeller sweep width (welding to be away from sweep area).

Propeller shaft brackets are to be the "Y" type, of fabricated mild steel construction, upper part to support shaft aft bossing and lower part to prevent wires entering nozzle thus protecting propellers.

223. **Sea Chests**

Four (4) sea chests shall be arranged in engine room- one (1) in low position, one (1) in high position and two (2) independent sea chest for Fi-Fi pumps.

One (1) sea chest shall be arranged in bow thrusters compartment for emergency fire

pump and bilge pump intake.

Plate thickness in way of sea chests to be 2mm above class requirement.

224. **Drain Plugs**

Drain plugs of 42mm diameter stainless steel screw fittings are to be fitted in all tank compartments adjacent to hull bottom plate (to be excluded for oil fuel, lub. oil and dirty oil tanks).

Two (2) sets of drain plug spanners to be supplied.

225. **Mud Tanks**

The mud tanks to be square tanks. Over-pressure caused by PV valve to be considered when size the scantling of the tank structure.

Each tank to be provided with two suction wells, one at forward and the other at aft.

226. **HIPAP Trunk**

To be provided as shown in GA, min. dimension 1.2 x 1.4 m. Lower part in way of gate valve to be enlarged.

SECTION 3 – ACCOMMODATION & COMPARTMENTATION

300. **General**

The accommodation is to be arranged and fitted out in accordance with the General Arrangement drawing. 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 owners for approval prior to purchase.

Modular toilet unit is to be provided for each cabin.

Separate mess room is to be provided for crew and officer.

Fire rating of partition and insulation to SOLAS requirement.

Cabin and wheelhouse clear height to be as much as practical, with 2,050mm as min. including modular toilet.

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.

Steel ladders to have chequered plate, flanged treads.

Schedule of Deck Coverings

Wheelhouse top, wheelhouse deck exterior & main deck : non skid deck paint.

Wheelhouse interior	:	3mm thick vinyl sheet with dimples on latex
Mess & passageways	:	3mm thick vinyl sheet on latex
Crew's cabins	:	1.8mm thick vinyl sheet on latex
Washrooms and galley	:	12” ceramic tiles on cement with curves at skirting
Engine room	:	steel chequer plate on top of floor bearers.
Steering gear compartment	:	steel chequer plate on top of floor bearers (if headroom permits)
Deck Stores	:	non skid deck paint
Provision stores	:	wood gratings on painted steel

302. **Minor Bulkheads & Lining**

All steel minor bulkheads are to be lined with non-combustible material. Free Standing bulkheads are to be non-combustible material. Internals of wash place to be painted. Galley is to be lined from deck to deck head with non-combustible material and stainless steel finishing. No lining for engine room, store rooms and steering compartments.

303. **Insulation**

All exposed steel work is to be insulated on the inside with min. 50mm thick glasswool and retained behind the linings. Min. 100mm thick rockwool for funnel bulkhead adjacent to accommodation areas.

1) Wheelhouse & deckhouse : deckhead and sides
2) Main deck cabins : exposed deckhead, bulkheads and sides
3) Air conditioning room : exposed deckhead, bulkheads and sides

In way of living spaces on main deck, such as mess rooms, hospital, galley etc, deck insulation with high noise reduction, like floating floor to be laid.

Fire insulation arrangement to comply with class requirements.

Thermal insulation to be provided for boundary of air-conditioned space adjacent to atmosphere.

304. **Windows & Scuttles**

All windows are to be steel framed type with tempered glass to suit the classification's requirements. Side scuttles are to be steel frame type with deadlight. All windows and scuttle frame finishing work to be of fibre glass or wood material.

305. **Steel Doors**

All external doors, except wheelhouse doors, to be of steel with coaming heights according to the loadline requirement.

Six dogs workable from both sides are to be fitted with clips and grease fittings. The doors to be channel-framed tightened to gaskets of soft neoprene or similar.

Doors to be fitted with sturdy padlocks and hold-back hooks to retain them in open positions.

Wheelhouse doors to be stainless steel type with fixed window.

Eye brow to be fitted over weather doors where there is no deck over hang.

306. **Carpenter's Work**

All external doors are to be in steel complimented with sandwich type doors except the wheelhouse doors. All internal doors to be self closing type provided with rubber stoppers to prevent rattling, device hold-back hooks to retain the doors in open position. Hardware to be of brass or chrome. Hinged doors with large windows in wheelhouse. Store rooms to be provided with steel shelves with retaining bars.

Arrangement of shelves, etc. to be sufficient for the intent of each store room. Ceiling in accommodation and navigation spaces are to be of non-combustible type.

307. **Wheelhouse**

The wheelhouse is to be located on nav. bridge deck as per GA and to be fitted with all navigation, communication and control equipment. The forward helmsman's chair to be with transversely sliding track and directly behind the console fitted at forward of the wheelhouse. Two (2) aft helmsman's chairs to be with longitudinally sliding track and fitted between the aft consoles. One (1) pilot chair to be provided.

Wheelhouse windows are to be arranged to give maximum visibility all round and provided with window wipers and clear view screen. Freshwater washing to be provided for windscreen wipers. The compass is to be located above the forward steering position.

One (1) toilet fitted with following to be provided in wheelhouse.

- 1 wash basin (hot and cold water)
- 1 toilet paper holder
- 1 water closet and grab rail
- 1 mirror cabinet
- 1 extractor fan

308. **Master's Suite**

The Master's suite arranged at forward officer deck on the starboard side. To comprise cabin with attached modular toilet compartment, fitted with the following:-

- 1 built in berth 2,000 x 1,000mm (Inner dimension), with drawers under

- 1 built in settee
- 1 kneehole desk with drawers
- 1 desk chair
- 1 wardrobe
- 1 coffee table
- 1 small refrigerator
- 1 book rack on desk
- 1 clock
- 3 hat and coat hooks
- 2 rectangular windows with curtain
- 4 spare power sockets
- 1 waste bin
- 1 32" LCD TV c/w DVD player
- 1 Safe (dimensions to be approved by Owners)

Attached Toilet (Module Type)

- 1 washbasin (hot and cold water)
- 1 toilet paper holder
- 1 towel hook
- 1 tumbler rack
- 1 water closet and grab rail
- 1 shower with plastic curtains on rail, hot and cold water
- 1 mirror cabinet
- 1 extractor fan

309. **Chief Engineer's Suite**

The Chief Engineer's suite is to be fitted out generally as per Master's cabin but no safe required.

310. **Attached Washroom for Crew Cabins**

Module type washrooms attached to each cabin are to be fitted out identically as follow:-

- 1 shower fitted with curtain, soap dish and grabrail
- 1 stainless steel washbasin with hot/cold water supplies

- 1 extractor fan
- 1 spare power point for shaver
- 4 coat hooks
- 1 pedestal WC (European type) with seat, lid & toilet roll holder & grabrail.

311. **One Berth Cabin**

The cabins are to be arranged on officer deck, for Officers, and to be fitted with the following:-

- 1 built in berth 2,000 x 1,000mm (Inner dimension), with drawers under
- 1 wardrobe
- 1 kneehole desk with drawers
- 1 desk chair
- 1 book rack on desk
- 1 small refrigerator
- 1 clock
- 2 hat and coat hooks
- 4 spare power sockets
- 1 rectangular window with curtain

312. **Two Berth Cabin**

Cabins to be arranged as shown on the General Arrangement Drawing, each with the following:-

- 1 built-in two-tier wooden berths with plywood bases and drawers under lower tier
- 2 lockers
- 1 book rack on desk
- 2 sets berth curtain rails
- 1 waste bin
- 1 desk
- 1 chair
- 4 spare power sockets
- 1 rectangular window with curtain

312. **Four Berth Cabin**

Cabins to be arranged as shown on the General Arrangement Drawing, each with the following:-

- 2 built-in two-tier wooden berths with plywood bases and drawers under lower tier
- 4 lockers
- 1 book rack on desk
- 4 sets berth curtain rails
- 1 waste bin
- 1 desk
- 1 chair
- 4 spare power sockets
- 1 rectangular window with curtain

NOTE: All bulkhead fitted accomodation furniture to have 5mm backing sheet
All mattresses to be minimum 150mm thick

313. **Crew Mess Room**

The mess room situated on the main deck is to be fitted out as shown on the GA :-

- Dining tables c/w formica top and edge fiddles
- 2 spare power point
- 1 sideboard
- 32 upholstered chairs
- 1 clock, battery quartz type
- 1 commercial four-slot toaster
- 1 500 litres refrigerator
- 1 bain marie (6 pans)
- 1 salad bar
- 1 drinking fountain
- 1 commercial coffee machine
- 1 900 watt microwave oven
- 1 hot & cold water dispenser, 2.5l/hr
- 1 40” LCD TV

.

314. **Officer Mess Room**

The mess room recreation room situated on the main deck is to be fitted out as shown on the GA :-

- 1 dining table c/w formica top and edge fiddles
- 3 spare power point
- 8 upholstered chairs
- 1 sideboard
- 1 40"LCDTV
- 1 commercial four-slot toaster
- 1 300 litres refrigerator
- 1 clock, battery quartz type

315. **Recreation Room**

To be fitted with:

- Built in settee with stowage under
- Coffee table with formica top.
- Card table and upholstered chairs.
- 1 sideboard with drawer.
- 1 Bookrack.
- 1 48” LCD TV
- 1 DVD player
- 2 spare power points
- 1 white notice board
- 1 coffee / tea machine

316. **Hospital / Sick Bay**

The hospital / sick bay shall have medical supplies in accordance with Class requirements for the number of personnel on board. The hospital/medic to be situated on main deck and are to be fitted out as follows:

- 1 hospital type bed and en-suite facilities fitted with emergency call facilities to wheelhouse
- Medical Chest in accordance to Flag Requirements
- Desks and chairs

- 1 4-drawer steel cabinet
- 1 attached wash room

317. **Store Room**

Stainless steel shelves are to be fitted.

318. **Laundry / Changing Room**

The laundry / changing room situated on the main deck is to be fitted out as follows:-

- 2 washbasin with cold and hot freshwater taps and soap dishes
- 2 industrial type washing machine (minimum. 10 kg capacity) with Stainless steel drums
- 2 industrial type spin dryer (minimum. 10 kg capacity) with Stainless steel drums
- 2 250mm diameter portlight with deadlight
- 2 spare power points
- 1 foldable ironing board
- 1 deep bowl sink
- 46 1m height lockers, stacked in two tiers
- 1 wood bench
- 1 shower cubical
- 1 toilet cubical
- 1 oil skin

319. **CO_2 Room**

This compartment is to install CO_2 bottles. Force exhaust to be arranged. CO_2 room arrangement is to comply with class requirements.

320. **Galley**

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

- 2 stainless steel 4 hot plate marine electric range c/w large ovens fitted with batten arrangements to prevent movement of pans, and with stainless steel exhaust canopy over electric range.
- 1 stainless steel twin bowl deep sink with shelves, lockers under and plate racks over.
- Assorted cupboards, workbenches, plates rack, etc – in stainless steel.

- 6 power sockets
- 1 commercial refrigerator of min. 400 L
- 1 food waste disposal to be fitted below sink
- 1 Commercial food mixer
- 1 Rice cooker
- 1 microwave oven
- 1 dishwasher (12 plate settings)
- 1 Commercial deep fryer
- 1 mixer
- 1 water heater 6 gallon
- 1 hot water urn, 19 litre
- 1 garbage compactor

321. **Ship Office**

To be fitted as shown on General Arrangement drawing, each to be fitted with:

- 2 steel filing cabinets (4 drawers)
- 1 desk and 1 upholstered chairs
- 24V telephone system to be fitted.
- Meeting table with chairs
- Emergency light connected to the ships main emergency system
- 1 quartz wall clock
- 2 spare power points
- 1 wall-mounted white board

322. **Common Toilet**

Common toilet on main deck to be fitted with following.

- 1 W.C. Pedestal c/w seat and lid, toilet roll holder and grab rail and water spray taps for general use.
- 1 washbasin with hot and cold FW supplies
- 2 urinals
- 1 mirror with tray and light
- Spare power point
- Extractor fan.

323. **Provision Store**

This compartment is to be fitted with stainless steel shelves c/w retaining battens. Wooden grating is to be fitted on floors. Ventilator to be arranged. Lock for the door. Provision room bulkhead and deckhead shall be painted.

324. **Air Conditioning Room**

One (1) Air Handling Unit (AHU) Room to be provided to house the air conditioning unit, located as per the General Arrangement Plan. Lightings, ventilation ducts and scupper pipe to be provided.

325. **Bosun Store**

The bosun store incorporated with the chain lockers is to be situated forward of the collision bulkhead on forecastle deck and fitted out with steel shelves. To be provided with storarge boxes (GRP) 2 x 1M3 for SOPEP equipmenr.

326. **Engine Room Fittings**

The engine room is to house all machinery and equipment at convenient locations described elsewhere. Steel chequer plates are to be used for flooring secured with galvanised steel self trapping screws to steel bearers and fitted with hand grib 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.

One common battery operated telephone to be fitted.

327. **Engine Control Room**

Engine control room is to be equipped with:-

- Main switchboard
- Machinery control console (MCC)
- 1 Office desk
- 2 Office chair
- 3 power points
- One (1) packaged air-conditioner, sea water cooled.

328. **Steering Gear Compartment**

This compartment is to be fitted out with steering gear. Common battery operated telephone to meet classification requirement to be fitted.

Shark haw / towing pin HPU and cabinets will be installed in this compartment.

329. **Chiller / Freezer Room (walk in type)**

Refrigeration plant of R407C system direct expansion type, water cooled, electrically driven, to be installed complete with all necessary accessories.

Two (2) compressors and condensers to be fitted, one acting as 100% standby.

The plant is to maintain temperatures of -18 degrees C in freezer room and +4 degrees C in chiller room.

Approx. capacity as follows.

Chiller: 14 m^2

Freezer: 10 m^2

Man-in-fridge alarm bell to be fitted for each compartment.

330. **Bow Thruster Compartment**

This compartment is to be fitted with bow thruster machinery with suitable forced ventilation. Flooring to be 4.5mm thick steel chequer plates.

331. **Cement Tank Compartment**

This compartment is to be provided for the housing of four (4) units of cement tanks. Forced ventilation, grating platform supported by angle bar at tween deck level and steel chequer plates passage are to be fitted.

332. **Fan Rooms**

Fan rooms to be provided for housing of vent fans.

333. **Towing Winch Casing**

Non-tight casing to be provided for towing winch as shown in GA.

334. **Paint Store**

To be fitted with timber shelves. Ventilation and ex-proof electrical fittings / lighting and sea water fire-extinguishing system to be provided.

335. **Praying Room / Gym**

Praying room and gym are to be provided. Praying room is to be provided with carpet and gym is as empty room only.

SECTION 4 - CORROSION PROTECTION

400. General

All de-scaling, shop-priming, de-rusting and painting work shall be carried out as outlined below.

The paint scheme is to be based on design life of five (5) years.

A detailed painting scheme based on the standards specified below shall be prepared by the builder to owner's approval. The chosen colours are based on the available standard colour shade of the supplier of coating material, but all exterior paints according to Owners standard colour shades.

Paint application should be in accordance with paint supplier's recommendations. Deviations or changes that prove to be required during execution of the work will be agreed jointly between the supplier, builder and Owner regarding necessary measures for the performance of work. On the event that the temperature conditions necessary during application are impossible to achieve, alternative coating system as recommended by supplier of coating material will be applied, subject to Owner's approval.

Steel structure surfaces, except manual welded beads, erection seams and butts, may be painted with primer of thickness accepted by Class Rules before leak test.

Final layer of coating is to be applied in one run.

Coating of machineries and electric equipment to be done in accordance with manufacturer's standard coating systems.

Colour scheme to be agreed between owner and builder.

Not listed members of items to be prepared and coated as per their surroundings.

Representatives of painting suppliers have to present during paint application at the yard for technical service and supervision.

Inaccessible spaces like tubular pillars are to be separated airtight from adjacent structure and will have no internal surface protection.

Gas cut sharp edges to be grounded smooth before application of paint.

The surface of copper, copper alloy, aluminium alloy, stainless steel, and non-corrosive material shall not be painted unless otherwise specified.

401. **De-scaling & Priming**

Plates and Profiles

All steel material to be pre-blasted to SA 2.5 and immediately coated with one (1) coat of shop primer.

Fittings and Equipment

The steel surface of fittings and equipments such as pipe seats, grating supports, auxiliary machinery seats, etc., to be generally power-cleaned with wire brush or disc-sander to remove the weather rust and loose mill-scale.

402. **Preparation & Application**

Surface Preparation before Painting

Surface preparation to be inspected and accepted by paint supplier and Owner before application of paint.

Prior to the application of the coating system, secondary surface re-preparation is to be carried out where the shop primer has been damaged or weathered or missing, according to the following schedule as guideline and subject to paint maker's recommendation :

(Surface salt content to be verified to paint makers' recommendation.)

Area	**Preparation Grade**
Underwater hull, flat bottom to deep load line	SA 2 ½
Topsides, above deep load line incl. external bulwark	SA 2 ½
Weather deck	P St. 3
Exterior superstructure and decks	P St. 3
Interior superstructure	P St. 2
engine room, stores etc.	P St 2
W.B. tanks, mud tank, brine tanks	SA 2 ½
F.O. tanks, D.O. Tanks, Sludge tanks	P St 3
L.O. tanks	P St 3
Potable water tanks	SA 2 ½
Void spaces & cofferdams	P St 3
Generally	P St 2

Definition of Grades

The Swedish Standard SIS 055900-1967 and/or German Standard DIN 55928, part 4, applies to all cleanness grades mentioned.

Application

The coating materials will generally be applied by means of airless spraying. Paint brushes or rollers will be used for marking the different coloured areas or for painting small structural members and for lettering, as well as for setting-off edges.

The paint not to be applied during periods of rain, snow, fog or mist in the open air, and also not to be applied when weather conditions may cause condensation (when relative humidity is above 85% and the steel temperature is lower as 3°C above dewpoint), except when paint maker has confirmed a particular paint can be applied during such weather conditions.

Film Thickness

All stated film thicknesses are dry film thicknesses. The actual total film thickness may deviate from the specified film thickness as follows:

- Shell external, water ballast tanks. Mud tanks, brine tanks: 85 % of the points measured are to correspond to the specified film thickness or more. Remaining points measured are allowed to be 15 % less of that stated film thickness.
- All other Areas: 85 % of the points measured are to correspond to the specified film thickness or more. Remaining points measured are allowed to be 15 % less of that film thickness.

Film thickness shall not to be measured on irregular surfaces, such as welding seams and corners or edges of structural members. For repair coats in overlaps, higher film thickness to be tolerated.

The shop primer is included in the total film thickness.

Appearance of Finish

Painting of the exposed structural steel surfaces such as outside of shell, deckhouse, etc. and of living spaces and passages in accommodation to be free from sags and runs. In other areas except the above, paint sags and runs which are not considered harmful to the performance, need not to be removed.

Damaged Coatings

The surface preparation of damaged or destroyed, partly finished or finished surfaces will be carried out by disc or wire brushed according to specification but max. to P St 3.

Covering

All parts and fittings (e.g. glass, label plates, rubber gaskets, spindles etc.) to be protected or covered before application of coatings is commenced.

403. **Painting Schemes**

Paint specifications see appendix.

Wheelhouse top and all exposed decks to be coated with paint makers' non-skid paint.

404. **Pipe Work Colouring**

All exposed piping system are to be identified with colour bands at 2m intervals in accordance with the following colour schemes. Base color to be white.

1) Bilge & ballast		:	black
2) Fire main		:	bright red
3) F.W. System	cold	:	blue
	hot	:	blue with red band
4) Fuel oil		:	brown
5) Lub. oil		:	yellow
6) Liquid Mud		:	pink
7) Dry bulk		:	green
8) Hydraulic oil		:	purple
9) Sea suction		:	green
10) Sea water cooling		:	light green
11) Compressed air		:	grey

Galvanised pipes are to be etched-primed and then top-coated with colour code.

405. **Cathodic Protection**

Appropriate numbers and sizes of zinc anodes are to be welded to the immersed loaded hull, thruster nozzle and inside of the sea chest for five (5) years lifespan.

SECTION 5 - MACHINERY & PIPING

500. **Machinery General**

Two (2) independent propulsion plants, each unit shall consist of:

- One (1) Main Engine
- One (1) Gear Box
- One (1) shafting set
- One (1) Controllable Pitch Propeller with nozzle

The entire propulsion plant is to be designed, constructed and installed according to the rules and requirements of Classification Society, IMO and Flag State.

Exhaust gas emission limitations, according to IMO, shall be noted as well as structural measures for sea-going vessels for the prevention of marine pollution by oil, sewage and garbage in conformity with MARPOL 73/78.

The installations of main and auxiliary machineries including their accessories are to be easily accessible in order to allow maintenance and repairs to be carried out with minimum expenditure for effort and time.

Before installation on board, the important machinery shall be inspected and proved by Classification Society and the Owner at manufacturers test bed. The designed output shall be demonstrated during trial for required duration.

The ambient data as described in section 1 shall be used for machinery design and material selection purpose.

Machinery and piping system design to comply with unmanned machinery space requirement.

501. **Main Engines**

Two (2) units of medium speed, turbo-charged, non-reversible marine diesel engine 6,120 BHP each, run on MDO. With front PTO for fire pumps.

The engine shall comply with the latest IMO requirement for NO_x emission.

Air starting for main engines. Fresh water cooling with sea water coolers

502 **Gear Box**

Each main engine to drive the propeller through a marine gear box. Gear ratio is to match the engine for appropriate propeller.

For alarms, safeguards and instrumentation, see separate clauses. All in accordance with standard shipbuilding practice.

PTO for shaft generators to be provided

503 **Shaft**

Each of the forged steel tail shaft to be sized to classification requirements. Shaft coupling between intermediate shaft and propeller shaft to be of the split coupling type.

The Builder shall install the complete twin screw controllable pitch propeller system.

Supply by Maker's propulsion package complete with all necessary interfacing.

A torsional vibration analysis of shafting system shall be prepared by the engine manufacturer and to be submitted to the Owner after approval by the Classification Society.

504. **Sterntube & Propeller**

Two fabricated mild steel sterntubes are to be supplied and fitted, secured at the bulkhead and at the "A" frame boss. Each is to be fitted with a cast iron white metal lined bushes, and arranged for oil lubrication. The sterntubes are to be fitted with seals, all in accordance with CP Propeller manufacturer's standards.

Two (2) sterntube oil tanks, are to be fitted and arranged, one to feed each tube by gravity.

The tanks are to have air release arrangements, an oil level gauge, and low level alarm provided.

Two (2) four or five bladed controllable pitch propellers to be supplied, one RH and one LH, and are to be operated in fixed nozzles.

Propeller blades and hubs will be in Ni-Al bronze or equal with all copper clad steel bolts, to be manufactured to ISO/TC 8 Class I standard and statically balanced. The blades will be designed for operation in propulsion nozzles. The entire CP propeller system is to be designed, built and installed to meet Classification standards.

Propellers to be designed to give speed and bollard performances as specified in section 1.

505. **Generating Sets**

The electrical power is to be supplied by

- Three (3) 550 kW diesel driven alternators (440V/3/60Hz).
- Two (2) 1,920 kW shaft alternators (440V/3/60Hz)

Each diesel generator in the engine room shall be driven by a water-cooled marine diesel engine. Starting of engines is to be by compressed air. All accessories shall be in accordance with the Classification Society.

The diesel engine and generator are to be fitted to a common foundation, which is to be resiliently mounted.

The engine shall comply with the latest IMO requirement for NO_x emission.

One (1) diesel-driven emergency generator, rated approx 99 KW (440V/3/60Hz), with air-cooled radiator system and to be of electric-start type shall be provided in the Emergency Generator Room located on the main deck and to be readily accessible from the open deck.

The emergency genset room is to be well insulated and the generator is to be mounted on resilient foundations to minimize noise and vibration.

Diesel oil service tank for the emergency generator set shall be fitted with low level and cut off alarm. The tank is to be served by an electrical power pump. Starting and stopping switch for the electric pump shall be located at the vicinity of the diesel oil tank in the emergency diesel generator compartment.

506. **Bilge / Ballast / Fire / G.S Pump**

Two (2) vertical self-priming centrifugal SW pumps of 120 m^3/hr at 75m total head. Suction and discharge pressure gauges to be provided.

- Casing : Bronze
- Shaft : Stainless steel
- Impeller: Bronze
- Seal : mechanical

507. **Bilge Pumps**

Two (2) vertical self-priming centrifugal SW pumps of 60 m^3/hr at 25m total head. Suction and discharge pressure gauges to be provided. Pump material is same as G.S pumps. At least one unit to be installed in bow thruster compartment.

One (1) daily bilge pump of 2 m^3/hr at 25m total head to be provided, self-priming type.

508. **Fuel Transfer Pump**

Two (2) 20 m^3/hr at 20m head horizontal gear. To have a cast iron body with carbon steel impeller and shaft. To have one (1) remote stop switch outside engine room.

509. **Water Cargo Pumps**

One (1) vertical centrifugal self priming pump to be provided for FW. Capacity 150 m^3/hr, at 75m head.

One (1) vertical centrifugal self priming pump to be provided for DW. Capacity 150 m^3/hr, at 75m head. The pump to be connected to ballast system.

Both pumps material to be as follows.

- Casing : Cast Iron with internal coating for FW, bronze for DW
- Shaft : Stainless steel
- Impeller: Bronze
- Seal : mechanical

510. **FO Cargo Pumps**

Two (2) vertical screw pumps to be provided, each capacity 200 m^3/hr at 90m head. To handle discharging of cargo fuel oil. Pump casing insert is to be of cast iron and main screw in nitrurated carbon steel. The pump is to be directly connected to electric motor complete with relief valve.

511. **Rec Oil / Mud / Brine Pump**

Two (2) horizontal pumps to be provided for mud, brine and RO system, hydraulic driven and eccentric screw type with integrated pressure relief valve, capacity 75 m^3/hr when discharging against 20 bar at mud of SG 2.5 t / m^3, 100 m^3/hr when discharging against 5 bar at RO of SG 1.0 t / m^3.

Pump HPU to be located in engine room.

512. **Mud Agitator**

Hydraulic type agitators to be installed inside mud tanks. To have same HPU as mud pumps.

513. **Dirty Oil / Sludge Pump**

One (1) electric driven horizontal positive displacement type screw pump installed in the engine room and shall deliver 5m3/hr at 29m head.

514. **SW. Cooling pump for Auxiliary Machinery**

One (1) vertical centrifugal S.W. cooling pump, electrically driven, to be fitted to serve air conditioning system and refrigeration systems. Capacity to be recommended by vendor. G.S. pump to be connected to the system to serve as stand-by.

One (1) vertical centrifugal S.W. cooling pump, electrically driven, to be fitted to serve deck machinery HPU. Capacity to be recommended by vendor. G.S. pump to be connected to the system to serve as stand-by.

Two (2) vertical centrifugal S.W. cooling pump, electrically driven, to be fitted to serve deck cement compressor. Capacity to be recommended by vendor.

Two (2) vertical centrifugal S.W. cooling pump, electrically driven, to be fitted to serve bow thrusters. Capacity to be recommended by vendor.

Two (2) vertical centrifugal S.W. cooling pump, electrically driven, to be fitted to serve stern thrusters. Capacity to be recommended by vendor.

Seawater cooling pump to be provided for other equipment if required, capacity to be recommended by vendor. G.S. pump to be connected to the system to serve as stand-by.

NOTE: All sea water pumps to have as a minimum stainless steel shafts and bronze impellers

Where self-priming pumps are specified air ejector type priming not acceptable.

515. **FW Pressure Set**

One (1) fresh water pressure set complete with about 3.5 m^3/hr at 35m head and one (1) pressure tank of about 500 litres with maximum working pressure 30-60 PSI with pressure relief valve.

516. **SW Pressure Set**

Additional set. Specs Identical to FW pressure set except for sea water. One additional pump to be provided as standby for both FW and SW sets.

517. **Emergency Fire Pump**

One (1) vertical self-priming centrifugal fixed emergency fire pump of 45 m^3/hr at 60m head to be electric motor driven and installed in bow thruster compartment.

518. **Exhaust Pipes & Silencers**

Exhaust pipes from main and auxiliary engines to be led to top of funnels. Exhaust pipes and silencers to be well insulated and covered with zinc-galvanized steel sheeting. Exhaust silencers to be able to suppress noise not less than 35 dBA and to be fitted with spark arrestor and suitable for oil field operation.

Drain for exhaust pipes to be provided.

519. **Engine Cooling System**

General

The cooling water system including main engine, aux. engines and auxiliary machinery. The cooling capacity of the heat exchangers to be dimensioned for a seawater temperature of 32 ^oC. One low suction and one high suction sea chest will be arranged in the engine room for cooling, ballast and general service.

Seawater cooling pumps to have direct suction from the sea main fitted between the sea chests, a strainer to be installed before each seawater cooling pump. The strainer to have housing of cast iron inside epoxy coated, and strainer inserts of stainless steel.

Main Engine Cooling Freshwater System

The freshwater cooling system is divided into a low temperature and a high temperature circuit. Each main engine is equipped with a built-on HT freshwater pump, a built-on LT freshwater pump, one (1) electric driven LT standby-by pump and one (1) HT stand-by pump of the centrifugal type will be installed for FW cooling system. Two (2) SW cooling pumps of the centrifugal type will be installed for each main engine SW cooling system. Thermostatic valve elements to be fitted where to control the high and low temperature.

For maintenance purposes proper closing valves are to be installed for all closing off positions. Separate expansion tanks of suitable size for the LT and HT system should be installed to accommodate for changes of volume due to varying temperatures and possible leakage in the LT and HT systems. The expansion tanks shall be equipped with vent pipe, level gauge, low level alarm switch and connections for filling the tank with water and corrosion inhibitor.

A system for preheating of the main engine, consisting of electric driven pump and electric heater shall be arranged, with capacity according to engine maker's recommendations.

One (1) LT coolers and one (1) HT cooler of plate type are to be installed for each main engine. HT cooler is to be connected to (cooled by) the LT circuit, and shall not be cooled by seawater directly. Capacity according to engine maker's recommendations, with other consumers connected to the system. All pipe connections to be arranged on the fixed part of the heat exchangers, thus disconnection of pipes for opening of the heat exchangers will not be necessary. Thermometers and pressure gauges shall be fitted at the inlet and outlet of the heat exchangers, filter before inlet of LT coolers to be fitted.

Materials in plates:

Low temp Cooler: Titanium

High temp cooler: Stainless steel AISI316

Auxiliary Engines Cooling Water System

Each main generator engine has its own built-on complete cooling water system. Only connections for inlet from sea main and discharge to overboard to be arranged.

The emergency generator engine has its own built-on complete cooling system, radiator cooled.

520. **Lub Oil System for Main / Auxiliary Engines**

Lub. Oil Filling System

Deck filling connection of 65A to be provided for M/E L.O. tank and A/E L.O. tank, overflow from M/E L.O. tank to be led to lub. oil service tank(double bottom tank) .

Lub. oil service tanks to be filled from M/E L.O. tank by gravity.

Lub. Oil Purification System

Two (2) automatic self-cleaning lubricating oil separators are to be arranged, with

capacity according to engine manufacturer's recommendations. The separator feed pumps will draw oil from the lub. oil service tanks under main engine, to the separator and deliver back to the lub. oil service tank. One elec.heater shall be installed between pump and separator. The heater is to be equipped with temperature regulator with filter, safety valve, pressure gauge and thermometer at outlet.

Lub. Oil System for Propulsion Machinery

Main engine features an entirely closed dry sump lub. oil system. The built-on lub oil pump draws the lub. oil from the lub. oil service tank through a stop check and a suction filter. Via a stop check valve with connection for the separate stand-by pump, the oil flows to a lub. oil cooler and an automatic lub. oil filter, etc. to the engine. Thermostatic elements ensure a constant lub. oil temperature to the engine. The back-flush oil from the automatic lub. oil filter is drained to the lub. oil service tank. Separate stand-by electric motor driven lub.oil pump to be provided for each main engine. Capacity as per engine maker's recommendation.

Stern Tube Lubrication System

For lubrication of the stern tube a gravity tank to be fitted in a distance above water line for each shafting according to recommendations from the seal supplier. Oil drain to be provided in order to enable taking oil samples for regular analysis.

Lub. Oil System for Aux. Engines

Aux. Engines fitted with pump, filter, cooler and thermostatic elements, etc, external piping fitted with one filling pipe from A/E L.O. tank, one drain pipe led to dirty oil tank(double bottom tank).

521. **Oxygen & Acetylene System**

Oxygen and acetylene bottles for gas welder / cutter set to be arranged in bottle room on main deck. Servicing to engine room and forward cargo deck to be by portable hose. Door of the bottle room to be double door made from expanded steel plate. Three bottles to be provided, 40 litre each, 2 bottles for Oxygen, 1 bottle for Acetylene.

522. **Compressed Air System**

Compressed air system for engine starting is to consist of :-

- 2 air compressors, air-cooled type, at 30Kg/cm^2, two (2) electrically driven, to be able to charge air receivers within one (1) hour.
- 2 air receivers, 2 x 2,000L at 30Kg/cm^2
- 1 oil/water separator

Compressed air system for working / general service is to consist of :-

- 1 air compressors, air-cooled type, at 10Kg/cm^2, electrically driven, to be able to charge air receiver within one (1) hour.
- 1 air receiver, 800L at 10Kg/cm^2
- 1 oil/water separator

Assorted pressure gauges, pressure reducing valves, relief valve etc to be supplied for both systems.

General service to tap off from working air system. Three (3) working air connections each to be provided on main deck at port and starboard, One (1) connection each on Fwd & Aft forecastle deck at port & starboard.

Sea chest blow-down to be 3/4" NB STP steel pipe, 10Kg/cm^2.

Main engine controls if any to be by working air system.

523. **Oily Bilge Water Separator**

One (1) MARPOL standard oily water separator complete with pump and oily water discharge alarm to be fitted. Capacity 1 m^3/hr with oil content less than 15 ppm.

524. **Bow / Stern Thrusters**

Two (2) transverse tunnel CP bow thrusters, each giving a thrust of approx.12T and one (1) stern thrusters giving a thrust of approx.10T, to be driven by electrical motor.

All necessary controls, interface to DPS and interlocks to be provided.

525. **Sewage Treatment Plant**

One (1) sewage treatment plant for 50 men. One sewage pump of 5m^3 capacity, 3 bar pressure to be provided.

526. **Fresh Water Maker**

Two (2) set of R.O. water maker (cap: each 10 tons per day) to be provided with UV

sterilizer.

527. **Purifiers**

Two (2) LO purifier (with heaters) each of 900 ltr/hr and one (1) Fuel oil purifier 2,200 ltr/hr both self-cleaning / discharge shall be installed by the Builder. Capacity to be confirmed by engine maker.

528. **Piping General**

All pipes are to be arranged according to good 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 is to be used where piping penetrates a watertight or oiltight bulkhead, deck or tank top. Expansion bends are to be fitted where necessary to avoid damage due to expansion or movement of the structure. Mudboxes, strainers, filters and valves are to be arranged according to classification's requirements. All seawater pipes are to be of galvanised steel.

All valves will be marked with appropriately named plates. Bunker station will be arranged on deck with common filling and discharge of diesel oil.

All bare steel pipelines to be painted with primer prior to final finish coat as per paint specification.

529. **Pipe & Valve Materials**

Pipes:-

Hull pipes to ISO / CB / GB or equivalent. For pipes passing through tanks, pipe scantlings may be increased to be to Classification requirement.

System	Material	Remarks
Bilge + Ballast	Galvanised steel	Seamless Sch 80
Fire + Washdeck	Galvanised steel	Seamless Sch 80
S.W. Cooling	Galvanised steel	Seamless Sch 80
F.W. Cooling	Black steel	Seamless Sch 40
Fuel Oil	Black	Seamless Sch 40
Lub Oil	Black	Seamless Sch 40

Sanitary, Fresh Water	Galvanised steel	Seamless Sch 40
	PE (accom)	to maker's standard
Soil Pipe	Galvanised steel	Seamless Sch 80
	PE (accom)	to maker's standard
Air + Sounding	To suit tank	Seamless Sch 80
Cement	Black steel	Seamless Sch 80
RO/Mud/Brine	Galvanised steel	Seamless Sch 80
Control	Copper	1-2 mm
Compressed Air	Black steel	Seamless Sch 40
Exhaust	Black steel	ME 8mm, AE 6mm

Where galvanising is specified, this is to be carried out after fabrication as far as practicable. Piping is not to be led through tanks as far as practicable.

Utility pipes in accommodation to be of PE material as much as practical.

Valves: see tables below (Disc and seat material to maker's standard).

System	Nom Dia (mm)	Type	Material				Pressure Standard Kgf/cm^2
			Body	Disc	Seat	Stem	
30 kgf/cm^2 compressed air	6 to 10	Screwed globe or cock	Forged steel or brass	-	-	Brass	30
	15 to 25	Flanged globe or angle	Forged steel	Brass	-	Brass	
	32 & above		Cast Steel	Brass	Brass	Stain-less steel	
10kgf/cm^2 compressed air Feed water pump outlet	6 to 10	Screwed globe or cock	Bronze	-	-	Brass or bronze	20
	15 to 40	Flanged globe or cock	Bronze	Bronze	-	Brass	16
	50 & above		Cast Steel	Bronze	Bronze	Brass	10
Fuel Oil supply pump outlet	6 to 10	Screwed globe or cock	Bronze	-	-	Brass or bronze	20
	15 to 40	Flanged globe or angle	Bronze	Bronze	-	Brass	16
	50 and above		Cast Steel	Bronze	Bronze	Brass	10
Fuel Oil (Exceed 60ºC)	6 to 10	Screwed globe or cock	Bronze	-	-	Brass or bronze	20
	15 to 40	Flanged globe or angle	Bronze	Bronze	-	Brass	5
	80 & above		Cast Steel	Bronze	Bronze	Brass	

System	Nom Dia (mm)	Type	Material				Pressure Standard Kgf/cm2
			Body	Disc	Seat	Stem	
Exhaust & Drain	6 to 10	Screwed globe or cock	Bronze	-	-	Brass or Bronze	20
Feed water (low pressure)	15 to 40	Flanged globe or angle	Bronze	Bronze	-	Brass	5
Potable Water	50 & above	Flanged globe or angle	Cast Iron	Bronze	Bronze	Brass	5
Cooling fresh water	50 & above	Flanged Gate	Cast Iron	Cast Iron	Bronze	Brass	5
Fuel Oil (below 60°C)	50 & above	Butterfly	Cast Iron	Cast Iron	Rubber	Stain-less Steel	5
Diesel Oil	50 & above	Butterfly	Cast Iron	Cast Iron	Rubber	Stain-less Steel	5
Lubricating Oil	50 & above	Butterfly	Cast Iron	Cast Iron	Rubber	Stain-less Steel	5
Cylinder Oil	50 & above	Butterfly	Cast Iron	Cast Iron	Rubber	Stain-less Steel	5
Cooling Sea Water	6 to 10	Screwed globe or cock	Bronze	-	-	Brass or Bronze	20
Bilge & Ballast	15 to 40	Flanged globe or angle	Bronze	Bronze	-	Brass	5
Sewage	50 and above	Flanged globe or angle	Cast Iron	Bronze	Bronze	Brass	5
Fire	50 and above	Butterfly	Cast Iron	Alumi-nium bronze	Rubber	Stain-less Steel	10
Deck Wash	50 and above	Butterfly	Cast Iron	Alumi-nium bronze	Rubber	Stain-less Steel	10
Ship side	40 and below	Flanged globe or angle	Bronze	Bronze	-	Brass	10
	50 and above	Flanged globe or angle	Cast Steel	Stainless steel	Stainless steel	Stainless steel	10
F.O. & L.O. tank emergency shut down valve	40 & below	Flanged globe or angle	Bronze	Bronze	-	Brass	5
	50 & above	Flanged globe or angle	Cast Steel	Bronze	Bronze	Brass	5

530. **Bilge & Ballast System**

Bilge and ballast pipes are to be arranged with valves, strainers, mud boxes, manifolds and pumps in accordance with the piping drawing to meet the classification's requirements.

Suctions are to be fitted to the following compartments:

- Forepeak SW ballast tank
- Store/bow thruster room
- Engine room
- Cement compartment
- Steering gear compartment
- D.W. / W.B. tanks

Mud boxes are to be galvanized.

High level bilge alarm is to be provided in engine room, steering gear compartment, bulk tank compartment and bow thruster compartment, etc. The micro-switch is to be of watertight type.

Bilge system valves to be remote controlled by pneumatic or electric actuators from location above main deck.

Chain lockers, bosun store to be drained by bilge ejectors driven by G.S pumps.

531. **Fuel Oil System**

Fuel oil pipes are to be arranged with valves, filters, manifolds, pumps and tanks in accordance with the piping drawing and to meet classification's requirements.

To be divided into ship FO system and cargo FO system, and cargo FO can be transferred to ship FO tank with non-return valve.

The fuel oil bunkers and daily service tanks are to be arranged as shown on the drawing. Daily service tanks to be positioned at convenient locations.

Sounding and air pipes are to be fitted to each tank.

The fuel transfer pump together with the manifold and valves etc is to be arranged to transfer fuel oil from one pair of tanks to others for forward and aft direction only. It is to draw from another bunker and discharge to either of the daily service tanks.

Each daily service tank is to be provided with supply, filling and overflow pipes, drain valves, sight glass or content gauge to meet classification requirement.

Drip trays of 150mm coaming height to be fitted in way of pumps. Drain from drip trays to be drained to dirty oil tank.

532. **Dry Bulk Handling System**

The system is designed for cement with a maximum specific gravity of 2.5.
All electrical fittings inside cement tank compartment are to be explosion proof type.
Loading/discharge stations are arranged at main deck, midship and aft locations, port and starboard sides. The piping plant to be arranged as two systems. The plant to be capable of discharging two types of dry bulk simultaneously through two separate discharge lines. Air dryer to be provided between air compressors and bulk tanks.
Fill/discharge piping to be 5". Fill/discharge stations to be equipped with 5" fig. 206 female unions. Bending radius for the fill/discharge pipes to be minimum 5" diameter in general. Bending radius for the vent pipes to be minimum 300mm.
Loading/discharge operation to be from Central Control Panel to be located in wheelhouse.
5" diameter quick couplings are to be provided complete with dust caps. A suitable amount of Straub Grip couplings or similar to be installed for easy removal of pipes in case of bulk blockage.
Ventilation through two common lines to be arranged with Kamlock coupling for connection of the vent hose.
Operation Pressure : 80 psi
Four (4) off vertical cement tanks.
All tanks rated for 80 psi working pressure
Test pressure 1.5 times working pressure.
To complete with aeration system hatch, lifting eyes, legs and pipe connection for discharge. Fill and vent lines and air supply plus high level indicators, pressure valve and safety valve which can be preset at any level between 40-80 psi.
The four (4) cement tanks shall be arranged as two systems, each system has individual filled and ventilated. The common discharges to be located one (1) at port amidships, one (1) at port aft, one (1) at starboard amidships, one (1) at starboard aft.
The bulk system shall be remote operated from the wheelhouse with the exception of butterfly valves (manual operated) located on the main deck. Deck connection shall be of quick connections type, quick couplings with cap of 130mm (5 inch) for cement.

One (1) remote control stand for four (4) tanks operation, having two purge valves and two (2) compressor stop buttons incorporated. It shall be located in wheelhouse.

Compressors:

2 off electrically driven compressor, sea water cooled.

Capacity : 22m3/min F.A.D. Working Pressure : 80 psi

After coolers completed with moisture separator and auto drain trap, all to manufacturer's recommendation.

Electric motors and compressor units mounted on common skid.

Dryer:

2 off moisture removal and dryers.

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

Two (2) remote control emergency stop switch to be provided, one (1) in the wheelhouse and the other on main deck.

The dry bulk system shall not be operated during oil recovery operation.

533. **Rec Oil / Mud / Brine System**

The system consists of four (4) RO / mud / brine tanks and two pumps, unloading by the two pumps, loading is by shore pumps.

Each tank to be fitted with a mud agitator, and mud circulation piping to be fitted at bottom part of mud tanks. Each tank to be provided with two suction wells, one at forward and the other at aft.

Recovered oil loading is through deck connection by gravity drop-in.

Piping inside other tanks if any around RO / mud / brine tanks to be all welded pipe without valves, flanges, fittings or take-down joints.

Piping and valves for the system to be arranged in dry bulk tank compartment and shaft tunnels port and starboard. Piping if any in engine room shall run of all welded pipe.

534. **Tank Vent System**

Liquid tanks to be fitted with vent pipe / head to class requirement. Location to be outside hazardous area.

Each R.O / mud / brine tank to be fitted with a PV valve, suitably sized vent pipe to be led from each tank into the pressure-vacuum valve, height min. 2m above main deck,

and the valve to open at: +0.14 bar(Gauge), -0.035 bar(Gauge), PV valves body to S.S material.

Single RO / mud / brine tank max. loading capacity is $100m^3/h$.

Pressure sensor to be fitted in each tank with a monitoring system in the wheel house, such monitoring equipment is also to provide an alarm facility, which is activated by detection of over-pressure or under-pressure conditions within a tank.

535. **Tank Remote Level Gauging System**

RO / mud / brine tanks and FO tanks to be fitted with pressure sensor type level gauging system with display at pump control location, ECR and wheelhouse aft control station. The pressure sensor to be installed in a short spool at tank bottom level outside the tank, with compressed air connection (if necessary) for blowing of the spool. High level alarm to be set at 85% and 95% level.

536. **Hydraulic Systems**

The hydraulic piping of solid drawn steel (internals to be acid cleaned) for the steering gear and other deck machinery to be arranged in accordance with the manufacturer's recommendations and to meet classification requirements. Adequate strainers to be provided.

537. **General & Wash deck Service**

Seawater for the general and wash deck service is to be supplied from the GS and fire pump to hydrants fitted on the main deck and, bow thruster room, steering gear compartment, dry bulk compartment and engine room.

538. **Air & Sounding Pipe**

Air pipes for water tanks shall be galvanized.

Ventilation head for fresh water to be provided with stainless steel insect screen and for fuel oil with stainless steel spark-arresting gauge. Sounding pipes shall be of welded type with closure devices.

539. **Freshwater System**

A cold F.W. piping system of galvanised main line pipe of Sch 40 and branch line is to be fitted complete with one UV sterilizer or equivalent filtering system for drinking and washing purposes. Potable water tanks are to be arranged as shown on the drawing.

Water is to be supplied to the accommodation and engine room through self-contained, automatic pressure tank fitted in the engine room. One (l) semi-rotary hand pump is to be fitted in the galley.

540. **Hot Freshwater System**

Hot freshwater system is to be drawn from cold freshwater into an electric calorifier, capacity 600 litre installed in engine room, and piped to wash places and galley. A hot water circulation pump of 2 m^3 / hr 20 head is to be provided. Hot water pipes to be suitably lagged.

541. **S.W. Sanitary System**

Saltwater sanitary pipes of galvanised main line and copper branch are to be arranged with valves, S-trap, scuppers and pressure set in accordance with good marine practice and meeting classification requirements.

542. **Sanitary Fittings**

1)	Washbasins	:	white vitreous China, or stainless steel 20" x 16" with 3/8" cold hot water supply. Taps to be chromed plated.
2)	Showers	:	light coloured 6” or 12” ceramic tiles with 3/8" cold and hot water screw down taps and mixing valves.
3)	W.C.	:	white vitreous China with plastic seats and lids. 1" S.W. supply with flush valve.
4)	Galley sink unit	:	16" S.W.G. stainless steel twin bowl unit 1/2" hot & cold F.W. supplies. Chrome plated taps.

543. **Scuppers & Discharges**

Discharges from washbasins, showers, sinks and internal scuppers are to be grouped into a common cross main to discharge overboard through storm valve. Air pipe to be

arranged from the cross main. Discharge from W.C. to be led to a sewage treatment plant.

Scuppers from the refrigeration spaces are to be led to the bilges. A scupper from the air conditioning compartment is to be led overboard via a storm valve.

50mm scuppers to be fitted in toilets. Laundry and galley scuppers to be 80mm. All internal scuppers to be trapped, and fitted with portable gratings.

Discharges and trips generally to be as follows:-

Showers: 50mm with P-trap

Washbasins: 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 min. 50mm scuppers.

Moisture condensate drainage to be provided from behind accommodation panelling.

No take down flanges to be fitted in way of accommodation/galley/mess room/provision store.

544. **Filling / Discharge Systems**

The cargo discharge lines are to be led to the rig discharge stations on deck.

The combined filling and discharge deck fittings are to be color coded. Color code to be advised by owner.

The systems to cater for:-

a) Cargo fresh water: Female 125 mm, one each at port midship and starboard midship.
b) Cargo fuel oil: Female 125 mm, one each at port aft and starboard aft.
c) Drill water: Female 125 mm, one each at port midship and starboard midship.
d) Dry bulk: see section 531.
e) Mud: Female 125 mm, one each at port aft and starboard aft.
f) Brine: Female 125 mm, one each at port aft and starboard aft.
g) Recovered oil: Female 125 mm, one each at port aft and starboard aft.

Deck terminations to be fitted with approved type of quick couplings. Butterfly valves to be fitted adjacent to quick couplings.

Except for fresh water, drill water and dry bulk, the rest of cargo connections to be

provided with drip trays with sufficient capacity.

For Sewage and dirty oil, deck discharge connection to meet MARPOL 73/78, location at main deck aft of deckhouse.

545. Ventilation & Air Conditioning

Accommodation spaces to be central air-conditioned with both cooling and heating, and maintained with overpressure.

		Designing Conditions
Outside Temperature	:	summer 45 °C,90% R.H, winter -1 °C.
Inside Temperature	:	summer 25 °C, winter 20 °C. 65% R.H.
Fresh Air Intake	:	about 30%

Living spaces, wheelhouse shall be fully air-conditioned and spot cooling for the galley by water-cooled marine type machinery. In addition to central air-conditioning, wheelhouse to be provided with two (2) independent air-con units, air-cooled and ceiling mounted. Compressor/Condenser units for wheelhouse if of air cooled type to be certified by Original makers (not air-con vendors) for use in marine environment.

Galley is to have an independent exhaust system with stainless steel hood over range. Blower units are to be designed and installed to give minimum noise level.

All vent outlets are to be fitted with adjustable dampers capable of closing completely. Cooling / heating of air through mechanical ventilation system is to be thermostatically controlled from one central location, on the air –conditioning unit.

One air-conditioning plant, with two compressors and condensers of Freon R407C and two AHU/blowers, each of 75% of total required capacity, to be installed to serve all living spaces & public spaces within the accommodation deck. The plant to maintain the inside climate conditions as described under this section.

Galv'd rectangular ducting to be provided for the equal air distribution to the air-conditioned space. Duct to be insulated with mineral wool wrapped with double sided aluminum foil externally acting as vapour seal.

The air-conditioning plant compressor and condenser shall be fitted with Cu-Ni tubings.

Engine Room Ventilation

Main and auxiliary diesel engines are to draw combustion and cooling air from engine

room. The engine room is to have two (2) separate electrically driven main fans of low-noise type, each to have 50% required capacity. One of them is to be reversible. The fans to have sufficient capacity according to ISO8861 requirement and to be capable to maintain overpressure in engine room. The fans to be installed in fan compartments at 2nd deck. Air ducts to be made of galvanized sheet. Natural exhaust shall be provided via funnel. Air inlets and outlets shall be installed at least 6 m above water level.

Steering Gear Room Ventilation

One (1) axial flow supply fan is to be provided above main deck for steering gear room ventilation. Exhaust by natural.

Cement Tank Compartment Ventilation

One (1) axial flow exhaust fan, explosion proof type, to be provided inside cement tank compartment for ventilation, min. 20 air changes per hour. Supply by natural. Air inlet and outlet are located at main deck.

Bow Thruster Compartment Ventilation

One (1) axial flow supply fan and one (1) axial flow exhaust fan to be provided inside bow thruster compartment for ventilation. Air inlet and outlet are located at forward of upper forecastle deck accommodation. The air supply is to cater for the cooling of bow thruster motors, emergency fire pump motor etc.

Wash Places & Galley Ventilation

Wash places and galley to be provided with exhaust fans.

Towing Winch HPU Room Ventilation

One (1) exhaust fan is to be provided for towing winch HPU room ventilation. Supply by natural.

546. **External Fire-fighting System**

External fire-fighting equipment for Fi-Fi Class 1 shall be installed.

The following equipment are to be fitted for the vessel:-

a) Fire Pumps

Two (2) units seawater pumps min. 1,650 m^3/hr at 140m head. To be confirmed by vendor to class requirements.

The pumps to be driven from main engine PTO via flexible coupling with clutch and step-up gear.

Independent sea suction and piping system for the pumps to be provided. Sea suction valve of class approved material and remote controlled from wheelhouse and manual control at valve. Pump outlet valve is electric actuated and remote controlled in wheelhouse. The pump casing to be cast iron with internal coating, shaft acid proof steel and impeller of Al-Bronze.

b) Fire Monitors

Two (2) units monitors at 1,200 m^3/hr each (one dual barrel water/foam)

The monitors are to be remotely controlled from wheelhouse, control system consisting of the following:

- One (1) main control panel – logic for operation of monitors.
- One (1) portable joystick panel for installation in wheelhouse with control of elevation and rotation of monitors.

c) Fixed Water Spraying System

The vessel is to be protected by a permanently installed water-spraying system consisting of a number of nozzles fitted on all deck levels. The fixed water spraying system is to provide protection for all outside vertical areas of hull, superstructures deckhouses and other equipment.

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

d) Foam System.

Foam system to install as per fire pump maker recommendation, one (1) set of foam mixer consisting of eductor and metering valve with mixing ratio 1-5% to be fitted.

547. **Lifting Beams**

Lifting beams are to be fitted over each main engine, diesel alternator and purifier.

Lifting Beams to be Load Tested and Statement of Fact issued by ABS.

548. **Lifting Lug in Engine Room**

Lifting lugs (with individual test certificate) suitable for use of chain blocks are to be fitted at the following positions:

- Two (2) points above each main engine, trolley beam c/w pulley and chain block
- Two (2) points above each generator engine
- One (1) point above each gearbox
- Two (2) points above each intermediate shaft
- Two (2) points above each generating alternator
- Two (2) points on outside of Hull and adjacent to each rudder
- One (1) point above each rudder stock on the under side of the main deck
- Six (6) points above and offset from each tailshaft line on the underside of the main deck, fwd & aft of the nozzle if applicable
- Allow for further 20 points as nominated by Owner's representative

549. **Flow Meter**

Flow meters with printer, strainer and air eliminator to be provided for
- Engine fuel consumption (no printer)
- One on loading line and one on discharge line for liquid cargoes (water and fuel).

All flow meters to be certified by independent 3rd party certification company.

550. **Maintenance & Technician Tools**

Following to be provided.
- 1-ton chain blocks x 2
- Workbench with adjustable light and drawers under in the engine room
- 125mm vice mounted to the workbench

- one set of assorted hand tools for general maintenance
- steel sounding tape x 2
- electrical hand inspection lamp with wandering leads x 2
- steel sounding rods and lines
- steel locker with padlock for spares
-Oxygen/Acetylene gas cylinders and cutting equipment

551. **Ballast Water Treatment Plant**

One (1) ballast water treatment plant to be installed, capacity to class/owners requirement.

552. **HIPAP Valve**

Gate valve of 500 NB for HIPAP unit to be installed in HIPAP trunk bottom, to be local or remote controlled from bridge by electric actuator. HIPAP valve and remote actuator to be supplied by DP system vendor

SECTION 6 - DECK MACHINERY & FITTINGS

600. **General**

All deck machinery and equipment are to be supplied and installed to meet classification requirements.

All fastening materials, bolts and nuts which are exposed to weather on the open deck shall be of stainless steel materials.

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:

- Two (2) AC-14 HHP stockless anchors, stowed in anchor-pockets, each of 2,460 kg.
- Total length of 742.5m x 44mm / Grade U3 stud-link-chain cables, divided to port and starboard side with swivel and shackle.
- Two (2) chain-stoppers
- Mooring lines: 4 x 180m long mooring ropes of min. 23.5 tonne breaking strength.

602. **Anchor Windlass**

One (1) set electro-hydraulic anchor windlass suitable for specified diameter cable complete with two hawser drums and two warping heads to be provided. The cable lifter, hawser drum and warping head are to be independently clutched. They are to be securely mounted on fabricated steel seating on forward of upper forecastle deck above the chain lockers. Chain pipes, cable stoppers and hawse pipes are to be arranged to suit. Local control as well as remotely from the wheelhouse.

Capacities - 10 tonnes at 9m/min for chain cables.

6 tonnes at 15m/min and at light loads 30m/min for mooring lines.

603. **Capstans**

Two (2) electro-hydraulic capstans shall be installed at main deck aft (P & S), with pulling force of 10 tonnes at 15m/min. Variable speed control to be located at main deck aft.

604. **Towing & Anchor Handling Winch**

One (1) set, low pressure electro-hydraulic driven, double drum, waterfall type.

Towing drum and anchor handling drum rated pull at first layer: 380 ton at 6 m / min.

Braking capacity : 500 ton

Stowing capacity : 76 mm dia. x 2,000m wire rope – Upper drum; (Towing)
76 mm dia. x 2,000m wire rope – Lower drum; (A.H.)

Wire rope : 76 mm dia.

Control : Remote control from aft control station in wheelhouse

Independent low pressure HPU to be installed on main deck.

At both end of the anchor handling drum, one (1) gypsies/wildcat each shall be fitted to handle rig chains of diameter 75 mm dia.

One (1) automatic gear lubrication system for gear wheels remote operated from wheel house.

One (1) double manual operated hydraulic spooling device of 22 tonnes side load for towing and anchor handling drums remote operated from bridge.

One (1) colour closed circuit TV monitor with keyboard control for operator interface.

Printer for printing out towing data.

Hardware for constant tension feature to be provided for the towing winch, with software included.

One (1) hydraulic oil supply tank to be fitted along with a drop tank (size to be 120% of system capacity for the towing winch).

The winch is to be delivered with empty drums.

605. **Towing Pin & Shark Jaw**

Two (2) angular type hydraulic towing pins of approved make, retractable type, closed top to be installed in the centerline of the main deck. The anchor handling pins to be able to take a side force of about 450 tonnes and to extend about 600mm above main deck level in the fully extended position. The pins are to be operable from wheelhouse and aft local control station on the main deck aft at the vicinity of shark jaws.

Two (2) sets of hydraulically operated anchor handling fork (hydraulic retractable shark jaws) of approved make to be installed in centerline on main deck aft. The stopper to be able to take 62mm to 114mm dia. chain and 40mm to 120mm dia. rope.

SWL to be 450 tonnes. Stopper and towing pins with common power unit and to be remotely controlled from the wheelhouse aft console and local control station.

606. **Tugger Winches**

Two (2) electro-hydraulic tugger winches of 15 tonnes at 15 m/min to be installed as shown on the General Arrangement. Each winch is to be complete with one (1) wire drum and one (1) warping head c/w 250m x 19 & 22mm dia. wire respectively.
Material of warping head to be cast steel, shaft to be stainless steel.
The winches are to be delivered with empty drums.

607. **Spare Wire Reel**

Two (2) single-drum hydraulic-operated spare towing wire reel to be installed, each drum capacity 2,000 m x 76mm (SWR) dia. wire rope and to be locally controlled.
The pull rating shall be 10 tonnes at 20m/min.
The reels are to be delivered with empty drums.
HPU layout and capacities to be proposed by vendor and approved by Owners.

608. **Stern Roller**

A 450t SWL stern roller, about 6.6m long by 3m diameter with SUS316 stainless steel shaft and SW lubricated external bearings. Roller to have pipe sockets fitted on both sides in order to use turning bar to keep the roller free to rotate.

609. **Deck Crane**

One (1) electro-hydraulic telescopic crane to be installed. SWL 5t at outreach 10m.
Independent hydraulic power pack to be provided for the crane.

610. **Mast**

The navigation mast is to be completely fitted out with necessary brackets and stays for navigation lights and shapes. Mast to have rungs to top, arranged for access to light trays and necessary fittings. Blocks for aerials, yard arms and ensign staff to be fitted and sheaves for signal flags and shape hoists to be arranged on masts, as required.
Cable fastener, bolt, nuts, fittings, bar and steps to be of sus material.

611. **Manholes**

All manholes are to be elongated shape with stainless steel studs and nuts. In way of accommodation, they are to be of recessed type with flush wooden covers to match deck level.

In engine room and main deck, they are to be "raised" type, if necessary.

Covers to bead-welded for identification and mark to indicate the fitted position.

Manholes for liquid mud tank shall be of 600mm dia. rounded and flushed type, located on the main deck.

612. **Draft Marks & Hull Marks**

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

Tank marks, bow thruster marks, bulbous bow marks etc. are to be provided.

Hull marking to comply with UWILD notation requirement.

613. **National Colours**

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

614. **Escape Hatches**

Watertight hatches to be provided for the following compartments:

- engine room (1 off)
- steering gear compartment (1 off)
- forward store (1 off)

Rungs or vertical ladder to be fitted for each hatch.

615 **Storm Rails (Grab Rails)**

Storm rails to be fitted all round wheelhouse and on exterior bulkheads. Storm rails also to be fitted in convenient positions in toilets and engine room. Storm rails inside accommodation spaces to be 32mm diameter polished stainless steel.

616. **Drainage for Decks**

Suitable scupper pipes to be positioned in funnels, along the main deck, forecastle deck

and wheelhouse top to facilitate deck drainage.

617. **Doors**

Steel doors to be fitted as shown on the General Arrangement drawing. All exterior doors and internal W.T./G.T. doors to be in steel. All watertight / weathertight doors to outside are complemented with composite material doors with deadlights, with automatic door close on inner doors.

Internal wooden doors in accommodation spaces to be of flush type.

618. **Mooring Chock**

To be provided for mooring arrangement.

619. **Handrails & Stanchions**

Stanchions are to be 75 x 9.5 F.B. x 1,000mm high with short backstays and spaced not more than 3 frames spaces apart. Top rails of 2" galvanised pipe and the lower rails of 1" galvanised pipe. At access points, pipes substituted by 1/4" short link galvanised chain with hook and eyes.

620. **Bollard, Fairlead, Loose Mooring Equipment**

Sufficient number of bollards and fairleads shall be provided as required by vessel mooring.

621. **Covers for Deck Equipment**

Strong canvas covers for compass, searchlights, tugger and anchor windlass are to be provided.

622. **Handrails & Grabrails**

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

623. **Ladders**

All ladders to be steel construction. External ladders to be non-slip, made of chequer plate or similar construction. Vertical ladder to be constructed with 19mm square bar

rungs welded to steel flat bar and to be 250mm clear of steel bulkheads.

Hand grips to be fitted as necessary.

624. **Hawse Pipes & Anchor Recesses**

Two (2) 12"NB, Sch. 80 hawse pipes welded to 19mm anchor recesses. Chain pipes to be 8" NB, Sch 80.

625. **Rubber Fenders**

Appropriate number of D type and aeroplane tyres c/w shackle and chain to be provided at shipside.

Bow & stern 300mm "M" type rubber fender to be fitted.

626. **Deck Sheathing**

75mm thick good quality marine type hardwood deck sheathing over T-section is to be fitted to the aft deck as shown on drawing.

627. **Gob Eye**

One gob eye to be installed on main deck centre line.

628. **Watertight Doors Below Main Deck**

All watertight doors below main deck are to be sliding type.

They should be able to be remotely operable locally from each side of the bulkhead. Indicators to be provided at the wheelhouse control station showing whether the door is closed or open, and an audible alarm is to be provided at the door closure. The door's power, control and indicators should be provided with emergency electrical power in case of main power failure. Individual hand–operated mechanism to be provided so that the door can be opened and closed by hand at both side if control system failed.

629. **Dispersant System**

An oil dispersant system consisting of 2 spray nozzles, complete with dispersant eductor and proportioning metering valve 0-10%.

The sea water shall be supplied by the General Service Pump.

630. **Cargo Rollers**

Fourteen (14) sets of cargo rollers, seven (7) at each side, to be installed between cargo rail and bulwark.

631. **Cargo Lashings / Separation Stanchions**

Fourteen (14) sets of cargo lashing / separation stanchions shall be provided.

SECTION 7 - SAFETY SYSTEM

700. **Life Saving Equipment**

Life saving equipment is to be in accordance with the requirements of the Class and Government authority for total complement of fifty (50). Quantity below are provided as guidance.

1) Liferafts : six (6) twenty five (25) men inflatable liferafts with full emergency pack in rigid fibreglass container conforming to SOLAS 74 convention.

2) Lifebuoys : total eight (8) lifebuoys to be supplied:
- four (4) 90ft buoyancy lines
- four (4) 90ft buoyancy line and self-igniting electric lights (Two [2] with smoke signals).

3) Lifejackets : fifty (50) approved type lifejackets to be supplied and stowed adjacent to each berth plus additional spare jacket, four (4) in nos.

4) Pyrotechnics :
- One (1) line throwing apparatus (4 projectiles & 4 lines)
- Twelve (12) parachute distress rockets.
- Two (2) orange smoke signals.
- Six (6) hand flares

5) Rope Ladders : Two (2) embarkation rope ladders to be provided

6) Rescue Boat & Davit: One (1) rescue boat with O/B motor capable of carrying 6 persons with davit for launching over one side. To be provided with SOLAS certificate.

7) Immersion suit : one for each crew, plus ten (10) spare sets to be provided.

8) Rescue basket: one to be provided.

9) First Aid Kit : 1 set conform to SOLAS standard

10) Emergency Escape Breathing Device : 8 sets conform to SOLAS standard

701. **Fire-fighting Equipment**

Fire-fighting equipment is to be provided to meet classification and government regulations and generally in accordance with the following:

1) Firemain

A firemain and 1-1/2" bronze hydrants are to be installed.

International shore connection is to be fitted.

2) Fireman's Outfit

Four complete fireman's outfit are to be provided, each consists of:

a) Two (2) aluminium asbestos-free protective clothing

b) One (1) breathing apparatus & safety line (c/w spare cylinder and BA compressor)

c) One (1) 12" fireman's axe

d) One (1) safety lamp of portable battery type (3 hours)

e) Two (2) sets of gloves & boots & helmet with visor

3) Portable Fire Extinguishers

Fire extinguishers as required by the classification/government authority are to be supplied and installed.

Replacement charges are to be supplied.

4) Fire Blanket

Two (2) off to be provided in engine room and galley.

Fire Axes

Two (2) off. 36" long fire axe with wooden handle.

5) Fixed CO_2 System

A full flooding CO_2 system consisting gas bottles c/w quick operated valves and auto alarms is to be provided for engine room and cement tank compartment fire fighting. The CO_2 bottles to be stowed inside a separate compartment.

Operation is to be manual arranged both on the bottle(s) and in a "break glass" pull box at the engine room access.

6) Engine room fixed water-based local fire-fighting system

The system should comply with IMO requirement and protect following areas at least.

- main engines and gensets

702. **Rescue Zones**

Rescue zones, length at least 5 m, shall be established at both sides of the vessel and shall meet the class requirements, in way of which bulwark gates with 2m width to be provided. When not in use, normal bulwark height is obtained. The area shall be clearly marked from outboard. It shall be serviced by means of scrambling nets. Rescue zone shall be cleared of any overboard discharge.

SECTION 8 - ELECTRICAL

800. **General Installation**

The electrical installation is to be made in accordance with the requirements of the Classification Society and IEC latest regulation.

All electrical and electronic equipment shall be accordance with modern technology for easy maintenance and simple operation. This shall include all control systems and electronic equipment as well as electrical components in engine room, engine control room, accommodation, and bridge including on deck.

All electrical fittings on exposed decks to be at least IP55 protection.

All electrical fittings in hazardous area to be explosion proof type.

Before sea trials commence, a thorough testing of all equipment shall be carried out.

Care is to be taken for prevention of Electro Magnetic Interference to ensure that only interference-eliminated equipment shall be allowed to install onboard.

Automation system design to comply with unmanned machinery space requirement.

801. **System of Supply**

a) 440 volts, 3 phase, 60 Hz - for power (motor)

b) 220 volts, 1 phase, 60 Hz - for general lightings and power less than 3 kW.

c) 24V D.C. - for alarms, emergency lights, radio, navigational aids, navigation lights and other emergency loads.

802. **Power Supply**

-Normal Supply :-

The A.C main power supply system is to be obtained from

- Three (3) 550 KW, 440/3/60, 0.8 P.F. and 3 wire diesel engine driven generators.
- Two (2) 1,920 KW shaft alternators (440V/3/60Hz).

The diesel driven generators and shaft alternators shall be capable of load transfer.

It is intended that one shaft alternator will power one forward and one aft bow thruster. The other shaft alternator will power one bow thruster and the anchor handling winch. This requirement will be reviewed if either the DP Vendors or ABS Class do not accept the proposal.

-Emergency Supply :-

For emergency duties the power supply shall be obtained from a 99KW capacity, 440/3/60 generator arranged for independent battery starting in the event the main power supply fails.

-Shore Supply :-

A 200 Amp T.P 440/3/60, 3 wire watertight shore supply complete with connection box, sequence indicator, circuit breaker and connected to the main switchboard.

-24V D.C Supply :-

a) The 24V D.C main supply is to be obtained from two (2) banks of 2 x 24V 200 AH main batteries via the main battery charger. Batteries to be sized for ship's transitional power supply for emergency duties without re-charging. Batteries to be float charged by two (2) 40 amp battery chargers.

   In the event of failure of the main (or emergency) source of power, the emergency batteries (transitional power supply) shall automatically supply power to the emergency lighting communications and navigation aids, etc.

b) A 24V D.C supply for the radio equipment is to be obtained from one (1) bank of 2 x 200 AH main batteries via the radio battery charging panel, powered by one (1) 40 amp battery charger, automatically regulated.

c) Two (2) 24V D.C UPS supply for automation, monitoring and main propulsion remote control.

803. **Switchboard - Main**

The main switchboard shall be of opened hinged front and opened back screw type and arranged in the engine control room. A fixed louver complete with fine insect netting shall be installed in the back plate.

It shall be fitted with split busbars, circuit breakers, voltmeters, ammeters, frequency meter and earthing for controlling the entire A.C. system. For generator protection the generator circuit breakers shall have under voltage trip inverse time over current and instantaneous trip devices. Synchronising equipment for semi-automatic parallel operation of diesel driven generators shall be installed with synchronising lamps,

synchroscope, selector switch for generators, frequency meter, governor motor switch etc. In addition to under voltage and over current relays, a reverse power relay shall be provided.

Interlocking between shore power connection and generators shall be fitted. An earthing indication light and testing switch shall be fitted and also a selector switch for ammeter and voltmeter.

The internal wiring of the switchboard shall be carried out in EPR insulated wire to Classification and specification with a maximum operating temperature and having the following insulation grades :-

- Power Cables : 660 volts
- Control Cables : 250 volts

On completion of manufacturing and before despatched to the vessel the switchboard shall be subject to an electrical voltage test of 2000 volts at a frequency between 25 to 100 cycles in accordance with Classification requirements.

A rubber insulating mat shall be laid full length in front of and behind the switchboard. It shall have a minimum width of 600mm.

All components throughout the switchboard shall be provided with white-black-white traffolite nameplates clearly indicating the components service and normal full load current ratings. The plates shall be secured with brass pins or screws.

An insulated handrail shall be fitted to the front of the switchboard, it shall be at a convenient height and run the full length of the switchboard.

PMS to be installed according to DPS requirement.

804. **Switchboard - Emergency**

One (1) emergency switchboard similar in construction to main AC switchboard shall be provided for the control of diesel engine driven emergency alternator set. During normal operation the emergency switchboard shall receive power from the main switchboard. Distribution of electrical power shall be made available both at 440V and at 220V levels. The 220V distribution shall be derived from a 440/220V transformer.

805. **Distribution Board - 24v D.C**.

The 24 volt D.C. switchboard shall be provided for battery charging and distribution of DC sources. It shall be equipped with all necessary voltmeters, ammeters, isolation,

changeover and selector switches for battery charging and circuit breakers, as required.

A dummy push button switch to simulate power failure shall be incorporated.

806. **Cable Installation**

All cables shall meet with Classification rules. Where exposed to damage, external weather and in machinery spaces, cables to have galvanised steel wire braid armour and PVC outer sheathed.

Care shall be exercised in the run of all cables to avoid areas of excessive temperature, action from condensed moisture or drip and protected from risk of mechanical damage.

When required, the watertightness of the cable ends situated below the bulkhead deck shall be ensured by appropriate means at the time of installation.

Normally cable runs shall not include joints. If a joint is absolutely necessary or desirable, it shall be carried out in a suitable box of such design that the conductors remain properly insulated and protected from atmosphere action, and fitted with terminals and busbar of 4 dimensions proportionate to the current rating.

In toilet and washroom areas as far as practicable only cables absolutely necessary for the supply of equipment used in these spaces shall be permitted.

All cables to be regularly colour coded or labelled.

Penetration of watertight decks and bulkhead shall be effected in watertight manner. Lighter individual stuffed glands or boxes containing several cables and filled with fire retarding packing shall be used for this purpose.

807. **Cable Colours**

Vessel current carrying parts of different polarity shall be clearly marked with distinguishing colours as follows :-

BLACK	:	PHASE ONE
GREY	:	PHASE TWO
BROWN	:	PHASE THREE

808. **Cable Tray / Supports**

Cables within machinery spaces shall be secured by approved type saddles onto perforated galvanised steel tray/galvanised cable ladder.

In accommodation spaces, cables shall be run behind panelling in horizontal or vertical

run in an orderly manner and clipped to straps welded to frames. Where it is not practical to run cable behind panelling the cable shall be covered with battens.

Cables subject to mechanical damage shall be run suitably supported in pipe with welded unions. Pipe shall be smooth on the interior and not subject to deterioration from the effects of moisture. The pipes shall have their ends shaped or bushed in such a way as not to damage the cable covering. The pipes shall be mechanically and electrically connected to terminating boxes

809. **Electric Distribution**

Distribution shall be by the three wires without neutral earthing.

Distribution of power throughout the vessel shall be generally as described.

810. **Distribution Boards**

Distribution boards situated in Accommodation spaces shall be installed in an easy accessible manner.

Outgoing circuits, shall be fitted with traffolite nameplates indicating the circuits, maximum amps, and rating of fuse fitted.

A.C. and D.C. distribution boards are to be double pole type.

Power and lighting distribution boards in number and size as necessary.

811. **Switch Panels**

Switch panels shall be sited at the wheelhouse and all outgoing circuits fitted with nameplates indicating the circuits.

- Radio Switch Panel (24V D.C.)

The radio switch panel shall be powered from the radio battery via the radio charging panel. It shall be fitted with indication lights, ampere and voltage meters, fuses, circuit breakers and alarm indicator, or to maker's recommendation.

- Navigation Light Switch Panel (24V D.C.)

See section 821.

812. **Motors**

All motors shall be suitable for working in climatic conditions and in accordance with the requirements of Classification.

Generators and motors in excess of 50 KW shall have built in space heaters.

813. **Motor Starters**

All motor starters shall be tested in accordance with Classification.

All motor starters shall be enclosed in 16 SWG quality bright mild steel cases. The applied paint shall be treated in accordance with Classification Regulation.

All cut outs and door edges shall be suitably sealed with gaskets, ensuring that the case is hose-proof to IP22.

All outgoing cable terminations shall be located above in removable 6.5mm gland plate located in the base of the case thus providing ready access to terminals and glands.

A starter shall be provided for all electric motor 0.5KW and above.

Motors up to 15KW rating shall be started by means of a 'DIRECT ON LINE' type starter. Motors between 15KW and 50KW shall be started by means of a "STARDELTA" type starter. Motors above 50KW shall be started by means of an "AUTO-TRANSFORMER" type starter.

All the motor starters for oil related pumps, heaters and fans to engine room shall be fitted with remote stop stations located one in the passageway outside the machinery space and one in the wheelhouse.

814. **Transformers**

Two (2) step-down transformers one as standby, shall be installed in Engine Room to provide for general lightings and power supply for the vessel, approximately 2 x 100 Kva capacity.

Two (2) step down transformer for 220V emergency supply, approx. 2 x 40 Kva capacity.

One (1) step down transformer rectifier shall be installed in the Navigation light switch panel. It shall be of the open type rated for an input of 220V, 1 phase, 60 Hz, with an output of 24V D.C. This transformer rectifier shall be in the normal supply to the navigation lights.

815. **Storage Batteries**

All batteries shall be of the lead acid type.

All batteries shall be installed in steel or GRP watertight ventilated boxes on the bridge

deck. The batteries shall be sat on non-absorbent insulating supports with similar spacer blocks at the sides to secure air circulation space all round the battery.

The battery space shall be painted with a corrosion resistant paint.

816. **Shore Connection Equipment**

Provision shall be made to connect a 200A, 440 Volt, 3 Phase, 60 Hz, supply from shore to the main switchboard.

A drip proof supply switch fuse box with male type plug receptacle shall be fitted on the main deck in a convenient position and be permanently wired via a changeover switch.

The system shall be arranged so that it is not possible to parallel ship's alternators with shore supply.

The connection box shall be complete with circuit breaker, pilot lamps and socket.

817. **Fuses & Circuit Breakers**

Fuses circuit breakers used throughout the installation shall be of the Classification approved type and shall be suitably sized to circuit requirements.

818. **Switches**

All switches in the accommodation are to be flushed mounted and switches in the engine room and other machinery and watertight compartments are to be watertight and metal mould (marine type)

Control switches shall be suitably sized to circuit requirements.

819. **Sockets & Terminals**

Cable sockets and connecting terminals shall be of such dimensions that the maximum current likely to flow through them shall not produce heat which would be injurious to the installation.

Where soldering is adopted for securing cable sockets and connecting terminals, corrosive solid or liquid flukes shall not be used.

- Accommodation :-

Non-watertight 220/1/60, switch sockets, flush or surface mounted shall be fitted throughout the accommodation spaces.

- Engine Room/Galley/Stores

Watertight 220/1/60, switch sockets, marine moulded type surface mounted shall be fitted throughout the engine room, galley and store space.

- Welding Sockets

One (1) each welding socket, 440/3/60, suitable for welding set with working current about 500A, to be fitted at

- main deck (watertight type)
- engine room (non-watertight)
- steering gear room (non-watertight)

820. **Lighting**

All rooms shall be provided with electric lighting. In general, fluorescent light are to be fitted unless the incandescent lamp shall be provided where impractical.

Main lighting shall be laid out for 220 V. Light fittings are to be fitted with vibrating dampers where necessary.

Emergency lights are to be installed according to the rules and IEC regulations.

Lighting for Accommodation

All cabins are to have ceiling light fitting, bed lamps, desk lamps, socket outlets. Mirror light with socket shall be mounted in cabins' bathroom/washstand.

Fluorescent light fittings are to be provided in all alleyways and stairs.

Bridge and chart room is to have ceiling lighting and working light over chart-table and radio table.

Plug sockets with suitable number shall be provided including dimming device for chart-table lamp, compass lights, tachometers and rudder angle indicator.

Plug socket for daylight signaling lamp shall be provided.

Proper lighting to be provided inside utility trunks.

Lighting for Engine Room & Other Technical Room Below Main Deck

Engine rooms and other machinery room below main deck are to be fitted with watertight fluorescent light fittings and watertight plug sockets. Engine room lighting shall be supplied from different distribution board and shall be arranged alternatively to minimize blackout of entire engine room should failure occur to any one source.

Lighting in cement tank compartment, shaft tunnels port and starboard, and other

hazardous area to be explosion-proof type.

Lighting for Deck

All lighting on deck shall be provided with on/off switches to be installed in the bridge. Watertight plug sockets are to be fitted in alleyways at outside doors in each side. Watertight light fittings are to be installed for outside lighting.

Sufficient lighting to be provided along the crash rails, rescue zones and main deck aft working area.

Lighting in hazardous area to be explosion-proof type.

Floodlights

6 x 1,000W, 2 forward, 4 aft. White Halogen type.

Searchlights

3 x 2,000W, c/w underdeck controls within reach of helmsman.

Suez Canal Light

Suitable Base to be provided on foreactle bulwark for temorary fittinf of Suez Canal Transit Light. 220 volts switc/plug socket (water tight) to be provided in suitable location for 3000 Watt light.

821. **Navigation Lights**

Double tier lens, 24V D.C x 40 watt navigation lights shall be fitted. The navigation lights shall be according to International Regulations. At least to consist of the following.

- Three (3) Masthead lights
- One (1) Towing lights
- One (1) Port light
- One (1) Starboard light
- One (1) Stern light
- Two (2) Anchor lights
- One (1) set of Immigration lights
- One (1) set NUC lights (three in number)

All navigation lights shall be controlled by a 6-way indicator panel fitted in the Wheelhouse. The supply shall be taken normally from the 220/1/60 A.C. supply via a 24V D.C output, transformer/rectifier and during emergency from the main batteries.

Each navigation light shall be controlled and protected by a double pole switch and fused on each conductor. A visual and audio indicator shall be fitted.

822. **Emergency Lights (240V A.C. / 24V D.C)**

Emergency light is to be provided and fitted at strategic points in

- the wheelhouse, lobby / corridor, steering gear, bow thruster and cement tank compartments, engine room at entrances, galley, mess and radio area: 220V A.C.
- the wheelhouse, lobby / corridor, steering gear, bow thruster and cement tank compartments, engine room at entrances, and radio area: 24V D.C.

All to Classification and relevant Authority requirements.

Emergency lights shall be automatically energised on failure of main A.C. supply and shall form part of the normal lighting system.

823. **Vessel Automation System**

An engineers call alarm system to be provided with a push switch in wheel house and an alarm bell each in chief engineer's cabin, mess room and the 2nd engineer's cabin.

Two operator stations located in ECR, each complete with color display of minimum 17" LCD, PC, keyboard, etc.

One operator station in bridge console complete with color monitor of minimum 17" LCD, pc, keyboard, etc.

Extension alarm system consist of watch call panels, dead man system in engine room as specified or required by regulations shall be fitted.

Alarms shall be divided into six (6) groups.

A- group: Main engine auto shut down

B- group: Main engine slow down necessary.

C- group: Essential alarm (Main engine).

D- group: Other alarm

E- group: Fire alarm

F- group: Tanks level

The extension alarm to be sent to the following places.

- Wheelhouse.
- Chief engineer's room.
- 2nd engineer's room

- 3rd engineer's room
- Mess room

The selector switch, "ATTENDED" and "UNATTENDED", shall be provided on the control room console in the engine control room. Under the "ATTENDED" mode, the extension alarm system shall not work, and the indication of "ATTENDED" shall be given. Under the "UNATTENDED" mode, the extension alarm system shall be operated and the indication of "UNATTENDED" shall be given. This mode shall further select one (1) duty engineer of the 2nd or the 3rd engineer.In case that engine room abnormal occurred under the "UNATTENDED" condition, alarm lamp and alarm buzzer of extension alarm panel in the room of duty engineer and common situation shall light and sound.

The "Dead man" alarm with adjustable alarm period to be provided in the engine control room, in wheelhouse with extension alarm.

The various alarms shall be arranged in separate groups for each engine and it's auxiliaries and the Alarm and monitoring system shall further be completely installed according to Class and Authorities rules and regulation.
The central unit shall be of a compact space saving type with one alarm indication for each alarm channel and group alarm.
Remote control operations for diesel engines, azimuth propellers and thrusters shall be fitted in the wheelhouse.
The wheelhouse maneuvering shall be actuated electrically with the regulating handle.
Choice of remote control location shall be made in the wheelhouse. The control selection and confirmation procedure shall conform to the requirements of the Classification Society.
Necessary instrumentation shall be provided at the engine side to support maneuvering from the engine site.
The system shall be interfaced with the DP control system and Power Management System (PMS).
The remote control systems shall be designed and installed as two (2) electrically and mechanically totally independent plants. One failure in one plant shall not put the other plant out of operation and vice versa. Each plant shall have two (2) galvanic

isolated power supplies.

Manual emergency stop button shall be provided in the ECR and wheelhouse.

824. **(Deleted)**

825. **(Deleted)**

826. **(Deleted)**

827. **(Deleted)**

828. **Safety & Emergency Operation**

All necessary safety and emergency operation are to be located in separate control panels.

Separate safety control system shall be situated in the control places in engine control room and on the bridge if required by rules and regulations.

The main engines are to be provided with separate safety system for each engine according to the rules. Indication and controlling of the vessel at the aft control station shall be reflection of actual movement of the vessel. Indication shall be properly colored and named.

Cargo pump remote shutdown

RO / mud / brine pumps to have remote shutdown near discharge station and at wheelhouse aft control station.

829. **(Deleted)**

830. **Fire Detection & General Alarm System**

The accommodation, engine room and service spaces are to be provided with a fire / smoke detection and alarm system as per Classification Society rules.

Alarm bells are to be sited within accommodation in accordance to Class requirements. Break glass alarm points are to be fitted in wheelhouse, main deck, thruster compartments, forecastle deck and engine room. An alarm horn and

revolving red light are to be installed in the engine room and an alarm horn only fitted in the steering gear compartment. An engineer alarm system to be provided in Chief Engineer's cabin.

A fire detection system based on the self-monitoring principle including periodic testing facilities shall be installed in the machinery spaces and accommodation. It shall be fed automatically from an emergency source of power by or separate feeder if the main source of power fails.

831. **Main & Auxiliary Engine Instrumentation & Alarm**

The main engine and auxiliary engine instrumentation are to be operated on 24V DC supply. Main engines are to be provided with an emergency stop in the wheelhouse. Clutch control indication panel to be provided in engine room and forward and aft wheelhouse control.

Main engine level alarms should be provided with a panel in the engine room, wheelhouse and Chief Engineer's cabin (common fault alarm only) with visual and audible indicators as required by regulations such as low oil pressure, high water temperature, low starting air pressure, low tank level, high bilge level etc. It shall be indicated at the same time more than one fault and the acceptance of any alarm shall not hinder another alarm. Alarms shall be maintained until they are accepted and the vessel indicators shall remain until the fault has been corrected.

The 24V DC supply to automatically changeover to a standby power supply in case of loss of normal power supply and failure of the normal power supply shall be indicated by alarm.

832. **Reefer Plugs**

Four (4) 440V and four (4) 220v reefer plugs to be installed at forward of cargo deck for connection of reefer containers.

833. **CCTV**

For monitoring of towing wire spooling, a CCTV system to be provided. It shall consist

of two cameras in towing winch casing and one monitor in wheelhouse aft station.

834. **Gas Detector**

Two (2) portable gas detector for H_2S, CO, O_2 and LEL be provided.

These must be calibrated maximum 30 days before delivery.

835. **LAN**

Cabling for LAN to be installed, with sockets in wheelhouse, ECR, ship office, single cabins and twin cabins. The hub to be installed in electronic room on upper forecastle deck.

836. **Oil Recovery Equipment Power Supply**

Power supply to non-permanent oil recovery equipment is to be provided. Power outlets to be arranged from connection box provided with a means to prevent disconnection of the portable cable unless power has been removed from the cable. The connection box to be located in starboard box cargo rail forward area.

The supply from main switchboard to the connection box to be permanently installed and provided with a separate switchgear with short-circuit and over-current protection.

SECTION 9 – NAVIGATION & COMMUNICATION SYSTEM

The following navigation and communication equipment for GMDSS A3 are to be supplied and fitted.

900. **Navigation**

Following navigation equipment should be supplied by Builder.

Brand as listed are for guidance only, other brand with similar standard may be proposed by Builder and subject to Owner's approval.

Item	Description	Model	Qty	Brand	Origin
1	**Radar 1**				
	X-Band ARPA Radar 21", 12kw, 96nm, TR UP, 24rpm, (with built-in RP/ARPA Function) for DC24V, 100-115VAC or 200-230VAC, single phase, 50/60Hz Operation	FAR-2117	1	FURUNO	JAPAN
	Comprising :				
	1 x Display Unit MU-201CR with pedestal (Local)				
	1 x Processor Unit RPU-013				
	1 x Control Unit RCU-014 (full-keyboard control unit OP03-183)				
	1 x Antenna Gear Box RSB-096 (RTR-078)				
	1 x Antenna Radiator XN-20AF (6.5ft)				
	1 x GC-10-1/2 Gyro Converter				
	1 x PM-31 Performance Monitor				
	1 x Hangrip Assembly FP03-098-40				
	1 x Bracket Assembly FP03-09820				
	1 x Connection Stand OP03-183				
	1 x Std Spare Parts				
	1 x Std Installation Materials incl. 30m antenna cable CP03-25710				
	1 x Operator / Installation Manual				

2	**Radar 2**				
	S-Band Marine Radar	FAR-2137S	1	FURUNO	JAPAN
	1x display unit MU-190				
	1x processor unit RPU-013				
	1x control unit RCU-014				
	1 x Antenna Gear Box RSB-098				
	1 x Antenna Radiator SN-36AF (12ft)				
	1x power supply unit				
	1x performance monitor PM-51				
3	**DGPS (IMO Approved)**				
	SIMRAD Model MX-512 DGPS or	MX-512	3	SIMRAD	Norway
	Complete set on 10-32VDC Power Supply			FURUNO	Japan
	Comprising:				
	1 x MX512 CDU				
	1 x MX521A Smart DGPS Antenna				
	1 x 40m Cable 500-100-1007/MX 10pin				
	1 x Pre-wired Junction Box				
	1 x Operator & Installation Manual				
	AC/DC Power Converter Unit	FM203AD	3	FM	S'pore
4	**Wind Anemometer**				
	RM Young Wind Monitor 05103-58 & Wind Tracker 06206H	05103-58	3	RM YOUNG	USA
	Comprising of:	06206H			
	1 x Wind Monitor / Sensor 05103-58 consist of:				
	* 05154 Housing Assembly				
	* 08234 Propellers				
	* 05190 Bearing Gap Gage				

	1 x Wind Speed Display Unit 06206H				
	1 x AC Adapter T48-400D-3				
	1 x Operator Manual				
5	**AIS**				
	Furuno Model FA-150 Automatic Identification System (AIS)	FA-150	1	FURUNO	JAPAN
	Meeting IMO Resolutions MSC.74 (69) Annex 3, A.694(17) IEC.61993-2 for DC24 Operation				
	Comprising :				
	1 x Transponder Unit FA-1501				
	1 x Display Unit FA-1502				
	1 x GPS Antenna GPA-017S-E				
	1 x Shakespeare 420 Marine VHF Antenna				
	1 x Std Inst. Materials Incl. 15m Antenna Cable TNC-PS-3D-15				
	1 x Aluminium Pipe 101 Threaded on one end for GPS AE				
	1 x OP24-3L Pilot Plug Assy (10m) AMP Type 9-Pin				
	1 x Standard Spares Parts				
	1 x Operator Manual				
	AC/DC Power Converter Unit	FM207AD	1	FM	S'PORE
6	**Echo Sounder**				
	Furuno FE-700 6.5-Inch IMO Type Echo Sounder (50KHz)	FE-700	1	FURUNO	JAPAN
	complete set for operation on DC 24V and 115/230VAC.				
	Comprising of: -				
	1 x Display Unit FE-701				
	1 x Distribution Box FE-702				
	1 x Matching Box MB-502 (for 50B-6B)				
	1 x Transducer Type 50B-6B with 15m				

	cables				
	1 x Transducer Tank TTF-5600				
	1 x Standard Inst Materials CP02-06301 & CP02-06400				
	1 x Standard Spares parts SP02-04101				
	1 x Standard Accessories FP02-04800				
	1 x Operator Manual				
	1 x Installation Manual				
	Remote Depth Repeater (for Fwd & Aft)				
	Furuno RD-30 Remote Digital Display, operates DC24V	RD-30	2	FURUNO	JAPAN
7	**Speed Log**				
	Furuno Model DS-80 Doppler Speed Log (-10 to 45 Knots)	DS-80	1	FURUNO	JAPAN
	complete set for operation on 115/230V				
	Comprising: -				
	1 x Display Unit DS-800				
	1 x Transducer DS-820-30				
	1 x Transceiver unit DS-810				
	1 x Distribution Box DS-801				
	1 x Terminal Box DS-802				
	1 x Transducer Tank DS-784				
	1 x Standard Installation Materials				
	1 x Standard Spare parts				
	1 x Operator manual				
	Transducer Cable 30m	CABLE	1	FURUNO	JAPAN
8	**Twin Gyro Compass System**				
	(ANSCHUTZ to replace SIMRAD)				
	Gyrocompass System		1		
	for 24VDC and 110/220V AC Operation				

	Comprising :-				
	1 x Sensitive Element				
	1 x Power Adaptor				
	1 x Standard Installation Accessories				
	1 x Instruction Manual				
	with the following interfaces :-				
	- NMEA				
	- 24 volt step output				
	- Rate of turn output				
	Repeater Compass				
	2 x Analogue Repeater for Fwd & Aft Console				
			2		
	2 x Single Scale Bearing with BB Repeater Bracket + Holder for PORT / STBD Wing Repeater		2		
	1 x Digital Repeater Compass for Steering Gear Room		1		
	<u>3rd Gyro Compass</u>				
	(ANSCHUTZ to replace SIMRAD)				
	Gyrocompass System		1		
	for 24VDC and 110/220VAV Operation				
	Comprising :-				
	1 x Sensitive Element				
	1 x Power Adaptor				
	1 x Standard Installation Accessories				
	1 x Instruction Manual				
9	**Autopilot**				
	ANSCHUTZ Digital Autopilot PILOTSTAR D	PILOT STAR D	1	Anschutz	Germ'y
	* Flush mounting				

	* For connection to Gyro Compass ANSCHUTZ course-bus or 6 step/deg				
	* For connection to Control of Steering Gear with				
	~ ON/OFF solenoid valves (max.45W) or				
	~ with proportional signal output (2 x ±10V)				
	~ and direct input for up to 3 tillers				
	Comprising :				
	1 x Operator Unit (IP 44) inluding 2.5m cable	102-864 NG001			
	1 x Connection unit with amplifier (IP 22)	102-863 NG001			
	1 x Set of Spare Parts				
	1 x Rudder Feedback unit with built-in	101-529 NG001			
	~ 1 Actual rudder angle transmitter (potentiometer)				
	~ 1 Set of limit switches				
	1 x lever drive for up to ±45° rudder angle or				
	1 x Belt drive for ±45° up to ±90° rudder angle				
	1 x Change-over switch, 4 position				
	**** Note:**				
	Lever drives for feedback unit can be used for rudder angles up to ±45°.				
10	**Weather Fax Receiver**				
	Furuno Model FAX-408 Weather Facsimile Receiver for operation DC 12-24V	FAX-408	1	FURUNO	JAPAN
	Comprising of: -				
	1 X Receiver Unit FAX-408				
	1 x Active Antenna FAX-5 c/w 15m cable				
	1 x 2.6m Whip Antenna 04S4176				

	1 x Standard Inst. Materials incl 3m power cable				
	1 x Standard Spare Parts				
	1 x Operator's Manual				
	1 x AC/DC Power Converter FM203AD	FM203AD	1	FM	S'pore
11	**Magnetic Compass**				
	Lilley & Gillie Mk2000 Magnetic Compass Outfit meeting European, ISO, IMO and Major Certification Authority Requirements	MK2000	1	LILLEY & GILLIE	UK
	Comprising:				
	1 x Binnacle, Type Lilley & Gillie Mk2000, Reflector, Grey c/w Heeling Error Magnets, B & C Correcting Magnets,Flinders Bar Set, 2 x 24V DC Lamps and 1 spare lamp fitted c/w gasket and mounting bolts	FW9850			
	1 x FW9853 Periscope Assembly for MK2000 Binnacle c/w	FW9853			
	-WD1150 Reflector Head	WD1150			
	-WD1153 Ceiling Flange	WD1153			
	-6 x W9122 Wood screw 1.5" and	W9122			
	-6 x W9138 Washer 1/4" (6mm)	W9138			
	2 x FW9856 Quadrantal Correctors for MK2000 Binnacle, c/w Bolts and Washers	FW9856			
	2 x FW9859 Compass, Type Lilley & Gillie, OCEAN, 175mm (6.9") Reflector Card c/w Individual MCA Wheelmark Certificate	FW9859			
	1 x FW9862 Control Unit for MK2000 Binnacle Lighting	FW9862			
	Inputs: AC Mains and 24V DC				

	Outputs: 2 x 24VDC				
	Features: Lamp changeover, on/off switch and dimmer, flush mounted c/w 4 x M6x30mm mounting screws, nuts and washers				
	1 x FW8870 1ltr Bottle of compass fluid	FW8870			
	1 x FW9011 Azimuth Mirror / Circle in Wood Stowage Box c/w 3 Shadow Pins	FW9011			
	1 x MED Wheelmark Type Approval Certificate for MK2000 Binnacle				
	1 x MED Wheelmark Type Approval Certificate for Lilley & Gillie OCEAN Compass				
	1 x MED Wheelmark Type Approval Certificate for Lilley & Gillie FW9011 Azimuth Mirror / Circle				
	1 x Ship's Manuals				

Other navigation-related items as follows.

1) CVS and window wipers: 4 x 300mm CVS & 4 horizontal window wipers (2 forward and 2 aft)
2) Navigation lights: to rule requirements
3) Ship's whistles: 1 x compressed air operated, 250-700 Hz, remote controlled in W/H consoles.
4) Horn: 1 x mechanical fog horn
5) Bell: 1 x 300mm dia. brass bell with ship's name
6) Barometer: 2 x 150mm dials in brass case
7) Clinometers: 4 off
8) International Code of Signals: 1 set plus national
9) Nautical publication: 1 lot, (owner supply)
10) Engine telegraphs: 3 locations (2 in W/H, 1 in ECR)

11) Navigation shapes: to rule requirement

12) Binoculars: 2 pairs, 7 x 50 adjustable with eye piece

13) Bar parallel rules: 1 off, 300mm (owner supply)

14) Thermometers: 2 off, 100mm diameter - 20º to 50 º C

15) Chronometer: 1 off

16) LRIT (FURUNO)

17) Bridge navigational watch alarm system: to rule requirements.

901. **Communication**

Following radio equipment to be supplied by Builder.

Item	Description	Model	Qty	Brand	Origin
1	**GMDSS Radio Comm. Sea Area 3 [with SSAS & LRIT]**				
	Furuno RC-1800T 250W GMDSS Radio Console System with Inmarsat-C duplication for Sea Areas A 1-2-3 complete set for operation on AC110/220V, 1PH, 50/60Hz	AREAS A1,A2,A3	1	FURUNO	JAPAN
	Comprising:				
	Rack Console RC-1800T with Built-in printer selector / distribution box for L/L data c/w operator manual	RC-1800T	1set	FURUNO	JAPAN
	Furuno FS-2570, 250W MF/HF Radiotelephone, DSC / Watch Receiver Complete set for DC Operation	FS-2570	1set	FURUNO	JAPAN
	Comprising:				
	1 x Transceiver Unit FS-2570T				
	1 x Control Unit FS-2570C				
	1 x Telephone Handset HS-2001				
	1 x Antenna Coupler AT-1560-25-AAS				
	1 x Standard Installation Materials				
	1 x Standard Accessories				
	1 x 10m cable 05S0949-0 between FS-2570T & AT-1560-				

	25				
	1 x 10m cable 05S0462-1 between FS-2570T & AT-1560-25				
	1 x 5m Cable 17JE23150-02 (D8C) between FS-2570C & FS-2570T				
	1 x Operator Manual				
	Furuno FELCOM-15 Inmarsat-C / SSAS on 10.8-31.2VDC Operation	FELCOM-15	2 sets	FURUNO	JAPAN
	Comprising: -				
	1 x Antenna Unit IC-115				
	1 x Terminal Communication Unit IC-215				
	1 x Distress Message And Receiving Call Unit IC-305				
	1 x Alarm Unit IC-306				
	1 x Junction Box IC-315				
	1 x Printer PP-510				
	1 x Standard Spare parts				
	1 x Standard Installation Materials with 30m Antenna cable				
	2 x SSAS Alert Button IC-307				
	1 x Operator's Manual				
	Furuno FELCOM-15 Inmarsat-F Complete Set on 10.8-31.2VDC Operation		1set	FURUNO	JAPAN
	Comprising: -				
	1 x Antenna Unit IC-115				
	1 x Terminal Com Unit IC-215 w/ Keyboard BTC-5100C PS/2				
	1 x Distress Message And Receiving Call Unit IC-305				
	1 x Junction Box IC-315				
	1 x Alarm Unit IC-306				
	1 x Printer PP-510				
	1 x Standard Spare parts				

	1 x Standard Installation Materials with 30m Antenna cable				
	1 x Operator's Manual				
	Furuno FM-8800S 25W Simplex / Semi-Duplex GMDSS VHF Transceiver with Blt-in Class A DSC & CH70 for 24V DC Operation	FM-8800S	2sets	FURUNO	JAPAN
	Comprising:				
	1 x Transceiver Unit FM-8800S with Built-in DSC-8V				
	1 x Handset with Hanger HS-2003 with Cradle FP05-05510				
	1 x Standard Installation Materials & Spare Parts				
	1 x Operator Manual for FM-8500				
	1set Power Supply Unit & Battery Charger		1 set	FM	SPORE
	1 x FM250ADAC Power Supply Unit with AC-DC Changeover	FM250AD			
	4 x FM207AD AC Power Supply Unit	FM207AD			
	1 x FM230AA-C Battery ChargeR	FM230AA-C			
	1set Antenna System		1 set	SHAKSPEARE	UK
	1) 4 x Shakespeare 420 Marine VHF Antenna	420			
	2) 2 x Shakespeare 393 SSB Antenna with 410 mount	393			
	1set Emergency Light & Lamp & etc...		1 set	CAN	SPORE
	1) 1 x OSRAM Emergency Lamp 24V for console				
	2) 2 x OSRAM Emergency Light for VHF				
	3) 1 x OP16-24 GPS Kit for Felcom-15				

2	**EPRIB**				
	McMurdo SMARTFIND E5 GMDSS Satellite 406MHz EPIRB	E5	1	MCMURDO	UK
	Comprising: -				
	1 x Lithium Battery				
	1 x Hydrostatic Release Mechanism				
	1 x Standard Accessories				
	1 x Operator Manual				
3	**SART**				
	McMurdo S4 GMDSS 9GHz Sart Radar Transponder	S4	2	MCMURDO	UK
	Comprising: -				
	1 x Lithium Battery				
	1 x Bracket				
	1 x Standard Accessories				
	1 x Operator Manual				
4	**Two Way Portable VHF Radio (GMDSS)**				
	McMurdo R2, 19Ch Waterproof GMDSS VHF Radio	R2	3	MCMURDO	UK
	Frequency Range 155-163MHz				
	Comprising: -				
	1 x 84-210 Lithium Battery (LTB3)				
	1 x 84-211 Ni-cd Battery (NC08)				
	1 x 84-215 12VDC Trickle Charger				
	1 x Antenna Unit				
	1 x Operator Manual				

5	**Navtex Receiver**				
	FURUNO to replace JMC				
	GMDSS Paperless Navtex Receiver		1		
	Freq 490-518+4209.5 kHz for DC24V Operation				
	Comprising:				
	1 x Navtex Reciever Unit				
	1 x Antenna NA-2000 c/w 10m cable RG-58A/U				
	1 x Whip Antenna				
	1 x Standard Installation Materials				
	1 x Instruction Manual				
	1 x AC/DC Power Converter FM203AD	FM203AD	1	FM	SPORE

Internal communication

Item	Description	Model	Qty	Brand	Origin
1	**Batteryless Telephone System**				
	VINGTOR BATTERYLESS TELEPHONE SYSTEM	VSP	1	VINGTOR	NORWAY
	CONSISTING OF :				
	WHEELHOUSE FWD (1)				
	MAIN STATION, 12-WAY,FLUSH MOUNTED	VSP-211-L	1		
	WHEELHOUSE AFT (1)				
	MAIN STATION, 12-WAY, FLUSH MOUNTED	VSP-213-L	1		
	CAPT & C/E CABIN (2)				
	MAIN STATION, 12-WAY, FLUSH MOUNTED	VSP-213-L	2		
	WOODEN CABINET WHEN WALL MOUNTED	VSPK	2		
	E/GEN RM (1)				

	MAIN STATION, 12-WAY, W/BLT-IN RELAY CCT, FLUSH MOUNTED	VSP-223-L	1		
	METAL BOX WHEN WALL MOUNTED	MBOKS	1		
	S/GEAR RM (1), ENGINE RM (1)				
	MAIN STATION, 12-WAY, W/BLT-IN RELAY CCT, FLUSH MOUNTED	VSP-223-L	2		
	METAL BOX WHEN WALL MOUNTED	MBOKS	2		
	HEADSET WITH BOOM MIC. WITH 10 METER CABLE	VSP-36-PEL	2		
	COMBINED AUDIBLE/VISUAL DEVICE 24VDC WT IP55 100DB AMBER	SON-16O	2		
	ECR (1)				
	MAIN STATION, 12-WAY, W/BLT-IN RELAY CCT, FLUSH MOUNTED	VSP-223-L	1		
2	**Automatic Telephone System**				
	VINGTOR ACM- ALPHACOM MARINE INTEGRATED TELEPHONE / COMMAND SYSTEM COMPRISING OF :	ACM	1	VINGTOR	NORWAY
	ACM INTEGRATED TELEPHONE/INTERCOM & COMMAND SYSTEM, CONSISTING OF:	ACM-M-D	1		
	* 1 X CABINET WITH SWING FRAME WITH SCREW TERMINALS FOR SHIP'S CABLE				
	* UP TO 5 DIGITAL SUBSCRIBERS				
	* UP TO 36 ANALOUGE SUBSCRIBERS				
	* UNLIMITED HANDSET CONVERSATIONS				
	* VOICE PAGING - GENERAL OR IN GROUPS				
	* 1 CONNECTION PUBLIC ADDRESS				

	POWER SUPPLY				
	220V AC MAINS SUPPLY				
	24V DC EMERGENCY SUPPLY				
	NAV, DECK BRIDGE				
	WHEELHOUSE FWD & AFT (2)				
	IP MASTER STATION, DISPLAY, FLUSH MOUNTED	1008031000	2		
	HANDSET FOR IP FLUSH MASTER	1008097100	2		
	WHEELHOUSE RADIO TABLE (1)				
	ANALOGUE TELEPHONE WITH CLIP FOR HANDSET	DT-700M	1		
	PT-625A-4-50 JACK SURFACE RJ11	PT-625A	1		
	OFFICE DECK				
	CAPT & C/E CABINS (4)				
	ANALOGUE TELEPHONE WITH CLIP FOR HANDSET	DT-700M	4		
	PT-625A-4-50 JACK SURFACE RJ11	PT-625A	4		
	C/O CABIN (1), 2/E CABIN (1), 3/E CABIN (1)				
	ANALOGUE TELEPHONE WITH CLIP FOR HANDSET	DT-700M	3		
	PT-625A-4-50 JACK SURFACE RJ11	PT-625A	3		
	UPPER FORECASTLE DECK				
	2 MEN CABINS (9), 1 MAN CABIN (1)				
	ANALOGUE TELEPHONE WITH CLIP FOR HANDSET	DT-700M	10		
	PT-625A-4-50 JACK SURFACE RJ11	PT-625A	10		
	FORECASTLE DECK				
	2 MEN CABINS (7), RECREATION RM (1)				
	ANALOGUE TELEPHONE WITH CLIP FOR HANDSET	DT-700M	8		
	PT-625A-4-50 JACK SURFACE RJ11	PT-625A	8		

	MAIN DECK				
	HOSPITAL (1), MESS RMS (2)				
	ANALOGUE TELEPHONE WITH CLIP FOR HANDSET	DT-700M	3		
	PT-625A-4-50 JACK SURFACE RJ11	PT-625A	3		
	GALLEY (1)				
	MAIN STATION W/ BUILT-IN 50 OHM L/S WT - IP-65	VMP-503	1		
	TWEEN DECK				
	ECR (1)				
	IP MASTER STATION, DISPLAY, FLUSH MOUNTED	1008031000	1		
	HANDSET FOR IP FLUSH MASTER	1008097100	1		
	ENGINE RM (1), S/GEAR RM (1), B/T RM (1)				
	MAIN STATION WT - IP-65	VMP-530	3		
	HORNSPEAKER 15W/20 OHM WT - IP-66	VML-1520	3		
	HEADSET WITH BOOM MIC. WITH 10 METER CABLE	VMP-36-PEL	3		
	COMBINED AUDIBLE/VISUAL DEVICE 24VDC WT-IP55-100DB AMBER	SON-16O	3		
3	**Talkback / Public Address System**				
	VINGTOR CTB TALKBACK / PUBLIC ADDRESS SYSTEM	CTB/VPA	1	VINGTOR	NORWAY
	COMPRISING OF :				
	WHEELHOUSE AFT (1)				
	CONTROL UNIT,PANEL MOUNTED,10 LINES	CTB-10	1		
	HAND MICROPHONE W/5 PIN DIN-PLUG	ETC-1-TB	1		

	CENTRAL 19"RACK 12HU	VMA-CU100	1		
	24VDC 220VAC				
	19" POWER AMPLIFIER 240W/100V - 220V AC/24V DC - 3HU	VPA-240	1		
	WHEELHOUSE FWD (1)				
	FLUSH MOUNTED SUBSTATION FOR MIC	STB-6	1		
	HAND MICROPHONE W/5 PIN DIN-PLUG	ETC-1-TB	1		
	CREW AND OFFICE MESS RMS (2), GALLEY (1), OFFICE (1)				
	WALL MOUNT INDOOR LOUDSPEAKER W/CALL & ANSWER BUTTON	STB-1	4		
	ECR (1)				
	CONTROL UNIT,PANEL MOUNTED,10 LINES	CTB-10	1		
	ENGINE RM (1), B/T RM (1)				
	CALLBOX WT WALL MOUNTED - IP-66	STB-2	2		
	HORNSPEAKER 15W/20 OHM WT - IP-66	VML-1520	2		
	HEADSET W/BOOM MIC. AND 10M CORD W/4-PIN C-16 PLUG	P-MT7	2		
	COMBINED AUDIBLE/VISUAL DEVICE 24VDC WT-IP55-100DB AMBER	SON-16O	2		
	FORE AND AFT DECK (2)				
	CALLBOX WT WALL MOUNTED - IP-66	STB-2	2		
	HORNSPEAKER 15W/20 OHM WT - IP-66	VML-1520	2		
	SPEAKERS				
	COMPASS DECK (1)				
	HORNSPEAKER 30W, WT - IP-67	HP-30T	1		

	(TAPPED TO 30W)				
	NAV BRIDGE DECK				
	WHEELHOUSE (3)				
	CL-200T, LOUDSPEAKER, FLUSH MOUNTED 6W (TAPPED TO 2W)	2131000100	3		
	OFFICER DECK				
	CAPT & C/E CABINS (4), OFFICERS CABINS (3), STAIRWAYS (1)				
	(TAPPED TO 2W)	2131000100	8		
	ALLEYWAY (3)				
	LOUDSPEAKER, WALL MOUNT, DOUBLESIDE 100V/4W (TAPPED TO 2W)	CAR-4T	3		
	UPPER FORECASTLE DECK				
	CABINS (11), STAIRWAYS (1)				
	CL-200T, LOUDSPEAKER, FLUSH MOUNTED 6W (TAPPED TO 2W)	2131000100	12		
	ALLEYWAY (5)				
	LOUDSPEAKER, WALL MOUNT, DOUBLESIDE 100V/4W (TAPPED TO 2W)	CAR-4T	5		
	FORECASTLE DECK				
	CABINS (9), CREW REC RM (1), STAIRWAYS (1)				
	CL-200T, LOUDSPEAKER, FLUSH MOUNTED 6W (TAPPED TO 2W)	2131000100	11		
	ALLEYWAY (5)				
	LOUDSPEAKER, WALL MOUNT, DOUBLESIDE 100V/4W (TAPPED TO 2W)	CAR-4T	5		
	MAIN DECK				
	HOSPITAL (1), STIARWAYS (1)				

	CL-200T, LOUDSPEAKER, FLUSH MOUNTED 6W (TAPPED TO 2W)	2131000100	2		
	CHANGING RM (1)				
	WALL LOUDSPEAKER W/T 100V 2.5W (TAPPED TO 2.5W)	SAFE-10PT	1		
	ALLEYWAY (3)				
	LOUDSPEAKER, WALL MOUNT, DOUBLESIDE 100V/4W (TAPPED TO 2W)	CAR-4T	3		
	TWEEN DECK				
	ECR (3)				
	CL-200T, LOUDSPEAKER, FLUSH MOUNTED 6W (TAPPED TO 2W)	2131000100	3		
	S/GEAR RM (1), B/T RM (1)				
	HORNSPEAKER 15W, WATERTIGHT - IP-66 (TAPPED TO 5W)	VML-15T	2		
	ENGINE RM (4)				
	HORNSPEAKER 15W, WATERTIGHT - IP-66 (TAPPED TO 10W)	VML-15T	4		

One (1) set of ECDIS to be provided. FURUNO

One (1) set of BNWAS to be provided. FURUNO

One (1) set of VDR to be provided. FURUNO

One (1) set of ECDIS to be provided. FURUNO

902. **TV Antenna**

TV FM-AM Antenna with 14outlets to be installed, complete with PRA-422 Pre-Antenna Power Supply Unit for Captain Cabin, C/E cabin, Mess Room, etc.

SECTION 10 – DYNAMIC POSITIONING SYSTEM

The vessel shall be equipped with dynamic positioning system to class requirement for DPS-2 notation.

The control of the DP shall be at the aft wheelhouse console together with the independent joystick system in accordance with class requirements.

The DP system shall consist of the following.

- Duplex DP workstations with two control and field cabinet
- One (1) Cyscan laser system
- VRU or MRU to DP-2 requirement
- Two (2) UPS
- Two (2) printer
- Two (2) sets of joy stick, one at forward station, the other at aft station
- One changeover switch (DP/IJS/manual control)
- Portable DP Joystick unit with 4 control stations outside wheelhouse

The system shall have interface with the acoustics, DGPS, gyrocompass, wind tracker, VRU, UPS, printer, etc.

The electrical system on vessel including the switchboard and the piping shall be designed and installed according to the class requirement concerning DP Class 2.

The FMEA report shall be completed and submitted to classification for approval and to the satisfaction of the owner.

The DP operation manual shall be completed by FMEA maker and submitted to classification for approval.

Provision to be made for HIPAP system to be fitted at later date. Suitable gate valve and lifting arrangements to be provided on bottom plating. Electrical and fibre-optic cables to be fitted from HIPAP valve to wheelhouse as per recommendations of DP2 vendor.