0 - GENERAL

0.1 GENERAL PROVISIONS

It is the intent of these specifications and accompanying Plan(s) to describe and set forth the details of technical matters such as performance, capacities, construction, equipment, material, etc., required for building, a vessel suitable for carrying chemical and oil products having a flash point below 60° C which is allowable to the design within the scope of these Specifications and/or General Arrangement plan(s) attached hereto.

The vessel shall be constructed, equipped, tested and delivered to the Owner by the Builder in accordance with the Contract, these, designs, Specifications and Plan(s).

The Builder shall furnish the vessel with all items required by the Rules and Regulations as specified in Section 0.6 “CLASSIFICATION, RULES AND REGULATIONS”, except those items specifically stated herein as supplied by the Owner.

Details which are not mentioned in these specifications but which are essential for a vessel of this class shall be furnished in accordance with the current common shipbuilding practice.

Any requirement of the Owner, which is in excess of the requirements from the Rules and Regulations as specified in Section 0.7 CLASSIFICATION, RULES AND REGULATIONS”, or the contents of these Specifications shall be subject to the adjustment of the contract price, deadweight, delivery date and/or any other items, if any, as the case may be.

If any item(s) is mentioned twice or more in these Specifications, it is to be understood that this item(s) shall be supplied and/or equipped only once.

If any inconsistency is found between the Contract and these Specifications, and/or these Specifications and Plan(s), the former shall prevail and govern unless otherwise specifically agreed.

It is regarded that chapter “0-GENERAL” prevails over all others.

In the event of conflict or inconsistency between the terms of the parts of the Specifications, the Hull part shall prevail in respect of hull items, the Machinery part in respect of machinery items, and the Electrical part in respect of electrical items.

Any amendment or change in the Rules and Regulations as specified in Section 0.7 ‘CLASSIFICATION, RULES AND REGULATIONS’, coming into effect after signing the contract, shall be carried out subject to adjustment of the contract price, deadweight, delivery date or any other item, if any, as the case may be.

0.1 GENERAL PROVISIONS – CONT'D

If the Owner desires to apply the said amendment and/or change to the vessel, the Builder shall submit a written document, its effect on the contract price, deadweight, delivery date or any other items, if any, as the case may be.

Any amendment and change to come into effect after agreement has been reached between the Owner and the Builder shall be recorded in a memorandum or a written consent which has been signed by both parties and shall be supplement to these specifications.

The draught of the vessel specified in these Specifications shall be of moulded figure unless otherwise specifically stated.

The deadweight of the vessel noted in these Specifications shall be of "all told" figure unless otherwise specifically stated.

All plans, booklets, name plates, caution/identification plates and whatever documents required for implementation of the Specifications shall be in English.

If any other language than English is required for any reason whatsoever, the text of translation shall be provided by the Owner and the cost incurred there from shall be borne by the Owner.

The Plan(s) listed below shall form an integral part of these specifications.

a) General Arrangement
Drawing No. : ST1436-G1 (Revision C)
Issue date : 07.10.2005

b) Principal Structural Section (Mid-Ship)
Drawing No. : ST1436-H1
Issue date : 07.10.2005

0.2 VESSEL DESCRIPTION

The vessel shall be designed as an 12,800 MT Dwt Tanker and suitable for World Wide Service.

The vessel shall have the capability of carrying seven (7) grades of cargoes simultaneously.

Products carried : -
- Oil petroleum Products.
- Chemical IMO II and III, D cargoes according to IBC code.

0.2 VESSEL DESCRIPTION – CONT'D

The hull form shall be of round bilge, curved stem with bulbous bow, transom with stern bulb and of one continuous freeboard deck with expansion trunk, forecastle and poop deck and shall be of all welded steel construction. The vessel's tank construction shall be double bottom and double hull.

H.F.O storage tanks shall be double hull and double bottom.

Cargo oil tank space shall be divided into six (6) pairs of cargo oil tanks and one (1) pair of slop tanks, incorporating longitudinal and transverse bulkheads double bottom and double hull.

Cargo tanks shall not be designed to act as heavy weather ballast tanks.

Water ballast spaces shall consist of fore peak, aft peak and the double bottom and double hull tanks in way of the cargo area.

Engine and machinery rooms and accommodation shall be located aft.

The vessel shall have good manoeuvring characteristics and shall be capable of having a small turning circle and short stopping distance when at full load and speed for operation in confined waters.

Propulsion shall be by a single medium speed marine diesel engine driving a controllable pitch propeller through a reduction gearbox.

A bow thruster together with a high lift rudder shall be provided to give added manoeuvrability.

0.3 SITE CLIMATIC CONDITIONS

The vessel's machinery and all equipment shall be suitable for operation under the following climatic conditions : -

Air temperature	:	35° C
Sea Temperature	:	32° C
Relative Humidity	:	95 %
Engine Room Temperature	:	45° C
Inside Temperature	:	Max 25°C

0.4 MAIN DIMENSIONS

Length Overall	:	128.80 M
Length Waterline	:	123.40 M
Length Between Perpendiculars	:	121.00 M
Breadth Moulded	:	20.00 M
Depth Moulded	:	11.50 M
Draught (Scantling)	:	8.90 M
Draught, Design Load (Summer)	:	8.70 M

0.4 MAIN DIMENSIONS – CONT'D

Freeboard type : Type "A" of International Convention on Load Lines 1996 and assigned freeboard corresponding to the design load draught.

Deck height at center line:

Main Deck to Forecastle Deck	:	2.50 M
Main Deck to Poop Deck	:	2.80 M
Poop Deck to Accommodation Deck	:	2.70 M
Accommodation Deck to Boat Deck	:	2.70 M
Boat Deck to Navigation Bridge Deck	:	2.70 M
Navigation Bridge Deck to Wheelhouse Top	:	2.70 M

Camber:

Main Deck	: Straight, 200 mm high
Poop Deck	: Straight 200 mm high
Accommodation Deck	: NIL
Boat Deck	: NIL
Navigation Bridge Deck	: NIL
Wheelhouse Top	: Straight, 50 mm high
Forecastle Deck	: Straight, 200 mm high

Sheer:

All decks NIL but due to camber only.

0.5 DEADWEIGHT AND CAPACITIES

0.5.1 DEADWEIGHT

The total deadweight in sea water (specific gravity of 1.025) shall be approximately 12,800 metric tons at the maximum Summer Load Line Draught.

The deadweight shall be calculated before delivery of subtracting the lightweight of the vessel from the displacement at the assigned draught.

The lightweight i.e., the weight of:

- All items as defined in SOLAS
- The empty ship
- Spare parts and inventories according to the requirements of the Class and other contractual Regulatory Bodies.
- Oil and water inside the machineries tanks, vessels, heat exchangers, pipes and valves in the engine room directly related to main engine based on the minimum quantity necessary for main engine starting.

The lightweight as calculated at the Inclining Experiment which shall be performed after trials of all machineries are completed.

0.5 DEADWEIGHT AND CAPACITIES – CONT'D

0.5.1 DEADWEIGHT – CONT'D

The deadweight thus to include:

- All oil and water including stern tube cooling water except those in minimum required quantity in engine room machinery and their piping which are directly related to the main engine starting.
- Spare parts and inventories in excess of the requirements of the Class and other contractual Regulatory Bodies.
- Tools and test equipments
- Crew, their luggage and effects
- Provisions
- Stores of all kinds
- All other out fitting items supplied by the Owner, if any.

0.5.2 CAPACITIES

The approximate capacities (100% full) shall be as follows : -

Cargo Oil Tanks	:	13,500	Cu.M
Slop Tanks	:	430	Cu.M
Fuel Oil (HFO),excluding 2 settling and 2 service tanks	:	640	Cu.M.
Diesel Oil (MDO), including 2 service tanks	:	80	Cu.M.
Potable Water	:	150	Cu.M.
Lube Oil Tanks,including, settling, service and storage tank.	:	50	Cu.M.
Hydraulic Oil	:	10	Cu.M.
Sewage	:	6.0	Cu.M
Oil Residue	:	10	Cu.M.
Foam Tank	:	7.0	Cu.M.
Water Ballast	:	5000	Cu.M

Notes : 1. Cargo flash point shall be below 60°C.

2. Cargo specific gravity shall not be greater than 1.55 Tonnes/ Cu.M.
3. The volume of water ballast tanks specified above means only geometric volume and some of the specific volume may not be utilized in ballast conditions to achieve proper trim and to avoid any excess structural stress with the detail design development.
4. The above capacities shall be checked by design calculation based on drawings.

0.6 MAIN ENGINE, SPEED, FUEL OIL CONSUMPTION AND ENDURANCE

0.6.1 MAIN ENGINE (1 NO.)

Type	:	Four stroke medium speed.
Maximum Continuous Rating (MCR)	:	6120 BHP x 750 RPM.

0.6.2 SERVICE SPEED

The vessel shall be capable of achieving a service speed at the summer design load draft of about 13.4 knots and at 90% MCR of the main engine with 15% sea margin, at the condition of clean bottom in calm and deep sea without the load of shaft generator.

0.6.3 RANGE

Duration of cruise at the normal continuous rating of main engine and on the condition of fuel oil consumption only for main engine using full bunker(based on heavy fuel oil : specific gravity of 0.98, 9,700 Kcal/kg in lower calorific value, filling ratio of 98%) shall be about 35 days.

Cruising range on the condition of above mentioned duration of cruise and service speed shall be about 11,000 sea miles with additional 300 sea miles as margin.

0.7 CLASSIFICATION RULES AND REGULATIONS

0.7.1 CLASSIFICATION

The vessel, including the hull structure, equipment, propelling machinery, piping systems and electrical installation shall be built under the survey of American Bureau of Shipping and in accordance with the latest Rules and Requirements of the Statutory Authority for the services intended.

The vessel shall be constructed and classed ✠A1 Oil and Chemical Carrier ✠AMS, ✠ACCU, ESP.

0.7.2 RULES AND REGULATIONS

The Vessel shall be registered in Panama and shall be built in compliance with the following Rules and Regulations which are published at the date of signing of contract and come into force before delivery of the vessel.

1) Relevant national rules and regulations of the ship's flag.
2) International Convention on Load Lines, 1966 with Protocol of 1988.
3) International Convention for the Safety of Life at Sea (SOLAS), 1974 including Protocol of 1978 and amendments up to 2000.
4) International Convention for the Prevention of Pollution from Ships, (MARPOL) 1973, Annex I, II, IV, V & VI (Reg 12/13/16) with Protocol of 1978 and amendments up to 1998.
5) International Convention for Preventing Collisions at Sea, 1972 and amendments up to 1993.
6) International Convention on Tonnage measurement of ships, 1969 as amended by IMO Res. A493(XII).
7) International Tele-Communications Convention and Radio Regulations 1974, 1982 and amendments.

0.7.2 RULES AND REGULATIONS – CONT'D

8) OCIMF guidelines for SPM and for mooring to be complied with as far as practical.
9) OCIMF mooring equipment guidelines 1997 (as practical).
10) ILO Convention concerning Crew Accommodation on board Ships (No.92, 133) (as practical).
11) ISO 6954-2000(E) – Guidelines for the Evaluation of vertical and horizontal Vibration in Merchant Ships, in the zone below upper line as guideline.
12) Code on Noise Levels on Board Ships IMO Resolution A468 (XII).
13) IMO Resolution A708(17) Guidelines on Navigation Bridge Visibility.
14) IMO Resolution A.751(18) Interim Standards for Ship Manoeuvrability.
15) International Code for the Construction and Equipment of Ship's Carrying Dangerous Chemical in Bulk including Amendments.
16) U.S. Coast Guard's Regulations for Foreign Flag Vessels Operating in the Navigable Waters of the United States.(CFR Tittle 33-part 155, 156,157,159 and 164, CFR Title 46 – part 34.05, 35.01-1, 35.30, 35.35, 39) with Letter of compliance
17) The International Electro-Technical Commission (IEC) Publication No. 92 (Recommendations for Electrical Installation in Ships)
18) Suez and Panama Canal Navigation Rules and Regulations including Tonnage Measurement of Ships.
19) USCG reulations of oil pollution and maritime sanitation device for foreign flag vessels
20) Marine Environmental and safety criteria for industry vessels in ExxonMobil affiliate service
21) Revised Marpol annex I & II and amended IBC code with Ships whose keels are laid later than 01 January 2007.
22) Maritime Traffic safety law of Japan
23) Saint Lawrence seaways regulations, Canada

0.8 CERTIFICATES

The Builder shall obtain following certificates and deliver to the Owner at the delivery of the vessel.

The following certificates shall be delivered to Buyer together with the ship:

1) Classification Certificate for hull and machinery issued by Classification Societies.
2) International Load Line Certificate issued by Classification Society.
3) Safety Equipment Certificate issued by Classification Society.
4) Safety Construction Certificate issued by Classification Society.
5) Safety Radio Certificate issued by Classification Society.
6) Builder's Certificate issued by Builder.
7) Deadweight Certificate issued by Builder.
8) Certificate of Compass adjustment issued by authorized party.
9) Deratting Exemption Certificate issued by National Authority.
10) International Tonnage Certificate issued by National Authority.
11) Panama Canal Tonnage Certificate issued by Classification Society.

0.8 CERTIFICATES – CONT'D

12) Suez Canal Tonnage Certificate issued by Classification Society.
13) International Certificate of fitness for carriage of Dangerous Chemicals in Bulk issued by Classification Society
14) IOPP Certificate issued by Classification Society.
15) Major Machinery, Equipment and Lifting Devices Certificates issued by Manufacturer (under authority by class).
16) CHG certificates (Cargo gear) issued by Classification Society.
17) Navigation lights and Special Signal lights issued by Manufacturer.
18) Life boat and Life Saving equipment certificates issued by Manufacturer.
19) Statement for compliance of IBC code by LR
20) P and A – sopep manual

Certificates of Inspection, Classification and Statutory Surveys, and other necessary certificates and documents indicating compliance with the Classification Society and Regulatory Bodies shall be obtained by the Builder at his own expense and furnished to the Owner at acceptance.

The Builder shall pay the charges for official measurements, certification above stated and Classification but the registration of the vessel shall be the Owner's responsibility.

One (1) original and two (2) copies of each certificate shall be provided.

Should any of such certificates be not available at the time of the delivery of the vessel, the Builder shall obtain and furnish to the Owner such temporary certificates as will serve the needs of the Owner until the Certificates are available.

0.8A MODEL TANK TEST

The object of the ship's model test shall be to fine tune the hull form for obtaining satisfactory characteristics of the vessel with regard to speed and propulsion.

The ship model test program shall be carried out by a well reputed ship model basin.

The model test program include : -

a) Evaluation of hull lines by computer and hull model manufacture.
b) Still-water performance tests, self-propulsion, open-water tests and manoeuvring prediction at one (1) approach speed in loaded and ballasted condition.
c) 3D-wake measurements in loaded and ballasted condition.
d) Streamline tests.

0.9 TRIM AND STABILITY

The preliminary trim and stability calculation shall be submitted to the Owner as soon as possible for the Owner's consideration for the following loading conditions : -

1) Light ship
2) Ballast Departure
3) Ballast Arrival
4) Fully Loaded Departure
5) Fully Loaded Arrival

For each calculation, bunker and other consumable supplies are presumed as follows:

- At departure : Full supplies
- At arrival : Approx. 10% supplies of each type for departure condition.

For the adjustment of trim, stability, bending moment and shear force at the above loading conditions, ballast water may be partially and/or fully loaded, if necessary.

Should other loading conditions be envisaged, they may be considered within the allowance range of trim and stability, propeller immersions, structural soundness, etc.

The vessel shall have adequate intact and damage stability for any loading condition in accordance with Rule requirement. Mid voyage and partial loading shall be included as well as stability during loading and discharging for a range of densities.

Specific gravity and filling ratio of liquid for calculation

- H.F.O : 0.980 T/M3 (98%)
- M.D.O : 0.860 T/M3 (98%)
- L.O : 0.900 T/M3 (98%)
- F.W : 1.000 T/M3 (100%)
- B.W : 1.025 T/M3 (100%)

Final trim and stability calculations on the above mentioned loading conditions shall be carried out based on the position of center of gravity of the vessel obtained from inclining experiment and submitted to the Owner.

0.10 COMPLEMENT

Captain Class	:	3
Senior Officer	:	3
Junior Officer	:	4
Petty Officer	:	4
Crew	:	6
Total	:	20

0.11 VIBRATION AND NOISE LEVELS

0.11.1 VIBRATION

The vibration levels in accommodation area shall be limited below "Adverse comments probable" zone as defined by ISO 6954-1984 (E) "Guidelines for the evaluation of vertical and horizontal vibration in merchant ships (peak values)" with the vessel in the sea trial condition with normal continuous rating of main engines

Special attention shall be paid in the detailed design and the construction of the vessel to minimum vibration and noise. Every effort shall be made to eliminate rattles from wood work etc. The Builder shall mount machinery on vibration dampers wherever required and as detailed elsewhere in the specifications. Any unsatisfactory conditions found during trial period resulting from the excitation of resonant frequency in any equipment not otherwise attributable to major hull or machinery vibration problem shall be corrected by the Builder by local stiffening of structure, installation of suitable mounting or other effective means.

0.11.2 NOISE LEVELS

Sound insulation and isolation treatment shall be provided as necessary to keep noise levels within the following values at normal sea going condition as defined by IMO Res. A 468 (XII):

		DB(A)
-	Engine Room and Cement Machinery Room	110
-	Engine Control Room	75
-	Wheelhouse including Chart Space	65
-	Private Cabins and Service Spaces	60
-	Mess Rooms and Offices	65
-	Galley, Laundry and Pantry	75

The noise level measurements shall be carried out when the vessel is running ahead steadily at normal continuous rating of main engine during sea trial under the following condition:

0.11 VIBRATION AND NOISE LEVELS – CONT'D

0.11.2 NOISE LEVELS – CONT'D

- Machinery unnecessary for normal navigation shall be stopped.
- Mechanical ventilation and air-conditioning equipment shall be in normal operation.
- All doors and windows of the room shall be closed.
- No intermittent sound and noise shall be included. (i.e., from air horn, sanitary flushing, laundry machine, telephone, speaker, foot-step noise in stair and corridor space, etc.)
- The measurement shall be taken at a height of 1.2m to 1.6m above deck in the center of each room.
- Mean value of graduations on the meter shall be taken as the noise level.

If the noise level exceeds 3 dB(A) above the specified value, the Builder shall make necessary improvement to a practical extent mutually agreed between the Owner and the Builder and Designer.

0.12 MATERIALS AND WORKMANSHIP

0.12.1 MATERIALS

Materials, machinery, equipment, appurtenance and outfit shall be normal shipbuilding and marine engineering quality, tested, inspected and certificated as and when required by the Classification Society and Regulatory Bodies concerned.

Welding shall be executed in accordance with the Builder's standard practices, approved by the Classification Society and all welders shall be Classification Society certified.

Physical dimensions and chemical compositions of material, equipment, machinery, etc. shall generally be in accordance with class requirements, the Builder's standard and the maker's standard as long as the standards are not inconsistent with the requirements of these Specifications.

Stainless steel described without grade notation means SUS 304

0.12.2 WORKMANSHIP

The Builder shall be responsible for the care of all machinery, equipment and outfitting items whether supplied by him or others. All items whether held in store or fitted to the vessel, shall be adequately protected against damage or deterioration. Any items that in the opinion of the Surveyors, the Owner or their Representative have been damaged or deteriorated due to lack of proper care as outlined above shall be replaced or retested at the Builder's expense.

The vessel shall be built in accordance with the current shipbuilding practice and workmanship of the Builder's yard, which has been approved as required by the Classification Society.

0.13 LAUNCHING

The Builder shall be responsible for the satisfactory launching of the vessel at such time and sufficiently advanced state of completion as mutually agreed upon by the Builder, the Owner's representative and the Classification Surveyor.

0.14 SUPERVISION, INSPECTION, TESTS AND TRIALS

The inspection, tests and trials during construction of the vessel shall be carried out by the Builder and/or the maker at the maker's shop or onboard in accordance with the requirements of the Classification Society and/or the Regulatory Bodies concerned to demonstrate satisfactory workmanship, suitability for the purpose intended and compliance with the Specifications in the presence of the surveyor of the Regulatory Bodies as far as they are concerned and in the presence of the Owner's representative who is informed by the Builder to attend the inspection, tests or trials, however these shall not be performed simultaneously. The protocol of tests and trial shall be submitted to the Owner in advance.

Throughout the time the vessel is under construction and at any time prior to delivery, the Owner, or his Representative shall be given free access to the Builder's yard and to the premises of sub-contractors for the purpose of supervising and inspecting the work. The Buyer shall be given reasonable notice of all formal inspections.

The Owner shall inform the Builder of the machinery which requires the Owner's attendance at the maker's shop test upon receipt of the Builder's preliminary schedule and the Builder shall inform the Owner of the shop test schedule when finally confirmed.

The inspections, tests and trials shall be carried out under prevailing circumstances and the results can be corrected according to design condition, if necessary.

The Owner's representative on receipt of the information, shall not delay unreasonably attendance of the inspection, test or trial to the extent that the Builder's construction schedule is affected.

The results of these inspections, tests and trials shall be submitted to the Owner as necessary.

Any objections raised by the Owner will be made good by the Builder free of charge to the Owner provided such objections are proven justified on consultation with the Builder's' competent representatives and/or the Surveyors of the Classification Society.

Any inspection carried out by the Owner's representative shall be for the purpose of verifying the quality control function of the Builder and shall not be used to relieve the Builder of his responsibility to maintain a high standard of workmanship through competent and through supervision.

0.14 SUPERVISION, INSPECTION, TESTS AND TRIALS – CONT'D

During building and in the assembling of prefabricated sections at the berth, the utmost care is to be taken to ensure good alignment and fairness. Keel sightings to be taken and measurements shall be recorded at regular intervals.

As to the details of inspection and test of machinery and electric equipment and installations, refer to relevant paper.

The Owner's representatives shall be furnished with adequately maintained offices, equipped with office furniture, telephones, changing rooms, clothing lockers. The office shall be provided with telefax and secretarial offices. The Owner shall have the right to establish at his own expenses an e-mail system.

0.14.1 INCLINING EXPERIMENT

The inclining experiment shall be carried out upon the substantial completion of the vessel in the presence of the Owner's Representative and the Classification Society's Surveyor and the results shall be presented to the Owner together with all necessary information for the calculation of the trim and stability under varied loading conditions, as well as for the measurement of the lightship weight and resulting deadweight.

During the inclining experiment, the vessel shall be in a suitable condition approved by the interested parties. There shall be no loose water or oil onboard, and all shipyard equipment, rubbish, etc., shall be removed

The inclining experiment shall be postponed during adverse weather conditions, especially strong winds.

The inclining experiment shall be carried out for the first vessel only.

The results shall be submitted to the Classification Society for approval.

0.14.2 TESTS AND TRIALS

The tests and trials shall be carried out to demonstrate the satisfactory performance of required functions of the equipment and devices as per the Rules, Regulations and maker's requirement.

The testing schedule ad items shall be set up by the Builder to suit its building program and shall be submitted to the Owner.

0.14.3 DOCK SIDE TRIALS

Dock trials shall be carried out to ensure correct performance of all machinery. During the dock trials, propulsion machinery, all engine room, auxiliary machinery, and all deck machinery shall be thoroughly tested.

0.14 SUPERVISION, INSPECTION, TESTS AND TRIALS – CONT'D

0.14.3 DOCK SIDE TRIALS – CONT'D

All necessary gauges and thermometers shall be in place for trials. The drinking water and sanitary systems shall be in continuous operation during trials and each tap, water closet, shower, etc, together with all fittings shall be operated and the specified pressures maintained on the systems.

Before the completion of the Vessel, the following trials shall be carried out to the satisfaction of the Owner and as required by the Classification Society.

a) All piping systems and pumps with associated valves and cocks shall be fully tested. A complete check shall be made of all valve nameplates.
b) Electrical power plants together with all lights and electrical loads.
c) Main and auxiliary machinery and associated alarms.
d) Ventilation and air-conditioning.
e) Refrigerated spaces.
f) Main engine and control system.
g) Navigation and radio equipment.
h) All deck machinery.
i) Steering system.
j) Bilge and Ballast system.
k) Fresh water and Sanitary systems test.
l) Fuel oil system, including transfer.
m) Other alarms and controls.

0.14.4 OFFICIAL SEA TRIALS

When the vessel is substantially completed the official sea trial shall be carried out by the Builder in accordance with the sea trial schedule and test procedures submitted to the Owner prior to sea trial.

During sea trials, the vessel shall be under the command of an experienced master nominated by the Builder who will arrange the catering and supply of all victuals and equipment at his own cost.

All oil fuel, lubrication oil, hydraulic oil, fresh water, pilotage, tugs and dues for the trials, shall be paid for by the Builder.

The fuel oil, gas oil and lub oil remaining onboard will be taken over by the Owner and paid for at the original cost except quantities in the systems.

The compasses shall be adjusted during sea trials and a deviation card shall be kept on board.

During the sea trials, following test and trials, as well as other items required by the Classification and/or the Regulatory Bodies concerned shall be conducted.

0.14 SUPERVISION, INSPECTION, TESTS AND TRIALS – CONT'D

0.14.4 OFFICIAL SEA TRIALS – CONT'D

a) Speed Trials

The speed at sea shall be measured by a conventional measured mile course or a radio instrument with correction to calm and deep sea condition if the sea state during the speed measurement is exceeding Beaufort Scale No.3.

Speed trials shall consist of two double runs for a range of power settings during which detailed and accurate records shall be taken, namely 50%, 70%, 90% and 100% MCR. During these trials power measurements of the main engines shall be taken.

The speed and power curves and a complete report of the trials shall be furnished to the Owner.

Details of Builders standard analysis of speed and correction procedures shall be submitted to Owner for approval.

b) Endurance Trials

Four (4) hours with the engine running at maximum continuous R.P.M. throughout the period. A full set of readings shall be taken at thirty (30) minute intervals.

c) Steering Trials

With the vessel running at full speed, the helm shall be put from 35 Degree port to 35 Degree starboard and the time taken for this operation recorded, this shall be repeated from starboard to port.

d) Turning Trial

Vessel to turn through 360 Degree port and starboard. Diameter of turning circles and time to complete circle shall be recorded.

e) Manoeuvring Trials (Zig-Zag)

The vessel shall continuously zig-zag from port to starboard for a duration of half an hour

f) Crash Stop and Astern Trials

With vessel full ahead, the propulsion system shall be reversed and the time and distance taken for the vessel to come to rest shall be recorded.

The above stopping trial shall be repeated with the vessel running astern at astern manoeuving speed and during the astern trial the vessel shall be inspected for the occurrence of local vibration.

0.14 SUPERVISION, INSPECTION, TESTS AND TRIALS – CONT'D

0.14.4 OFFICIAL SEA TRIALS – CONT'D

g) Anchor Trials

Anchor trials shall be carried out at sea depth in accordance with Classification reqirements, accurate time being recorded for heaving and lowering each anchor.

h) Mooring Winches

The winches shall be tested under full load.

i) Generators

The following confirmation tests applying water resistant load shall be carried out on the generating sets and associated switchboard.

i) Individual Running Test
ii) Insulation Resistant Test

j) Vibration Test

Verification of the levels mentioned in 0.11.1 shall be recorded.

k) Noise Test

Verification of the levels mentioned in 0.11.2 shall be recorded.

l) Ventilation Test

During sea trial each exhaust and supply fan shall be tested to verify the capacities.

0.15 PLANS FOR APPROVAL

Three (3) copies of the Builder's key plans (along with soft copy) and the major Maker's plans shall be submitted to the Owner for approval in accordance with "LIST OF DRAWING FOR APPROVAL".

The Builder's standards Plans and subcontractors' or makers' Plans may be used as working Plans for approval.

0.16 FINAL PLANS AND INSTRUCTION BOOKS

0.16.1 FINAL PLANS

At the time of delivery of the vessel, Three (3) copies of the final plans shall be furnished to the Owner in accordance with "LIST OF AS FITTED PLANS".

1) General Arrangement
2) Principal Structural Sections.
3) Aft Shell Expansion
4) Forward Shell Expansion.
5) Superstructure Construction – Main Deck.
6) Superstructure Construction – Accommodation Deck.
7) Engine Girder.
8) Stern Gear, 'A' – Brackets and Shafting Details
9) Rudders, Rudder Trunk and Rudder Stock Details.
10) Engine Room Arrangement.
11) Bilge and Ballast Piping – Diagrammatic.
12) Fire and Washdeck Piping – Diagrammatic.
13) Oil Fuel Filling, Air and Sounding Arrangement
14) Fresh Water and Sanitary Piping – Diagrammatic.
15) Fuel Oil Piping – Diagrammatic (Main & Aux. Engines)
16) Engine Cooling Piping – Diagrammatic (Main & Aux. Engines)
17) Pneumatic Air Piping – Diagrammatic.
18) Dirty Oil Piping – Diagrammatic.
19) Sewage Holding & Discharge Piping – Diagrammatic.
20) Filling Pipe Details.
21) D. C. Electrical One Line Diagrammatic.
22) A. C. Electrical One Line Diagrammatic.
23) Safety Plan – LSA (Including all relevant control / alarm system)
24) Safety Plan – Fire Fighting (Including fire detection system).
25) Arrangement of Navigation and Signal Lights.
26) Cathodic Protection
27) Docking Plan
28) Sounding Tables
29) Emergency Lighting
30) Battery Charging System
31) Dimensional Profile.
32) Piping Seatings System for Steering System
33) CO_2 System Details.
34) Fire Detection System.
35) Tank Calibrations.
36) Hydrostatic Data.
37) Cross Curves of Stability Data.
38) Final Stability and Trim Booklet.

In addition, one (1) each of the following plans shall be furnished in a frame and placed on board the vessel : -

0.16 FINAL PLANS AND INSTRUCTION BOOKS – CONT'D

0.16.1 FINAL PLANS – CONT'D

1) General Arrangement Plan.
2) Capacity Plan.
3) Safety Plan (Fire Safety Plan). In addition two (2) plans shall be provided outside the accommodation in a watertight steel casing on both port and starboard sides.
4) Safety Plan (Life Safety Plan).
5) Instruction of donning of life jacket in each cabin and all alleyways.
6) Instruction of launching of life raft at all liferaft stations and two as spare.
7) Muster List (list to be provided by Owner).

0.16.2 INSTRUCTION BOOKS

Three (3) sets of Instruction Books, Maintenance Manuals Inventory Lists (Hull and Machinery) and Spare Parts Lists, in English, for all items of machinery and equipment shall be handed over to the Owner at the time of delivery of the vessels of each vessel.

The above includes all necessary drawings and schematics.

The Builder also shall prepare three (3) sets of data booklets for the hull, machinery and electric equipment giving the name / address of makers and reference to such information as maintenance instruction books and / or spare parts list.

The Builders / Manufacturers shall instruct the ship's personnel on how to operate all equipment.

0.17 SPARE PARTS, TOOLS AND ACCESSORIES

The spare parts, tools and accessories shall be furnished in accordance with the guidelines of the Classification Society and the Regulatory Bodies concerned and in accordance with maker's normal standard.

The spare parts, tools and accessories shall be properly protected and stored in a way which gives easy access and control depending on its type and size.

The steel cabinets, shelves and drawers shall be used for storing spare parts in accordance with the Builder's practice and the recommendations of the makers.

During the tests and trials, the Builder may use some of the supplied spare parts, tools and accessories to the vessel if necessary, and the Builder shall furnish them within the period mutually agreed between the Owner and the Builder.

0.18 OWNER'S SUPPLY

0.18.1 STORING

The following shall be supplied by the Owner and shall be stored onboard by the Builder:

- All hoses, steel wires, mooring ropes, etc. other than those mentioned in these Specification.
- All charts, nautical and radio station books, house flag and national flag.
- All consumable stroes.
- All medicines and medical equipment.
- Boatswain's and Carpenter's tools other than those mentioned in these Specifications.
- All chandlery (soaps, lamp oil, etc).
- All bedding and linen (blankets, sheets, covers, etc).
- All napery (serviettes, table clothes, etc).
- All cooks and steward's utensils (crockery, cutlery, silverware, earthenware, glasses, pots. Pans, etc).
- All lubricants, grease/hydraulic oil, working oil and other consumable liquid except those consumed during construction and test/trials before delivery.
- All other spares, stores and equipment in excess of Rules' requirements and maker's standard.

0.19 CHANGE OF EQUIPMENT AND APPROVAL

If for any reason the Owner or Builder should want to change any Make or Brand of equipment, components or materials, etc., both parties shall mutually agree and any difference in prices shall be adjusted according to the Contract Price.

The Builder shall submit to the Owner types and samples of Builder furnished equipment for the Owner's approval in writing.

0.20 DELIVERY

When completed and after successful trials, the Builder shall deliver the vessel in accordance with the Contract and the Specifications, in a fully clean condition, ready for use, and the Owner's equipment installed or stowed onboard.

All parts of the vessel shall be thoroughly cleaned of dirt and extraneous material to the satisfaction of the Owner. All tanks and other spaces aboard shall be in condition to receive their designated contents and ready to put to immediate use.

0.21 GUARANTEE PERIOD

The Builder shall guarantee the vessel against defects due to faulty materials, machinery, equipment and workmanship including all subcontractor's supplies for a period of twelve (12) months after delivery.

1 - HULL

1.0 GENERAL

The vessel shall be of all welded construction, with the hull and superstructure of steel as approved by Classification Society for all welded construction.

The hull shall be of round bilge form, flat bottom, bulb bow and bulb stern. The hull shall have a smooth fair appearance free from objectionable distortion or waviness and built mainly on the longitudinal framing system and sub-divided by twelve (12) main watertight transverse bulkheads extending to the main deck.

The hull shall be divided into thirteen (13) watertight compartments. They shall be as follows:

a) Steering Gear Compartment/Water Ballast Tanks (P&S).
b) Engine Room/ECR.
c) H.F.O Tanks.
d) Slop Tanks.
e) No.6 Cargo Oil Tank (P&S).
f) No.5 Cargo Oil Tank (P&S).
g) No.4 Cargo Oil Tank (P&S).
h) No.3 Cargo Oil Tank (P&S).
i) No.2 Cargo Oil Tank (P&S).
j) No.1 Cargo Oil Tank (P&S).
k) Water Ballast Tanks (P&S).
l) Bow Thruster Compt/Water Ballast Tanks P&S.
m) F.P Ballast Tank/Chain Lockers.

A forecastle deck shall be fitted housing the following :-

a) Bosun Store.
b) Paint Stores.

The hull structure shall be designed and constructed for loading cargo of specific gravity 1.55 t/m^3 in all cargo tanks and slop tanks.

1.0.1 MATERIALS AND SCANTLINGS

1.0.1.1 MATERIALS

All materials and equipment used in building of the ship shall be new, the best of their respective kinds, taking into account, cost, vessel capabilities, design, performance, working environment, ease of maintenance and usage.

All equipment shall be standard units with readily available Manufacturers spare parts. No special or non standard equipment shall be used in the construction of the ship or the machinery.

1.0.1 MATERIALS AND SCANTLINGS – CONT'D

1.0.1.1 MATERIALS – CONT'D

Steel for hull construction shall be as required by Class and proof of Certificates shall be produced.

All stainless steel used for ladders, rails, platforms, brackets in cargo tanks shall be of AISI 316L.

Any special strengthening and quality of material exceeding the requirement of the Classification Society except specially mentioned in the specifications and the plans submitted to the Owner for approval shall be applied on Owner's account, so long as the works will not disturb the Builder's working schedule.

Before fabrication, all steel plates and profiles shall be grit blasted to SA 2.5 and shop primed as per selected scheme.

Finish coats shall be applied as per painting specifications.

All wood used in the vessel shall be well seasoned free from sap, shakes, warps and other defects and shall be reasonably free from knots.

1.0.1.2 SCANTLINGS

The scantlings shall be based on the scantlings draught of the vessel and to the requirements of the Classification Society for thickness of plating and modulus of sections.

The scantlings not specified by the Classification Society shall be in accordance with the Builder's practice.

Stanchions and supports shall be provided where required, to support concentrated loads, deck machineries and equipment, etc., and wash plates will be furnished in tanks where required to minimise free surface effect of fluids.

Care shall be taken to provide structural continuity and changes in scantlings shall be gradual.

1.0.2 WORKMANSHIP

1.0.2.1 ELECTRIC WELDING AND STRESS RELIEVING

The vessel shall be all welded construction. Except where specified otherwise, electric welding shall be employed in the construction of the vessel. All welded connections shall be in accordance with the requirements of the Classification Society for the construction of steel vessels, except where continuous welding is specifically required, in lieu of intermittent welding to reduce corrosion damage.

1.0.2 WORKMANSHIP – CONT'D

1.0.2.1 ELECTRIC WELDING AND STRESS RELIEVING – CONT'D

Double continuous welding shall be employed throughout in all areas exposed to weather and sea, and in water tanks. All electrodes used shall be of a type approved by the Classification Society.

The preparation of plate edges shall be accurate and uniform. All joints shall be properly aligned and closed or adjusted before welding. Excessive force shall not be used in fairing and closing the work. Means shall be provided for holding the work in proper alignment without rigid restraint, during welding operations. Where excessive gaps exist between surfaces or edges shall be joined. The corrective measures adopted for above shall be to the satisfaction of the Classification Surveyor and Owner's representative.

Tack welding shall be kept to a minimum and where used, tack weld shall be equal in quality to the finished welds. All defective tack welds shall be cut out before completing the finished welds. Care shall be taken when removing tack welds and temporary fittings used for assembly to ensure that the material of the hull is not damaged.

All finished welds shall be sound, uniform and substantially free from slag inclusion, porosity, undercutting and other defects. Care shall be taken to ensure thorough penetration and fusion.

Clips for stages inside cargo tanks shall be removed and scars ground down and undercut welds built up prior to grit blasting and tank coating.

All welding shall be completed to the greatest possible extent before blasting of welded seams and painting.

Arrangements shall be made for the inspection of finished welds by Classification Society's Surveyor as required. Inspection of welded joints in important locations shall be carried out preferably by radiographic inspection. Welds found to be faulty by such inspection shall be gouged out and rewelded. The total number of radiographic examinations made on the completed welding during the construction stage shall be as required by Class.

1.0.2.2 ACCESS OPENINGS AND TEMPORARY PIECES

Provisional openings may be cut where required for access, communication and/or ventilation, etc. for Builder's workers during the construction and shall be closed by insert plate after completion of the work concerned.

Lifting lugs and their reinforcements, in the engine room, pump room and steering gear compartment, considered not inconvenient nor intrusive for future service may remain according to the Builder's practice.

1.0.2.3 LEAK AND STRENGTH TEST FOR HULL TANKS

In general, the leak test shall be carried out by air using detective reagent soapy water on the building berth except shop fillet joints and erection butt joints where on-block air compression test and vacuum test can be done respectively.

The structural strength test shall be carried out for a few tanks selected by the Classification Society, by filling with water during the construction or afloat at the Builder's convenience to ensure integrity of tank boundaries.

1.0.3 CONSTRUCTION GENERAL

The structural details in general shall be in accordance with the Builder's practice and shall be approved by the Classification Society.

The forward end of the vessel and the engine room shall be transversely framed, 500mm apart and the side frames in way of the cargo holds 650mm apart. The deck, bottom and double bottom in way of the cargo holds shall be longitudinally framed 625mm apart.

The vessel's tank construction in way of the cargo holds shall be double bottom and in the engine room, partial made up of built in tanks.

All longitudinal stiffeners in ballast tanks and void spaces should be of bulb plates.

Access and limber holes and scallops shall be cut in the structure as indicated on the Construction Plan and as necessary to provide clear and uninterrupted drainage to bilge suctions and pipe accesses. All such holes shall be cleanly oxy-cut without serrations or roughness to minimise risk of cracks in plating and welds.

Adequate drain holes and air course shall be provided in the internal structural members to ensure free movement of contents to suctions and of air to vents.

The reinforcement for docking shall be carried out according to the requirement of the Classification Society.

Moulded line shall be based on stiffener side, in general.

The decks under machinery and other heavy concentrated loads shall be reinforced by carlings and insert plates as required by the Classification Society.

1.0.4 SHELL AND APPENDAGES, ETC.

1.0.4.1 SHELL PLATING

The bottom and side shell shall be erected fair and smooth and where local strengthening is required, insert plates shall be used in preference of doubler plates.

1.0.4 SHELL AND APPENDAGES, ETC. – CONT'D

1.0.4.1 SHELL PLATING – CONT'D

The sheer strake plate thickness shall be in excess of class requirements to give greater protection when berthing. The sheer strake shall be 12mm thick.

The shell plate shall be gradually tapered in thickness from midship to ends. Where the thickness of the shell plate is different from adjacent plate by more than 3 mm, the edge of the thicker plate shall be chamfered at a suitable taper on the outside.

The bottom forward shall be strengthened for rough sea based on sea going on the normal ballast condition in compliance with the requirements of the Classification Society.

Flat plate keel shall be fitted throughout the length of the vessel as far as practicable and shall be extended to near the bow and stern and sufficient reinforcement in way of docking blocks shall be provided.

1.0.4.2 BILGE KEELS

Continuous type bilge keel shall be fitted on bilge strake port and starboard in the midship region of approximate length 30% of the LWL.

Fore and aft ends of the bilge keel shall be gradually tapered.

1.0.4.3 BOTTOM PLUGS

40 mm diameter stainless steel drain plugs shall be fitted to each tank. Each ballast tank shall have two (2) drain plugs. Ballast tanks shall have one (1) forward and aft and void tanks shall have plugs on port and starboard sides.

Bottom plugs shall be fitted as close as possible to the lowest point of each tank and shall be kept clear of points where the keel blocks are laid beneath in dry dock.

Plugs for ballast tanks shall be separate type.

Two (2) spanner wrenches shall be supplied for opening/closing of all the above bottom plugs.

1.0.4.4 BULWARKS

The bulwarks of steel plate, suitably stiffened and fitted with stays at moderate spacing, shall be fitted on forward part of the forecastle deck and at the bridge wings.

Guardrails/bulwarks shall be fitted on all other decks

The height of the bulwark shall be 1.0M and shall have a 75 mm x 8 mm F.B. top rail with stays spaced not more than 1.5M apart.

1.0.4 SHELL AND APPENDAGES, ETC. – CONT'D

1.0.4.4 BULWARKS – CONT'D

All stays and top rails shall be fully welded.

Wind deflector shall be provided on the front bulwark of bridge wing at side of the wheelhouse.

The top of bridge wing bulwark shall be capped with timber.

The bulwark plating shall be increased in thickness or shall be reinforced by doubling in way of openings for the fairleads, mooring pipes, etc., if necessary.

A portion of the bulwark at the bow (P&S) shall hinge outwards to form a chequered plate platform to enable checking of anchors over ships side.

1.1 AFT BODY CONSTRUCTION

The aft body shall be transversely framed spaced 600mm apart in conjunction with longitudinal girders.

The stern shall be of the open water type with poop and designed to obtain adequate clearances for the propeller and to support the rudder.

One (1) pair of aft peak ballast tanks shall be arranged as shown on the General Arrangement Plan.

Steering gear compartment shall be arranged on the steering gear flat above these tanks.

The flooring in the steering gear compartment shall be of mild steel chequered plates. An internal communication system with the bridge control shall be fitted to meet SOLAS requirements.

Necessary eye plates for lifting rudder, shaft and propeller shall be provided.

1.1.1 STERN

The stern shall be of fabricated mild steel construction.

The stern boss shall be well connected to the shell plate by electric welding.

Stern tube of steel fabricated type shall be welded in between the stern frame bossing-piece and the aft peak bulkhead.

1.1.2 AFT PEAK BULKHEAD

The aft peak bulkhead shall be of plane type with adequate stiffeners.

Stern tube cooling water tank shall be arranged at lower part of the aft peak tank.

1.1.3 RUDDER AND ASSEMBLY (1 NO.)

1.1.3.1 RUDDER

One (1) balanced "Schilling" highlift rudder without heel support shall be provided as shown on the General Arrangement plan.

The watertight rudder shall be fabricated of steel plate filled with Bituminous paint and drained. A stainless steel filing plug at the top and a stainless steel drain plug at the bottom shall be fitted.

The rudder shaft shall be fitted with stainless steel liners and bushings of approved metal or synthetic material.

The rudder shall be controlled from the bridge front and wing consoles.

1.1.3.2 RUDDER STOCK, RUDDER CARRIER AND BEARINGS

The rudder stock shall be made of forged steel with stainless steel liner and bronze or synthetic bush. A coupling to the rudder by means of horizontal flange secured with bolts or with cone coupling. A lifting eye bolt provided on the top of the rudder stock.

Eye plates for lifting rudder and propeller shall be welded longitudinal to the shell at suitable positions.

Internal bearing of steering gear shall be used as rudder carrier bearing.

Rudder manufacturer shall provide means of locking bushing to rudder stock to prevent crepage. Rudder manufacturer shall also provide high quality seal or packing on rudder stock to prevent intrusion of sea water into steering compartment.

1.1.3.3 STEERING GEAR

Steering gear compartment shall be arranged at the stern under the main deck as shown on the General Arrangement plan.

A steering gear shall be installed in the steering compartment. The steering gear shall be actuated by two (2) pumps units coupled to electric motor.

The pump unit shall be capable of moving the rudder from 35 degrees on one side to 30 degrees on the other side in 28/14 seconds with one/two pump unit when the vessel is running at the maximum service speed at the full loaded draft.

1.1.3 RUDDER AND ASSEMBLY (1 NO.) – CONT'D

1.1.3.3 STEERING GEAR – CONT'D

One (1) pump unit shall be operated in normal service navigation and the other shall serve as a stand-by, using both during manoeuvring.

Maximum rudder angle shall be abt. 60 degrees port and starboard for Schilling-type rudder. Max. rudder angle stoppers shall be fitted.

Materials shall be in accordance with the Classification Society's requirements.

The steering gear shall be controlled by the electric autopilot system in the wheelhouse and emergency steering shall be controlled in the steering gear room. There shall be emergency power supply from the emergency switchboard.

Type	:	Electro-hydraulic, rotary vane type.
Torque	:	According to maker and class requirement.
No of pump unit	:	Two (2) sets.
Hydraulic pipe	:	Seamless steel pipe

1.2 ENGINE AREA

1.2.1 DOUBLE BOTTOM

The engine room shall be built on longitudinal framing system integrated with longitudinal girders.

Continuous longitudinal girders shall be provided to incorporate the main engine foundations which are strengthened in accordance with the maker's recommendation and to class approval.

Necessary tanks, bilge wells and sea chests shall be properly arranged at suitable places in the double bottom.

Sea chest walls shall have an additional thickness of +3mm above class requirements.

1.2.2 DECKS, SIDE SHELL AND ENGINE CASING, ETC

The main deck shall be longitudinally framed and side shell transversely or longitudinally.

The platform deck shall be arranged in the engine room.

The platform deck shall extend from side to side with opening around main engine.

All openings in the platform decks of the engine space shall be fitted with on-deck coaming.

1.2 ENGINE AREA – CONT'D

1.2.2 DECKS, SIDE SHELL AND ENGINE CASING, ETC – CONT'D

Bulkheads and engine casing shall be constructed of steel plate with stiffeners and welded to the decks.

Primary structural members shall be arranged as required by the layout of machinery paying special care to minimize transmission of machinery vibration.

Minimum thickness for exposed deckhouse plating shall be not less than 6mm.

1.2.3 TANKS

Storage tanks, settling and service tanks etc. for fuel oil, diesel oil and lubricating oil shall be suitably arranged in the engine room and double bottom.

Large tanks shall be integrated with the side and bottom shell.

All tanks inclusive of double bottom shall each be provided with the following fittings : -

a) Manhole size 600 x 400mm with bolted cover plate, situated to give convenient access for inspection, cleaning and maintenance.

b) Access ladder or steps.

c) Air and sounding pipe. Striking pads shall be fitted in way of sounding pipes.

d) Filling/Emptying Connection

All the above shall be fitted with name-plates where necessary. Self closing water drain cocks, sight glass valve and glass gauge shall be fitted on fuel oil daily service tanks.

No tanks or compartment boundaries shall be coated or painted until testing has been completed and the compartment has been passed. When each tank is air or water tested, care shall be taken to ensure that all associated air, filling, sounding and suction pipes shall be fitted in place and subject to the same pressure.

1.2.4 FUNNEL

The funnel shall be of square type of mild steel construction, fitted with vertical stiffeners and horizontal webs inside.

The funnel shall contain the exhaust pipes and shall taper to the top and shall be of a height suitable for exhaust emissions to clear the decks and wheelhouse.

1.2 ENGINE AREA – CONT'D

1.2.4 FUNNEL – CONT'D

The funnel top plate shall be 20mm thick and join the exhaust pipe lines and the outer periphery. The connected plates shall have an inclination so that there is no accumulation of water inside the funnel.

The funnel top plate shall drain by pipe down to the deck scuppers.

The Owner's logo, cut from steel plate, shall be welded to the funnel P&S.

1.2.5 ACCESS/ESCAPE

Engine room access shall be by an inclined ladder from the main deck starboard side via a gas tight door opening out into the accommodation.

Engine room escape trunk shall be at the starboard side via a vertical ladder and 'two way' escape hatch.

1.2.6 ENGINE ROOM FLOOR PLATES

Chequered steel gratings shall be fitted in the engine room to provide adequate walkways throughout.

A solid welded frame shall be built to support the gratings and portable sections shall be arranged in the frames to facilitate removal of pipes or equipment. The plates shall be secured to the framing by stainless steel hexagon head screws.

The grating shall be broken into convenient sections and shall be arranged where necessary, to give access to valve hand wheels, etc.

1.3 CARGO ARREA

1.3.0 GENERAL

Bulkheads to be arranged as shown on the general Arrangement plan.

The structure throughout the cargo tank area shall be designed to facilitate cleaning the tanks.

The cargo area to be divided into twelve (12) tanks by a longitudinal bulkhead at centre line and transverse bulkheads.

Two slop tanks shall be arranged at the aft part of the cargo space and two water ballast tanks at the forward end.

Cargo tanks and slop tanks shall be designed for cargo up to sg = 1.55 t/m^3.

1.3 CARGO ARREA – CONT'D

1.3.1 DOUBLE AND INNER BOTTOM AND DOUBLE SKIN

Double bottom shall be sloped towards the centreline.

Double bottom and double skin shall be provided throughout cargo space. The double skin side tanks outside the cargo tanks shall be as ballast tanks. These side tanks and the double bottom ballast tanks shall be separate.

Suction wells of coldpress type stainless steel 316L shall be placed as far aft as possible and close to centreline.

1.3.2 MAIN DECK

The main deck shall be arranged continuous throughout the ship with a camber of 200mm.

In way of cargo and slop tanks all deck stiffeners and transverses shall be welded on top of the main deck.

Longitudinals shall be of mild steel bulb plates spaced 625mm apart in conjunction with 3 side girders port and starboard.

Mild steel transverse webs 950mm deep with flat bar face plate shall be spaced 2450 mm apart.

1.3.3 TRANSVERSES BULKHEADS

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

Transverse bulkheads between slop tank and pump room shall be of plane construction with stiffening outside of slop tank.

Transverse bulkheads between ballast tanks shall be plane with stiffening.

1.3.4 LONGITUDINAL BULKHEADS

Two (2) continuous longitudinal wing bulkheads and one (1) longitudinal centre bulkhead shall be provided throughout cargo space.

Longitudinal side bulkheads in cargo area shall be of plane type with stiffeners facing into side tanks.

Longitudinal centreline bulkhead shall be of corrugated construction.

1.4 FORE BODY

1.4.0 STRUCTURAL GENERAL

The forebody shall consist of water ballast tanks, chain locker, bow thruster room and fore peak tank as shown on the General Arrangement Plan.

The shell plate shall be increased in thickness in way of hawse pipe and at the anchor rubbing areas as per the Builder's normal practice.

Framing at forward end shall have deep floors, deep web frames, side stringers and breast hooks as required by the Classification Society.

Side frames in the fore peak tank shall be arranged longitudinally or transversely.

The collision bulkhead (aft of the fore peak tank) shall be of plane type stiffened by vertical stiffeners supported by horizontal stringers fitted as suitable.

1.4.1 FORECASTLE

The forecastle shall be arranged above the main deck and shall house the upper chain lockers, paint locker and bosun store.

Rope stowage space shall be part of the bosun store.

1.4.2 FORE PEAK TANK

The fore peak tank shall be designated as a water ballast tank. The tank shall be arranged under the main deck.

Adequate care shall be taken to paint the areas that are difficult to access such as fine shape of the bow internals, penetration down to the keel, ballast suction etc.

If due to the 'fine' shape of the bow it is difficult to penetrate down to the keel for painting or ballast suction, then these spaces shall be filled with cement.

1.4.3 CHAIN LOCKERS

Self stowing chain lockers of sufficient capacity shall be arranged to stow the cables well clear of the deck over.

The lockers shall be of watertight construction and fitted with a perforated false bottom grating with one removable steel cover approximately 800 mm above the bottom of locker.

The chain cables shall be secured by quick releasing type bitter end fittings.

1.4 FORE BODY – CONT'D

1.4.3 CHAIN LOCKERS – CONT'D

The structure shall be adequately stiffened in way of bitter ends and provided with all necessary fittings.

One (1) access manhole shall be arranged on the main deck for the inspection of locker and cables.

1.4.4 HAWSE PIPE, ETC.

The hawse pipe with bolster fish eye mouth shall be fitted in such a way that free anchor fall is secured.

The hawse pipe shall be of diameter and length to easily house the anchor shank and end shackle.

Washing outfittings with two (2) jetting nozzles shall be provided in each hawse pipe.

Castings if fitted shall be of good quality and projections shall be trimmed off and ground smooth.

The position of the bolster fish eye mouth shall be designed to have the clearance of min. 350 mm between bow and anchor with flukes lying inboard under the ship's upright condition on even keel.

A removable cover shall be provided at the top of each hawse pipe.

1.5 BOW THRUSTER

One (1) hydraulic motor driven FPP tunnel thruster shall be installed in the forebody.

The hydraulic motor shall be driven by the central power pack of 'FRAMMO'.

The bow thruster shall be controlled from bridge front and wing consoles.

Rated capacity shall be 550 kW.

The construction, material and accessories shall be in accordance with manufacturer's standard. Spare parts and tools of manufacturer's standard shall be supplied.

Open type protection removable steel grids shall be fitted on shell opening on port and starboard sides. Grid shall be fitted with stainless steel bolts and nuts at one side and hinged at the other. The grids shall be galvanized.

Anodes shall be fitted in bow thruster tunnel.

1.6 SUPERSTRUCTURE

Exterior boundary walls shall be of plane construction with vertical stiffeners.

The decks shall be transversely stiffened.

Inside division bulkheads shall be vertically stiffened flat type or wedged type where suitable.

The sides and end plating shall be taken up 50mm above the decks to form a retaining coaming.

The arrangement of internal webs, pillars and steel bulkheads shall be specially considered to minimize vibration.

Bridge wings shall be secured to the deckhouse side with suitable supports.

Painting lugs shall be provided underneath the bridge wings.

An access ladder and gangway from main deck to accommodation on port side shall be provided.

2 - MATERIAL CONSERVATION

2.1 PAINTING

2.1.0 GENERAL

The vessel shall be kept clean during construction.

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

Colours of finish for hull shall be in accordance with the Owner's colour scheme.

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

Pre-erection joint of hull block shall be painted before leak test and not to be considered block erection joint.

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

The surface of materials other than steel shall not be painted and permanently enclosed space except outfitting and fitting's support shall be preserved by vapor corrosion inhibitors.

Machinery, electrical equipment, fittings, valves, deck machinery, navigation equipment, furniture, etc., shall be painted in accordance with the makers' standards unless otherwise specified.

To prevent deterioration and damage, completed work and equipment placed onboard shall be protected during the course of construction by temporary covering of canvas, P.V.C. Sheet, or other suitable material as shall be deemed necessary by the Owner's representative.

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

The vessel shall be thoroughly cleaned and paint work of all machinery and/or equipment made good prior to handing over the vessel to the Owner.

The painting scheme, surface treatment and paint application shall be in accordance with the recommendations of the paint manufacturer.

2.1.1 TREATMENT OF STEEL SURFACE

2.1.1.1 PRIMARY AND SECONDARY SURFACE PREPARATION

a) Primary surface preparation shall be the blasting of steelplates to SA 2.5 and shoppriming prior fabrication, whereas secondary surface preparation shall be repair of damaged areas due to welding, burning and rubbing.

b) DWB, Cargo, Slop, FW tanks are to be shotblasted to SA 2.5 before application of tank coating.

2.1.1.2 SURFACE CLEANING BEFORE OVERCOATING

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

2.1.1.3 SURFACE PREPARATION IN CARGO OIL, SLOP AND W.B. TANKS

a) In cargo holds all sharp edges shall have two pass grinding.
b) All spatters, slags and so forth shall be removed with grinder etc. as far as practical.
c) Sharp edges of brackets, stiffeners, face plates, scallops, drain holes, air holes, slots and round cut of snip end, etc. shall be ground off while rolled sections left as they are. Sharp edges shall have 2 pass grinding with not less than 2mm radius.
d) Extremely protruded surface on welding bead shall be improved in order to keep specified film thickness.
e) All dogs for fitting purposes shall be removed and the scar on the surface ground off.
f) Lifting eye lugs shall be cut and ground off.
g) Oil, grease, soap solution and water shall be removed and all surfaces of structural members shall be cleaned by grit blasting as secondary preparation after erection.
h) Local damaged areas after painting shall be repaired as per Paint Maker’s recommendation.

2.1.2 APPLICATION OF PAINTING

The painting shall be carried out by airless spray, in general. Where the spraying is impracticable, the brush or roller shall be used.

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

The painting schedule specified hereunder may have alteration in number of coats and the dry film thickness shall be measured for each coat by the Paint Maker’s Representatives.

2.1.2 APPLICATION OF PAINTING – CONT'D

In the edges of small holes such as slots, scallops, drain holes, air holes, etc. and corners of flame burnt free edge of structural members, the dry film thickness may not always be the specified, but have one (1) stipe coat after first coat has been applied except in way of water ballast tank where two (2) stripe coats shall be applied.

The painting of the exposed structural steel surface such as outsides of shell, deckhouse, funnel, etc., and of living space and passages in living quarters shall be free from sags and runs.

After the specified coating is applied, the damaged parts of paint film shall be repaired at the proper time.

When such a damage penetrates to the steel surface and rust occurs, the surface shall be cleaned by the wire brush and/or disc sander and shall be coated as originally specified.

When such a damage does not penetrate to the steel surface, the surface shall be touched up to the specified film thickness.

The dry film thickness specified in the painting schedule shall be attained on at least 85% of the measuring points and at least 85% thickness of the specified one to be attained on remaining 15% measuring points except plate edges, etc.

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

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

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

2.1.3 PAINTING SCHEDULE

All paints and compositions used shall be of good marine quality and the application shall be of standard practice in accordance to this type of vessel.

PU coating shall be used as final coates for exposed hull and deck house surface as per paint makers recommendation over the specified and of dft 50 – 75µ.

Ballast tanks and cargo tanks shall be painted in a controlled environment as required by Sigma Paints.

All paints used shall be Sigma (or equal) and shall be applied according to the manufacturer's recommendation for guarantee of two (2) years.
Chlorinated rubber shall not be applied on the decks.

2.1.3 PAINTING SCHEDULE – CONT'D

The following shall be complied with : -

Description		D.F.T (Micr.)
1) Painting, External Parts		
1.1) Underwater, Bottom, Bootop		
7416	Sigmaprime	125
7416	Sigmaprime	125
7467	Sigma Hullrite	75
7384	Sigma Alphagen 20 Series	125
7384	Sigma Alphagen 20 Series	125
1.2) Topside		
7416	Sigmaprime	125
7466	Sigma CM Coating	125
1.3) Exposed Area and Hull Outiftting		
Weather Deck		
7416	Sigmaprime	125
7466	Sigma CM Coating	125
Bulwark		
Outside		
7416	Sigmaprime	125
7466	Sigma CM Coating	125
Inside		
7416	Sigmaprime	125
7466	Sigma CM Coating	125
Deckhouse		
Outside wall		
7416	Sigmaprime	125
7466	Sigma CM Coating	125
Exposed decks		
7416	Sigmaprime	125
7466	Sigma CM Coating	125

2.1.3 PAINTING SCHEDULE – CONT'D

Description		D.F.T (Micr.)
1)	**Painting, External Parts – Cont'd**	
	Funnel	
	Outside	
7416	Sigmaprime	125
7466	Sigma CM Coating	125
	Inside	
7416	Sigmaprime	125
7466	Sigma CM Coating	125
	Mast Post and Vent Duct	
	Outside	
7416	Sigmaprime	125
7466	Sigma CM Coating	125
	Inside ventilation duct	
7416	Sigmaprime	125
7466	Sigma CM Coating	125
	Inside elsewhere	
7416	Sigmaprime	125
7466	Sigma CM Coating	125
	Platforms, Handrails and Stanchion	
7416	Sigmaprime	125
7466	Sigma CM Coating	125
	Deck Machinery, Mooring Fitting and Outside of Steel Pipes	
7416	Sigmaprime	125
7466	Sigma CM Coating	125
2)	**Cargo Areas**	
	Cargo Tanks including Slop Tanks and Suction Wells	
7409	Phenguard Primer	100
7435	Phenguard Coating	100
7435	Phenguard Finish	100

2.1.3 PAINTING SCHEDULE – CONT'D

Description		D.F.T (Micr.)
3)	**Accommodation Areas**	
	Accommodation and stores	
	Wall and overhead	
	Bare steel	
7416	Sigmaprime	125
7238	Sigmarine BTD	50
	Behind lining / insulation	
7416	Sigmaprime	125
	Bare steel	
7416	Sigmaprime	125
7238	Sigmarine BTD	50
	Refrigerated provision Chamber	
7416	Sigmaprime	125
7238	Sigma CM Coating	100
	Provision Store and Working / Machinery Spaces	
7416	Sigmaprime	125
7238	Sigmarine BTD	50
	Converter Room	
7416	Sigmaprime	125
7238	Sigma CM Coating	100
4)	**Engine Room and Bow Thruster Room**	
	Wall and Overhead	
7416	Sigmaprime	125
7238	Sigmarine BTD	50
	Deck and Flat	
7416	Sigmaprime	125
7238	Sigmarine BTD	50

2.1.3 PAINTING SCHEDULE – CONT'D

Description		D.F.T (Micr.)
4) Engine Room and Bow Thruster Room – Cont'd		
Tank top (Below Lowest Gratings)		
7416	Sigmaprime	125
7416	Sigmaprime	125
Behind Lining		
7416	Sigmaprime	125
5) Steering Gear Room		
Wall and Overhead		
7416	Sigmaprime	125
7238	Sigmarine BTD	50
Deck		
7416	Sigmaprime	80
7238	Sigmarine BTD	50
6) Tanks		
Water Ballast Tanks (including FPT and APT)		
7400	Tankshield Primer	150
7473	Tankshield Coating	150
6) Tanks		
Ballast Pipe (if steel)		
Inside		
7400	Tankshield Primer	150
7400	Tankshield Primer	150
Outside		
Same as surrounding		
Fresh Water / Drinking Water Tank		
7416	Sigmaprime	75
7785	Sigmaguard CSF 85	300

2.1.3 PAINTING SCHEDULE – CONT'D

Description		D.F.T (Micr.)
6) Tanks – Cont'd		
Engine Cooling Water Expansion		
7416	Sigmaprime	125
7433	Sigmaguard EHB	200
Bilge Tanks in Engine Room and Lub Oil Tanks		
7416	Sigmaprime	125
7416	Sigmaprime	125

2.2 PIPEWORK COLOURING

All exposed piping systems shall be identified in accordance with the following colour scheme painted in wide bands : -

Bilge and Ballast	:	Black
Firemain	:	Bright Red
F.W. System	:	Blue
Fuel Oil	:	Brown
Lube Oil	:	Yellow
Hydraulic Oil	:	Purple
Sea Suctions	:	Green
Sea Water Cooling	:	Light Green

2.3 CATHODIC PROTECTION

For Hull exterior

The underwater hull shall be fitted with an impressed current cathodic protection with a mean current density of 35mA/m^2.

For Water Ballast Tanks

Sacrificial aluminium anodes shall be fitted in water ballast tanks to provide corrosion protection according to the following design conditions.

- Life time : Five (5) years
- Mean current density : 5.0 mA/m^2.
- Ballast time : 50 %

2.4 GALVANIZING

2.4.0 APPLICATION GENERAL

Galvanizing shall be applied for items as described throughout these Specifications.

Pipes shall be pickled internally before galvanising.

The galvanizing shall be by the hot dip method except bolts, nuts, etc. which shall normally be electroplated.

All galvanising of pipelines shall be performed after completion of fabrication.

Damage area of galvanizing part caused by the electric welding, mechanical damage, etc. shall be touched-up by one (1) coat of zinc rich paint as far as practicable.

3 - HULL OUTFITTINGS

3.1 ANCHORING AND MOORING EQUIPMENT

3.1.1 DECK MACHINERY

Electro-hydraulic, high pressure, non auto-tension type deck machinery shall be provided as shown on the General Arrangement Plan.

The reduction gear for windlass/winch combination unit and aft mooring winches shall be of open type.

Each deck machinery shall be fitted with two halves type hand-operated friction brake and clutch operated locally.

The brake holding force shall be in accordance with the requirements of the Classification Society.

The warping head shall be of cast steel of smooth barrel tube type without help and directly connected to the driving shaft without clutching device. The clutch shall be arranged to permit operation of the warping head while the mooring drum remains stationary.

The control handle combined with control valve shall be provided near the driving motor of windlass and shall be operated at the machine side only.

Seat of deck machinery shall be of open type steel construction with height as low as possible.

Resin chocks may be used for the foundation/installation, if the temperature permits without additional heating.

The material of main parts of windlass shall be as follows ;

Cable lifter	:	Cast steel
Mooring drum	:	Mild steel
Warping head	:	Cast steel
Shaft	:	Carbon steel

The construction, other material, etc. shall be in accordance with the requirements of the Classification Society and the maker's standard unless otherwise specified.

3.1.1.1 WINDLASS/MOORING WINCH (2 NOS.)

Two (2) sets of windlass combined with the mooring winch shall be installed on the forecastle deck as shown on the General Arrangement Plan.

Each windlass shall have one (1) cable lifter, two (2) mooring drums and single warping head (2 speed).

3.1 ANCHORING AND MOORING EQUIPMENT – CONT'D

3.1.1.1 WINDLASS/MOORING WINCH (2 NOS.) – CONT'D

The windlass shall be designed to obtain a line pull according to the requirements of the Classification Society (min. 10.6 Tonnes nominal pull) at average hoisting speed of 10 m/min on the cable lifter, with individual operation of the cable lifter. The cable lifter and mooring drums shall be operated independently by the mechanical clutch.

3.1.1.2 MOORING WINCHES AFT (2 NOS.)

The following mooring winches shall be provided as shown on the General Arrangement Plan.

Location	No.	Rated capacity (ton x m/min)	Combination	
			Mooring drum	Warping head
Forecastle deck	2 #	6.5x 15	2	1
Poop deck	2	6.5x 15	2	1

The mooring winches on forecastle deck marked "#" on above table shall be combined with the windlass.

The rated capacity of each mooring winch shall be obtained on the first layer of the drum at operation of single drum.

Either of the two drums on each winch shall be operated independently by the mechanical clutch.

All mooring drums shall be non-split type.

Slack rope speed shall be in accordance with the maker's standard.

3.1.1.3 HYDRAULIC POWER UNITS FOR DECK MACHINERY

Two (2) sets of electro-hydraulic power units shall be provided, one in the steering gear compartment and the other in the forward store space.

The forward power unit shall supply the hydraulic power to all deck machinery on the forecastle deck and the cargo hose crane, while the aft power unit shall supply the hydraulic power to all deck machinery on the poop deck.

The forward power unit shall have a capacity for operating one cable lifter or one of mooring drums at rated capacity, while the aft power unit shall have a capacity for operating one mooring drum at rated capacity.

One (1) set of electro-hydraulic power unit shall supply the hydraulic power for the windlass and be located in the bow thruster room.

3.1 ANCHORING AND MOORING EQUIPMENT – CONT'D

3.1.1.3 HYDRAULIC POWER UNITS FOR DECK MACHINERY – CONT'D

Each power unit shall consist of hydraulic oil pumps, electric motors, starters and other necessary accessories as per maker's standard.

No interconnection between forward power unit and aft power unit shall be provided.

Oil tanks, filters, relief valves, thermometer, non return valves, pressure gauges, etc. for hydraulic system shall be provided according to the maker's standard and the Builder's practice.

3.1.2 ANCHORS, ANCHOR CHAIN AND CHAIN STOPPERS

The anchor and chain cable shall be provided in accordance with the requirements of the Classification Society.

The anchor weight and length/diameter of chain cable described hereunder to be determined in accordance with the final equipment number of the Classification Society at detail design stage.

3.1.2.1 ANCHORS

Two (2) sets of stockless bower type anchors of 4320 kg each shall be provided.

The material of anchor shall be of cast steel.

3.1.2.2 ANCHOR CHAIN

One (1) set of stud link chain cable (Grade 3) shall be provided. The diameter of the anchor chain cable shall be 50 mm and total length of 550M.

The chain cable shall be connected to the anchor by forerunners with swivel and Kenter type joining shackle.

One end of each anchor chain shall be fastened and/or released by a cable clench (bitter end) in the chain locker.

The chain shall be marked with white paint and stainless steel band at stud in last link of every unit length (about 27.5 m).

Accessories and spare parts for anchor chain to be supplied as follows and to be stowed in bosun's store.

2 - Spare kenter shackle
1 - Spare anchor shackle
5 - Spare taper pin for Kenter shackle

3.1 ANCHORING AND MOORING EQUIPMENT – CONT'D

3.1.2.2 ANCHOR CHAIN – CONT'D

1 - Spare taper pin for anchor shackle
1 - Shackle punch
1 - Pin punch
4 - Chain hook
2 - Anchor hammer
1 - Disengaging tool for Kenter shackle

3.1.2.3 CHAIN STOPPERS

One (1) set of chain stoppers shall be arranged between each hawse pipe and windlass.

The chain stopper shall be of welded steel construction with a cast steel roller and a bar type stopper.

Necessary turnbuckles and steel wire ropes shall be provided for fastening the anchor chain.

3.1.3 MOORING ROPES, TOW LINE AND MOORING FITTINGS

3.1.3.1 MOORING ROPES AND TOW LINE

The mooring ropes approved by the Classification Society shall be supplied as follows as per class rules:

Mooring ropes - Polypropylene rope, diameter 65mm
180 M x 4 sets x 205.90 kN minimum breaking strength.

Both ends of each mooring rope shall be fitted with an eye splice and a protective cover of leather / canvas shall be provided over the splicing.

Tow Line - 200M x 835.50 kN minimum breaking strength, wire rope type. Both ends of tow line shall be spliced.

Mooring ropes other than mentioned above shall be supplied by the Owner.

3.1.3.2 CHAFING BAR

The chafing bar shall be fitted around the mooring fittings so that the mooring ropes as well as coating on the hull plating can be protected under the mooring condition.

3.1 ANCHORING AND MOORING EQUIPMENT – CONT'D

3.1.3.3 BOW STOPPER

Two (2) sets of tongue bow stoppers and bow chocks capable of accepting 50mm dia. chain cable to be provided in accordance with the recommendation of O.C.I.M.F.

Necessary chains and other fittings shall not be provided by the Builder.

3.1.3.4 MOORING FITTINGS

The mooring fittings shall be arranged as shown on the General Arrangement Plan.

The drawing showing arrangement shall be submitted to the Owner for approval at detailed design stage.

The mooring arrangement shall be as symmetric as possible. However, the mooring arrangement can be slightly changed during the detail design stage in accordance with the Builder's practice.

The mooring fittings shall be designed to apply one(1) mooring rope as per normal mooring practice.

All moving parts shall have grease nipples.

The construction, material, dimension, etc of the mooring fittings except otherwise specified in this Specification shall be in accordance with the Builder's standard.

All surfaces of the fittings in contact with the mooring ropes shall be ground smooth so that the mooring ropes can be protected from wearing.

The foundation for mooring fittings shall be provided where necessary.

Bollards : Eighteen (18) x 300 mm dia. double bitt type and of welded construction with steel pipe or steel plate according to the Builder's standard.

Deckstand Roller : Eight (8) rollers on pedestals shall be provided for changing the direction of mooring lines. The rollers shall be efficiently lubricated with grease.

Material	:	Cast iron (roller) Mild steel (seat)
Size of roller	:	250mm dia.

3.1 ANCHORING AND MOORING EQUIPMENT – CONT'D

3.1.3.4 MOORING FITTINGS – CONT'D

Mooring/Chocks : Opening size shall be designed according to Panama the size of mooring ropes and the requirements of Regulation concerned.

Fifteen (15) Closed chocks : 400 x 250 opening.

Material : Cast iron (chock)
Mild steel (seat)

The horizontal fixed guide of pipe construction shall be provided for leading the mooring ropes running athwartships, in way of cargo lines where necessary.

All securing facilities for cargo manifold shall be provided in accordance with the recommendation of O.C.I.M.F.

3.2 DECK OUTFITTING

3.2.1 SHIP'S SERVICE HANDLING GEAR

3.2.1.1 PROVISION HANDLING CRANE

One (1) set of electro-hydraulic operated provision handling gear shall be provided, starboard aft on the accommodation deck as shown on the General Arrangement Plan for handling provision and light machinery parts in the engine room.

Principal particulars of crane

Lifting capacity	:	1.0 metric ton SWL x 1 set
Hoisting speed	:	10m/min. approximately
Luffing time	:	Maker's standard
Slewing speed	:	Maker's standard
Working radius	:	Max. 6m

Operation : One motion each (hoisting, slewing or luffing).

Above principal particulars of the crane shall be based on the vessel at even keel and upright condition and may be slightly changed subject to the maker's standard. The construction, material, etc. shall be in accordance with the maker's standard design, unless otherwise specified.

The crane shall be equipped with hoisting, luffing and slewing device and designed to operate satisfactorily at vessel's heeling by 5 deg. as maximum.

The crane shall be controlled from the fixed control standard fittind on the crane body without cabin.

3.2 DECK OUTFITTING – CONT'D

3.2.1.1 PROVISION HANDLING CRANE – CONT'D

Sufficient length of galvanized steel wire rope shall be provided on the winch drum so that the hook can be lowered to the waterline when the vessel is in normal ballast condition.

3.2.1.2 CARGO HOSE/F.O HOSE HANDLING CRANE

One (1) set of electro-hydraulic, single boom crane with self-contained hydraulic power unit shall be provided for the handling of cargo oil hose and fuel oil hose on the main deck amidship near cargo manifold.

The crane shall be equipped with hoisting and luffing device and designed to operate satisfactorily at vessel's heeling by 5 deg. as maximum.

The crane shall be controlled from an open control platform without cabin arranged on its body.

Overload protection, hook stop at upper position and all fail safe systems as per O.C.I.M.F. recommendation shall be provided.

Suitable arrangement shall be provided for securing the jib safely when the crane is not in use.

Principal particulars :

Lifting capacity	:	5.0 metric ton SWL
Lifting/lowering speed	:	12m/min. approximately
Luffing speed	:	Maker's standard
Angle of slewing	:	360 degrees
Slewing	:	Maker's standard manual
Outreach	:	16m
Operation	:	One motion each (hoisting or luffing)

Above principal particulars are based on the vessel at even keel and upright condition and may slightly be changed subject to the Maker's standard.

The construction, material, etc. shall be in accordance with the Maker's standard design, unless otherwise specified.

The crane shall be able to be operated by one man.

Hose rails approximately 6M long and 200 mm dia. shall be provided in way of the manifolds P&S.

3.2.2 ACCOMMODATION LADDERS ETC.

3.2.2.1 ACCOMMODATION LADDERS

Two (2) sets of accommodation ladders shall be provided, one on each side of main deck amidship and shall be one man operated type.

The accommodation ladder shall be of the aluminium construction with fixed curved steps of non-skid type, and to be stowed on the main deck by the self-stowing system. The ladder shall be one piece type with a swiveling type upper platform and a lower platform of manual level adjusting type.

The length of accommodation ladder shall be sufficient to reach down to about 610 mm above waterline when the vessel is in normal ballast arrival condition and when the ladder is lowered to the maximum angle of 60 degrees to the horizontal.

The width of the ladder shall be about 600 mm and the height of the hand rail shall be about 1,000 mm.

The ladder shall be designed to support a uniform load equivalent to 75 kg on every step when the ladder is in horizontal position. Individual steps to be designed to withstand a central point of load of 75 kg.

The platform shall be designed to support a uniform loading of 400 kg/m2.

The ladder shall be stowed in a manner that the steps are positioned vertically within the vessel's side line with height as low as possible and to be controlled at the accommodation ladder side.

The manual lashing device shall be provided for sea going condition.

One (1) life net of polypropylene ropes shall be provided.

Material	:	Frame, steps	-	Aluminium alloy
		Upper platform	-	Galvanized steel
		Lower platform	-	Aluminium alloy
		Top rail, stanchion folding type)	-	Aluminium alloy
		Mid rail	-	Polypropylene rope with vinyl tube
Accessory	:	One (1)	-	Wooden fender of sliding type
		One (1)	-	Side roller
		Two (2)	-	Sheave box

3.2.2.2 ACCOMMODATION LADDER DAVIT

One (1) set of davit of fabricated steel construction shall be provided on each side of the vessel and to be fitted with the necessary fittings such as chocks, eyes and sheaves.

3.2.2 ACCOMMODATION LADDERS ETC. – CONT'D

3.2.2.2 ACCOMMODATION LADDER DAVIT – CONT'D

Galvanized steel wire rope for hanging the ladder shall be supplied for each davit.

One (1) set of air winch shall be provided for operation of each accommodation ladder. Means of manual emergency operation shall be provided.

3.2.2.3 PILOT LADDER

One (1) set of manual pilot rope ladder without reel shall be provided on each side of the upper deck in accordance with the requirement of SOLAS and National Authorieis.

The pilot rope ladder shall be used in conjunction with the accommodation ladder.

The length of pilot rope ladder shall be sufficient to reach down to about 610 mm above waterline when the vessel is in normal ballast arrival condition.

Gate, steps, rail and stanchions and eyes shall be efficiently provided as required by the Regulatory Bodies concerned.

3.2.2.4 WHARF LADDER

One (1) set of aluminium alloy wharf ladder of 7 m length, one piece type, 600 mm clear breadth with handrope, stanchions, wheels, etc., shall be provided and shall be stowed along side of cargo oil pipe lines within the outreach of the cargo hose handling crane.

The ladder shall have a shore roller at outboard end and hook at the other end.

The necessary fittings to secure the ladder shall be provided on the shipside.

3.2.3 ACCESS HATCHES, MANHOLES AND DOORS

3.2.3.1 ACCESS HATCHES FOR CARGO OIL AND SLOP TANK

Oiltight hatches shall be provided for access to cargo oil and slop tanks as shown on the General Arrangement Plan.

Each hatch shall be provided with a manually operated horizontal swiveling flat type steel cover with SUS compression bar.

Hatch opening on the main deck shall be elliptical form to minimize the stress concentration. Edges shall be ground smoothly.

Fittings shall be of stainless steel.

3.2.3 ACCESS HATCHES, MANHOLES AND DOORS – CONT'D

3.2.3.1 ACCESS HATCHES FOR CARGO OIL AND SLOP TANK – CONT'D

Each hatch cover to be clearly marked with the tank number by painting with welding bead outline.

Item	C.O. / Slop Tank
Type of tightness	Oiltight
No. per each tank	One (1)
Gasket	Teflon with rubber core
Coaming inside (mm dia.)	760
Coaming height (mm)	800

3.2.3.2 OTHER HATCHES

The following hatches, hinged or bolted type shall be provided as shown on the General Arrangement Plan.

The material of eye bolts and butterfly nuts shall be of brass.

The packing shall be of neoprene rubber.

Watertight hatches of 600 mm x 600 mm x 610 mm coaming height shall be provided as follows :-

- Poop Deck

  To engineering workshop.
  To steering gear compartment/rope store.
  To provision store lobby.

- Forecastle Deck

  To bosun store/rope store.

The hatches for rope storage space to be provided with round bar at top and bottom of coaming so as to protect ropes from wearing. Inside of the rope hatch covers to be provided with a rope holder.

Bolted watertight portable panels shall be provided over pump room and on accommodation deck over engine casing.

3.2.3.3 MANHOLES

Manholes shall be of oval type, 600 mm x 400 mm in size with bolted steel plate cover.

Manholes shall be watertight, oiltight or gastight depending upon their location and purpose.

3.2.3 ACCESS HATCHES, MANHOLES AND DOORS – CONT'D

3.2.3.3 MANHOLES – CONT'D

Manholes shall be located as near to the transverse partition as possible.

Ladders or steps shall be fitted in a way of the manhole for access to the compartment inside where necessary.

The manhole cover shall be provided with hand grips and marked with the name of the compartment by painting together with welding bead outline.

The handle for the cover of manholes on main deck shall be foldable and zebra marking of about 1.0m x 0.5m shall be painted in way of each manhole on exposed main deck for traffic safety of personnel.

The gasket of the manhole shall be of oil resistant rubber (NBR).

The manholes shall have stainless steel (SUS 304) stud bolts and nuts on weather part, and galvanized mild steel hexagonal nuts indoors.

The manhole for space below E/R tank top shall have 150 mm high coaming. Each ballast tank shall have two (2) manholes, one forward and one aft.

For the location, quantity and type of the manholes of each compartment, refer to the table following.

Compartment	Location	No.	Type	Coaming
Fore peak tank & fwd water ballast tanks	On main deck	6	Watertight	Steel liner
Aft peak tank & aft water ballast tanks	In steering gear room & engine room	4	Watertight	Steel liner
Chain lockers (port & stbd)	In Bosuns store	2	Watertight	Steel coaming
Water ballast tanks (Wing)	On main deck	24	Watertight	Steel liner
Fuel oil bunker tanks	In engine room	2	Oiltight	Steel coaming
Fuel oil day/settling tanks	In engine room	1 each	Oiltight	Steel coaming
Double bottom tanks in engine room	Tank top in engine room	1 Each	Oiltight	Steel coaming

3.2.3 ACCESS HATCHES, MANHOLES AND DOORS – CONT'D

3.2.3.3 MANHOLES – CONT'D

Fresh water tank (P&S) & aft peak	In engine room	4	Watertight	Steel coaming
Stern tube oil tank	Bulkhead in engine room	1	Oiltight	Steel liner
Other hull structural tanks in E/R	Suitable position	1 Each	Water or oiltight	Steel liner

3.2.3.4 STEEL DOORS

Watertight and Weathertight steel doors shall be fitted at the following entrances as per Rule requirements.

a) Watertight

Entrance to steering gear compartment, engine room and engine escape trunk as per Class requirements.

The door to the steering gear compartment shall be steel water tight type, and a notice stenciled on the door,**"THIS DOOR MUST BE KEPT CLOSED AT ALL TIMES".**

b) Weathertight

Entrances to accommodation spaces, deck store, emergency generator room, Co2 room, bosun's store, battery room and wheelhouse (16 Nos.).

Weathertight doors with fixed glass and lockable shall be provided on each side of Wheelhouse. Exposed doors shall have eyebrow over. Gas tight steel doors shall be provided at the Engine room entrances.

The clear height of door opening from deck covering, sill height, number of clips, etc. shall be in accordance with the requirements of International Load Line Convention and the National Authority. The number of clips shall be limited to the minimum required.

All door openings shall be rectangular with round corners.
The steel door shall be rectangular with round corners for non-tight doors and with square corners for weathertight doors.

3.2.3 ACCESS HATCHES, MANHOLES AND DOORS – CONT'D

3.2.3.4 STEEL DOORS – CONT'D

All steel doors shall have heavy hinges which are strong enough to withstand the weight of the doors. The hinge pins shall be of stainless steel (SUS 304) and shall be equipped with a grease nipple for lubrication.

The clip handles shall stand at right angles to the frame when the door is closed while the clip handles shall stand parallel to the frame when the door is opened. All handle movements shall be limited by the spring washer.

Adequate stoppers shall be fitted for all hinged doors.

The clear height shall from the top of door opening from deck covering to be not less than 1,900 mm, and clear width shall be 700 mm in general.

Padlocks shall be provided where necessary.

As for doors in living quarters, refer to Accommodation Section.

3.2.3.5 TESTS FOR HATCHES AND STEEL DOORS

The hose test for hatches as required by the Regulation concerned and the chalk test for the weathertight steel doors shall be carried out.

3.2.3.6 CATWALK, PLATFORMS AND CARGO MANIFOLD ETC.

a) A Catwalk of angle frame construction with top plate of galvanized gratings and hand rail of galvanized steel pipe shall be provided from poop deck to forecastle deck above main deck as shown on General Arrangement. The Catwalk shall incorporate fire monitor operation platforms.
b) The grating under and outside the manifolds shall be reinforced for carriage of cargo hose supports.
c) Cross bitts and closed chocks shall be fitted on upper deck near the hose rest for securing shore hoses.
d) Cargo manifold arrangement shall be made in accordance with the recommendation of O.C.I.M.F.
e) Eye plate for rigging fender (fender shall be provided by Owner).

3.2.4 LADDERS

The ladders and stairs shall be arranged in accordance with the General Arrangement Plan and where required in tanks, on deck, on masts, etc.

All ladders and stairs shall be of steel. The spacing of treads and rungs shall be as uniform as practicable through the whole ladders and stairs.

3.2.4 LADDERS – CONT'D

The steps of inclined ladders except in tanks shall be fillet-welded to the stringer, while the steps of vertical ladder and inclined ladder in tanks shall penetrate both sides of the stringers and welded.

If it is impracticable to have either inclined or vertical ladder, the steps of square bar shall be directly fitted on the surface.

Handrail endings shall be closed in adequate way according to the Builder's practice.

The material, size, etc. of ladders shall be in accordance with the following tables.

TABLE OF ACCESS LADDERS

Inclined Ladders

Application	Side stringer-Step breadth (mm)	Rung or step	Top hand rail
Around deckhouse as shown on the G.A Plan, engine room, bow thruster room	250 x 50 x 6mm steel E.A 600 wide	6.0mm thick steel chequered plate . Pitch : abt 250mm. Inc. to Hor. : Abt. 55 Deg	34mm O.D steel pipe (SPP)
Cargo/slop tank	125 x 75 x 10mm Steel U.A 450 wide	Two (2) rungs of 22mm stainless-steel (316L) Sq.B. Pitch:abt.250mm. Inc.to Hor. : Abt. 65 Deg.	Two (2) handrails of 25mm dia. stainless steel (316 L) R.B.

Vertical Ladders

F.O tank	65 x 9 mm steel F.B 350 wide	Rung of 19mm mild steel Bar.Pitch : abt.300mm	19mm dia. handgrip of mild steel round bar where necessary
Water ballast tanks, peak tanks & fresh water tanks	65 x 9mm steel F.B. 350 wide	Rung of Sq. Bar. Pitch : abt. 300mm	19mm dia. handgrip of steel R.B where necessary
Masts & Funnel	50 x 9mm steel F.B 350 wide	Rung of Sq. Bar. Pitch : abt. 300mm	

3.2.4 LADDERS – CONT'D

Vertical Ladders – Cont'd

Access trunk, Access to wheelhouse top	50 x 9mm steel F.B 350 wide	One (1) Rung of Sq. Bar. Pitch : abt. 300mm	19mm dia. handgrip of steel R.B where necessary

REMARK :

Inclined/vertical ladders shall be painted same as surrounding areas except galvanized handrail of inclined ladder for weather deck.

3.2.4.1 ACCESS LADDER FOR OTHER TANKS

One (1) set of vertical ladder or steps shall be provided for access to tank from each manhole.

3.2.4.2 OUTSIDE LADDERS

Adequate number of inclined ladders shall be provided for outside of accommodation decks as shown on the General Arrangement Plan.

3.2.4.3 OTHER ACCESS LADDERS

Vertical ladder with safety hoop or steps of 300 mm or 350 mm width shall be provided where necessary for access to mast, etc.

3.3.1 RAILS AND STANCHIONS

3.3.1.1 HANDRAILS

In general, the rails and stanchions shall be fitted around all exposed decks and house tops as shown on the General Arrangement Plan, except where the bulwarks or screens are provided and where a protection is afforded by equipment, such as liferafts, etc.

The handrails and stanchions with stay of shipside, deckhouse and engine casing on exposed deck only shall be galvanized. Other handrail and stanchion shall be painted as per Section 2 - MATERIAL CONSERVATION.

The top rail shall be 40mm O.D steel pipe (SPP), mid rails 19mm dia. (steel R.B.) stanchions 65mm x 10mm flat bar and stays 65mm x 8mm flat bar.

The height of top rail shall be min. 1,000 mm above the deck or deck covering and shall be a minimum of 900 mm above platform and stringers in tanks.

Number of mid rails shall be in accordance ICLL 1966.

3.3.1 RAILS AND STANCHIONS – CONT'D

3.3.1.1 HANDRAILS – CONT'D

The stanchions on superstructure decks shall be welded to the curtain plates or deck and to be well stayed to ensure rigidity of rails.

A gate shall be arranged port and starboard in way of accommodation ladder, pilot rope ladder and life boat embarkation station, etc. Ends of handrails shall be closed in suitable way to protect personnel and his clothings in accordance with the Builder's practice.

The stanchions shall be provided, in general, at about 1500 mm intervals and the stays at every third stanchion.

A walkway shall be provided for access to the bridge front windows and shall have safety railings all round.

3.3.1.2 STORM RAILS

Galvanized storm rails of 34 mm outside diameter steel pipe shall be fitted on outside wall of deckhouse where men usually walk around and positioned at about 1000 mm above the deck covering with adequate distance from the wall.

3.3.2 MASTS

The masters and posts with necessary blocks and fittings shall be installed as shown on the General Arrangement Plan.

Climbing rungs for 19 mm square bars shall be fitted to the mast for maintenance and access to equipment, lights etc.

The hull structure under the mast shall be stiffened to prevent vibration.

The height of the masts shall be determined in accordance with the Regulation concerned.

Loose parts of all accessories such as blocks and shackles shall be galvanized as per the Builder's practice.

3.3.2.1 FORE MAST

A self-staying fore mast of fabricated mild steel and/or steel construction forming a stayless "D" section with platform and railing on top shall be provided. Following equipment and fittings shall be arranged :

- Halyard for black ball
- Mast headlight
- Flood light
- Anchor light
- Electric horn
- Other required equipments specified in the specification

3.3.2 MASTS – CONT'D

3.3.2.2 RADAR MAST (AFT MAST)

A combined radar and signal mast of stayless "D" type steel construction shall be provided on top of wheelhouse at centerline. The wire stays with rigging screw shall be fitted, if necessary, to reduce vibration.

Following equipment and fittings shall be arranged :

- Mast headlight
- Radar scanner
- Signal flag yard
- Signal light
- Air horn
- Other required equipments specified in the specification

3.3.2.3 ANTENNA MAST

An antenna mast with necessary accessory to be provided on around compass bridge deck according to the equipment supplier's recommendation.

Loose parts of accessory to be galvanized as per the Builder's practice.

3.3.2.4 JACK STAFF AND ENSIGN STAFF

The jack staff and ensign staff with necessary fittings to be provided at bow and stern respectively and to be galvanized as per the Builder's practice.

3.3.3 CANVAS COVERS

All deck machineries shall have heavy duty canvas/pvc covers, including windlass, capstan, searchlights and rescue boat.

3.4 VENTILATION SYSTEM

3.4.1 GENERAL

This section describes the details of ventilation system mainly for the steering gear compartment, stores and other areas except for the living quarters and machinery space which are described separately in the Accommodation Section and Machinery Section, respectively.

Gooseneck, mushroom or wall louvre type ventilators shall be provided as ventilation heads on the weather deck.

The ventilators shall be of fabricated mild steel plate with sufficient cross sectional area and shall be weathertight. The coaming height shall be decided in accordance with the requirement of Rules and Regulations concerned.

3.4 VENTILATION SYSTEM – CONT'D

3.4.1 GENERAL – CONT'D

The size and type of ventilators shall be determined according to the Builder's standard and the requirements of Rules and Regulations concerned.

If the height of coaming exceeds 900 mm, brackets may be fitted on the coaming of mushroom vents.

3.4.1.1 VENTILATION DUCTS

The trunks and ducts shall be rectangular type and shall be of galvanized steel sheet. The thickness of duct to be 2.3 mm for main lines and 1.6 mm for branch lines respectively.

The ducts shall be well arranged to minimize the pressure drop.

3.4.1.2 MECHANICAL VENTILATION

The mechanical ventilation system shall be designed and installed in accordance with the requirement of the Classification Society and Regulatory Bodies concerned.

Each space shall be provided with either supply or exhaust fans(s) with/without duct system depending upon the characteristics of the compartments.

The number of fans and group of independent duct system, etc. shall be decided considering the arrangement in each compartment and size of ventilators.

The capacity of ventilating fans shall be based on the following air change rates for empty space listed below neglecting deductions made by equipment and other furnishings.

COMPARTMENT	Air change rate (times/hour)	
	Supply	Exhaust
Steering gear compartment combined with aft hydraulic power unit space	10	-
Bow thruster room combined with fwd hydraulic power unit space	10	-
Bosun store/rope storage space	5	-
CO2 room	-	5

3.4 VENTILATION SYSTEM – CONT'D

3.4.1 GENERAL – CONT'D

3.4.1.3 NATURAL VENTILATION

Spaces other than machinery ventilated spaces included in section 3.4.1.2 shall be naturally ventilated with suitable ventilators.

The location of ventilators shall be carefully decided to ensure satisfactory ventilation.

3.4.1.4 VENTILATION FANS

Marine standard axial flow type fans of which the impeller and electric motors are incorporated in the fan casing, shall be provided.

The impeller of fan shall be dynamically balanced.

The fans shall be mounted on the coaming with mushroom ventilators.

All external ventilators shall be correctly and clearly identified with a name plate showing the service area.

The capacity and static pressure of fan(s) shall be sufficient to cover the specified air change rate of the respective compartment and combustion air requirement.

3.5 LIFE SAVING EQUIPMENT

The equipment, arrangement, installation and other provisions shall be in compliance with the requirements of SOLAS and the National Authority.

The life saving appliance shall be equipped for twenty (20) persons.

3.5.1 LIFE BOAT AND DAVIT

3.5.1.1 FREEFALL LIFE BOAT (1 NO.)

The lifeboat shall be provided as shown on the General Arrangement Plan.

The name of vessel and port of registry shall be painted at bow and top.

All outside surfaces shall be of orange colour and inside surface shall be of the Maker's standard.

No. of boats	:	One (1).
Type	:	Fiberglass reinforced plastic totally enclosed type boat driven by water cooled diesel engine. Starting system shall be as per SOLAS.

3.5.1 LIFE BOAT AND DAVIT – CONT'D

3.5.1.1 FREEFALL LIFE BOAT (1 NO.) – CONT'D

Dimension : Maker's standard.
Capacity : 20 persons.
Speed : Not less than 6 knots in smooth water.

The life boat shall be equipped with all loose gears required by the Regulation concerned.

A suitable embarkation rope ladder of enough length required by the Regulation shall be stowed on a proper seating with fixed shackles near each boat station in order to provide an access to the survival craft when afloat.

The ladder shall be long enough at normal ballast draft.

3.5.1.2 LIFE BOAT DAVIT

One (1) set of approved type life boat davit shall be provided as shown on the General Arrangement Plan.

The davit shall be made of fabricated steel plate and shall be complete with winches, blocks, falls, brakes, etc.

Each winch shall be operated by a fixed electric motor and to be equipped with handles for manual operation in case of emergency. The winch shall have a sufficient capacity for lowering fully equipped life boat with persons onboard to the normal ballast draft.

Falls shall be of galvanized steel wire rope.

The davit shall be directly welded to the dark. All moving parts shall be lubricated by means of standard grease nipples.

The design of boat davit shall be of the Maker's standard and shall fulfill the requirements of the National Authority and Regulatory Bodies concerned.

3.5.2 LIFE RAFTS, BUOYS, JACKETS, ETC.

3.5.2.1 LIFE RAFTS

The following inflatable life rafts shall be provided:

Location	No.	Capacity
Poop Deck (P & S)	2	20 persons
Forecastle Deck	1	6 persons

Each life raft shall be stowed in fiberglass reinforced plastic container and shall be located where easily accessible.

3.5.2 LIFE RAFTS, BUOYS, JACKETS, ETC. – CONT'D

3.5.2.1 LIFE RAFTS – CONT'D

The number of persons, which an inflatable life raft is designated to accommodate, shall be marked on the life raft and its container in permanent characters.

All life rafts shall be push launchable and secured with the hydrostatic releasing device except for the 6 person unit. One of the 20 person units shall be served by the launching device.

The stowage of life raft shall be secured that overflowing water cannot damage or remove the raft and cannot actuate the release mechanism.

All necessary loose equipments shall be contained with life raft in accordance with the requirement or regulation concerned..

3.5.2.2 LIFEBUOYS

The circular lifebuoys shall be provided as follows.

Location	No.	Accessory
Navigation Bridge Deck	2	Self-igniting light and self-activating smoke signal with quick release device.
Boat Deck	6	Self-igniting light.
Main Deck (Midship)	2	Self-Igniting light.
Forecastle Deck	2	Buoyant life line 30M

The lifebuoy shall be made of rigid polyurethane and shall be covered with plastic. Each lifebuoy shall be marked with the name and port of registry of the vessel in block letters and to be fitted with a grab line.

The self-activating smoke signals shall be capable of producing smoke of a highly visible colour for at least 15 minutes.

3.5.2.3 LIFEJACKETS

Twenty two (22) rigid type lifejackets shall be provided, fitted with a whistle, light and retro-reflective tape.

The lifejackets shall be stowed in each cabin and the remainder to be stowed in a life jacket box.

All lifejackets shall be coloured in orange and the name and port of registry of the vessel shall be marked.

3.5.2 LIFE RAFTS, BUOYS, JACKETS, ETC. – CONT'D

3.5.2.4 OTHER LIFE SAVING APPLIANCES

Following shall be provided as per the requirements of the Regulatory Bodies concerned.

a) Line Throwing Apparatus -One (1) 'Schermully' type with 4 projectiles and lines. (Easily accessible).

b) Distress Rockets - Twelve (12) parachute type.

c) Smoke Signals - Two (2) orange type.

d) Two (2) man overboard float lights with battery.

e) Retro-reflective materials shall be fitted on all lifesaving appliances (extinguishers, axes, fire alarms, etc.).

f) One (1) fully stocked medical chest (suitable for a crew of 20) complete with "Ship Master's Medical Guide" (located in the hospital).

g) All escape routes in the accommodation and engine room shall be marked with luminescent tape and signs and kept clear of all obstructions.

   The position of all life saving appliances (extinguishers, axes, fire alarms etc.) shall be marked with luminescent signs.

h) Thermal Protective Aids (TPA) and Immersion suits shall be supplied as per the Regulations, or exemption of these items should be obtained from the Flag Authorities.

In addition to the above, other necessary life saving equipment shall be provided in accordance with the requirement of the Regulatory Body and the National Authority.

3.5.2.5 RESCUE BOAT/WORK BOAT

One (1) 6 Man Rescue boat of rigid fibreglass, in accordance with SOLAS requirements, shall be provided on the accommodation deck aft, port stowed in a state of readiness for launching in not more than 5 minutes. The boat shall be propelled by a Johnson (or equal) outboard motor.

The boat shall be launched/retrieved by a SOLAS approved electro-mechanical davit which shall be capable of hoisting at a speed of about 0.3m/sec., when loaded with 6 persons and equipment.

3.6 MISCELLANEOUS

3.6.1 MARKINGS

The name plates, caution plates and signs shall be provided and fitted as follows.

Generally all name plates, warning sign, etc. on doors, hatches, pipes, valves, etc. shall be written in English.

All external doors shall have label plate, while hatches and manholes shall be marked with welding bead.

All cabins and public rooms, stores and lockers shall be provided with name plates.

Name of vessel shall be marked on the bow and stern, and port of registration marked at the stern. These marks shall be of 6.0 mm thick steel plate with painting. The name shall be in letters 300mm high and port of registry 200mm.

The vessel's name shall be painted on liferafts, lifebuoys and rescue boat. The markings on the rescue boat shall conform to Rules.

Bulbous bow mark shall be marked with intermittent welding bead.

The draft marks of 6mm thick steel plate shall be painted on each side of the vessel, port and starboard, at the bow, midship and stern and measured from underside of keel produced.

Draft marks shall be in Arabic numerals having a height equivalent to 100 mm in vertical elevation and set off at 200 mm intervals extending 600 mm above datum waterline from the keel.

Loadline markings shall be cut from 6mm steel plate, welded to the ships side, port and starboard and painted in colours contrasting to the ship's colour scheme, all as required by the Regulations.

Funnel mark secured by bolts shall be outlined on both sides of the funnel by 6mm thick steel plate in accordance with the Owner's logo and painted.

Marks of transverse bulkhead in way of cargo oil tanks shall be made of welding bead on outside shell.

Tonnage and official number shall be marked in accordance with the requirement of Regulations concerned.

Vessel's call letters of brass plate shall be fitted in radio room and wheelhouse.

Bulkhead Marks, tug pushing mark, manifold marks, Owner's mark and pilot embarkation marks shall be provided with intermittent welding bead and painting on outside shell as per the Builder's practice.

3.6 MISCELLANEOUS – CONT'D

3.6.1 MARKINGS – CONT'D

The demarcation mark shall be provided with welding bead between boottop and topside.

3.6.2 ANCILLARY OUTFITTING

3.6.2.1 BOSUNS STORE OUTFITTING

Two (2) tiers of shelf shall be fitted at each side of the bosuns store for the stowage of deck gears, etc.

Hanging rods shall be also provided.

The shelves shall be made of soft wood or steel fabricated.

Wooden gratings shall be fitted in way of rope hatch openings for drying of ropes.

3.6.3 DECK INVENTORY

3.6.3.1 NAUTICAL INSTRUMENTS

One (1) Pair binoculars, prism, night-glass, magnification 7 times, 50 mm object glass.
One (1) Aneroid barometer millibar scale.
One (1) Thermometer for sea water.
One (1) Thermometer for atmosphere.
One (1) Hand lead, 3.2 kg, with 46 meters line.
One (1) Chronometer, portable type (battery use).
Two (2) Ship's bells, 300 mm diameter, one on bridge and one on forecastle.
Four (4) Black balls, 600 mm diameter folding type, two NUC and anchor.
One (1) Black diamond shape, 600 mm dia.x 1200mm long, folding type.
One (1) Black cylindrical shape 650 mm dia. x 1200mm long, folding type.
One (1) Gong with beater.
One (1) Mechanical foghorn, hand siren type with box.
One (1) Loudhailer.
Five (5) Clinometers, one small clock type in wheelhouse, the other large pendulum type in engine room, captain's cabin, engine control room inside and cargo control room.

Note : Other equipments not mentioned above shall be provided by the Owner.

3.6.3 DECK INVENTORY – CONT'D

3.6.3.2 SIGNAL FLAGS AND BOOK

One (1) Set of International Code of signal flags, c/w National Ensign.
One (1) International signal code book.

Others not mentioned above shall be supplied by the Owner.

3.6.3.3 PUBLICATIONS AND DATA RECORDING (OWNER'S SUPPLY):

a) Deck Log Book
b) Compass Error Book
c) Watch keeping standing instructions and night order book, including 24 hours radio watch.
d) British Admiralty Charts for area of operation corrected up-to-date. "Notices to Mariners" file shall be kept onboard.
e) Admiralty Pilot Books for the area of operation.
f) Nautical Almanac, Browns or similar with Rules of the Road included.
g) Nautical Tables (Nories or similar).
h) Navigation and Communication Equipment Failure/Repair file.
i) Bridge Procedure Guide.
j) List of Light and Radio Publications.
k) GMDSS Book.
l) List of Coastal Stations.

3.6.3.4 BOATSWAIN'S AND CARPENTER'S TOOLS

	NAME	SIZE	MAT'L	QTY	REMARK
1)	Carpenter's Chisel	19 mm	Carbon Steel	1	Strike Chisel
2)	Carpenter's Chisel	13 mm	Carbon Steel	1	Hollow Chisel
3)	Gimlet	40x200		2	
4)	Sledge Hammer	Abt.6kg	Carbon Steel	1	
5)	Hand Hammer	0.5kg 0.9kg		1 1	
6)	Claw Hamer	0.8kg			
7)	Large Wood Hammer	150dia.x250	Wood		
8)	Hatchet	L=350			

3.6.3 DECK INVENTORY – CONT'D

3.6.3.4 BOATSWAIN'S AND CARPENTER'S TOOLS – CONT'D

	NAME	SIZE	MAT'L	QTY	REMARK
9)	Fid	45dia.x300 55dia.x380 60dia.x460	Hard Wood		
10)	Marine Spike	20dia.x200 25dia.x350 30dia.x500	High Grade Steel		
11)	Serving Mallet	80dia.x150 x300	Wood	2	
12)	Serving Board	30x100x100	Wood	2	
13)	Sail Maker's Palms		Leather	2	Right type
14)	Chipping Hammer		Carbon Steel	4	
15)	Big Scraper	L=760		2	
16)	Triangular Scraper	L=250	Carbon Steel	2	
17)	Paint Scraper	L=200		4	
18)	Wire Brush	L=300		2	
19)	Squeezer	L=1200		2	
20)	Mop	L=1250	Linen	4	
21)	Coir Broom	L=1000	Coir	1	
22)	Paint Pot	200x200	Galv.Steel	3	
23)	Long Paint Brush	L=600		6	Round type
24)	Paint Brush	100x230		4	Flat type
25)	Crow Bar	L=1500 L= 800		1	
26)	Monkey Wrench	L= 250 L= 375		1	

3.6.3 DECK INVENTORY – CONT'D

3.6.3.4 BOATSWAIN'S AND CARPENTER'S TOOLS – CONT'D

	NAME	SIZE	MAT'L	QTY	REMARK
27)	Common Spanner	13x17 19x24 24x27 30x32 36x41		1 1 1 1 1	
28)	Cutting Plier	L= 210		2	
29)	Tin Shears	L= 300		2	
30)	Screw Driver	5dia.x100 8dia.x150 10dia.x200		1 1 1	"-" "+" each type
31)	Shovel	240x270 L=900		6	
32)	Sharpening Stone	Fine Medium		1 1	Oil Stone Oil Stone
33)	Cork Fender with Rope	450dia. 20dia.x15M	Cork Manila	6 sets	
34)	Rat Guard with Rope	O.D : 600 I.D : req. mooring rope	Galv. Steel	½ of req. no.of mooring rope.	For mooring rope.
35)	Oiler	106t	Galv.Steel	2	
36)	Funnel	155Mm 200MM	Galv. Steel	1 1	
37)	Oil Measure	3 L	Plastic	1	
38)	Lamp Scissors	L=200	Steel	1	
39)	Bench Vice	125 MM		2	
40)	Bosun Chair with Block & Rope	200x620x30MM 18dia.x50M	Wood Manila	Wood	2 sets

3.6.3 DECK INVENTORY – CONT'D

3.6.3.4 BOATSWAIN'S AND CARPENTER'S TOOLS – CONT'D

	NAME	SIZE	MAT'L	QTY	REMARK
41)	Paint Stage with Block & Rope	350x260x50t 20dia.x50M	Wood Wood Manila	4 sets	
42)	Hand Saw	L=600		2	
43)	Safety Net	6Mx4M 3dia.rope	P.P Rope	2	
44)	Grease Pump with Adapter	18L		2	
45)	Work Bench	LxB=1500x700 H = 900mm	Wood	1	To be installed in Bosun's Store

4 - ACCOMMODATION

4.0 GENERAL

4.0.1 LAYOUT

The living quarters such as living space, public space, office space, navigation and control space, corridor space, sanitary space, catering space, provisions space and sundry space shall be arranged in the aft deckhouse as shown on the Accommodation Layout Plans.

The general layout of the vessel shall be of good quality both externally and internally and be of pleasant appearance. For special preference, the Buyer shall advise the Builder on the scheme of decoration together with colour schemes.

Accommodation shall be arranged for Twenty (20) crew. Air conditioned berth and mess area shall be arranged to fully accommodate the vessel's crew in accordance with International Labour Organization (ILO) Convention 92, Supplement 133 and Recommendation 140.

Designation	Allocation
Living space	Cabin and annexed similar space.
Public space	Officer Mess, Crew Mess , Community Room, Hospital, Change Rooms, Duty Mess.
Office Space	Cargo Control Room/Ship's Office, Engine Control Room.
Navigation and control space	Wheelhouse with chart space and Radio Space, Battery Room, Emergency Generator Room, Navigation Equipment Room, CO_2 Room, Fire Control Room.
Corridor space	Passage Way, Stairway
Sanitary space	Private Toilet, Public Toilet, Hospital Bathroom, Laundries, Changing Rooms, Drying Room.
Catering space	Galley, Pantry.
Provisions space	Dry Provision Store, Refrigerating Chambers, Bonded Store.
Sundry spaces	Changing Room, Air Conditioning Unit Room, Co_2 Room, Other miscellaneous stores and lockers.

4.0.2 CLEAR HEIGHT

The clear height in the living quarters shall be about 2100 mm, but sanitary space may be about 2050 mm from the top of floor covering to the bottom of overhead deck to ceiling. However, the protruding part such as ceiling lamp, shall be excluded from the measurement.

4.0.3 GRADE AND ALLOCATION

The space shall be furnished in accordance with the following grades :-

	Living Space	Public Space etc.
Captain Class	Captain's, Chief Engineer's and Chief Officer's Dayroom and Bedroom (3 Cabins)	Private Toilet
Senior Officer Class	Chief Officer, 2nd Engineer, 2nd Officer and Owners Bedroom (3 Cabins)	Private Toilet
Junior Officer Class	4 Cabins	Share Toilet (1 between 2)
Petty Officer Class	4 Cabins	Share Toilet (1 between 2)
Crew	Six Crew cabins	Share Toilet (1 between 2)
Hospital	Twin Berth Room	Bathroom

The following spaces are common : -

- Wheelhouse c/w chart and radio spaces.
- Mess rooms.

4.1 INSULATION

4.1.0 INSULATION MATERIAL

The insulation material and construction shall be in accordance with the relevant Rule and Regulation.

Approximate bulk density of insulation material shall be as follows :-

Rock wool /equivalent, mat & firebatts : Abt. 30-40 kg/m3 for heat and sound insulation.
Abt. 110 kg/m3 for fire insulation

Rock wool shall be secured with pins and washers.

4.1.1 HEAT INSULATION

4.1.1.1 OVERHEAD AND SIDE INSULATION

The portion of compartment facing weather, exposed part shall be insulated in accordance with the following table.

As for the space partially exposed, the insulation shall extend to 300 mm beyond the boundary as far as practical.

Following abbreviations shall be used.

RW : Rock Wool / Equivalent
GC : Glass Cloth and aluminium foil
GS : Galvanized Steel Sheet (0.5 mm thick)

Compartment	Overhead in the compartment		Side in the compartment	
	Deck	Beam & girder	Wall	Stiffener
Living, public and all other spaces except below spaces	50 RW + Ceiling	25 RW	50 RW + Lining	50 RW + Lining
Laundry, Public toilet & Changing Room	50 RW + GS	25 RW	50 RW + GS	50 RW
Air conditioning unit room. Dry Provisions Store, Bonded Store. Hydraulic power unit room. Other miscellaneous, stores and lockers which have an entrance to accommodation space. Emergency Generator Room.	50 RW + GC	25 RW + GC	50 RW + GC	50 RW + GC
Refrigeration Chambers	50 RW	25 RW	50 RW	25 RW

Note : Beam and girder above 300 mm in depth shall be insulated by 300 mm and remaining parts shall be left bare.

4.1.1.2 FLOOR INSULATION

The floor in the engine control room shall be insulated with 50 mm thick silicate board.

4.1.2 SOUND INSULATION

No sound insulation shall be provided, except for engine control room unless noise level exceeds the specified levels mentioned in the specification.

4.1 INSULATION – CONT'D

4.1.3 FIRE INSULATION

The fire insulation shall be provided according to the Rules and Regulations.

The fire insulation in engine room shall be covered with glass cloth with aluminium foil as oil vapour barrier.

4.2 PARTITION, CEILING, LINING, DOOR, WINDOW, ETC.

4.2.0 GENERAL

Material and installation shall be in compliance with the Rules and Regulations.

All decorative formica laminates shall be of low flame spread type. The lining shall cover all exposed steel so that no stiffeners, brackets etc., can be seen. Trims, corners and joints shall be suitable to match the decor. The deckhead shall be lined in a similar manner so that all cable runs, air conditioning ducts and other domestic services shall be concealed.

All corridor bulkheads of steel shall be painted and not lined. These bulkheads shall be straight and free from distortion.

Ceilings in passageways shall be lined with 'C' class fire retardent panels. Should passageways be lined then this lining shall also be of 'C' class fire retardent panels.

Bottom of joiner bulkhead shall be set in welded steel profile on deck.

Watertight coaming shall be made by the bottom profille behind lining in way of wet space and exterior steel boundary bulkhead.

Wall panels shall be installed with galvanized steel 'H' joint profile in general.

Other detail of securing and construction of the bottom profile, top profile, skirting, etc. shall be in accordance with the Builder's normal practice, unless otherwise required by the Rules and Regulations.

The Builder shall provide samples of quality and colour for the Owner's selection of panel finishing.

4.2.1 PARTITION, LINING AND CEILING

4.2.1.1 PARTITION BULKHEADS

Material and thickness of partition shall be as follows:

Corridor bulkhead (B-class) : 50 mm thick. (B-class) thermal noise fire panel 0.56mm galvanized steel sheets and finished with decorative PVC film (low flame spread type) on both sides.

4.2.1 PARTITION, LINING AND CEILING – CONT'D

4.2.1.1 PARTITION BULKHEADS – CON'D

Division bulkhead : As for corridor bulkhead.

Following spaces shall be enclosed with steel wall:
Navigation space
Engine control room
Air conditioning unit room
Galley
Dry Provisions store
Bonded store
Refrigerated chambers
Stairways
Engine casing
Miscellaneous stores and lockers having an area of more than 4 Sq.M.
Public toilets
Laundry room
Changing room

4.2.1.2 LINING AND CEILING

The ceiling and lining shall be applied as follows:

Compartment	Ceiling	Lining
Living Space Public Space Corridor Space Wheelhouse, Chart Space and Radio Space	50mm thick rock wool with 0.56mm thick. PVC foil finished sheet (B-15 class)	25mm thick rock wool with galvanized steel sheets on both sides and decorative PVC film on visible side.
Private Toilets, Shared Toilets and Bathroom	50mm thick rock wool with 0.56mm thick galvanized steel sheet and decorative PVC film on visible side (B-15 class)	25mm thick rock wool with 0.56mm thick galvanized steel sheet and decorative PVC film on visible side.
Catering Space	0.7mm thick stainless steel sheet	0.7m thick stainless steel sheet.
Dry Provisions Store, Public Toilets, Laundry and Drying Room, Change Room, CO_2 Room, Hydraulic Power Unit Room, Misc. Stores and Lockers having an area of more than 4 m^2.	Paint finish in case of steel fabrication.	Paint finish in case of steel fabrication.

4.2 PARTITION, CEILING, LINING, DOOR, WINDOW, ETC. – CONT'D

4.2.2 DOORS AND FITTINGS

The door shall be of pontoon type steel door and finished with PVC except weather hinged door as per class.

Rubber stoppers and retaining hooks shall be provided to all doors other than those with self-closing device to secure in the open position.

Good quality deadlocks with two (2) labelled keys each shall be fitted to doors of all cabins, stores, drawers, cupboards, lockers and other compartments throughout the accommodation. Cabin doors shall be openable from outside even when locked inside.

They shall be fitted with anti-corrosion fittings and hinges of the loose pin type.

Rain shade shall be provided for doors and windows facing the weather without having overhanging deck above.

Sill height shall be in accordance with the relevant Rule and Regulation and shall be provided with stainless steel top.

Step of chequered steel plate shall be provided to the entrance from the weather side on upper deck.

Top of weather door shall be about 1900 mm high above the surface of the deck covering.

Joiner door shall have clear head height of 2000 mm from top of deck covering to top of door opening except the refrigerating chamber, catering space and sanitary space.

Wooden airlock doors shall be provided at main entrances/exits of deckhouse because of air conditioning.

The clear width of the door shall have about 650 mm opening except for private toilet and shared toilet door which shall be 600 mm.

Door auto self-closing device shall be applied as follows :

- Stairway, catering space
- Entrance door from outside except steel single plate door
- Public space, public toilet
- Engine room entrance door from accommodation space.
- Engine control room.

Electric magnetic door holders with release from accommodation fire alarm system shall be provided for main stairway doors.

4.2.2.1 WEATHER HINGED DOOR (I)

Material : Steel plate.
Construction : Single plate with square corners with steel clips and dogs.
Application : Entrance to corridor on poop deck and sundry spaces facing weather side.

4.2.2.2 WEATHER HINGED DOOR (II)

Material : Steel plate.
Construction : Pontoon with 250 mm diameter fixed glass.
Application : Entrance to corridor on poop deck and above except wheelhouse.

4.2.2.3 "A" CLASS DOOR

Material : Door Frame - 4mm SIS 1142 frame or as per Class.
Door Leave - 1.25mm SIS 1142 or as per Class.
Construction : Pontoon with 62mm door thickness and insulated core with internal stiffeners. Door frame shall be welded to the bulkhead.
Application : Stair case, galley, wheelhouse, and other space according to Rule requirement.

4.2.2.4 "B" CLASS DOOR

Material : Door Frame - 2mm SIS 1142 or as per Class.
Door Leave - 2mm SIS 1142 or as per Class.
Construction : Pontoon 39mm door thickness.
Application : Cabin and other space facing corridor space.

4.2.2.5 "C" CLASS DOOR

Material : Steel plate.
Construction : Pontoon.
Application : Cabin door led to bedroom, private toilet shared toilet and hospital bathroom.
Inside entrance to corridor on "C" wood poop deck with 250 mm diameter fixed glass.

4.2.2.6 WEATHER SLIDING DOOR (WHEELHOUSE)

Material : Aluminium.
Construction : Pontoon with square fixed glass.
Application : Wheelhouse.

4.2.2.7 INTERIOR WOODEN DOOR

Material : Wood.
Construction : Pontoon with square fixed glass.
Application : Entrance to poop deck (P&S) – 2nd door.

4.2.3 WINDOWS AND SIDE SCUTTLES

4.2.3.1 WINDOWS

The forward wheelhouse windows shall be sloped to suit structure. Slope shall be sufficient to give adequate shade.

Windows outer side shall be flush with bulkhead outer side.

Spray fresh water pipe connected to domestic fresh water line (frost protected) shall be led over the wheelhouse front windows and both port and starboard sides for washing / cleaning and shall have individual stop cocks.

Exposed windows and side scuttles shall have an eyebrow over (except fixed ones).

Window boxes shall be provided for all windows.

Windows in the deckhouse front and in a range of 5m from such deckhouse front shall be of steel frame and fixed type.

Other windows shall be of aluminium alloy anodized frame.

Windows facing cargo area shall be of A60 type according to rules.

Front windows in way of maneuvering panels shall be fitted with electric defrosting elements.

All bridge windows shall be fitted with sun-screens.

Clear size (W X H)	Location	Remark
As big as possible	Wheelhouse Front Centre	Fixed type. Double glass.
Abt. 1,1m x 900mm	Wheelhouse Front Side	Fixed type. Double glass.
As big as possible	Wheelhouse Side	Fixed type, upper window. Bridge wings' windows shall be hinged (one on each side).
400 x 800mm	Living Rooms and Public Rooms	Inside open hinged type or fixed type laminated glass. Front windows to be approved heat resistant type.

4.2.3.2 SIDE SCUTTLES (SIDELIGHTS)

Side scuttles shall be of weldable steel frame (300 mm diameter), shall be opening and of aluminium alloy/brass. Sidelights internally shall have a water trap.

The side scuttle on the main deck level shall be fitted with top hinged deadlight of steel.

4.3. DECK COVERINGS

All weather deck surfaces shall have no deck covering.

Steel decks shall be thoroughly cleaned and prepared and all deck coverings shall be installed strictly in accordance with Manufacturer's recommendations. Deck coverings shall be laid under all furniture except where built-in. These areas shall be left as bare painted steel.

Deck coverings shall be to Owners choice of make and colour. (MMD approved where applicable).

The deck covering for the accommodation on the main deck level, basically no leveling work shall be made for providing horizontal plane to the cambered deck part, except for office or public space which requires horizontal plane floor.
PVC skirting shall be provided as boundary over lining wall.

4.3.1 SCHEDULE OF DECK COVERINGS

The deck coverings shall be provided as follows :-

Material	Application
2mm thick fire-retardant (asbestos free) vinyl sheet to BS3261 : Part 1 (type A) on 6mm thick deck composition of levelite latex type.	Living space (except living space specified below), corridor space, public space, (except public space specified below), office space, wheelhouse, chart & radio space.
Non-skid type rubber matting	About 900 mm width across wheelhouse between doors.
Wall to wall carpet on 6mm thick deck composition of latex type.	Captain class, senior officer class and community room.
Teak wood grating	At steering position in wheelhouse, under all shower 1000 mm x 1000 mm.
Paint only	Except as specified above.

4.3.2 FLOOR COVERING FOR WET SPACES

The floor of the wet spaces shall be covered with : -

Mosaic tile (unglazed) : Public toilet, laundry
Quarry tile (non-slip) : Galley, pantry

The cement bed or equivalent shall be laid under tiles so that the total thickness of cement and tile shall be average 25mm and necessary slope to scuppers shall be provided.

Other spaces not specified above shall have paint finish only.

4.4 STAIRWAYS, STORM RAILS, ETC.

4.4.1 INTERIOR STAIRWAYS

The steel interior stairway shall be fitted as shown on the Accommodation Layout Plan.

Clear breadth	About 800 mm
Inclination	45 to 55 Deg. To horizontal
Side frame	Steel, painted
Tread without riser	Steel, covered with 2mm thick vinyl sheet.
Step guard (non slip)	Stainless steel with PVC inlay.
Hand rail	Stainless steel.
Handrail stanchion	Stainless steel.

Safety treads shall be fitted at the head and foot of all ladders and on the deck on both sides of exterior doors. Such treads shall be fitted on bare steel only, rubber mats shall be provided in these positions where flooring is laid.

4.4.2 STORM RAILS

The storm rails in living quarters shall be of PVC coated steel pipe and arranged as indicated on the detailed joinery plan about 900 mm high above the deck according to the Builder's practice.

4.5 FURNITURE AND FITTINGS OF LIVING, PUBLIC, CATERING, NAVIGATION AND CONTROL SPACES

4.5.0 GENERAL

The furniture and fittings shall have rigid construction in harmony with decorative treatment of the space and shall be in accordance with the Builder's practice making use of natural timber, veneers and plastic laminates as appropriate.

Main furniture and fittings shall be as described in detail and the size and number of furniture may be changed slightly by the cabin arrangement.

In general, the furniture shall be constructed of plywood/chipboard and covered with melamine film finish in visible part only. Where the solid wood for leg or frame is adopted, the local timber shall be used.

All plywood, wherever used, shall be of the best available marine quality and particular attention shall be paid to the protection of the back and the end grain.

All solid timber shall be carefully selected, well seasoned and free from knots, sapwood and other defects.

All unpainted or unvarnished timber shall be treated with wood preservative.

4.5 FURNITURE AND FITTINGS OF LIVING, PUBLIC, CATERING, NAVIGATION AND CONTROL SPACES – CONT'D

4.5.0 GENERAL – CONT'D

Top of the reception table, mess tables and desks shall be finished with the melamine plastic laminate.

The steel furniture (if used) shall be of commercial stock with durable construction.

The size of steel furniture may be changed slightly to meet those of commercial stock, irrespective of the descriptions in the Specifications, with prior approval from Owners in writing.

The shape of furniture shall be of standard type and the fixing arrangement of furniture to the wall, deck and/or ceiling shall be in accordance with the Builder's practice.

The leg of large table shall be welded directly to the deck and others such as reception table shall be of portable type.

All drawers and cupboard doors shall have securing so they stay closed even when not locked.

The colour scheme with reference samples shall be submitted to the Owner for approval.

4.5.0.1 HARDWARE

The hardware shall be of aluminium or chromium coated brass in general.

Lock and key shall be fitted accordingly to the general practice.

All door handles shall be of lever type.

Hat and coat hook shall be fitted where necessary.

Padlocks shall be fitted to steel door exposed to weather.

One group master key shall be provided.

All keys in 3 sets shall be provided with brass name tag.

Lock for door of hospital bath room shall be fitted with occupation indicator.

Door hook or holder shall be provided for door which are kept open where necessary.

Fastening chain to the deck shall be provided for loose chairs in public room.

4.5.0 GENERAL – CONT'D

4.5.0.2 FURNISHINGS

a) Berths And Mattresses

Berths for officers shall have at least 2.0M x 1.2M inside measurement and for junior officers, petty officers and crew at least 2.0M x 0.8M and fitted with the board 0.2 metre above the mattresses and provided with four drawers underneath the berth.

Each berth shall be provided with a 100mm thick foam mattress and pillow. The mattress shall be of the same size as the internal measurement of the berth.

b) Lockers

All accommodation cabins shall be provided with lockers. These shall be constructed of plywood and local hardwood framings complete with shelves, hangers rod, hooks and lifejacket stowage on top. The size of the lockers shall be sufficient to accommodate box file of size 400 mm x 280 mm.

c) Chairs

All loose chairs in cabins, messrooms, etc., shall have cushion seats and shall be upholstered with good quality vinyl coated fabric.

d) Mess Tables

Mess Tables shall be of pedestal type with two substantial pedestals of metal bolted to deck. Pedestals shall not hinder the movement of people. Retention fiddles shall be fitted.

The table top shall be laminated plastic covered.

e) Settees

Settees shall be built-in and fitted with lockers underneath the seats for storage of small tools and spares in all officer's cabins. They shall be fitted with seat cushions and back squabs made from foam rubber of minimum 100m/m thickness and covered with good quality vinyl coated fabric.

f) Shelves

Wooden shelving shall be provided and fitted as necessary in the provision store and stores. A wooden grating shall be fitted on the floor of the provision store.

Shelves in the galley shall be made of stainless steel.

4.5.1 FURNITURE APPLICATION FOR LIVING SPACE

CAPTAIN CLASS ROOM (3 NOS.)

Bed	Overall size Drawers		1-2000x1200x470 mm 2 - drawers
Desk	Size Drawers		1-1550 x750x720 mm Both sides
Table	Size		1-1000x600 x450 mm (reception) 2-450x450x450mm (side)
Wardrobe (built in)	Size Mirror		1-1200x600x1970 mm 1-long
Chest of drawer w/mirror	Size		1-800x600x720 mm
Side board	Size Type		1-2400x600x720 mm Combined with book case and VTR rack
Sofa with Arm rest both sides	Upholstery		Fabric
	Stuffing	Seat / Back	Polyurethane sponge
	Size		1 - 3 seat type
Chairs	Type		1-Revolving arm chair, 2-Easy chairs, 1-Arm chair, 1-Stool
	Upholstery Stuffing	Seat / Back	Fabric Polyurethane sponge
Filling cabinet			2-(3-drawer)
Hat and coat hooks			5
Mattress	Upholstery Stuffing Thickness		1-Cotton cloth Polyurethane sponge with coil spring 150 mm
Pillow	Upholstery Stuffing		Cotton cloth Synthetic material
Miscellaneous			1-Small refrigerator (Abt.100 L) 2-Safe (Captain only) 1-Computor table (1050x460x650mm)

4.5.1 FURNITURE APPLICATION FOR LIVING SPACE – CONT'D

SENIOR OFFICER CLASS ROOM (3 NOS.)

Bed	Overall size Drawers		1-2000x1200x470 mm 2 - drawers
Desk	Size Drawers		1-1550 x750x720 mm Both sides
Table	Size		1-1000x600 x450 mm
Wardrobe (built in)	Size Mirror		1-1200x600x1970 mm 1
Chest of drawer w/mirror	Size		1-800x600x720 mm
Book case	Size Type		1-1200x390x720 mm Cabinet of floor type
Sofa with Arm rest both sides	Upholstery		Fabric
	Stuffing	Seat / Back	Polyurethane sponge
	Size		1 - 3 seat type
Chairs	Type		1-Revolving arm chair, 2-Arm chairs, 1-Stool
	Upholstery		Fabric
	Stuffing	Seat / Back	Polyurethane sponge
Filling cabinet			1-(2-drawer)
Hat and coat hooks			5
Mattress	Upholstery Stuffing Thickness		1-Cotton cloth Polyurethane sponge with coil spring 150 mm
Pillow	Upholstery Stuffing		Cotton cloth Synthetic material
Miscellaneous			1-Keybox (Chief Officer only)

4.5.1 FURNITURE APPLICATION FOR LIVING SPACE – CONT'D

JUNIOR OFFICER CLASS ROOM (4 NOS.)

Bed	Overall size Drawer		1-2000 x800 x470 mm 2 drawers
Desk	Size Drawer		1-1000x600x720 mm One side
Table	Size		1-600mm dia x450 mm
Wardrobe	Size Mirror		1-800x600x1970 mm 1
Book rack	Size		1-600x250x330 mm
Settee	Size & number		1-2 seat type
	Upholstery		Fabric
	Stuffing	Seat / Back	Polyurethane sponge
Chair	Type & number		1-Arm chair
	Upholstery		Fabric
	Stuffing	Seat / Back	Polyurethane sponge
Hat and coat hook			2
Mattress	Upholstery Stuffing Thickness		Cotton cloth Polyurethane sponge with coil spring 150 mm
Pillow	Upholstery Stuffing		Cotton cloth Synthetic material

4.5.1 FURNITURE APPLICATION FOR LIVING SPACE – CONT'D

PETTY OFFICER CLASS (4 NOS.) AND CREW CLASS ROOMS (6 NOS.)

Bed	Overall size Drawers		1-2000 x800 x470 mm 2 drawer
Desk	Size Drawers		1-1000x600x720 mm One side
Wardrobe	Size		1-600x600x1970 mm
Book rack	Size		1-600x250x330 mm
Settee	Size		1-2 seat type
	Upholstery		Fabric
	Stuffing	Seat / Back	Polyurethane sponge
Chair	Type		1-Common chair
	Upholstery		Fabric
	Stuffing	Seat / Back	Polyurethane sponge
Hat and coat hook			2
Mattress	Upholstery Stuffing Thickness		Polyurethane sponge 150 mm
Pillow	Upholstery Stuffing		Cotton cloth Synthetic material

4.5.2 FURNITURE APPLICATION FOR PUBLIC AND OFFICE SPACE

OFFICER'S MESS / RECREATION ROOM (1 NO.)

Tables	Size		1-1200mm dia.x720 mm 1-1800x800x720 mm
	Material	Top plate Pedestals	Steel Steel fixed
Sofa	Type		1-5 seat type
	Upholstery		Fabric
	Stuffing	Seat / Back	Polyurethane sponge
Chairs	Type		12-Armchair
	Upholstery		Fabric
	Stuffing	Seat / Back	Polyurethane sponge
Hat and coat hook			10
Miscellaneous			1-Cupboard (1200x600x900mm)

4.5.2 FURNITURE APPLICATION FOR PUBLIC AND OFFICE SPACE

CREW'S MESS AND RECREATION ROOM (1 NO.)

Tables	Size		2-1800x800x720 mm
	Material	Top plate Pedestals	Wood Steel fixed
Settee	Type		1-5 seat type
	Upholstery		Vinyl leather
	Stuffing	Seat / Back	Polyurethane sponge
Chairs	Type		12-Common chair
	Upholstery		Fabric
	Stuffing	Seat / Back	Polyurethane sponge
Hat and coat hook			10
Miscellaneous			1-Cupboard (1200x600x900 mm) 1-Sideboard (2400x600x720 mm) combined with game locker, book case and audio/video locker.

DUTY MESS ROOM (1 NO.)

Tables	Size		2-1200x800x720 mm
	Material	Top plate Pedestals	Wood Steel fixed
Chairs	Size		4-Common chair
	Upholstery		Fabric
	Stuffing	Seat / Back	Polyurethane sponge

ENGINE CONTROL ROOM

Desk	Size		1-1000x600x720 mm
Chairs	Type		2-Revolution arm chair
	Upholstery		Vinyl covering
	Stuffing	Seat / Back	Polyurethane sponge
Filling cabinets			2-(2-drawer)
Miscellaneous			1-White board 1-Notice board 1-Book rack

4.5.2 FURNITURE APPLICATION FOR PUBLIC AND OFFICE SPACE – CONT'D

CARGO CONTROL ROOM / SHIP'S OFFICE (1 NO.)

Desk	Size			1-1550X750X720 mm
Chairs	Type			1-Revolution arm chair 2-Common chair
	Upholstery		Vinyl covering	Do.
	Stuffing	Seat / Back	Polyurethane sponge	Do.
Book case	Size		-	1-1200x390x720 mm
Filling cabinet				1-(3-drawer)
Miscellaneous				1-Computor table 1-C.R.T table 1-Hat and coat hook 1-Key box 1-White board 1-Notice board 1-Drawing locker for finished plans (1500x390x1970 mm)

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Beds			2-2068x968x950 mm (Steel)
Wardrobe			1-450x500x1790 mm (Steel)
Chair	Type		1-Common chair
	Upholstery		Vinyl covering
	Stuffing	Seat / Back	Polyurethane sponge
Hat and coat hooks			4
Miscellaneous			1-Bedside locker (half height) 1-Medicine locker located outside hospital

COMMUNITY ROOM

Table	Size		1-1200mm dia.x720 mm
Chairs	Type		4-Arm chair
	Upholstery		Fabric
	Stuffing	Seat / Back	Polyurethane sponge
Cupboard	Size		1-1200x600x900 mm

4.5.3 FURNITURE APPLICATION FOR NAVIGATION AND CONTROL SPACE

WHEELHOUSE AND CHART SPACE (1 NO.)

Tables	Size	1-Chart table with chart locker 1-Folding table 1-Radio table
Chairs	Type	1-Pilot chair with arm 1-Revolving arm chair 2-Stools
Book Cases	Size	2-1200x390x720 mm
Miscellaneous		1-Flag locker 1-Binocular box 1-Notice board 1-White board 1-Flag pigeon box 3-Hat and coat hooks 1-Sofa (3 seat)

RADIO EQUIPMENT SPACE (1 NO.)

Table	Size	1-Working table (1000x600x720 mm)
Chair	Type	1-Revolving arm chair
Book Case	Size	1-1200x390x720 mm
Filling Cabinet		1-(2-drawer)
Miscellaneous		1-Sideboard (900x600x900 mm) Regarding the wireless equipments, refer to “ELECTRIC PART”

4.5.4 CURTAINS

Curtains shall be of fabrics or printed cloth with white lining and shall be provided as follows:

Window curtains	:	Window or side scuttle except in wheelhouses, chart space, galley and engine control room.
Black partition curtain	:	Between the wheelhouse and chart space and radio space
Vinyl curtains	:	All shower spaces
Door curtain	:	Door between dayroom and bedroom of captain class.

4.6 FURNISHINGS AND FITTINGS OF SANITARY SPACES

Furnishings and fittings shall be provided according to the table of section 4.6.9.

All exposed metal fixtures, type, valves, accessories and trim shall be of chromium coated brass.

Rubber washers shall be fitted between all china plumbing fixtures and metal supports.

One lamp shall be provided for toilet cabinet or mirror and illumination of the toilet space.

4.6.1 WASH BASINS

Material	:	White vitreous china
With	:	Hot and cold water with mixer, rubber stopper and keep chain. Liquid soap container, mirror, tray and coat hook at each washing position. plash plate for public toilet

4.6.2 WATER CLOSETS

Type	:	Gravity type
Material	:	White vitreous china (European type)
With	:	Hard plastic seat and lid, stainless steel storm rail and toilet paper holder.

4.6.3 SHOWERS

Shower cubicles be composed of fixed type swivel shower head with hot/cold mixing valve, curtain, stainless steel storm rail and stainless steel soap tray.

4.6.4 TOILET CABINETS

Material	:	Moulded plastic
With	:	Shelf inside and mirror on the hinged door

4.6.5 TOILET RACKS

Type	:	Wall mounted
Material	:	Plastic and chromium coated brass.
With	:	Glass plate.

4.6.6 MIRRORS

Type	:	Frameless mirror

4.6 FURNISHINGS AND FITTINGS OF SANITARY SPACE – CONT'D

4.6.7 BATHTUB (FOR HOSPITAL)

Type : European style.
Material : Fiberglass reinforced plastic.
Hot and cold water faucet with thermostatic mixing valve, telephone type hand shower.

4.6.8 GALLEY SINKS

Type : Deep type securely attached to work bench
Material : Stainless steel
With : Rubber stopper and keep chain
Quantity : Two (2) Nos.

4.6.9 FURNISHINGS OF TOILETS

Item / Space	Private Toilet (13 Nos.)	Hospital Bathroom (1 No.)	W'house and Poop Dk Toilet (2 Nos.)	Changing Rooms (2 Nos.)
Bathtub	-	1	-	-
Shower	1	1(hand)	-	-
Wash basin	1	1	1	1
Toilet rack	1	1	1	1
Mirror	1	1	1	1
Water closet	1	1	1	-
Toilet cabinet with mirror	1	-	-	-
Paper holder	1	1	1	-
Soap dish	1	1	1	1
Liquid soap dispenser	1	1	1	1
Towel rail	1	1	1	1
Hand grip	1	1	1	-
Coat hook	2	1	2	4
Wooden bench	-	-	-	1

4.6 FURNISHINGS AND FITTINGS OF SANITARY SPACE – CONT'D

4.6.10 FURNISHINGS OF LAUNDRIES

Both Officer's and Crew's Laundries shall be furnished as follows : -

Item	Quantity	Remark
Washing machine	1	9.5 kg capacity, marine type.
Tumbler drier	1	5 kg capacity.
Washing tub	1	Stainless steel.
Iron board	1	Folding type
Elect. Hand iron	1	Domestic type
Shelf	1	For soap and detergent

4.7 FURNISHINGS OF CATERING, PROVISIONS AND SUNDRY SPACE

4.7.1 CATERING SPACES

In general, the metal part directly in contact with prepared food shall be of stainless steel and remainder of steel painted.

Shelfs and racks of stainless steel shall be provided as suitable.

4.7.1.1 GALLEY

1 - Elect. cooking range with 4-hot plate and 1-oven with canopy over and exhaust fan arranged.
1 - Microwave oven (Capacity : 34 litres).
1 - Juice blender (Capacity : 1 litre).
1 - Small water filter (domestic type).
1 - Elect. Waste disposal (under counter type).
1 - Elect. refrigerator (abt. 300 L each).
1 - Hot water boiler.
1 - Dresser with two deep, stainless steel sink with hot/cold water supply, shelves, lockers under and plate and cup racks above.
1 - Galvanized steel working table with stainless steel top and necessary drawers under.
1 - Chopping table.
1 - Washbasin (White Vitreous China).
1 - Waste bin.

Note : The capacity of above equipment shall be based on the number of ship's personnel.
Shelves, racks, hooks, lockers, etc. as necessary to suit the room.

Serving hatches shall be arranged for access to each mess together with fire shutters as per Rules.

4.7 FURNISHINGS OF CATERING, PROVISIONS AND SUNDRY SPACE – CONT'D

4.7.1.2 PANTRY

2 – Electric rice cookers (2.7 litre)
2 – Electric toasters.
1 – Electric water boiler (9 litre)
1 – Rack and Shelf
1 – Set Cup hooks (wall mounted)

4.7.1.3 ENGINE CONTROL ROOM (ECR)

1 – Refrigerator (100 litre)

4.7.2 PROVISIONS SPACES

4.7.2.1 DRY PROVISIONS STORE AND BONDED STORE

Two(2) tier fixed type shelves of galvanized steel shall be provided.

A grating of soft wood shall be fitted on the floor under shelf.

All shelves and gratings shall be painted white in colour.

4.7.3 SUNDRY SPACES

The stowage space in following table shall be arranged as shown on the Accommodation layout plan.

The shelves shall be of galvanized steel.

The grating of soft wood shall be fitted on the floor under shelf.

Each space shall be furnished as follows :

Compartment	Shelf (Tier)	Remarks
Linen locker	1 No. of 2-tier type	-
Other lockers in accommodation	1 No. of 2-tier type	-

4.8 REFRIGERATED PROVISIONS CHAMBERS

The refrigerating chambers shall be divided into the following compartments ; -

Compartment	Approx. Volume (#)	Temperature
Freezer Room (Meat and Fish)	14 m3	-18 Degree C
Chiller Room (Vegetable)	10 m3	+ 4 Degree C
Preparation Lobby	40 m3	Uncooled
	Total : abt. 64 m3	

Volume shall be inside gross volume.

A refrigerating plant shall be designed to maintain the above temperature at cooling water temperature of 37 Deg. C and at the outside temperature of 55 Deg. C.

The dial thermometer for each chamber shall be provided.

Alarm and light shall be specified in section.

One refrigerating unit shall have capacity enough to maintain the specified temperature within 12 hours running per day after cooling down while the other unit shall serve as stand-by.

4.8.1 REFRIGERATING SYSTEM

The cooling system shall be of R-404 direct expansion and air circulating system with automatic control device and be able to keep the temperature of the refrigerating chamber as specified in this Specification.

Valve panel shall be located in the adjacent part of each cooler as per the Maker's standard.

The electrical defrost system with timer shall be provided for the meat and fish room.

The material and design shall be as per the Maker's standard unless otherwise specified.

Cooling down test for refrigerated provision chamber shall be carried out after the completion in accordance with Builder's practice.

4.8.1.1 UNIT AIR COOLERS

No. : One (1) in each compartment.
Type : Wall or ceiling suspension type consisting of copper cooling coil with aluminium fins and one (1) electric motor actuated propeller fan, drip pan and casing.

4.8.1 REFRIGERATING SYSTEM – CONT'D

4.8.1.2 COMPRESSORS

No. : Two (2).
Type : Multi-cylinder single acting type driven by an electric motor via vee belt or directly.

4.8.1.3 COOLING PUMP

No. : One (1).
Type : Centrifugal, horizontal type.
Material to be as per Section 7.8.3.

4.8.1.4 CONDENSERS

No. : Two (2).
Type : Horizontal straight shell and tube type.

4.8.1.5 MISCELLANEOUS

One (1) gas dryer.
Automatic temperature control device.
One (1) ozone generator in chiller room.

4.8.2 PIPING SYSTEM

Cooling water shall be supplied by one reefer cooling water pump in the engine room or from the sea water general service in emergency case.

4.8.3 INSULATION

4.8.3.1 CEILING, LINING AND FLOOR

Location	Construction
Overhead and side wall	0.7 mm galvanized steel sheet + 125 mm foamed polyurethane + 0.7 mm SUS sheet
Division wall between compartments	0.7 mm SUS sheet + 100 mm foamed polyurethane + 0.7 mm SUS sheet
Floor	100 mm foamed polyurethane + 18 mm plywood + 40 mm thick cement mortar + ceramic tiles

4.8.3 INSULATION – CONT'D

4.8.3.2 DOORS

Type	:	Air tight hinged pontoon
Material	:	Stainless steel filled with foamed polyurethane
Clear breadth	:	700 mm
Clear height	:	About 1700 mm
Accessories	:	1 set – rubber packing
	:	1 - Door fastener with handle which can be unlocked from inside of the chamber by pushing a push rod. 1 - Hand grip inside of the chamber. 1 - Hook and eye for keeping door at open position.
Door frame	:	Stainless steel filled with foamed polyurethane.

Electric heating cable shall be provided for door frame of meat and fish room.

4.8.3.3 MISCELLANEOUS

Galvanized steel meat rail and stainless steel hook shall be fitted in the meat room.

Galvanized steel shelf shall be provided in each chamber except lobby.

The grating of soft wood shall be fitted on the floor under shelf.

One (1) chopping table shall be provided for preparation lobby.

4.9 VENTILATION AND AIR CONDITIONING SYSTEM

4.9.1 GENERAL

The living quarters shall be ventilated and air conditioned as follows :

A) The following spaces shall be air conditioned : -

- Living space
- Public space
- Office space

B) Catering space, wheelhouse, chart and radio space, bonded store and dry provisions store shall be conditioned by spot cooling without consideration of the heat gain from the space.

Air in air conditioned spaces (except hospital) shall be exhausted into the passage through the door louvres and into the appropriate private sanitary space, if applicable, through the door gap.

The engine control room shall be air conditioned by the package type unit cooler.

4.9 VENTILATION AND AIR CONDITIONING SYSTEM – CONT'D

4.9.1.1 VENTILATION AND AIR CHANGE RATE

The air conditioning and mechanical ventilation system shall be designed to have the following minimum rate of air change (times/hour) based on the volume of each compartment.

Compartment	Air Conditioning	Mechanical	
		Supply	Exhaust
Living Space	6	-	-
Public Space	8	-	-
Office Space	8	-	-
Wheelhouse, Chart and Radio Space	8	-	-
Radio Equipment Room	10	-	-
Private Toilet	-	-	10
Public Toilet, Laundry and Drying Room	-	-	15
Changing Room	-	-	10
Galley	10	20	40
Dry Provisions Store	10	-	-
Stores, Linen Locker	-	-	5

4.9.1.2 AIR CONDITIONING SYSTEM

The material and design shall be as per the maker's standard unless otherwise specified.

The air conditioning system shall be of low pressure and single duct system.

The air conditioning system shall be with central heating and cooling unit.

The plant shall be designed to cool or heat the supply air and to maintain the following condition when the doors, window and side scuttles are closed.

The capacity of the air conditioning plant shall be decided on the condition that about 30% of fan intake to be taken from outside.

This ratio may be changed if so required to meet the fresh air rate requirement of the Regulatory Body of ship's registry.

The plant shall be dimensioned to meet following conditions :

	Dry bulb temp.	Relative humidity
In summer :		
Outside air	35 Degree C	70%
Inside air	27 Degree C	50%
Sea water temperature	32 Degree C	

4.9 VENTILATION AND AIR CONDITIONING SYSTEM – CONT'D

4.9.1.2 AIR CONDITIONING SYSTEM – CONT'D

In winter :

Outside air	-20 Degree C	
Inside air	22 Degree C	50%

The engine control room shall be air conditioned with its own system using a split unit.

4.9.1.3 TESTS AND TRIALS

The central unit shall be tested at the maker's shop in accordance with the maker's usual practice with Owner's attendance.

After the completion of the air conditioning system, the following tests shall be performed in accordance with Builder's practice.

1. Air volume test
2. Cooling or heating test
3. Noise level test in each cabin
4. Air flow rate in each cabin
5. Air temperature and humidity in each cabin after system has run for 8 hours at least.

The air conditioning test shall be carried out as applicable in connection with testing season. When the cooling is not applicable, only the running test shall be performed.

Above test result shall be submitted to the Owner for review and reference upon completion of each test.

4.9.1.4 AIR CONDITIONING PLANT

The air conditioning plant shall consist of two (2) central air conditioning units each of 75% capacity installed in the air conditioning unit room.

The material and design shall be as per the Maker's standard unless otherwise specified.

4.9.1.5 AIR HANDLING UNITS (2 NOS.)

Each unit shall consist of the following : -

One (1) Fresh air-recirculation air mixing damper (manual).

One (1) Removable air filter.

One (1) R-404 direct expansion coil.

One (1) Ventilating fan of single speed electric motor driven centrifugal type.

4.9 VENTILATION AND AIR CONDITIONING SYSTEM – CONT'D

4.9.1.6 REFRIGERATING CONDENSING UNITS (2 NOS.)

Two (2) R-404 compressors driven by an electric motor directly or via vee belt.

Two (2) Condensers of horizontal straight shell and tube type.

Two (2) Gas dryers.

One (1) Sea water cooling pump shall be provided for the condenser. Material shall be as per Section 7.

4.9.1.7 PIPING SYSTEM

Cooling water shall be supplied by one refrigerator cooling water pump in the engine room or from sea water general service system in emergency case

4.9.1.8 DUCTING SYSTEM

Fresh air for the central unit shall be drawn through the air supply head and shall be led to the central unit.

Recirculation air for the central unit shall be drawn through the grille provided on the wall or ceiling of the corridor space and be led to the central unit.

Air conditioning supply ducts shall be pre-insulated spiral duct made of galvanized steel sheet for branch line and box type for main duct.

Controllable diffuser shall be fitted at the outlet of the air conditioning supply duct in air conditioned space and punkah louvre in other space.

Trunk and duct exposed to weather deck shall be 6 mm thickness and shall be weathertight.

4.9.1.9 TEMPERATURE CONTROL SYSTEM

(1) The refrigerant gas for air cooling to be controlled to maintain a reasonable constant temperature of discharge side by means of unloading mechanism of the refrigerating compressor.
(2) When the ambient temperature becomes lower than condition (1) the compressor shall be stopped automatically and restarted automatically when the temperature is higher than condition (1), by the electro-magnetic valve and thermostat, having thermobulb located in return air duct.

4.9.2 MECHANICAL VENTILATION

4.9.2.1 FANS

The electric motor driven centrifugal or axial ventilation fans shall be provided as follows:-

4.9.2 MECHANICAL VENTILATION – CONT'D

4.9.2.1 FANS – CONT'D

System	No. of fans
Galley and pantry exhaust system	1
Galley supply system	1
Sanitary and sundry space exhaust system (as stated) in section 4 ventilation air exchange rate).	1 (Each)
CO_2 room exhaust system	1

4.9.2.2 VENTILATION DUCT SYSTEM

Mechanically ventilated spaces which is not specified above shall be incorporated into the system which is preferable on duct arrangement.

Mechanical ventilation ducts shall be single spiral or rectangular duct made of galvanized steel sheet having same thickness as the air conditioning supply duct, but shall not be insulated.

Supply and suction side of the mechanical ventilation duct shall have duct opening with screen.

CO_2 bottle room exhaust fan suction shall extend down the room up to the deck level.

Ventilating hood of stainless steel with easy removable and washable stainless steel grease filter shall be provided over the cooking range in the galley.

Outlet terminal of exhaust fan from the sanitary space and galley shall be arranged away from air intake as far as practicable.

4.9.3 NATURAL VENTILATION

Spaces which are not air conditioned or mechanically ventilated, shall be provided with natural ventilators such as mushroom ventilator, wall ventilator or door louvre, where necessary.

Ventilating louvre may be provided on the door leading to the passage from the living space (except hospital), public spaces and office space.

Coaming height of ventilator shall be as rule requirement for the main deck and poop deck and shall be as the Builder's practice for the other decks.

Stainless steel insect screen with the stainless steel wire mesh guard screen shall be provided at weather opening of the supply and exhaust ventilation ducts.

Natural exhaust ventilation for hospital shall be provided.

5 - HULL PIPING

5.1 GENERAL

The general requirements for the piping systems contained herein are particularly applicable to the piping systems outside the engine room, unless otherwise especially stated. For the detailed and/or the specific requirements of a particular system, refer to that section which describes the system and to the applicable Rules and Regulations.

The materials and dimensions of pipes, joints, valves including bolts, nuts, etc. shall be manufactured in accordance with the class requirments and/or the Builder's Standard except otherwise specified hereinafter.

Whatever the standards other than above referred are specified, the Builder may apply the equivalent of above standards subject to the Owner's approval.

Piping shall be arranged in a neat, orderly manner and should not obstruct or interfere with the operation of doors, hatches or scuttles. Piping shall permit free passage in walking areas and performance of work in designated working areas.

The operation and control of machinery shall not be impeded, and the interference of piping with maintenance of equipment and ship structure shall be minimised. Wherever practicable, piping shall be kept clear of removal panels provided in the ship's structure for installation and removal of machinery or equipment. The access to a compartment or tank shall not be limited by the piping.

Piping shall be removable in way of machinery and equipments that require dismantling for periodic overhaul, and wherever necessary for access to other piping systems or electrical systems. Cutout valves shall be sensibly located to isolate sections of piping intended for removal during maintenance and overhaul of machinery and equipment, so that interference with continued operation of the remainder of the system is minimised.

Expansion bends or offsets in piping, without causing undesirable pockets, shall be provided to accommodate the pipe movements due to hull deflections. Alternatively in some cases approved expansion joints may be used.

The amount of piping led through the crew cabins shall be minimised. Piping in this space shall be symmetrically and neatly arranged and installed in the most inconspicuous location practicable, consistent with efficent operation and maintenance of the Piping System.

Where pipes are carried through watertight or oiltight bulkheads or decks, the watertight integrity of the structure shall be maintained.

Suitable sleeves/bulkhead pieces shall be fitted in way of pipes passing through the bulkheads.

Pressure gauges, thermometers, level gauges and other instruments shall be located so that they are visible from equipment operating areas.

5.1 GENERAL - CONT'D

Every effort shall be made to locate valve handwheels such that they can be conveniently operated and where this is not possible, extended spindles shall be fitted.

Manifolds may be used wherever globe or angle valves are satisfactory, provided their use results in a simplified piping arrangement or affords an advantageous operational feature. In so far as practicable, manifolds shall be installed with their body just above the floor plates.

Inlet piping to safety and relief valves shall be short and direct. Where relief is to the atmosphere, open ends of discharge piping shall be such as not to damage machinery, equipment or endanger personnel.

The piping shall be adequately supported by hangers or guides so that the weight of the piping is not excessively transmitted to valves and fittings. Pipe supports shall be designed and arranged so as not to restrain thermal expansion of the piping (e.g. exhaust) and to ensure that excessive loads are not imposed on connected equipment.

Piping shall be supported with sufficient space between tank top, deck etc to allow painting and maintenance.

Supports shall be installed for heavy valves and fittings to prevent their weight from overloading the attached piping or causing vibration problems. The number of supports installed, the type selected and their location shall prevent excessive vibration of piping under all operating conditions; but they shall not restrain the piping to such an extent as to cause excessive transfer of load from support to piping, or from piping to machinery, equipment or ship structure.

All the pump suctions and outlet lines shall be installed with pressure gauges, air vent line and gate valves, if required by the Classification Society on the pump side.

Crank case breather pipes shall have save all.

5.2 PIPING MATERIALS AND WORK

5.2.1 PIPING

The materials and wall thickness of pipes shall be in accordance with section 5.3 "MATERIAL SPECIFICATION FOR PIPING" and to meet the requirements of the Classification Society.

The specification of pipes forming a part of machinery or equipment supplied by the maker in package shall be of the maker's standard.

Pipe bore shall be decided so as to accommodate given flow quantity and corresponding pumping pressure.

5.2 PIPING MATERIALS AND WORK – CONT'D

5.2.1 PIPING – CONT'D

As far as practicable, the pipe lines shall be led directly with a minimum number of bend and the arrangements to avoid wells or sumps where drainage water is likely to stay.

Suitable draining arrangement of minimum 15 mm dia. valve or drain plug shall be provided at well part of small bore domestic pipes where those may be stuffed, and the surface treatment of drain pipes shall be same as that of connected pipe.

Liquid pipelines shall be kept away from the switchboard and the electrical appliances. Where the piping is unavoidably led above the electrical appliances, the welded joint shall be provided.

No liquid pipe shall pass through the ECR.

Where the piping penetrates girders or any structural element, the compensation, if necessary, shall be provided in accordance with the requirements of the Classification Society and the Builder's standard.

The arrangement of piping shall be designed in consideration of convenience in painting hull, cargo handling etc as far as practicable. Piping shall be of sufficient height above decks, floors etc for ease of painting and maintenance.

Piping shall be designed to release the excessive stress due to thermal expansion/contraction and deflection of the ship's structure.

5.2.2 VALVES

In general, the valve size shall be of the same nominal bore as that of the pipes connected except automatic control valves.

In general, globe valves shall be fitted for small bore pipes and butterfly valves for large bore pipes of 100 mm and above.

Butterfly valves shall be of flangeless type and shall have neoprene rubber seat except otherwise specified.

Use of gate valves shall be limited where required by the Classification Society.

Gate valves shall be of non-rising stem type and shall have solid wedge disc.

Cast steel or ductile cast iron valves shall be fitted to such locations as required by the Classification Society.

Installation of the ship side valves shall be in accordance with the Classification Society's Requirements and shall be fitted rigidly to the shell with short stub piece of heavy wall as far as practicable.

5.2 PIPING MATERIALS AND WORK – CONT'D

5.2.3 IDENTIFICATION SYSTEMS

An identification plate shall be fitted to each valve handwheel to indicate its purpose of operation. All pumps, air pipes, sounding pipes, filling pipes, filters, etc., shall be similarly identified. Where important pipe system components are fitted below portable panel in floor plates, engraved plates shall be fitted to the portable plates indicating the concealed components.

All visible sections of pipework shall be colour coded in accordance with an acceptable system.

N.B: All identification and markings shall be in the English Language.

5.2.4 PIPE JOINTINGS

Unless otherwise specified, the welding joints of outside sleeve type, butt welding and flange connections generally shall be applied to the pipe connections with valves, fittings, machinery and where necessary for the work according to the Builder's Practice.

The material of pipe connections shall be of same material or similar to that of pipe, unless otherwise specified.

In general, the flanges shall be of steel slip-on welding type for steel pipings and the slip-on brass brazing type for non-ferrous pipings of small diameter.

Where the flange joint of large size stainless steel or non-ferrous pipes shall be applied, the inner ring of composite flange shall be of the same material as the pipes connected and the outer flanges shall be of hot dip galvanized mild steel.

All flanges shall be finished with plain contact surface.

Steel pipe flange for liquid handling shall have seal weld at the pipe inside, but protection pipes for electric cable to have weld outside only.

Flange ratings shall be as follows :

- Applicable range : -

JIS 5K ..... Thermal Oil, Water and Oil working pressure up to 6Kg/cm2.
JIS 10K ..... Thermal Oil, Water and Oil working pressure up to 12 Kg/cm2.
JIS 16K ..... Thermal Oil, Water and Oil working pressure up to 25Kg/cm2.
JIS 30K ..... Water and Oil working pressure up to 45Kg/cm2.

Preformed welding sockets shall be used for high pressure steel pipe such as hydraulic oil lines, etc.

Butt welded joints shall be applied for elbow, reducer, tee and others except otherwise specified.

5.2 PIPING MATERIALS AND WORK – CONT'D

5.2.4 PIPE JOINTINGS – CONT'D

Bite type unions or welded type unions may be used for small bore steel pipes.

Bite type union or brazing type socket joints shall be applied for small bore pipes of non-ferrous pipes.

Sliding type coupling joints shall be generally used for tank cleaning, fire main, fuel oil transfer, cable protection lines, etc., where necessary, to compensate the pipes from expansion and contraction.

Packing for sliding type coupling joints shall be of neoprene rubber in general.

Sleeve type coupling joints with gland packing shall be applied to the high temperature pipe lines such as steam and the system required by the Classification Society.

Offset expansion bends (loop) may be applied to the compressed air line, high pressure hydraulic oil lines and wherever practicable.

In cargo oil main lines and stripping line on deck and in tanks shall be fitted with expansion bends.

5.2.5 BULKHEAD AND DECK PENETRATIONS

Where the piping passes through the watertight or oil tight bulkheads and decks, the bulkhead or deck shall be sufficiently compensated, where necessary, in accordance with the requirements of the Classification Society, and the connection shall be made tight by means of spool piece, direct welding or sleeve reinforced pipe piece according to the Builder's practice.

The connections through the insulated bulkheads shall be of sufficient length to permit access to the flange connections without disturbing the insulations.

For the copper and copper alloy pipes, steel made deck penetrating pieces shall be fitted directly to the bulkhead and/or deck by welding through which those pipes run with proper tightening means.

No ballast, bilge or water line shall in any condition pass through cargo oil tanks or fuel oil and lub. oil tank in engine room.

5.2.6 BRANCHES, BENDS AND OTHER FITTINGS ETC.

Branch pipes for the low pressure piping up to 50 Kg/cm2 shall be welded to the main pipe.

Elbow pieces and reducers shall be of fabricated steel made by electric arc welding.

5.2 PIPING MATERIALS AND WORK – CONT'D

5.2.6 BRANCHES, BENDS AND OTHER FITTINGS ETC. – CONT'D

Fittings forming a part of pipe shall be of the equivalent material as adjoining pipes in general.

As a standard for steel and non-ferrous pipes, the pipe bending shall be carried out by means of cold bending machine with bending radius of approximately 3 times the outside pipe diameter, to maximum practicable extent according to shipyard facilities and design convenience.

Hot bending process may be limitedly adopted in special case, if unavoidable, such as adjustment of pipe alignment, etc.

In following cases, standard elbow pieces shall be used.

a) When the capacity of existing bending machinery is not enough to form the bend.
b) When small bending radius is necessary to facilitate the piping arrangement.

Generally the fittings shall be fitted by butt welding.

Loose Fittings

(Filters, Strainers, Traps, Rose Box, Mud Box, Rose Plates, Plugs, Nozzles, Orifice, Expansion Couplings, Separators, Air Pipe Heads, etc.).

The loose fittings shall be selected by pipe size, line pressure and pipe line material according to class requirements.

5.2.7 SUCTION BELLMOUTH

Inverted hopper shape suction bellmouth fabricated of mild steel shall be used in general.

The clearance between suction bellmouth and tank bottom shall be as follows in general : -

Nominal Dia.	Clearance (mm)		Nominal dia.	Clearance (mm)	
	Round	Elliptical		Round	Elliptical
50	20	-	200	35	45
65	20	-	250	-	55
80	20	-	300	-	65
100	20	-	350	-	65
125	25	-	400	-	75
150	25	40	450	-	85

5.2 PIPING MATERIALS AND WORK – CONT'D

5.2.8 REACH RODS

The valve operating reach rods shall be of stainless steel (316L) in the tanks and solid steel round bar for outside the tanks.

The reach rod shall be provided with a deck stand, a stuffing box on weather deck penetration, a fork/yoke piece, level gear and universal joint, where necessary.

5.2.9 GASKET AND PACKING

Asbestos free sheet gasket packing of anti-sticking surface shall be applied in general.

The thickness of gasket packing shall be of 1.5mm for 300mm in nominal diameter and below, and 3.0mm for 300mm and above.

The material of packing for the valve stem shall be of valve maker's standard.

5.2.10 PIPE SUPPORTS

The piping shall be properly supported and braced as per the Builder's Practice to avoid damage, vibrations and movement due to thermal and/or ship's deflection.

Support for non-ferrous pipe shall be inserted with similar non-ferrous sheet metals and/or similar non-ferrous metal hanger so that steel shall not be in direct contact with the pipes.

Fixing supports shall be provided for preventing floated pipe from excessive free movement, where required.

For clamping, 'U' shape steel round bar bolt clips shall be used for steel pipes and flat bar band clips for non-ferrous pipes. In exposed areas 'U' clamps shall be of stainless steel material with stainless steel nuts.

U-bolts shall be secured to the supports by means of double nuts (each one on both sides of the support) for pipes of 100mm in nominal diameter and above and single nut with spring washers for 80mm and below.. All hydraulic pipes and heating coils shall be secured by means of double nuts.

Pipe supports for main lines in longitudinal direction with nominal diameter of 125 mm and above on upper deck except electric cable protection pipe shall be fitted with phenolic resin sliding pad to allow free sliding pipe movement.

Pipe supports for main lines on main deck shall be of fabricated steel 'H' beams and arranged at a height of 1,500 above main deck.

5.2 PIPING MATERIALS AND WORK – CONT'D

5.2.11 PIPE PROTECTION

The piping works shall be protected from mechanical damage, where necessary, and the protection shall be constructed with steel angles, plates or channels as per Builder's Practice.

5.2.12 SURFACE TREATMENT AND CLEANING

The surface treatment and coating of the machinery, loose fittings and valves shall be carried out in accordance with maker's standard for the intended purpose, and no special surface treatment shall be made exceeding the maker's standard unless otherwise specified.

The pipe fittings whose function is to join branches of the system (such as tees, Y-pieces, elbows, flanges, unions, sleeve joints, etc.) shall be painted same as connected pieces.

The loose fittings other than the above pipe fittings supplied by makers (such as expansion coupling, filters, strainers, traps, separator, rose boxes, nozzles, plug, orifice, etc.) shall be painted in accordance with the maker's standard unless otherwise specified.

For galvanized pipe in such case that welding after galvanizing is unavoidable as undermentioned, the external of the damaged parts shall be touched up with one (1) coat of zinc primer, and internal parts shall be touched up with the same paint as far as practicable.

a) Welded sleeve joints fabricated on-board.
b) Flanges of pipes adjusted on-board.
c) One of flanges of bulkhead/deck penetrating piece.
d) Anchoring pieces welded on galvanized pipes after adjusting on-board.
e) Butt weld joint adjusted on-board.

The lubricating oil and hydraulic oil pipes shall be pickled before installation. After installation on-board, the pipes shall be flushed and cleaned prior to being connected to the machinery.

Where the acid pickling is necessary for pipes, the acid pickling shall be done and inside shall be treated with oil or to prevent rust before installation on-board.

5.2.13 INSPECTIONS AND TESTS

All the tests and inspections of pipe lines shall be carried out in accordance with the requirements specified in the specification and/or the Rules and Regulations and the Builder's standard.

VISUAL TEST

The dimensions, scantlings, locations, surfaces finishing, welding, fastenings, joints, etc. shall be visually inspected where necessary.

5.2 PIPING MATERIALS AND WORK – CONT'D

5.2.13 INSPECTIONS AND TESTS – CONT'D

LEAKAGE TEST (FLOW TEST)

The pipes which shall be occasionally filled up by gravity or pipes through which liquid flow without pressure during the actual service shall be tested by free flow of water to confirm tightness of the pipe lines.

PRESSURE TEST

The statical hydraulic pressure test shall be carried out in accordance with the requirements of the Classification Society and Regulatory Bodies where applicable.

During the pressure test, a blank flange shall be provided at the open ends with the valves and/or any other means of closing on the piping fully open.

INTERNAL INSPECTION

Welded joints and fitments shall be internally inspected, wherever possible.

5.3 MATERIAL SPECIFICATION FOR PIPING

The following material specification shall be intended as a guide in the preparation of hull piping schedules for the vessel. However, it should meet with class requirements.

5.3.1 ABBREVIATIONS IN THE TABLE

JIS	:	Japanese Industrial Standard.
(STPG 38) (STPG 370)	:	Carbon steel pipes for pressure service. Min. tensile strength 38 kg/mm2 (370 N/mm 2), (JIS G3454).
STS 38 (STS 370)	:	Carbon steel pipes for high pressure service, seamless. Min. tensile strength 38 kg/mm2 (370 N/mm 2), (JIS G3455).
STPT 38 (STPT 370)	:	Carbon steel pipe for high temperature service, Min. tensile strength 38 kg/mm2 (370 N/mm2) (JIS G3456).
STPY 41 (STPY 400)	:	Arc welded carbon steel pipes. Min. tensile strength 41 kg/mm2 (400 N/mm2) (JIS G3457).

5.2 PIPING MATERIALS AND WORK – CONT'D

5.3.1 ABBREVIATIONS IN THE TABLE – CONT'D

ERW S 38	:	Electric resistance welded special carbon steel pipes equivalent to STPG 38 (STPG 370) material, Min. tensile strength 38 kg/mm2 (370 N/mm2).
SPP	:	Carbon steel pipes for ordinary service SPP (comparable to JIS SGP) series in KS pipe thickness standard KS D3507).
SUS TP	:	Stainless steel pipe (JIS G3459).
SUS TPY	:	Arc welded large diameter stainless steel (JIS G3468).
SUS ERW	:	Electric arc welded special stainless steel equivalent to SUS TP material.
SMA	:	Hot rolled atmospheric corrosion resistant steel (JIS G3114).
SCH. 40	:	Schedule No. 40 series in JIS pipe thickness standard.
SCH. 80	:	Schedule No. 80 series in JIS pipe thickness standard.
Galv.	:	Galvanized.
Alum.	:	Aluminized.
ERW	:	Electric Resistance Welded.
SAW	:	Submerged Arc Welded.
SMLS	:	Seamless.
PVC	:	Polyvinyl chloride.

5.2 PIPING MATERIALS AND WORK – CONT'D

5.3.2 PIPE THICKNESS TABLE

1) **Steel Pipe**

			Pipe wall thickness (mm)								
Nom dia. (A)	Out dia. (mm)	Spp	7.99 mm	Sch. 40	9.5mm		Sch. 80	12.7mm	Sch. 160		16.0 mm
10	17.3	2.35		2.3	For		3.2	For	Sch 80 -		For
15	21.7	2.65		2.8	Sch.40		3.7			4.7	Sch
(20)	27.2	2.65		2.9			3.9			5.5	160
25	34.0	3.25		3.4			4.5			6.4	
(32)	42.7	3.25		3.6			4.9			6.4	
40	48.6	3.25		3.7			5.1			7.1	
50	60.5	3.65		3.9			5.5			8.7	
65	76.3	4.0		5.2			7.0			9.5	
80	89.1	4.05		5.5			7.6			11.1	
100	114.3	4.5		6.0			8.6			13.5	
125	139.8	4.85		6.6			9.5			15.9	
150	165.2	4.85		7.1			11.0				16.0
200	216.3	5.85		8.2			12.7				16.0
250	267.4	6.4		9.3				12.7			16.0
300	318.5	7.0			9.5			12.7			16.0
350	355.6	7.6			9.5			12.7			16.0
400	406.4	7.9			9.5			12.7			16.0
450	457.2	7.9			9.5			12.7			16.0
500	508.0	7.9			9.5			12.7			16.0
550	558.8	7.9			9.5			12.7			16.0
600	609.6	7.9			9.5			12.7			16.0
650	660.4		7.9			9.5			12.7		16.0
700	711.2		7.9			9.5			12.7		16.0
750	762.0		7.9			9.5			12.7		16.0
800	812.8		7.9			9.5			12.7		16.0
850	863.6		7.9			9.5			12.7		16.0
900	914.4		7.9			9.5			12.7		16.0
1000	1016.0		7.9			9.5			12.7		16.0
SPP		0									
STPG 38				0			0				
ERW S38					0			0			0
STPT38/STS 38										0	
STPY 41 (#)			0			0			0		0

Note (#) : shall be applied for Nom. dia. 650 A and above.

5.2 PIPING MATERIALS AND WORK – CONT'D

5.3.2 PIPE THICKNESS TABLE

2) Copper Pipe

Nom. dia. (A)	Out. dia. (mm)	Pipe wall thickness (mm)			
		10 K	40K	70K	140K
4	6	1.2	1.4	1.6	2.0
5	8	1.2	1.4	1.8	2.5
6	10	1.2	1.6	2.0	3.0
8	12	1.2	1.8	2.3	3.5
10	15	1.4	1.8	2.5	4.0
15	20	1.6	2.2	3.0	5.0
(20)	25	1.6	2.5	3.5	6.0
25	30	1.6	3.0	4.0	7.0
(32)	35	1.6	3.0	5.0	8.0
40	45	2.0	3.5	6.0	10.0
50	55	2.0	4.5	7.0	11.0
65	70	2.0	5.0	8.0	14.0
80	85	2.5	6.0	10.0	17.0
100	110	3.0	8.0	12.0	21.0
125	140	3.0	9.0	15.0	26.0
150	160	3.5	11.0	17.0	30.0

Material : JIS H3300

20A & below : C1220T - 0, C1220T - $^1/_2$H

25A & above : C1220T - $^1/_2$H

5.2 PIPING MATERIALS AND WORK – CONT'D

5.3.2 PIPE THICKNESS TABLE

3) Stainless Steel Pipe

Nom dia.(A)	Out dia. (mm)	Sch. 10S	Pipe wall thickness (mm)						
				Sch.		Sch. 40	9.5mm	Sch. 80	12.7 mm
6	10.5	1.2		1.5		1.7	FOR	2.4	FOR
8	13.8	1.65		2.0		2.2	SCH.	3.0	SCH.
10	17.3	1.65		2.0		2.3	40	3.2	80
15	21.7	2.1		2.5		2.8		3.7	
(20)	27.2	2.1		2.5		2.9		3.9	
25	34.0	2.8		3.0		3.4		4.5	
(32)	42.7	2.8		3.0		3.6		4.9	
40	48.6	2.8		3.0		3.7		5.1	
50	60.5	2.8		3.5		3.9		5.5	
65	76.3	3.0		3.5		5.2		7.0	
80	89.1	3.0		4.0		5.5		7.6	
100	114.3	3.0		4.0		6.0		8.6	
125	139.8	3.4		5.0		6.6		9.5	
150	165.2	3.4		5.0		7.1		11.0	12.7
200	216.3	4.0		6.5		8.2		-	12.7
250	267.4	4.0		6.5		9.3		-	12.7
300	318.5	4.5		6.5			9.5	-	12.7
350	355.6	-	5.0	-	8.0	-	9.5	-	12.7
400	406.4	-	5.0	-	8.0	-	9.5	-	12.7
450	457.2	-	5.0	-	8.0	-	9.5	-	
500	508.0	-	5.0	-	8.0	-	9.5	-	
M	SUSTP	0	-	0	-	0	-	0	-
A	SUSPTY	-	0	-	0		-	-	-
T	SUSERW	-	-	-	-		0	-	0
L									

5.2 PIPING MATERIALS AND WORK – CONT'D

5.3.3 APPLICATION OF PIPES & VALVES

System	Size	Pipe Material and thickness	Joint	Valve Type	Valve Body	Pressure rating of Flange (Kg/Cm^2G)
Cargo oil	250mm above	Stainless steel pipe (316L) As required	Expansion, flange	Ball, Butterfly	Stainless steel 316	10 : pump suction side
	200mm and below	Stainless steel pipe (316L) As required				
Ballast (in ballast tanks	250mm and above	GRP	As per Maker's standard	Butterfly	Nodular Cast iron	5
	250mm and below	GRP				
Bilge (under grating)	All	Carbon steel Sch.80 Galvanized	Flange, sleeve	Globe, screw down non-return	Cast iron	5
Bilge (other than above)	All	Carbon steel Sch.80 Galvanized				
Cargo vent and vapour return	250mm and above	Stainless steel pipe (316 L) As required	Flange, sleeve, sliding type coupling	Butterfly	Stainless steel 316	5
Tank cleaning	250mm and above	Carbon steel (JIS STPG 38) Sch. 80	Flange, sliding type coupling	Diaphragm type at branch connections	Bronze	10 : pump suction side
	200mm and below	Carbon steel (JIS STPG 38E) Sch. 80				
Fuel oil	All	Carbon steel Sch.40	Flange, sleeve, sliding type coupling	Butterfly Gate	Cast iron	5

5.2 PIPING MATERIALS AND WORK – CONT'D

5.3.3 APPLICATION OF PIPES & VALVES – CONT'D

System	Size	Pipe Material and thickness	Joint	Valve Type	Valve Body	Pressure rating of Flange (Kg/ Cm^2G)
Air vent & sounding	All	Carbon steel THK to meet Rule requirement. Gal. except for oil tanks	Flange, sleeve	-	-	5
Foam system	All	Carbon steel (JIS STPG 38E) Sch.40 Galv.	Flange, Sliding type coupling	Gate		
CO_2 pipe from cylinder to discharge valves to nozzles	All	SMLS carbon steel Sch. 80	Flange, sleeve, union	Maker's standard		
CO_2 from discharge valves to nozzles	All	Carbon steel Sch. 40 Galvanized				
Fresh water	All	Copper	Sleeve, union flange	Globe	Bronze	5
Hot water (in accomm-odation)	All	Copper	Sleeve, union	Globe	Bronze	5
Fresh water system other than accommo dation and E/R space	50mm and above --------- 40mm and below	Carbon steel (JIS STPG 38E) Sch.40 Galv.	Flange, Sleeve	Globe	Cast iron _____ Bronze	5
Drainage system in accomm-odation	50mm and above --------- Below 50mm	Carbon steel Sch.40 THK Galvanized	Sleeve	-	-	Gravity

5.2 PIPING MATERIALS AND WORK – CONT'D

5.3.3 APPLICATION OF PIPES & VALVES – CONT'D

System	Size	Pipe Material and thickness	Joint	Valve Type	Valve Body	Pressure rating of Flange (Kg/ Cm^2G)
Soil system in accomm-odation	50mm and above -------- Below 50mm	Carbon steel Sch.40 THK Galvanized	Sleeve	-	-	Gravity
Weather deck scupper (outside engine room)	All	Carbon steel Sch. 40 THK; Galvanized	Butt welding	-	-	Gravity
Fire & wash deck	50mm and above --------- Below 50 mm	Carbon steel Sch. 80 Galvanized	Flange, (Sleeve in acc.) sliding type coupling	Gate, globe, hose conne-ctor	Cast _____ bronze	10
Steam supply & conden-sate on weather deck (cleaning machine)	50mm and above --------- 40mm and below	Carbon steel (JIS STPG 38E) Sch. 40 for return and Sch. 80 for supply	Flange steel	Globe	Cast steel --------- Bronze	10, 5
Heating coil in (H.F.O.T) sett/day tank)	All	SMLS carbon steel (JIS STPG 38S) Sch. 80		-	-	5
Compress ed air for gen. Service	50mm and above --------- Below 50mm	Carbon steel Sch. 40 Galvanized	Flange,	Globe	Cast steel ---------- Bronze	10
Control air	15mm and above	Carbon steel Sch.40 Galvanized	Flange, sleeve, union	-	-	10
	Other than above	Copper tube	Brazing socket union	Globe	Bronze	To suit service pressure

5.2 PIPING MATERIALS AND WORK – CONT'D

5.3.3 APPLICATION OF PIPES & VALVES – CONT'D

System	Size	Pipe Material and thickness	Joint	Valve Type Body	Pressure rating of Flange (Kg/ Cm^2G)
R-404 line	50mm and above --------- Below 50mm	Copper tube THK; to maker Recommendation	Sleeve Brazing ---------- Brazing union	Maker's standard	
Hydraulic line for deck machinery	All	Seamless precision steel tube	Flange, union, welding socket	Maker's standard	
Hydraulic oil main line for valve control (from H.P.U. to solenoid valve box)	All	Seamless precision steel tube	Union, welding socket	Maker's standard	
Hydraulic oil for cargo pumps and bow thruster valve control (from H.P.U. to solenoid valve box)	All	Seamless Stainless steel pipes SUS 316L	Maker's standard	Maker's standard	
Hydraulic oil for valve control (from solenoid valve box to each valve) (if applicable)	All	Seamless Stainless steel tubes (SUS 316)	Union, welding socket Compressor Fitting		
Hydraulic oil for cargo pumps and bow thruster including pilot pipes	All	Seamless Stainless steel pipes SUS 316L	Maker's standard	Maker's standard	

5.2 PIPING MATERIALS AND WORK – CONT'D

5.3.3 APPLICATION OF PIPES & VALVES – CONT'D

The above tables shall be applied generally for the system, and the special requirement by the Rule, if necessary shall also be complied with.

1. Material of ballast valves on sea chest, collision bulkhead and overboard discharge valves fitted on shipside shall be of cast steel body.

2. Diameter and thickness of hydraulic pipe for valve control shall be sized as per maker recommendation.

3. Material of hydraulic pipes for deck machinery in this specification shall be based on high pressure hydraulic system for deck machinery. In case low pressure system is selected, pipe thickness of supply line shall be Sch. 40.

4. Pipe unless specified as "galvanized" shall be painted in same colour as surrounding.

5. Pipe supports shall be painted in same colour as surrounding.

6. Sounding pipe for Water Ballast tanks shall be Sch. 80.

7. GRP piping may be installed where approved by Class and Owner.

5.4 SCHEDULE OF INSULATION OF PIPES

5.4.1 THERMAL INSULATION

(The enclosed space other than engine room)

The pipe insulation shall be applied as follows :

Piping System	Pipe dia.	Insulation Spec. (mm)
Thermal oil supply / return and / or drain line	All	Mineral wool (#) + Galvanized sheet + Steel wire (SWG #18)
Hot fresh water line	All	
Refrigerant pipe line	All	Cross linked polyethylene foam or equivalent

Note (#) : Mineral wool cover : 30t, 110 kg/m3
Mineral wool felt : 25t, 80 kg/m3

5.5 WATER BALLAST SYSTEM

The ballast system shall be arranged to facilitate complete ballasting or deballasting of the vessel.

Ballast pumps for cargo area shall be located in the ballast tanks P and S and shall have piping arrangement for filling and discharge of water ballast in cargo area.

The ballast piping shall be of GRP material.

All ballast valves in tanks shall be of butterfly type and hydraulically remote operated from cargo control room. The pump discharge valve shall be a throttle valve with remote indication in CCR. Ballast valves to have open/closed indication in CCR.

Single suction bell mouths shall be provided at each ballast tank suction.

Ballasting shall also be done by direct flooding from the sea chest.

No separate stripping line with bell mouth shall be provided, but there shall be one ballast eductor for stripping of ballast tanks. Drive water shall be supplied by ballast pumps.

The ballast system shall be arranged for connection to cargo manifold by spool piece for emergency ballasting. Blind flanges shall be fitted on both sides at manifolds.

Remote reading level gauging system for water ballast tanks shall be fitted.

Ballasting Piping System in Engine Room :

The aft peak and stern tank shall be used as ballast tanks in engine room. The fire/G.S. pump shall be connected to the sea main suction line and serve as ballast pump. Piping material shall be of galvanized steel.

Ballasting Piping System in Bow Thruster Compartment :

The fore peak tank and fwd deep water ballast tank shall be connected to the fwd ballast. Pump in the bottom compartment. Piping material shall be of galvanized steel.

5.6 BILGE SYSTEM

Bilge in the bosun store and chain lockers shall be handled by an eductor driven by a pressure flow from the fire main line and be discharged overboard through the screw down non return stop valve.

5.6 BILGE SYSTEM – CONT'D

The bilge in the steering gear compartment and secondary fire pump space shall be led to the bilge well in the engine room through a self closing valve. The outlet shall be terminated in visible place over working flat.

Bilge suction pipes shall have a diameter as required by the Classification Society.

An international flange connection (MARPOL) with a stop valve discharging from dirty oil tank engine room bilge to shore shall be provided at each side of the deck house.

The connections shall be blanked off with a blind flange.

For the bilge handling in the engine room, refer to Chapter "7- MACHINERY".

5.7 FUEL OIL & LUBRICATING OIL SYSTEM

5.7.1 FUEL OIL FILLING SYSTEM

Four (4) shore connections of 150 mm in nominal diameter with a butterfly valve and a blank flange shall be provided, two (2) on each side of the ship.

One (1) shore connection shall be placed at the forward of the cargo manifold and the other one at the aft of the manifold (near to the poop deckhouse) on each side of the ship.

The shore connections shall be connected to the fuel oil deck main line led to each heavy fuel oil bunker tanker.

Two (2) shore connection of 100 mm in nominal diameter with a butterfly valve and a blank flange shall be provided, one (1) on each side of the ship. The shore connections shall be placed at the aft end of the cargo manifold and shall be connected to the diesel oil deck main line led to each diesel oil tank.

The fuel tanks shall have a line for cross transfer of fuel.

Two (2) fuel oil transfer pump of electric driven gear displacement type, capacity of about 25 m3/hr at 20m head shall be provided for transferring fuel oil from storage tanks to their respective service tanks.

Local manual starting/stopping and a remote stopping from outside engine room shall be arranged.

Sampling cocks shall be fitted at position near the deck filling connection for the fuel oil and diesel oil line and a boss with gauge cock for portable pressure gauge and a boss with plug for portable temperature gauge shall be provided on each shore connection.

5.7 FUEL OIL & LUBRICATING OIL SYSTEM – CONT'D

5.7.1 FUEL OIL FILLING SYSTEM – CONT'D

Adaptors with ANSI flanges (one (1) set of 10" x 6" and one (1) set of 6" x 8") shall be supplied for the heavy fuel oil filling shore manifold in accordance with the OCIMF recommendation.

5.7.2 LUBRICATING OIL FILLING

One (1) lubricating oil filling connection of 80mm in nominal diameter with a blank flange shall be provided for the main engine system oil and auxiliary engine system oil, one (1) on each side of the ship.

Filling connection of suitable size shall be provided for the main engine cylinder oil.

5.8 AIR ESCAPE AND SOUNDING PIPES

5.8.1 AIR ESCAPE PIPES

Air pipes shall be arranged to all spaces as required by the Rules and Regulations.

One (1) or two (2) air pipes shall be fitted so that the total sectional area of air pipes shall be not less than 1.25 times of the sectional area of the filling pipe connected to the tank.

Air pipes shall be located at the highest point in tanks as far as practicable.

Float type air pipe head shall be fitted on the top of the air pipe.

Air pipe for the oil tanks and fresh water tanks to have a removable stainless steel wire net screen.

Oil coaming shall be provided around the air pipe of oil tanks.

Height from the deck and the thickness of the air pipes shall meet the requirements of the Classification Society.

Air escape for the secondary fire pump sea chest shall be provided at the upper part of sea chest to weather deck.

Name plate of brass shall be fitted to the air pipe head.

5.8.2 SOUNDING PIPES

A sounding pipe shall be fitted to each engine room tank, bilge well, oil tank, water ballast tank, chain locker and cofferdam as required by the Classification Society.

5.8 AIR ESCAPE AND SOUNDING PIPES – CONT'D

5.8.2 SOUNDING PIPES – CONT'D

Sounding pipes shall be led as vertical as practicable. If inclination can not be avoided, such inclination should not exceed 10 Degree from vertical line.

Sounding pipes shall be installed as close as practicable to the suction pipe.

Sounding pipe for the fuel oil tanks shall be black steel pipe and the others shall be of galvanized steel pipe and shall be fitted with stand type or deck flush type sounding cap on each pipe top in accordance with the Builder's standard design.

A strike protector of 25mm thickness steel piece shall be fitted at the bottom end of each sounding pipe.

Equalizing holes (at least two) shall be provided on each sounding pipe at uppermost level in tank.

Thickness of the sounding pipe shall meet the requirements of the Classification Society.

Two (2) sounding tapes, one (1) for fuel oil tanks and one (1) for bilge and ballast tanks shall be furnished.

Name plate of brass shall be fitted on the top of sounding head.

A leveling cock shall be provided on the top of sounding head.

A glass level gauge with protection cover shall be provided for each fresh water tank along with a sounding pipe.

Inspection steps shall be provided near each glass level gauge.

5.9 COMPRESSED AIR SYSTEM

One (1) deck service compressed air line of 40 mm in nominal diameter shall be led on the upper deck and to supply for the followings.

The pressure shall be 7 kg/cm2 at the source.

From : Main air receiver in engine room.
To : Hose connections (15 mm in nominal diameter JIS type couplings and valves) for : -

- Bosun store
- Steering gear room
- Air conditioning room
- CO2 and foam room
- Accommodation deck (Navigation bridge deck, boat deck, accommodation deck and poop deck)

5.9 COMPRESSED AIR SYSTEM – CONT'D

Cont'd……

- Emergency generator room
- Pump room
- General use such as cleaning/chipping at approx. 30m interval on main deck

A fixed blow out connection shall be provided for all sea chests.

5.10 FIRE EXTINGUISHING SYSTEM

5.10.1 FIRE FIGHTING EQUIPMENT

The fire precaution, extinguishing and fire fighting apparatus shall be provided in compliance with the requirement of SOLAS, Classification Society and National Authority.

Fire extinguishing system shall be installed to the spaces as follows :

Cargo tank deck	:	Low expansion foam (synthetic type), Sea water
Engine room and bow thruster room	:	High pressure CO2, Sea water, Portable fire extinguishers
Living quarters	:	Sea water, (Hydrant station)
	:	Portable fire extinguishers

For the fire detection system, refer to Section 8.

5.10.2 FIRE AND WASH DECK SYSTEM

A fire and wash deck line shall be served by the bilge, fire and general service pumps in the engine room.

A fire and wash deck main line shall be led on the main deck and the branch lines shall be led from the main line so that the fire protection as well as the deck washing may be done in accordance with the requirement of Authorities.

One (1) line shall be branched from the fire main on main deck to accommodation.

Branch lines from the main shall be led to following:

1. Fire hydrants
2. Bilge eductor for chain lockers
3. Anchor chain washing nozzles
4. Cooling for deck machinery, if necessary
5. Ballast stripping eductor

5.10 FIRE EXTINGUISHING SYSTEM – CONT'D

5.10.2 FIRE AND WASH DECK SYSTEM – CONT'D

Isolation valves shall be fitted in the fire main at the accommodation front in protected position and on the tank deck at intervals of not more than 40m to preserve the integrity of the fire main system in case of fire or explosion.

A pressure gauge shall be fitted at the highest point on the fire main line to check the system pressure.

One (1) International Shore Connection Port and Starboard shall be provided in accordance with the requirement of the Regulatory Bodies.

For the detail of bilge, fire and general service pumps, refer to Section 7.

The fire & wash deck line shall be suitable for F.W. cleaning on deck and interconnection shall be arranged between Bilge, Fire and G.S. pumps, if necessary.

Two (2) drain plugs shall be provided on the fire main, one on the port side and the other on the starboard side.

The pressure relief valve shall be fitted on the fire main, which shall be set at 5-6 kg/cm2. The sea water release pipe shall be extended up to the deck level with a striker plate welded underneath the pipe.

5.10.3 FIRE HOSES AND HYDRANTS

Fire hydrants and hoses with instantaneous quick coupling of approved type shall be provided in accordance with the Rules and Regulations.

Fire hose shall be provided with a coupling and a combined jet and water fog nozzle of bronze.

Fire hydrants of 65 mm in nominal diameter shall be arranged for the exposed decks, living quarters and engine room.

The arrangement of fire hydrants and the provisions of hoses and nozzles shall be in accordance with the Rules.

Fire hoses shall be stowed on the racks or reels and shall be arranged for easy removal. Applicators, where required, and adjustable spanner wrench shall be secured with clamps or clips.

Hose racks or reels outside of accommodation shall be located on the side of deckhouse and shall be enclosed in the F.R.P. cabinets. Cabinets in the forward part of the ship shall be located to minimize impact by sea.

Hose racks and hydrants inside the accommodation space shall be provided with doors where practicable.

5.10 FIRE EXTINGUISHING SYSTEM – CONT'D

5.10.4 EMERGENCY FIRE PUMP

One (1) emergency fire pump shall be installed at the low level in the bow thruster room.

The pump to draw from the independent sea suction and discharge to the fire and wash deck main line with an isolating valve arranged in an accessible position.

Start/stop of the pump and the operation of sea suction valve shall be in accordance with the rule requirements.

The pump shall have following particulars.

Type	:	Electric motor driven, self priming,horizontal centrifugal type
Capacity	:	60 m3/hr
Total head	:	70 m
Material	:	Same as E/R centrifugal pump

Suction compound gauge and discharge pressure gauge with gauge cock shall be provided at the local position.

5.10.5 CO2 FIRE EXTINGUISHING SYSTEM

A total flooding, high pressure CO2 fire extinguishing system consisting of CO2 bottles, piping, control device, discharge nozzles, etc., shall be provided for requirements of the Regulatory Body concerned.

CO2 bottles shall be stowed in a separate room which shall be arranged at safe and readily accessible location.

The CO2 room shall be provided with mechanical ventilation, gastight boundaries and insulation as required by Regulatory Body concerned.

Discharge of CO2 gas shall be controlled from fire control station and starting CO2 bottle to activate opening of cylinder valve of each CO2 bottle.

CO2 gas shall be released through master control valve and shall be distributed to engine room.

Alarm shall be given before release of CO2 gas and means of automatic shut down of ventilation fan, etc. shall be provided. Instructions for operations of the system shall be displayed at an approved location.

Provision shall be made for changing the CO2 bottles and checking contents of CO2 bottles by weighing device.

The operation stations for CO2 release shall be situated as per the requirement of the Regulatory Authorities.

5.10 FIRE EXTINGUISHING SYSTEM – CONT'D

5.10.6 DECK FOAM FIRE EXTINGUISHING SYSTEM

A fixed foam system comprising the pump, foam tank, monitors, proportioner, valves and pipe work shall be installed to provide fire protection for the cargo tank deck area in accordance with the requirement of Regulatory Bodies concerned and Classification Society.

A foam water main shall be led along the upper deck to supply manually operated foam monitors.

Water shall be supplied by the two (2) fire monitor pumps in the machinery room.

Manually operated sectional valves of gate type for the emergency use shall be fitted in the foam water main forward of each monitor branch line so that each monitor shall be capable of being isolated locally.

The capacity of each monitor pump shall be not less than 50% of the capacity of the deck foam system.

Hose connections shall be provided on the foam main line so that 2 applicators can cover the cargo tank deck areas screened from the monitors during fire fighting operations.

Four (4) Nos. of portable applicators on the foam main line so that 2 applicators can cover the cargo tank deck areas screened from the monitors during fire fighting operations.

Foam liquid tank and fittings such as proportioner, pressure gauge, etc. shall be located in the fire control room on the main deck level.

The ratio of foam expansion shall be about 6 times.

Foam, water shall be of mixed liquid of 3% volume foam concentrate and 97% volume sea water, mixed at a foam proportioner.

The rate of supplied foam solution, materials, etc., shall be in accordance with the requirement of Regulatory Bodies and Maker's standard.

5.10.7 MISCELLANEOUS FIRE FIGHTING OUTFITS AND CONTROLS

a) Fire Extinguishers

Fire extinguishers shall be in accordance with Safety of Life at Sea (SOLAS) Regulations but shall have a minimum of eight fire extinguishers in the accommodation.

One approved foam extinguisher of not less than 45 pound capacity shall be fitted in every engine space and one (1) portable foam extinguisher for every 750kw of engine power part. Also, a minimum of one 10 pound dry powder and four CO2 portable extinguishers shall be supplied.

5.10 FIRE EXTINGUISHING SYSTEM – CONT'D

5.10.7 MISCELLANEOUS FIRE FIGHTING OUTFITS AND CONTROLS – CONT'D

b) Shore Connection

One (1) International type on each side of vessel.

c) Fire Man Outfits

Two (2) Firemen's Outfits, each shall be contained in its own separate and marked storage unit and stored in the fire control station.

d) Fire Buckets

Two (2) c/w attached lanyard and stowed in wooden stand.

e) Fire Blankets

Two (2) number, one in the engine room and one in the galley.

f) Fire Axes

Three (3) Fire Axes, one shall be sited outside accommodation adjacent to the working deck.

g) Smoking Signs

"No Smoking" notices shall be prominently displaced by the gangway manifold positions.

5.11 DOMESTIC WATER SERVICE SYSTEM

5.11.1 FRESH WATER FILLING SYSTEM

Fresh water hose station shall be provided (P&S) with 4" kamlock type fitting.

5.11.2 FRESH WATER SERVICE PIPING

Refer to Section 7.

5.12. DRAINS AND SANITARY DISCHARGING SYSTEM

5.12.1 WEATHER DECK SCUPPERS

Suitable number of scuppers from decks above the forecastle deck shall be led down to the weather deck below.

Drain from the forecastle deck shall be discharged overboard through the scuppers led to the side shell, which is terminated at about 400 mm below the main deck.

5.12. DRAINS AND SANITARY DISCHARGING SYSTEM – CONT'D

5.12.1 WEATHER DECK SCUPPERS – CONT'D

Mechanical rubber plugs shall be provided for drain holes in the cargo area.

Drains from the deck scuppers shall be led clear of the freeboard marks and must not be led immediately above the sidelights or windows.

All superstructure decks shall be efficiently drained by the scuppers led down to the waterway on the main below.

Scuppers shall be placed at the lowest point when the vessel is at even keel, and the arrangement shall be sufficient to give efficient drainage.

5.12.2 GUTTERWAYS

W.T. sweat gutters shall be provided behind lining space of the living quarters faced to weather side according to the Builder's practice.

Drains of the drip pans of windows and side scuttles shall be led down to the sweat gutters.

The drain from the sweat gutters shall be led down to the sweat gutters on the deck below or in case of no sweat gutter, to the exposed deck through the drain plug.

Cargo deck gutter bars shall be fitted according to Exxon Rules.

5.12.3 OIL COAMINGS (DRIP PANS)

Steel coamings shall be fitted under the air pipe heads and filling connections which are located on the weather deck for the diesel oil tanks, lub. oil tanks and in way of the international sludge discharge in compliance with the rule requirement. Drain plugs shall be fitted at the lower position of the oil coaming for easy drainage.

5.12.4 INDOOR SCUPPERS

Scuppers shall be fitted in the following compartments where water is used:-

Compartment	Size of scupper
Catering space	100 mm
Sanitary space	40 mm
Passage entrance	50 mm
Provision refrigerating chambers	80 mm

Scuppers shall be fitted in all four corners of galley for efficient drainage.

5.12. DRAINS AND SANITARY DISCHARGING SYSTEM – CONT'D

5.12.5 WASTE WATER AND SOIL DISCHARGE SYSTEM

Soil discharge from living quarters shall be suitably collected through main pipes and shall be led via sewage treatment plant to overboard and through screw down storm valves. The lines shall have a bypass arrangement to a sewage holding tank.

Discharge outlets of waste water and soil drainage mains shall be located near the ballast water line level.

6 – CARGO OIL EQUIPMENT AND SYSTEM

6.1 CARGO LOADING AND UNLOADING SYSTEM

The vessel shall be able to load and discharge four (4) different kinds of cargo oil simultaneously without contamination and with double valve segregation.

Loading of cargoes shall be from manifold with a bypass arrangement on the cargo pumps.

The cargo pumping systems shall allow cargo maximum discharge rate of 1500 m3/hr with four (4) cargo pumps running simultaneously.

The vessel shall achieve a cargo loading rate of approximately 1,500 m3/hr through the cargo manifolds.

6.1.1 CARGO OIL PUMPS

Pump	Cargo pumps (inside cargo tanks)	Cargo pumps (inside slop tanks)
Number	12	2
Type	Single stage submerged	Single stage submerged
Driven by	Hydraulic motor in engine room	Hydraulic motor in engine room
Capacity	375 m^3/h x 110 mlc, sp.g 0.8, visc 1.0 cSt	100 m^3/h x 110 mlc, sp.g 0.8 visc 1.0 cSt
Material	Stainless steel AISI 316	Stainless steel AISI 316

The pipestack between the top-plate and the pumphead consists of the main cargo pipe, stripping and purging pipes and a concentric hydraulic pipe.

The hydraulic high pressure pipe is located inside the return pipe and the complete hydraulic section is isolated from the cargo by a cofferdam ventilated to the atmosphere.

Pump discharge pressure sensor on all cargo pumps connected to the cargo control console shall be installed.

Hydraulic driven transportable cargo pump (1 No.)
Material : Stainless steel AISI 316.

Associated equipment included :

One (1) set of 18m hydraulic hose mounted on pump with control valve and quick-couplings.

Four (4) sets connection valves with blind flanges on hydraulic lines for connection of the portable pump.

One (1) set of 18m hydraulic extension hose with quick-couplings.

One (1) of tripod with winch for hoisting.

6.1 CARGO LOADING AND UNLOADING SYSTEM – CONT'D

6.1.1 CARGO OIL PUMPS – CONT'D

Capacity : 70 m3/h – 70 mlc – sp.g. 0.8 – visc. 1.0 cSt.

For the pump control and instrumentation, refer to Section 6.2.

6.1.2 HYDRAULIC POWER SYSTEM

One (1) set of : Hydraulic Power Unit, consisting of hydraulic oil expansion tank, 3 of hydraulic power packs each 220 kW, jockey pump, cooler, filter and temperature control valve.

Total power : 600 kW.

Protection grade/voltage of el. motors : IP54 – 415/3/50.

Simultaneous operation/discharge rate :
Four (4) of Cargo Pumps – each 375 m3/h at rated head.
Total discharge rate : 1500 m3/h – 110 mlc – sp.g. 0.8 – visc. 1.0 cSt.
Total power consumption 630 kW (shaft power).

One (1) set of : Hydraulic Oil Transmission Equipment

One (1) set of : Hydraulic Transfer Unit with 1,1 kW el. motor

6.1.3 CARGO OIL MAIN LINE

The cargo oil main line shall be arranged for cargo tanks, slop tanks and on the main deck as shown on "Piping Diagram of Cargo Oil System".

Cargo oil lines in tanks and on deck shall consist of independent systems serving the following groups and shall be capable of performing loading or unloading of different kinds of products simultaneously and shall be capable of changing the combination of tanks and pumps using the inter connection line and header manifold. Suitable height coaming to contain spillage shall be fitted throughout the main deck.

The cargo oil tanks shall be fully segregated into seven (7) groups of cargo with double segregation as follows : -

No. 1 Group	:	No 1	P & S cargo tank.
No. 2 Group	:	No 2	P & S cargo tank
No. 3 Group	:	No 3	P & S cargo tanks.
No. 4 Group	:	No 4	P & S cargo tanks.
No. 5 Group	:	No 5	P & S cargo tanks.
No. 6 Group	:	No 6	P & S cargo tanks.
No. 7 Group	:		P & S slop tanks.

6.1 CARGO LOADING AND UNLOADING SYSTEM – CONT'D

6.1.3 CARGO OIL MAIN LINE – CONT'D

Carriage of up to seven (7) segregated cargoes.

Simultaneous loading of seven (7) grades over seven (7) manifolds and direct drop lines to cargo tanks, with venting to atmosphere.

A common cargo crossover with connections to individual crossovers by bends / spool pieces etc., for loading/discharging unit cargoes shall be included.

Simultaneously loading of seven (7) grades over seven (7) manifolds and direct drop lines to cargo tanks, with vapour return line back to cargo tanks.

Direct drop line shall be arranged for each cargo tank.

All structural members within the tanks must be selfdraining.

Pockets of likely contamination or sources for accumulation of stagnant fluid must be eliminated as far as possible.

Cargo piping shall be of AISI 316L stainless steel welded pipe. These pipes shall be supported on resilient Teflon packing on pipe stools to reduce the transmission of noise and vibration.

Expansion bends shall be used on the main deck.

Sampling cock shall be provided on each cargo manifold and a boss with gauge cock for portable pressure gauge and a boss with pocket for portable temperature gauge also shall be provided on each cargo manifold.

Cargo reducers with ANSI 150 PSI flanges shall be supplied.

Shore connections shall be provided amidship on both side of main deck in accordance with MARPOL requirement.

The shore connection flanges shall be ANSI flat face. Two (2) sets of reducers of 4", 6", 8", 10" from 12" Sch. 80 pipes. These reducers shall be of stainless steel, internally and externally coated with epoxy.

A drain spill tank for the manifold shall be fitted to each side of the manifold. Each spill tank shall be provided with open grating at top as a working platform.

Manifold height above main deck shall be about 1.8 meter and distance of manifold from ship's side shall be about 4.0 meter.

Drain from spill tanks (P&S) and shore connections shall be led to port side slop tank by a portable air motor driven rotary type drain pump through a permanent piping.

6.1 CARGO LOADING AND UNLOADING SYSTEM – CONT'D

6.1.3 CARGO OIL MAIN LINE – CONT'D

Discharge points located port, starboard and amidship shall be designed suitable for four (4) 'FRAMMO' pumps operating simultaneously.

The spill tank shall be extended at least 1,200mm beyond the outermost flange of vapor collecting manifolds.

Cargo valves shall be butterfly valve in.

Material of butterfly valves shall be as follows :

- Body : Stainless Steel
- Disc : Stainless Steel (SUS 316)
- Stem : Stainless Steel
- Seat : PTFE (To suit chemicals)
- Ball : Stainless Steel

6.1.4 CARGO OIL VALVE OPERATION

All cargo valves shall be of AISI 316 stainless steel butterfly-type valves.

All cargo valves except manifold valves shall be remote operated from cargo control room. Local control also shall be arranged on deck.

Discharging valves for each cargo pump outlet shall be remote controlled and have the possibility to regulate from 0 – 100% gradually, not only for open or closed.

Cargo valve reducers and spool pieces shall be installed in accordance with the OCIMF requirement. Securing arrangement for reducers, spool-pieces, bends, etc. shall be arranged on top of deck trunk at cargo manifolds.

One (1) additional spare cargo manifold valve of manual type shall be supplied.

6.1.5 SAMPLING POINTS

A sampling cock (approx. 25 mm dia.) shall be provided at each cargo manifold. Sample points shall have a drip tray under. A boss with gauge lock for portable pressure gauge and a boss with pocket for portable temperature gauge shall also be provided on each cargo manifold.

All cocks shall be of stainless steel type.

Sufficient space shall be provided for the safe keeping of samples.

A deckhouse shall be arranged above walkway housing four compartments, i.e. sample store, store for portable equipments, ventilation blower compartment and nitrogen bottle storage.

6.1 CARGO LOADING AND UNLOADING SYSTEM – CONT'D

6.1.6 CARGO OIL STRIPPING

Stripping of cargo tanks shall be done by the submerged cargo pumps which have a built in stripping system.

6.2 CARGO OIL TANK VENTING SYSTEM

6.2.1 CARGO OIL TANK VENTING

The air pipes shall be sized according to the loading rate and shall comply with the Classification requirements.

Cargo tank venting with two (2) central venting stations shall be through approved systems that expel vapours clear of the tank deck area in accordance with ISGOTT.

Two (2) independent high velocity pressure/vacuum valves shall be provided for each cargo/slop tank and grouped to form centralised venting system.

Each riser shall be provided independently and shall be about 2 metres high above deck and provided with a flame arrestor and a weather bond.

Each individual pressure-vacuum valve shall be of "SS PV" type and be fitted and each tank.

The pressure/vacuum valves shall be set at 0.14 kg/cm2 for pressure and 0.035 kg/cm2 for vacuum.

A system for vapour return of 2 cargos simultaneously with pressure sensor shall be installed.

Service air shall be utilized for operation of portable gas freeing fans.

6.3 CARGO OIL TANK CLEANING SYSTEM

6.3.1 TANK CLEANING LINE

Fixed tank cleaning machines in each tank c/w flexible rubber hoses, couplings and hose saddles suitable for tank washing shall be provided operated by a special pump of 10 bar. For this a minimum 60 m3 of additional FW is required which can be stored in the aft peak instead of WB.

The system shall be designed with the four (4) tank cleaning machines operating simultaneously.

In addition four (4) nos. portable machines of the following specification shall be provided.

Type : Portable, twin nozzles.
Rating : 15 m3/hr at 7 bar.

6.3 CARGO OIL TANK CLEANING SYSTEM – CONT'D

6.3.1 TANK CLEANING LINE – CONT'D

The machines shall be connected to a tank cleaning main line operated by a special pump of 10 bar.

One (1) stop valve shall be provided for each fixed machine.

Suitable number of branch lines with 50mm dia. diaphragm valves and hose coupling shall be provided for the fixed and portable machines.

One (1) pressure gauge shall be provided in tank cleaning main line and the pressure shall be indicated at the local position.

Interconnection between tank cleaning main line and fire and wash deck main line shall be arranged by a special piece on deck.

A) Tank Cleaning Hatches (14 Nos.)

One (1) of diameter 320 mm per tank shall be provided with coaming height of 150 mm for openings. Hinge pin and butterfly nuts shall be stainless steel.

The above specified numbers of hatches per tank is subjected to final arrangement and may be increased accordingly (but limited to maximum of 3 numbers per tank) due to difficult hidden corners.

B) Tank Cleaning Machine

The technical data of the T.C. machines shall be submitted to the Owner for installation of T.C. holes and decision of branch pipe bore before design stage.

6.3.2 TANK GAS FREEING SYSTEM

A fixed gas freeing system shall be used with fixed means of duct ventilation using a separate blower.

6.3.3 OIL DISCHARGE MONITOR

One (1) unit MARPOL "Category I" Oil Discharge Monitoring System consisting of the following shall be provided :-

a)	One	(1)	main computer unit.
b)	One	(1)	control terminal with printer.
c)	One	(1)	measuring unit.
d)	One	(1)	sample feedpump and electric motor assembly plus starter.
e)	One	(1)	ejector unit.

6.3 CARGO OIL TANK CLEANING SYSTEM – CONT'D

6.3.3 OIL DISCHARGE MONITOR – CONT'D

f) Two (2) bulkhead penetration.
g) One (1) sample probe.
h) One (1) flow meter system.
i) One (1) solenoid valve for operating of pneumatic controlled overboard valve.
j) Overboard discharge valve.
k) Recirculating valves.
l) Remote valve position indicator connected to speedlog.
m) Operation manual to Class approval.

All installation of equipment in engine room and cargo control room shall be tested and commisioned to Classification and Owner's Representative satisfaction.

The monitor shall be connected to the cargo system overboard discharge.

A separate overboard discharge system for chemicals, as per Marpol Annex II shall be installed.

The sampling arrangement to fulfill the latest IMO requirements.

The overboard discharge of water from slop tank shall be automatically isolated and dumped back to slop tank if monitored value of oil content is above pre-set value.

a) The vessel shall carry one (1) set of portable steel gauging tape approved by ASTM with a 150 mm (6") weight attached to one end.
b) The vessel shall carry one (1) set of API/ASTM/IP approved electronic type thermometer on board for manual temperature measurement of the cargo.
c) The latest ASTM temperature/specific gravity/density correction tables shall be available on board for calculation of bunker volume.

One (1) set of vapor control valve on each cargo tank deck and each slop tank deck shall be provided for ullage, interface, hand dipping and which shall be used for cargo sampling as well. The vapor control valves shall be ball valve or spring loaded type as per Maker's standard and shall be sealed when not in use.

100mm dia ullage hatches shall be provided on the top of the access hatches and the reference height shall be stated in the calibration tables.

6.4 CONTROL SUPERVISION AND INSTRUMENTATION

6.4.1 CONTROL SYSTEM

One (1) Cargo pump control panel with pot. Meter levers and instruments for each remotely operated pump in the cargo control room.

One (1) Hydraulic system control panel with start/stop functions for all hydraulic power packs including alarm and monitoring functions for the complete hydraulic system.

6.4.2 CARGO PUMP CONTROL AND INSTRUMENTATION

A) Two (2) Emergency stop buttons (ex proof) for deck location.

B) The provisions to start/stop the cargo pumping system and tank cleaning pump shall be provided at cargo control room.

C) Instrumentation (For cargo pumps only)

Shall be as Maker's standard for cargo pumps

For tank cleaning pump

Gauge	Motor side	Pump side	C.C.R
Running lamp	0	-	0
Suction/discharge pressure	0	0	0
Start/stop	0	-	0

6.4.3 CARGO CONTROL CONSOLE

The following controls and facilities shall be provided on the cargo control console.

- A mimic diagram of cargo and ballast system.
- Start and stop control with running indicating lamp of main cargo pumps (speed control for cargo pumps).
- Level indicator for each cargo and slop tank..
- High level alarm for each cargo and slop tank.
- Oil discharge monitoring and control unit.
- High level bilge alarm in thruster room.
- Pump discharge pressure gauge.

6.4 CONTROL SUPERVISION AND INSTRUMENTATION – CONT'D

6.4.3 CARGO CONTROL CONSOLE – CONT'D

An alarm on the Monkey Island so that the high level alarm can be heard on deck. Each level switch shall be explosion proof type. An independent level sensing system that is separate from tank level gauges shall be incorporated with temperature sensing pockets with three sensors per tank (at three levels) and connected to the cargo control console shall be installed.

A cargo loading computer (LI – Loading/Instrument) shall be installed.

6.4.4 TANK MONITORING GAUGE

Cargo Oil Tank and Slop Tank ;

Cargo oil tanks and slop tanks shall be provided with radar type level gauging system.

Reading of liquid level shall be done remotely in the cargo control room.

High level alarm integrated with cargo tank level gauges shall be provided in cargo control room.

6.5 CARGO TANK HATCHES (14 NOS.)

Cargo tank hatches of 760mm dia. x 800mm high with swivel type covers shall be arranged for each tank. Fittings shall be stainless steel.

A solid round bar of stainless steel, 12mm shall be welded all round the top edge of coaming.

6.6 POLLUTION CONTROL EQUIPMENT

Pollution control equipment must be available in accordance with the OPRC Convention 1990. As a minimum the following equipment shall be available:-

1) Sorbents.
2) Non-sparking hand scoops, shovels and buckets.
3) Containers suitable for holding recovered waste.
4) Emulsifiers for deck cleaning.
5) Protection clothing.
6) Two (2) non-sparking portable pumps with hoses in good operating condition. For vessels fitted with fixed dump valves portable pumps are not required.

6.7 PORTABLE GAS DETECTION EQUIPMENT

The vessel shall carry the following : -

a) Two (2) portable explosimeters.
b) Two (2) portable oxygen analysers.
c) One (1) toxic gas detector or analyzer.

6.8 CARGO TANK HEATING

The cargo shall be heated.

The system shall have a capacity of maintaining 13500 Cu.M of cargo at 50°C.

The system shall consist of twelve (12) vertical deck mounted cargo thermic fluid heat exchangers for forced circulation by submerged cargo pumps.

Material : 316L
Heating by : Thermal oil 180 degr. C inlet
Capacity each : 220 kW

6.9 NITROGEN SYSTEM

For blanketing of cargo tanks, nitrogen from bottles with compressed nitrogen shall be used. A nitrogen supply line shall be arranged from nitrogen bottle connection manifold, via a reduction panel, to the cargo tank ventilation towers.

At the ventilation towers, valves and quick couplings for making connections with cargo ventilation line risers by flexible hose shall be arranged. Number of connections at each ventilation tower shall be minimum half the number of risers. The nitrogen line from reduction panel to ventilation towers shall be DN25 made of stainless steel AIS1 316.

Nitrogen bottles shall be arranged in store room. Bottles shall be arranged with easy access for filling and changing of bottles. The bottle room shall be open to deck. Each bottle to contain 50 litres at 200 kg/cm^2 pressure.

One reduction station with reduction valves from 200 bar to 16 bar, from 16 bar to 8 bar and from 8 bar to 0.017 bar shall be fitted.

7 - MACHINERY

7.1 GENERAL

The vessel shall be propelled by a single medium speed marine non-reversible diesel engine coupled to a controllable pitch propeller through a reduction gearbox.

The propeller shaft can be withdrawn outboard after removal of propeller and rudder.

The electric power plant shall consist of three diesel engines driving main generators and one diesel engine driven emergency generator. Each diesel auxiliary shall be capable of providing sufficient electricity for the normal ships service.

All items of machinery and equipment shall be suitable for marine service, of good quality and in accordance with Classification requirements. They shall be supplied and fitted by the Builder. Arrangements shall be made for full bridge control of main engine speed, shaft rotation, rudder angle and vessel manoeuvring shall be provided. Alternative local controls shall be provided in the engine control room.

The propulsion system shall be free of torsional vibrations throughout the entire working range as recommended by the engine manufacturer.

Design conditions for the engine room machinery and equipment shall be based on the maximum sea water temperature of 32 Degree C and the engine room temperature of 45 Degree C, unless otherwise especially stated.

7.1.1 ABBREVIATIONS

Abt.	.....	About
A.C.C.	.....	Automatic Combustion Control
Air-con	.....	Air Conditioning Plant
A.P.G.	.....	Air Purge type Level Content Gauge
ATMOS	.....	Atmospheric
Auto.	.....	Automatic
Aux.	.....	Auxiliary
BHP	.....	Brake Horse Power
Cap.	.....	Capacity
C.O	…….	Cargo Oil
Cyl.	.....	Cylinder
D.B.	.....	Double Bottom
D.E.D.	.....	Diesel Engine Driven
D/G.	.....	Diesel Generator
Dia.	.....	Diameter
D.W	…….	Drinking Water
ENG.	.....	Engine

7.1 GENERAL – CONT'D

7.1.1 ABBREVIATIONS – CONT'D

E.M.H.C	.....	Engine mounted horizontal centrifugal
E.M.H.G	.....	Engine mounted horizontal gear
F.A.	.....	Free Air
F.W	…….	Fresh Water
FWD	.....	Forward
FLG	.....	Float Level Gauge
G	.....	Gauge
Galv.	.....	Galvanized
G/E	.....	Generator Engine
G/S	.....	General Service
G.L.G.	.....	Glass Level Gauge
H	.....	Horizontal
H.F.O	…….	Heavy Fuel Oil
I/G	.....	Insert Gas
K	.....	Kg/cm2G
K.D.P.	.....	Delivery Pressure (Kg/cm2G)
L.C.V.	.....	Lower Calorific Value
L.O.	.....	Lubricating Oil
MCR	.....	Maximum Continuous Rating
M.D.	.....	Electric Motor Driven Centrifugal
M.D.H.C .	.....	Electric Motor Driven Horizontal Centrifugal
M.D.H.G	.....	Electric Motor Driven Horizontal Gear
M.D.H.S	.....	Electric Motor Driven Horizontal Screw
M.D.O. (D.O.)	..……...	Marine Diesel Oil
M.D.V.G	.....	Electric Motor Driven Vertical Centrifugal
M.D.V.G.	.....	Electric Motor Driven Vertical Gear
MTH	.....	Total Head (Meter)
M/E	.....	Main Engine
Press.	.....	Pressure
Ref.	.....	Refrigerating Plant
RPM	.....	Revolution Per Minute
Sat.	.....	Saturated
S/B	.....	Stuffing Box
SS41	.....	Rolled steel for general structural purpose, min, tensile strength 41 kg/mm2
S.G.	.....	Specific Gravity
SP	.....	Sounding Pipe
S/T	.....	Stern Tube
S&T	…….	Shell and Tube
S.W.	.....	Sea Water
S.W.L.	.....	Safe Working Load
SWRM	.....	Mild Steel Wire Rod
THK	.....	Thickness
TBA	.....	To be advised.

7.1 GENERAL – CONT'D

7.1.2 MACHINERY INSTALLATION

First class workmanship and best quality materials shall be employed throughout the construction and fitting of the entire machinery installation which shall conform to the best modern marine practices. Machinery and equipment shall be installed on solid foundations to minimize the effect of vibration, deflection in the crankshaft and couplings and misalignment etc.

All piping runs to and from engines, gears, hydraulic pumps, etc., shall be provided with flexible connections at the machinery or equivalent, where required by vibration calculations as approved by the Buyers representative.

Wherever possible all valves, sea bilge, water, fuel manifolds, strainers etc., shall be mounted at floor plate level and shall be readily accessible.

Every pump, filter and valve shall be easily removable without the necessity of moving any other pieces of equipment. Every system installed in the vessel shall be tested at full capacity to demonstrate its ability to function as intended.

7.2 MACHINERY PARTICULARS

Principal machinery shall be provided in compliance with this MACHINERY PARTICULARS and auxiliary equipments/accessories of the principal machinery shall be equipped in accordance with the maker's standard and the Builder's practice.

7.2.1 MAIN ENGINE

Particular	Description
Type	Inline, single acting 4 stroke cycle, direct-injection, water cooled, turbo-charged, diesel engine.
Brake horse power (BHP) (minimum)	6120 MCR
Engine revolution (RPM)	600 to 750
Specific fuel oil consumption	178g/kWh at 150 condition + 5% tolerance excluding engine driven pumps.
Direction of Rotation	Counter clockwise viewed from stern
Cooling System	Fresh water cooling with sea water and jacket water pumps
Lubricating System	Wet type with forced lubrication with engine mounted gear pump
Starting System	Air starting (from engine room)
Stopping System	Stop Button (from engine room & wheelhouse)

7.2 MACHINERY PARTICULARS – CONT'D

7.2.2 SHAFTING

Shafting shall consist of one propeller shaft subject to final design configuration.

The hollow bored shaft, containing oil pipes for propeller blade adjustments shall have integral forged flanged at propeller sides and a hydraulic coupling at forward side, so that withdrawal of the shaft to aft is possible.

The oil distribution shall be fitted at forward side of reduction gear.

The stern tube shall be of welded construction of steel plate and welded to the stern frames boss and constructed as a part of hull structure.

Bush bearings shall be of cast iron lined with white metal.

Oil lubricated split type stern tube seal shall be provided at the both ends of the stern tube to enable lubricating part of the propeller shaft.

The stern tube shall fulfill class requirement for extended intervals of shaft survey.

The shafting system shall be designed so that no serious peak of torsional vibration shall occur within the normal operating range of the main engine.

7.2.3 PROPELLER

Number	One (1) set with four (4) blades	
Type	Controllable Pitch	
Material	Propeller	Nickel - Aluminium Bronze
	Hub	Nickel - Aluminium Bronze

The blades shall be bolted to the hub and the hub shall contain a hydraulically operated actuating cylinder for propeller blade adjustment.

The hub shall be flange mounted to the propeller shaft.

Net/Rope Cutter of 'Cadyma' type (or equal) shall be provided.

Hydraulic System for C.P.P.

A hydraulic power system shall be supplied by C.P.P. maker, consisting of one prefabricated set of hydraulic oil tank with two (2) sets of electric motor driven pumps.

The stand-by pump starts automatically in case of oil pressure drop in the hydraulic system.

One (1) set of hydraulic oil cooler shall be provided if required, according to manufacturer's standard.

7.2.4 OIL FIRED BOILER

Number	:	One (1).
Type	:	Vertical, oil-fired steam boiler cylindrical type, in all welded steel construction to heat 60 Cu.M/h S.W/F.W from 10 Degree C to 70 Degree C. The boiler shall also be suitable for heating thermic fluid for cargo heating.
Normal working pressure	:	7 bar
Max. permissible working pressure	:	9 bar
Feed Water Temp.	:	Abt 50 Degree C.
Type of Fuel	:	HFO having a viscosity up 180 cst at 50 Degree C.

Temperature in particular tanks shall be :

HFO storage tanks	:	45 Deg C
HFO settling tanks	:	70 Deg C
HFO service tanks	:	70 Deg C
Used (sludge) oil tank	:	60 Deg C
Separator drainage tank	:	40 Deg C
Fresh water tanks	:	+2 Deg C
Dirty oil storage tank	:	+30 Deg C

For HFO tanks temperature control device shall be provided.

7.2.5 GENERATOR SETS

7.2.5.1 MAIN GENERATORS – THREE (3) SETS

Particulars	Description
Type	High speed marine diesel engines, turbo-charged, heat exchanger cooled, fuel-injected and electric start.
Output	450 kW (minimum) at 1200 RPM
Voltage	450V, 3PH, 60 Hz, 0.8 PF 3 wire
Fuel Oil	MDO
Starting System	Air start.

7.2.5.2 SHAFT GENERATOR

Type	Driven by the reduction gear P.T.O
Output	600 kW
Voltage	450V, 3PH, 60Hz, 0.8F, 3 wire

7.2.5 GENERATOR SETS – CONT'D

7.2.5.3 EMERGENCY GENERATOR – ONE (1) SET

Type	Four stroke, turbo-charged, diesel engine, battery start, located in, the emergency generator room.
Output	99 kW at 1800 RPM
Voltage	450V, 3PH, 60Hz, 0.8 PF 3 wire

7.2.6 BOW THRUSTER – ONE (1) NO.

Type : Transverse tunnel with C.P.P.
Power : 550 KW.
Drive : Hydraulic (from FRAMMO hydraulic system)

7.2.7 PUMPS

7.2.7.1 MAIN ENGINE PUMPS

The main and auxiliary engine lubricating and cooling pumps shall be supplied as per the engine manufacturer's recommendations. Standby emergency sea water and fresh water supply for the main engine shall be from a motor driven pump and auxiliary engines shall be from the G.S pump.

Emergency motor driven lub. Oil pump shall be provided as per engine manufacturer's recommendation.

7.2.7.2 MISCELANEOUS PUMPS

Particulars	No	Type	Capacity Cu.M/H @ Head		Remarks
Fire/GS/Bilge	2	MDHC	100	@90	
Ballast	2	Submerged centrifugal	400	@15mlc	In Ballast Tanks P and S
Ballast (Fwd)	1	MDHC	100	@3Bar	In Fwd Pump Room
Emergency Fire	1	MDHC	60	@70	
G.E Cooling	1	MDHC			If Required
Tank Cleaning	1	MDHC	60	@110	
Fire Monitor	2	MDHC	80	@70	
Boiler F.O	2	}TBA	80	@70	}Maker's
Boiler Feed	2	}			}Standard
H.F.O Transfer	1	MDHG	25	@20	
M.D.O Transfer	1	MDHG	25	@20	
Dirty Oil Transfer	1	MDHG	5	@20	
Sewage Discharge	1	MDHS	5	@20	
L.O Transfer	1	MDHG	5	@20	

7.2 MACHINERY PARTICULARS – CONT'D

7.2.7 PUMPS – CONT'D

7.2.7.2 MISCELANEOUS PUMPS – CONT'D

A/C Cooling S.W	1	MDHC	}TBA		}Maker's
Ref. Cooling S.W	1	MDHC	}		}Standard
H.W Circulating	1	MDHC	2	@5	
Air Cooler Chemical Cleaning	1	TBA			Maker's Standard

7.2.8 AIR COMPRESSORS AND RESERVOIRS

Particulars	No	Type	Capacity Cu.M/H Kg/Sq.Cm^{2}G		Remarks
Main Air Compressors	2	M.D., 2 stage reciprocating air cooled	30	@30	
Working Air Compressor	1	M.D. rotary water cooled	250	@8	
Main Air Reservoir	2	Cylindrical	500 Litres	@30	Engine Maker's standard
Working Air Reservoir	1	Cylindrical	1500 litres	@8	
Refrigerant Air Dryer	1	Refrigerant type			As per Maker's Standard

The capacity of the air compressor shall be sufficient to give the number of engine starts as required by the Classification Society.

7.2.9 OIL PURIFIERS/FUEL TREATMENT PLANT

One (1) complete heavy fuel heating and treatment plant as per manufacturer's recommendation.

Purifiers

1) General

The purifiers shall be arranged for the purification of HFO, MDO and lub. oil.

They shall be of a self cleaning centrifugal type with controlled discharge for HFO, MDO and total discharge type for the lub. oil.

2) Heavy Fuel Oil Purifiers

Two (2) sets of heavy fuel oil purifiers shall be provided. The purifiers shall be fully automatic, self cleaning controlled partial discharge type and shall be driven by an electric motor.

Timer control shall be provided for sludge discharge.

7.2 MACHINERY PARTICULARS – CONT'D

7.2.9 OIL PURIFIERS/FUEL TREATMENT PLANT – CONT'D

2) Heavy Fuel Oil Purifiers – Cont'd

A heater shall be provided.

The piping system for these purifiers shall be designed so that they can operate in series as well as parallel mode.

3) Diesel Oil Purifier

One (1) set of diesel oil purifier shall be provided and having the same controls as the HFO purifier. A heater is not required for this purifier.

The HFO and DO purifiers shall be interconnected.

4) Lub, Oil Purifier

One (1) automatic L.O purifier shall be provided. The set shall be fully automatic with heater.

5) One (1) working table for these purifier bowls shall be provided.

6) F.W. flushing tank and temperature thermostat pneumatic control shall be fitted.

7) Sludge tank/bilge and oily tank with high level alarm shall be installed.

7.2.10 HEAT EXCHANGERS

All heat exchangers shall be designed with the fouling margin of 15% for shell and tube and 10% for plate type based on sea water temperature of 32 Deg. C.

Cooling or heating tubes of each heat exchanger except oil heaters shall be fitted with tube plates by being expended at both end and the shell shall be provided with a shell expansion joint.

The cooling system shall be fresh water central system.

Titanium heaters to be used for F.W Cooling.

Water velocity in tube shall never exceed the allowable limit recommended by Maker.

For plate type heat exchangers, the heat exchanging surface shall consist of a number of corrugated titanium or stainless steel plates clamped together in a frame and sealed at edges by rubber gasket. The gaskets in plate type heat exchanger shall be suitable for the relevant medium and temperatures.

7.2 MACHINERY PARTICULARS – CONT'D

7.2.10 HEAT EXCHANGERS

Heat exchangers built into machinery or supplied together with equipment shall be according to manufacturer's standard.

Accessories :

Each heat exchanger shall be supplied with following accessories :

- Thermometer for each inlet and outlet of sea water, fresh water, lubricating oil and fuel oil.
- Safety valve (for heaters).
- Air cock or valve and drain cock or valve.
- Inspection and/or cleaning hole (tube type except oil heater).
- Each one seat for connection of soda cock and steam boiling (tube type except oil heater).

Air coolers for main engine and auxiliary engines, L.O. cooler for auxiliary engines shall be tube type.

L.O. Cooler :

The heat exchangers shall be plate type for L.O. coolers for main engine.

For plate type coolers, the material of plates shall be of stainless steel.

Tubes for tube type heat exchangers shall be of aluminium brass and shall be expanded into the tube plate at both ends.

Tubes sizes and material for small coolers shall be Maker's standard.

F.O. Heaters and L.O. Heaters :

Tube and shell type heater shall be provided for all H.F.O and L.O. heaters and preheaters.

The material and construction shall be according to Manufacturer's standard.

One (1) main engine F.O. heater shall have surface to heat the fuel oil when main engine is opening at maximum continuous rating.

Design basis for all heaters shall follow equipment manufacturer's recommendation.

Oil heaters supplied with equipment shall be of Maker's recommendation.

7.2 MACHINERY PARTICULARS – CONT'D

7.2.11 FRESH WATER SERVICE SYSTEM

Particulars	No.	Capacity	Type	Remarks
Sterilizer	1	2,000 L/H	Ultra violet ray	
Calorifier	1	Flow : 2 Cu.M Tank : 200 L Heating range 10-70 Deg.C	With electric heating element and circulating pump	
F.W. hydrophore unit c/w MDHC pump	1	3.2 Cu.M @28M head. Tank : 300 L		

One (1) standby pump to run in parallel to the system c/w cut-in and cut-out pressure switch.

7.2.12 WORKSHOP EQUIPMENT

Particulars	No.	Capacity	Remark
Lathe	1	Centre distance : 500 mm Swing over bed : 450 mm	
Column Drill	1	Maximum drilling diameter 25mm	
Bench Grinder	1	Double wheel type, diameter 255 mm.	
Transformer Welding Machine	1	300 A.	
Gas Welding / Cutting Kit	1	Set Bottles Oxygen - 2 Each Acetylene – 1 Each	
Injector Test Stand	1	The M.E. Maker's standard	With test bench
M.E. Exhaust Grinding Machine	1	The M.E. Maker's standard	
Work Bench	1	With one G-vice	
Double Door Cabinet	1	No.	
Tool Board	1	No.	
Box for Rags	1	No.	

The location of workshop shall be port aft on the main deck with the engineers store inside. The construction of the store shall be expanded metal.

7.2 MACHINERY PARTICULARS – CONT'D

7.2.13 VENTILATION FANS

Particulars	No.	Type	Capacity (M^3/Min) Per Fan	Static Pressure (mmAq)	Remark
Engine Room	1	M.D. Axial flow, reversible	350	38	
	1	M.D Axial Flow Non-Reversible	350	38	
Bow Thruster Room	1	Axial flow	200	20	Inlet (Natural Exhaust)
Steering Gear Compartment	1	Axial flow	20	20	Inlet (Natural Exhaust)
Galley	2	Axial flow	100	20	1 – Inlet 1 – Exhaust
Toilets and Laundry	16	Axial flow	20	20	Exhaust
Stores (Engineers)	2	Axial flow	20	20	Exhaust

The above are indicative, however, engine room ventilation fan capacity shall be at least 100% higher than the combustion air requirement of both main engines and three generators running at MCR.

7.2.14 MISCELLANEOUS

Particulars	No.	Type	Capacity	Remarks
Oily Bilge Separator	1	15 ppm, 2-stage complying/with Marpol	1.0 Cu.M/h	C/w alarm for bilge overboard discharge
Incinerator	1	Sludge oil and solid waste burning	Abt. 180,000 Kcal/h	
Sewage Plant	1	Biological	For 22 man crew	
Overhead Crane	1	M.D	2 Tonne S.W.L	

7.2 MACHINERY PARTICULARS – CONT'D

7.2.15 FILTERS / STRAINERS

All engine, gear box and generator filters/strainers shall be provided by the Equipment Supplier.

Miscellaneous

Particulars	No.	Mesh Suct. Disch.	Type
Oily Bilge Pump	1	24	Simplex, magnetic
Dirty Oil Pump	1	24	Simplex, wire mesh
Boiler F.O. Pump	1	Boiler Maker's Standard.	

7.2.16 TANKS

Particular	No.	Cap. Cu.M	Level Gauge (Local)	Remark
M.E. L.O Settling	1	30	SP	
L.O. Drain (Clean)	1	1	-	
S.T. L.O. Gravity	1	01	GLG	Maker standard
G.E. L.O. Storage	1	1	GLG	
Oil Residue (Dirty Oil)	1	10	SP	
Auxiliary L.O	3	1	GLG	
Hydraulic Oil	1	0.5	GLG	
H.F.O. Settling	2	10	S.P APG	
H.F.O. Service	2	10	SP APG	
M.D.O. Service	2	4	SP APG	
Cooling F.W. Expansion	2	1/0.5	GLG	For M.E / For G.E.
Hydraulic Oil Storage	1		SP APG	Capacities to suit 'FRAMMO' System
Hydraulic Oil Drain Tank	1		-	Capacities to suit 'FRAMMO'System
Bilge Holding	1	7	SP	
Sewage Holding	1	6	GLG	For port use
Sludge	1	10	SP	Self closing drain valve
Foam	1	7	GLG	
Thermal Oil Storage	1		SP	
Thermal Oil Expansion	1		GLG	Maker standard

The above capacities are approximate.

Small tanks in the engine room and fore peak stores shall be bulkhead mounted.

7.3 TEST AND INSPECTION

7.3.1 SHOP TESTS AND INSPECTION

The undermentioned running tests shall be executed at the maker's shop to demonstrate performance of the main diesel engines, diesel generator engines and other auxiliary machinery. Final tests required shall be subject to the Maker's Standard.

The performance data shall be recorded during these tests and the results shall be submitted to the Owner.

Inspections and tests for main engine and diesel generator engines shall be carried out on the basis of the rules of the Classification Society and the maker's inspection standard.

For such auxiliary machinery as air compressors, pumps, etc. for which certificates of Classification Society are required, the shop tests shall be carried out in the presence of the surveyor of the Classification Society as far as required thereby and otherwise by the makers' own inspection schedule without attendance of the surveyors. Builder shall advise the Owner of the shop test schedule for attendance if required.

(A) Main Engines

a) Load Test :

50%	Load	.....	30 minutes
75%	Load	.....	30 minutes
100%	Load	.....	60 minutes
110%	Load	.....	30 minutes

The brake horse power shall be measured by the maker's hydraulic type dynamometer.

Marine diesel oil of specific gravity 0.9 at 15° C shall be used for the shop test.

b) Lowest revolution running test (About 5 minutes)
c) Governor test
d) Starting and reversing test
e) Emergency trip test
f) Astern running test at no load
g) Automatic trip test
h) Fuel consumption test

B) Diesel Generator Engines

a) Load Test :

25%	Load of Generator	.....	30 minutes
50%	Load of Generator	.....	30 minutes
75%	Load of Generator	.....	30 minutes
100%	Load of Generator	.....	60 minutes
10%	Overload of Generator	.....	20 minutes

7.3 TEST AND INSPECTION – CONT'D

7.3.1 SHOP TESTS AND INSPECTION - Cont'd

B) Diesel Generator Engines – Cont'd

Marine diesel oil shall be used during the shop test.

b) Starting test
c) Governor test
d) Emergency trip test
e) Voltage and speed regulation test
f) Parallel running test
g) Reverse power relay test
h) Overload test
i) Over speed trip test
j) Fuel consumption test

These tests shall be carried out with the alternator coupled to the engine.

C) Oil Fired Boiler

To be tested to Maker's standard.

D) Propeller

Survey and balance test after completion

E) Pumps, purifier, air compressor and others

Note: Shop test shall be carried out in accordance with each maker's standard if required by the Regulatory Bodies.

7.3.2 INSPECTION AT SHOP

a) Main Engines

Open inspection shall be carried out as below after shop test.

No.1	Overhaul Item	Quantity	Inspection
1.	Crankshaft	1 bearing	Appearance inspection without lifting up from bed plate (main and crank pin bearing only shall be dismantled)
2.	Main bearing	1 bearing	Appearance inspection (Upper and lower shells shall be dismantled from bed plate)
3.	Cylinder liner	1 cyl.	Appearance inspection of inner surface
4.	Cylinder cover	1 cyl.	Appearance inspection of combustion surface (shall be dismantled from engine)

7.3 TEST AND INSPECTION – CONT'D

7.3.2 INSPECTION AT SHOP – CONT'D

a) Main Engines – Cont'd

5.	Crank pin bearing	1 cyl.	Appearance inspection of bearing surface (top and bottom)
6.	Piston complete	1 cyl.	Appearance inspection, (shall be dismantled from engine)
7.	Camshaft drive gear train	1 engine.	Appearance inspection (to remain in engine)
8.	Exhaust valve	1 unit	Appearance inspection

b) Diesel Generator Engine

Open inspection shall be carried out in accordance with the maker's standard overhaul check which shall be submitted to Owner.

7.3.3 ON BOARD TEST

After the main diesel engine, diesel generator engines, auxiliary machinery and electrical equipment are installed onboard and relevant piping and wiring are fitted, these machines shall be operated and examined to check whether their functions are satisfactory.

On board test procedures shall be submitted for Owner's approval.

7.4 MAIN ENGINES

7.4.1 GENERAL

The main engines shall be in accordance with the particulars described in the Section 7.2 "MACHINERY PARTICULARS" and the following description.

The construction, materials and fittings for the engine shall be in accordance with the engine maker's standard.

The engine shall be complete with lubrication oil, fresh water and sea water pumps, filters, heat exchanger, oil cooler, 24 volt battery charging dynamo, silencer, spark arrestor and all necessary gauges and instruments.

One (1) flexible coupling shall be fitted for connection between the flywheel of the engine and the gearbox.

The diesel engine shall be remotely controlled at the bridge unit control panel with local controls in the engine control room (ECR).

7.4 MAIN ENGINES – CONT'D

7.4.1 GENERAL – CONT'D

Fresh water make up tanks, fresh water and lub oil coolers shall be installed and connected in accordance with the engine manufacturer's requirements.

The engine shall be heat exchanger cooled and draw fuel oil from the daily service tank through suitable duplex filters.

The engine shall be aligned and secured to the satisfaction, and within the tolerances specified by the Engine Suppliers and the Surveyors.

Resin chocks shall be fitted between the engine mounting surfaces and engine bearer plates for levelling the engine foundation as well as for taking the thrust in both directions. Fitted bolts shall be used to secure the engine as shown on the Engine Girder Construction Drawing and Engine Manufacturers recommendations.

A central railing shall be fitted over both the main engines with a pulley block on each railing to facilitate lifting of parts while overhauling main engine.

All air reservoirs shall be installed at an inclination of about 5° from the horizontal and the drain cock shall be provided at the lowest point on the air reservoir.

7.4.2 ACCESSORIES AND FITTINGS

The following accessories and fittings shall be included with the main engine supply.

(A) Exhaust Gas Turbocharger :

Type	:	VTR type. (The roller bearing and gas outlet casing of turbine side shall be colled by F.W.).
Bearing	:	Blower side : Ball bearing Turbine side : Roller bearing
Lubrication	:	Self-lubricating.
Accessories	:	Water washing device for blower side and dry-cleaning equipment for turbine side.
Lubrication	:	Self-lubricating.
Accessories	:	Water washing device for blower side and dry-cleaning equipment for turbine side.

7.4 MAIN ENGINES – CONT'D

7.4.2 ACCESSORIES AND FITTINGS – CONT'D

(B) Air Cooler : Single stage

Permanent chemical cleaning system shall be arranged for the air side in accordance with the Maker's recommendation. Permanent flange connection shall be provided on S.W. inlet/outlet for chemical cleaning.

(C) Auxiliary Blower :

In the lower power range of the main engine, the electric blowers shall assist the turbocharger in order to ensure surge-free operation of the turbocharger as well as good acceleration performance.

Capacity : The Maker's standard

(D) Turning gear type : Planetary gear, reversible driven by electric motor built in gear and brake. A control device for turning gear consisting of starter and manual remote control box.

(E) Thrust Shaft and Bearing.

(F) Flywheel with Protection Cover.

(G) Starting Valve.

(H) Cylinder Lubricator.

(I) Governor.

(J) Indicator Gear.

(K) Slowturning Device.

(L) Mechanical Balancer

(M) Others shall be in accordance with the maker's standard.

The drawing of other accessories and fittings as recommended by the engine maker shall be submitted to Owner for reference.

7.5 SHAFTING AND PROPELLER

7.5.1 GENERAL

The shaft diameter, the propeller diameter, the number of blades and other details shall be determined and designed in consideration of the main engine's torsional vibration as well as hull vibration.

Consideration shall be given to the engine's rotating masses including shafting, main engine and propeller so as shall be free of all major stresses due to torsional vibration in the normal operating range.

Torsional vibration calculation, prepared by the engine maker, shall be submitted to the class for approval.

7.5.2 PROPELLER SHAFT

The shafting shall be arranged with an oil type lubricating system.

The shafting comprises a propeller shaft and an intermediate shaft to (if required) Rule Requirements.

The intermediate shaft shall be of forged steel with keyed tapered end to suit the couplings.

The aft end of the tail shaft shall be tapered for fitting the keyed propeller and hydraulic nut.

The keys shall be of forged steel and securing screws of stainless steel.

A locking system shall be incorporated in the shafting arrangement.

An earthing system shall be fitted.

7.5.3 STERN TUBE AND BUSH

The stern tube shall be of mild steel pipe which is welded to the ship's stern boss which is rigidly secured to the hull structure by welded mild steel struts.

The stern tube bush shall be of gun metal with a lining of white metal having a length consistent with a suitable bearing load.

A condition monitoring system shall be provided to measure the variation in the clearance between the stern tube bush and the propeller shaft.

Alignment shall be effected by resin solution of a type approved by the Classification Society.

7.5.4 COUPLING BOLTS AND NUTS

Forged steel plain type reamer bolts and nuts shall be used for flange coupling between the gear box and the propeller shaft.

7.5 SHAFTING AND PROPELLER – CONT'D

7.5.5 STERN TUBE SEALS

The seals shall be of LIPS type (or SIMPLEX).

The forward face seal has cylindrical, moulded, elastomeric body which incorporates a split Face Insert.

The oil lubricating system for both forward and aft face seal is common to that as used in the lubricating stern bearing.

A common oil tank shall be sighted above max. draught and circulation shall be either by thermo siphoning or oil-lubricating pump.

7.5.6 PROPELLER

The four or five blade controllable pitch propeller shall be cast in NI-AL bronze.

The material shall have a minimum ultimate tensile strength of 450 kgf/sq.mm and shall be tested to the satisfaction of the Surveyors.

The direction of rotation shall be clockwise viewed from the aft when running ahead.

The propeller shall be designed in conjunction with analysis of propulsion efficiency, cavitation and the extent of vibration to the hull's superstructure and machinery.

The keyless propeller hub shall be attached to the cone part of the propeller shaft which has the taper of about 1/20 and secured by a hydraulic nut. A simple hydraulic oil injector shall be furnished.

Oil grooves shall be provided on the inner surface of the taper bore of the hub for fitting and removal.

The propeller cap of NI-AL bronze shall be secured to the hub by stainless steel screw and its interior shall be filled with suitable rust preventative materials.

After finishing according to ISO Class I, the propeller shall be statically tested according to the maker's standard method and polished all over to give a smooth surface.

A stainless steel rope guard shall be provided between the stern boss and the propeller hub around the propeller shaft.

Net cutters of 'Cadyma' type shall be provided for protection against ropes, fishing nets etc.,

The propeller pitch shall be selected so as to absorb MCR power at MCR RPM with about 3% margin at design draft, in calm sea and with clean hull bottom condition.

7.6 THERMAL OIL PLANT

7.6.1 GENERAL

The capacity of the thermal oil heater shall be so decided as it can supply thermal oil required for cargo heating at their required load.

7.6.2 STEAM ECONOMISER

One (1) exhaust-heated steam economizer of water coil type, shall be fitted in the casing, supplying steam to the oil-fired boiler.

The capacity of the exhaust-heated boiler shall be suited to the waste heat available from the main engine's exhaust.

7.7 ELECTRIC POWER PLANT

7.7.1 MAIN DIESEL GENERATOR ENGINES

General

The diesel generator engines shall be of four stroke, single shaft system type equipped with turbocharger.

The diesel generator engines shall operate on marine diesel oil.

The cylinder jackets and cylinder covers shall be cooled by fresh water while the air cooler and lubricating oil cooler shall be cooled by sea water.

The governor shall control the diesel engine speed which shall be within the requirements of the Classification Society and Authority.

Each set shall have its alternator driven by the engine through a suitable flexible drive coupling and all machines mounted on a fabricated steel base plate.

Fuel filters shall be fitted in accordance with the Engine Manufacturer's requirements. Fuel return pipes shall be led from the engines through a check valve to the service tank.

The generators shall be complete with the manufacturers scope of supply.

Accessories and Fittings (for one diesel generator engine) shall be in accordance with the following description.

A) AIR INLET SYSTEM

- Air cleaner, regular duty, dry, round type.
- Rain cap at air inlet to prevent ingress of rain.

B) CHARGING SYSTEM

- Charging alternator, 24 volt.

7.7 ELECTRIC POWER PLANT – CONT'D

7.7.1 MAIN DIESEL GENERATOR ENGINES – CONT'D

C) COOLING SYSTEM

- Oil cooler, engine mounted.
- Thermostat and housing.
- Jacket water pump, gear driven, centrifugal type, engine mounted.
- Auxiliary sea water pump, gear driven, rubber impeller, engine mounted.
- Expansion tank, engine mounted.

D) EXHAUST SYSTEM

- Exhaust manifold & turbocharger.
- Spark arrestor muffler.

E) FUEL SYSTEM

- Fuel transfer pump.
- Fuel priming pump.
- Flexible fuel lines, supply loose.
- Primary fuel filter which may be of twin filter assembly type with one filter in use at a time.

F) LUBE SYSTEM

- Crankcase breather, top mounted.
- Oil filter.
- Oil filler.
- Dipstick.
- Oil pan.

G) STARTING SYSTEM

- Air start.

7.7.2 EMERGENCY DIESEL GENERATOR ENGINE

The emergency diesel generator engine shall be a radiator cooled type.

The engine shall be started by the electric storage battery primarily and the second starting method according to the Maker's standard.

7.8 AUXILIARY MACHINERY

7.8.1 AIR COMPRESSORS

A) General

Electric motor driven compressors shall be fitted with automatic start/stop devices at preset pressures.

7.8 AUXILIARY MACHINERY – CONT'D

7.8.1 AIR COMPRESSORS – CONT'D

B) Main Air Compressors

Positive displacement, 2-stage, electric motor driven, direct coupled air compressor shall be installed.

Cooling : Air.
Lubricating : Self-contained lubricating system.

Accessories :

L.O. system according to the marker's standard.
Unloading device for starting.
Gauge board with air and L.O. pressure gauges.
Drain chamber with a drain valve.
Automatic drain trap.
Safety trip device for low L.O. pressure.
Alarm device for discharge air high temperature.
Air suction filter.
Air outlet non return valve.
Air safety valve.
Flexible mounting.
Pressure switch for auto start / stop for each compressor (main as well as working).

C) Working Air Compressor

Positive displacement, 2-stage, electric motor driven, direct couple air compressor shall be installed.

Lubricating : Self contained lubricating system.

Accessories shall be in accordance with the Maker's stamdard/

7.8.2 AIR RESERVOIRS

Main Air Reservoirs

The main air reservoir shall be of the cylindrical welded steel construction and the inside of the air reservoir shall be coated with bleached tar epoxy.

The air reservoirs shall be installed at an inclination of about 5° from the horizontal and the drain cock shall be provided at the lowest point on the air reservoir.

The total capacity of air reservoir shall be sufficient to meet the requirements of the Classification Society.

7.8 AUXILIARY MACHINERY – CONT'D

7.8.2 AIR RESERVOIRS – CONT'D

Accessories :

1 - Relief valve
1 - Charging valve
1 - Main stop valve
1 - Auxiliary stop valve
1 - Manhole cover
1 - Pressure gauge
1 - Drain valve (double valve)

7.8.3 WORKING AIR RESERVOIR

The working air reservoir shall be of the cylindrical welded steel construction and the inside of the air reservoir shall be coated with bleached tar epoxy.

Accessories :

1 - Relief valve
1 - Charging valve
1 - Main stop valve
1 - Manhole cover
1 - Pressure gauge
1 - Drain valve (double valve)

7.8.4 MOTOR DRIVEN CENTRIFUGAL PUMPS

The electric motor for each pump shall have sufficient power for the entire discharge range of the pump.

Horizontal type pump and motor shall be mounted on a common bed plate.

In the case of a vertical pump having a bottom side bearing, the bearing shall be immersed in the handling liquid.

Centrifugal pumps shall be fitted with mechanical seals except deep well type centrifugal pumps, which are provided with the seals according to the maker's standard.

Stuffing boxes of pumps required to operate under suction vacuum shall be arranged for water sealing.

Pump casings, except for small size pumps and specially constructed type pumps, shall be so constructed that the rotating members may be overhauled for inspection or replacement without disconnecting the attached pipe.

However, the electric motor may be taken off according to the maker's standard.

7.8 AUXILIARY MACHINERY – CONT'D

7.8.4 MOTOR DRIVEN CENTRIFUGAL PUMPS – CONT'D

Each impeller shall be dynamically balanced.

Wear ring and sleeve shall be provided as required by the maker's standard.

Capacity of pumps are as mentioned in 7.2.7.2.

Materials :

Sea Water Pumps

Casing	:	Cast Bronze
Impeller	:	Bronze or phosphor bronze
Shaft	:	Stainless steel

Fresh Water Pump

Casing	:	Cast iron
Impeller	:	Bronze or phosphor bronze
Shaft	:	Stainless steel

The self priming type pump shall be provided with the rotary type vacuum pump attached to the pump. The vacuum pump shall be driven by a common electric motor through a conical friction clutch.

Submerged Ballast Pump (Hydraulic driven)

The pump and self priming unit are integrated.

The hydraulic oil is led from deck to the submerged pump through a concentric pipe stack where the hydraulic pressure pipe is placed inside return pipe to obtain maximum safety. Further, the hydraulic is separated from the water by a cofferdam which shall be filled with a water/glycol mixture.

Control	:	Remote and local stepless capacity regulation.
Material pump housing	:	Stainless steel AISI 316.
Material pipestack	:	Stainless steel AISI 316.
Material impeller	:	Seawater resistance bronze.
Seal	:	Mechanical type.

7.8.5 ROTARY PUMPS

Mechanical seal shall be provided for stuffing box in all vertical positive displacement pumps.

The horizontal type pump shall be fitted with a mechanical seal and motor shall be mounted on a common bed plate.

All oil service pumps shall have internal type bearing and shall be self lubricated by the handling liquid.

7.8 AUXILIARY MACHINERY – CONT'D

7.8.5 ROTARY PUMPS – CONT'D

Materials :

Gear type

Casing	:	Cast iron
Gear and Shaft	:	Carbon steel

7.8.6 OTHER PUMPS

The construction materials and design for other pumps which are not mentioned in this Specification shall be in accordance with the maker's standard.

7.8.7 OIL PURIFIERS

a) General
Each purifier shall be independently and thermostatically controlled by thermal heating.

b) Heavy Fuel Oil Purifier
Two (2) units – One (1) for working and the other for stand-by.

c) Lubricating Oil Purifier
One (1) set shall be used for main engine.

d) MDO Purifier
One (1) set shall be used for generator engine and main engine.

7.8.8 ENGINE ROOM VENTILATION FANS

The fans shall be of the vertical and axial flow.

The fan impeller and driving motor shall be incorporated in the fan casing.

The total supply capacity of ventilation fans shall be determined based on the amount of air consumed by the main engine running at its MCR, the air consumption of three generator engines at full load, boiler and incinerator.

Materials :

Casing	:	Steel plate
Impeller	:	Aluminium alloy

Each fan shall be of split with hinged open type casing. Fire damper arrangement for the ventilation fan shall meet the requirement of the Classification Society. The suction of the fan shall have a wire mesh of size 12mm pitch.

7.8 AUXILIARY MACHINERY – CONT'D

7.8.9 INCINERATOR

The incinerator shall be a steel frame enclosing a combustion chamber, which is made of specially designed fire bricks and insulated on the outside.

Sludge oil and solid waste can be burnt simultaneously.

Rotary cup burner shall be provided.

The incinerator shall be equipped with a door for loading garbage/discharging ash and an inspection hole.

The solid waste cannot be loaded while in operation.

7.8.10 HYDROPHORE UNITS

One (1) fresh water hydrophore unit (300 litres) shall be provided. The fresh water unit shall supply fresh water for the domestic, sanitary and engine room service and for drinking water purpose via an ultra violet sterilization system.

A fresh water line shall be run to the wheelhouse and one to the cargo machinery room.

The unit shall consist of a hydro-pneumatic pressure tank and electric motor driven centrifugal supply pump mounted on the pressure tank.

The supply pumps shall start and stop automatically at the preset pressure.

Accessories / Set :

Supply pump	:	2 sets
Charge air valve	:	1 set
Water level gauge	:	1 set
Pressure switch	:	1 set
Safety valve	:	1 set
Drain valve	:	1 set
Cleaning hole	:	1 set

Materials :

Tank	:	Steel with pure epoxy coating
Charge air valve	:	Bronze
Water level gauge	:	Bronze
Safety valve	:	Bronze
Drain valve	:	Bronze
Pump	:	Refer to section on centrifugal pump

7.8 AUXILIARY MACHINERY – CONT'D

7.8.11 STERILIZER

Ultraviolet type sterilizer shall be furnished downstream of the hydrophone unit in order to produce safe and disinfected water from sea water through a low pressure fresh water generator for drinking.

The single stage fresh water generator has a distillate production capacity of 16T/Day with condensation sea water at temperature maximum 32° C and engine jacket cooling water temperature at 80° C.

7.8.12 CALORIFIER (Water Heater)

Hot water calorifier heated by electricity shall be provided in order to supply hot water to the accommodation.

The unit shall consist of vertical cylindrical body, and an electric heating element, insulation and other accessories.

Materials :

Body	:	Stainless steel
Electric heater	:	Stainless steel

7.8.13 OIL BILGE SEPARATOR

The oily bilge separator shall be of approved type by the national authorities under IMO Resolution A.393(X).

Gravity separating type oily water separator shall be provided.

The oily bilge separator shall be composed of separation column(s) and an oil level controller with detector and solenoid valve.

The oil content of treated water shall be less than 15 ppm and a 15 ppm oil content bilge alarm and automatic recirculation system shall be provided.

Materials :

Shell : Steel plate (coated inside with anti-corrosive paint).

7.8.14 SEWAGE PLANT

One (1) biological type sewage plant with one (1) holding tank shall be provided in the engine room.

The sewage plant shall be fitted with one sewage discharge pump of materials to the Maker's standard.

The capacity of the pump shall be $5M^3$/hr at 25M head.

7.8 AUXILIARY MACHINERY – CONT'D

7.8.14 SEWAGE PLANT – CONT'D

Toilet discharge in the accommodation shall be connected to the sewage tank. Shower space, bath tub and galley drains shall be led directly overboard.

A bypass arrangement to sewage tank shall be provided to connect overboard directly if required.

7.9 MISCELLANEOUS

7.9.1 FLOORS, GRATINGS AND LADDERS

Platforms, gratings and ladders shall be provided for access, operation and repair of the machinery and other apparatus.

The chequered plates shall be arranged in the engine room, around the main engine and on the walkway for access to other machinery.

The chequered plate shall be 4.5 mm thick or as required, max. 800 x 1,200mm plates, supported by steel angle frames, and fixed to steel angle frame by counter sunk screws where regular maintenance is required shall be provided.

Open grating where used shall be of fabricated galvanized steel and supported by steel angle frames.

A hinged hand hole cover shall be provided on the floor plate for operating valves and strainers.

The name plate shall be provided on valve hand wheel.

The main access grating and ladder shall have a width of about 600 mm in principle.

The slope of the main access ladder shall be about 55 degrees in general.

The ladders shall be provided with a non-slip type tread or open grating and hand rails.

The main ladder shall be provided with a dust plate at the under side if there is a passage under the main ladder.

A vertical ladder with hand grip at upper part shall be provided as far as practicable where the installation of an inclined ladder is impractical.

The hand rails shall be of steel pipes painted same as surrounding.

The stanchion shall be of steel pipe for inclined ladders or flat bar for vertical ladders.

7.9 MISCELLANEOUS – CONT'D

7.9.1 FLOORS, GRATINGS AND LADDERS – CONT'D

Keep (safety) chain of hand rail shall be provided in way of vertical ladder to tank top from floor deck.

7.9.2 SEA CHESTS

One low and one high level sea chest and one dedicated to the emergency fire pump shall be installed.

The sea chests shall be provided with aluminium anodes of two and a half (2.5) years life time.

The sea chests shall be of welded steel construction with removable galvanised steel grids with a clear area of at least 2.5 times the cross over area of the sea valve.

The grids shall be secured with stainless steel (SUS 316) bolts and nuts and shall be fastened so that no part extends past the shell plate. A positive locking arrangement shall be provided to the fastening bolts so that they do not become loose in service.

Each sea chest in the engine room and for the submerged ballast pumps shall be provided with an air blowing connection.

A vent shall be provided on top of each chest which shall be led to the weather deck ending in a goose neck.

7.9.3 OVERBOARD SEA CONNECTIONS

The overboard sea connections shall be steel pipe or fabricated steel plate of suitable thickness in accordance with the requirements of the Classification Society and Builder standard.

The discharge valves shall be attached to the shell plate under the light load water line in principle.

Overboard discharge connections shall be avoided in and around the rescue boat area and the accommodation ladder.

7.9.4 UPTAKES AND FUNNELS

A) Main and Diesel Engine Exhaust Gas Uptakes

The exhaust gas uptake from the main engine exhaust gas turbocharger shall be led to the atmosphere through a silencer to the top of the funnel.

The diesel generator engine exhaust gas uptake shall be led from engine to the atmosphere through a silencer to the top of the funnel.

7.9 MISCELLANEOUS – CONT'D

7.9.4 UPTAKES AND FUNNELS

A) Main and Diesel Engine Exhaust Gas Uptakes – Cont'd

Bellows type expansion joint of stainless steel shall be provided on the exhaust gas uptake of the engines as necessary.

The exhaust gas uptakes shall be supported from the ship's structure.

It is not permitted to run the exhaust pipes of two or more engines together.

Exhaust pipes and silencers shall be suitably insulated with heat resisting insulating slabs embedded on temperature resisting compound and covered with approved material.

Special attention shall be given to the prevention of entry of water when the engines are shut down for long periods.

Suitable draining arrangement shall be provided on the main engine and generator uptakes before vertical bends.

B) Boiler Uptake

The auxiliary boiler uptake shall be led from the boiler to the atmosphere.

Bellows type expansion joint of stainless steel shall be provided on the boiler exhaust gas uptake.

C) Incinerator Uptake

The waste oil incinerator uptake shall be led from the incinerator to the atmosphere.

Bellows type expansion joint of stainless steel shall be provided on the exhaust gas uptake.

D) Funnel

A funnel of suitable height and ample size for the pipes and access shall be provided as shown in the General Arrangement Plan.

The funnel shall be kept weather-tight by horizontal weather shield with access hatch.

The drain from the weather shield shall be led to the weather scupper.

7.9 MISCELLANEOUS – CONT'D

7.9.5 VENTILATION

The machinery space shall be ventilated by a mechanical ventilating system.

Engine room ventilation shall be calculated taking into consideration the combustion air requirements for main engines and auxiliary engines.

The ventilating fans shall supply fresh air to the control station and other necessary places in the engine room through air ducts.

The air ducts shall be of fabricated steel plate of 2.3 mm thickness for main lines and branch lines and painted.

The height of the vent ducts shall be approx. 2,100mm from the passage as far as practicable.

The mean air velocity shall be about 8m/sec. at the outlet of each branch duct.

The exhaust air from the engine room shall be led to the atmosphere through an opening at the rear wall of the funnel.

The exhaust air opening and fresh air intakes shall be provided with wire pulled type emergency shut-off fire dampers from the outside of the engine room.

Purifier spaces exhaust air shall be extracted through separate duct.

Each inlet shall be fitted with a 'rat proof' screen.

7.9.6 ENGINEER'S WORKSHOP/STORE AREA

An engineer's workshop / store shall be arranged on the main deck separately with an entrance door with a lock.

The machine tools and equipment as listed in the paragraph 7.2.13 shall be efficiently arranged in the workshop and also a tool board, a tool locker and two shelves shall be provided.

Oxygen and acetylene bottles for gas welder shall be arranged separately with partition wall in suitable place on main deck and two permanent stainless steel pipings for these shall be led to the workshop through a regulating valve and pressure gauge.

Electrical test panel and one (1) self shall be provided in electrician workshop.

Shelves shall be provided in the store room for storing spare parts, tools and general equipment.

The shelf frames shall be fabricated steel angle, and the shelves shall be of fabricated steel.

7.9 MISCELLANEOUS – CONT'D

7.9.6 ENGINEER'S WORKSHOP/STORE AREA – CONT'D

Boxes for spare parts and tools shall be of steel construction and as provided by the maker's standard of the subject equipment.

Cabinet steel drawer shall be provided for storing small parts and tools.

7.9.7 ENGINE CONTROL ROOM (ECR)

This shall be located in the engine room and incorporate, switchboard, desk & chair for engineer, communications, alarm panel etc.,. This room shall be air-conditioned separately using a split unit.

7.9.8 TANKS

The tanks of large capacity shall be, in general, integral with the hull construction while small size tanks shall be independent from the hull.

All tanks shall be of welded construction made of steel plate and shall be provided with stiffeners as necessary.

Each tank shall be equipped with necessary fittings, such as a sounding device, air vent, manhole or hand hole, etc.

Overflow and draining device also shall be fitted where applicable.

The size of the air vent and overflow shall be in accordance with the requirements of the Classification Society.

Test cock shall be provided for sludge and F.O./L.O.drain tanks.

7.9.9 LIFTING GEAR

A) Main Engine

Overhead crane shall be installed above the main engine and to be supported by two side-rail laid across fore and aft the engine room at sufficient height.

End stoppers shall be provided to prevent motion at end of travel.

Limit switch shall be provided on E/R crane.

The overhead crane shall be able to reach heavy spare parts stored in the vicinity of the main engine.

Hoisting	:	Electric motor driven (two speed).
Travelling	:	Electric motor driven.
Transversing	:	Electric motor driven.

7.9 MISCELLANEOUS – CONT'D

7.9.9 LIFTING GEAR

B) Main Diesel Generator Engine

Fixed I-beam and plain trolley shall be provided for overhaul.

C) Shafting

Eye lugs shall be provided for removing the shaft.

D) Purifier

Fixed I-beam shall be arranged for overhaul of the purifier.

E) Workshop

Fixed I-beam shall be arranged for workshop.

F) Other Machinery

Chain blocks, shackles, beam clamps etc. shall be furnished in accordance with the Section 7.9.9 Engineer's General Tools and Equipment" and stored in the store room.

Eye-lugs shall be suitably fitted for motors, pumps, heat exchangers and heavy strainers of 40 kg and above.

7.10 INSULATION

A) General

The surfaces having normal operating temperatures above 60 Degree C shall be insulated, except valves and flanges, where required, for maintaining internal fluid temperature and for personal protection.

Insulation of all machinery such as diesel engines, calorifier etc., shall be in accordance with each maker's standard practice.

Wherever insulated piping contains flanges, fittings and valves, the ends of the insulation shall be suitably terminated to permit free removal of bolts and to allow for movement of the pipe on its hangers.

Insulation materials for vertical exhaust gas uptakes shall be fastened on suitable stoppers (protecting rings) which are directly welded on the uptakes.

Exhaust gas uptakes in the funnel shall be insulated up to about 2,100 mm in height at the bottom of funnel.

7.10 INSULATION – CONT'D

A) General – Cont'd

H.F.O. lines except H.F.O. filling, drain, overflow and air vent line shall be insulated as recommended by Engine Maker.

Tanks and pipes below the floor shall not be insulated, in principle, except where it is necessary for protection of personnel and reducing heat losses.

B) Insulation of Exhaust Gas Uptake

No.	Description	Dimension	Material	Remark
1	Cover Felt	50 mm t 100 mm t	Asbestos free Calcium silicate	450 & below 500 & above
2	Steel wire	# 16	SWRM	
3	Steel plate	0.5 mm t	SS41	Galvanized
4	Self Tapping screw	Size G10 X ½"	SS41	Galvanized or cadmium plated

1. Main engine
2. Boiler
3. Diesel generator engine
4. Incinerator

C) Insulation of General Piping in E/R

No.	Description	Dimension	Material	Remark
1	Mineral wool cover	30 mm t	Rock wool (or Equivalent)	25A & above (for pipe)
2	Steel wire	# 18	SWRM	
3	Bond		Non-flammable	
4	Glass cloth with Al-foil	0.12 mm t	Glass cloth with Al-foil	
5	Tape	0.12 mm t	Glass cloth with Al-foil	For elbow

The valves and flanges of 25A and above for the heating tracing pipes in engine room and insulated pipes in the purifier room shall be lagged with mineral wool felt (25 mm thickness) and glass cloth cover with AL-foil.

7.10 INSULATION – CONT'D

D) Covering for Sweat Prevention

- Cold fresh water and sea water running above electrical equipment.

No.	Description	Dimension	Material	Remark
1	Canvas	0.5 mm t	Cotton	Or as Builder's practice
2	Bond		Non-flammable	

E) Others

No.	Description	Dimension	Material	Remark
1	Glass cloth	0.5 mm t	Glass	
2	Bond		Non-flammable	
3	Steel wire	# 18	SWRM	

F) Insulation of Tanks

1) H.F.O. service tanks.
1) H.F.O. settling tanks.
2) Incinerator waste oil tank.

In case of hull structure tank, front and side walls facing into engine room area only shall be insulated.

No.	Description	Dimension	Material	Remark
1	Mineral wool	25 mm t	Rock wool	
2	Steel plate	0.5 mm t	SS41	Galvanized
3	T-Bar	25 mm 25 MM x 1.6 mm t	SS41	
4	Pop rivet	Dia. x 12L	AL. SS41	

7.11 SPARE PARTS, ACCESSORIES AND TOOLS

7.11.1 SPARE PARTS AND ACCESSORIES

Spare parts for one (1) year's service and accessories shall be neatly stowed in the store room or engine room.

Suitable rust preventive coatings shall be applied where necessary.

7.11 SPARE PARTS, ACCESSORIES AND TOOLS – CONT'D

7.11.2 TOOLS

The following tools shall be provided for the stated machinery.

A) Main Engine

As per the main engine maker's standard.

B) Shaft and Propeller

One (1) - Turning bar for propeller shaft nut
One (1) - Spanner for coupling bolts
One (1) set - Tools for oil seal gland
One (1) set - Hydraulic tools for propeller fitting.

C) Main Diesel Generator Engine, Auxiliary Boiler, Air Compressor And Other Machineries.

Tools shall be supplied in accordance with the maker's standard.

7.12 PIPES AND FITTINGS

7.12.1 GENERAL

The pipes shall be designed to absorb the stresses caused by thermal expansion and deflection of the ship's structure.

The liquid and oil piping shall be arranged sufficiently far from electrical instruments, in principle.

Pipe fittings shall be so arranged that the leaking may not disturb the electrical gear such as switch gear, etc., if unavoidable, proper protection shall be provided.

The piping shall be suitably supported so as it shall not be damaged by vibration.

Neoprene, lead or brass plate lining shall be inserted in pipe straps for non-ferrous pipes in accordance with Builder's standard practice.

Air pockets in the piping shall be eliminated wherever possible. If unavoidable, air vents or screwed drain plugs shall be fitted.

The vents and drain lines shall be sloped effectively wherever possible. If unavoidable, a plug shall be fitted for drainage.

7.12 PIPES AND FITTINGS – CONT'D

7.12.1 GENERAL – CONT'D

The pumps, heat exchangers and other equipment shall be capable of overhauling without removal of the connected pipes. Also minimum clearance shall be left around all valves fittings and strainers to allow overhauling/cleaning without piping being removed.

Generally, slip-on flange, joints shall be used for connections of steel pipes.

However, the pipes of the diameter of 10 mm and below shall be connected by union or sleeve joints for overhaul and inspection of valves or machinery.

Where pipes pass through water-tight decks or bulkheads. penetration pieces shall be used.

The pipes shall be hydrostatically tested in accordance with the requirements of the Classification Society.

Emergency shut-off valves which are fitted on the oil tank suction in compliance with the requirements of the Classification Society shall be of such a design that can be shut quickly by means of mechanical controlled from outside engine room.

Asbestos shall not be used as the materials of insulation, gasket, etc.

7.12.2 PIPING MATERIALS AND APPLICATION

Materials for pipes and valves on each system shall be as follows : -

These are indicative. Builder's standard procedure complying with class requirement will be applicable.

For pipe thickness and abbreviation used in the following table, refer to section 5.3.1. There are indicative Builder's standard practice complying with class requirements will be applicable.

7.12 PIPES AND FITTINGS – CONT'D

7.12.2 PIPING MATERIALS AND APPLICATION

Table 1- Piping Application Table

System	Nominal bore of pipe and valve	Pipe Material and thickness	Joint	Valve Body	Pressure rating Kg/Cm^2
Drain	40mm and below	SCH. 40		Bronze	
Heating coil in H.F.O tanks	All size	Stainless steel SCH.40	Sleeve	-	10
Cooling fresh water	50mm and above	Carbon steel	Sleeve, flange	#Cast iron	5
	40mm and below	SCH. 40		Bronze	
Engine room F.W. service & sanitary water	All sizes (Galvanized)	Carbon steel SCH. 40 (Galv.)	Sleeve, flanged	#Cast iron Bronze	5
Drinking hot water	15mm and above ---------- 10mm and below	SUS 304 SCH. 20	Flanged Bite type union		10
Sea water cross over & cooling sea water	125mm and above	Carbon steel (Galvanized) SCH. 80	Sleeve flanged	#Cast iron Bronze (40mm and below)	5
	100mm and below	Carbon steel SCH. 80			
Fire, bilge line	200mm and above	Carbon steel (Sch. 40) Galvanized SCH. 80	Steel flanged	#Cast iron Bronze (40mm and below)	5 (10 for fire)
	150mm and below	Carbon steel SCH. 80) Galvanized			

7.12 PIPES AND FITTINGS – CONT'D

7.12.2 PIPING MATERIALS AND APPLICATION – CONT'D

Table 1- Piping Application Table – Cont'd

Lubricating oil	All sizes	Carbon steel SCH. 40	Steel flanged	#Cast iron Bronze	5
Fuel oil booster pump discharge	All sizes 40mm and below	Seamless Carbon steel SCH., 80	Steel flanged	Cast steel Bronze	10
Fuel oil handling (except) the above	All sizes	Carbon Steel	Steel flanged	Cast iron Bronze	5
Drain line for water, L.O. and F.O.	All sizes	Carbon steel SCH. 40	Steel flanged	#Cast iron Bronze	5
Compressed air of 30 kg/cm^2G	All sizes	Seamless carbon steel SCH.80	Forged steel flanged	Forged steel	5
Compressed air of $7kg/cm^2G$	50mm and above	Carbon steel SCH. 40	Steel flanged	#Cast iron Bronze	10
	10mm and below	Seamless copper	Bite type union		
System	Nominal bore of pipe and valve	Pipe Material and thickness	Joint	Valve Body	Pressure rating Kg/Cm^2
Exhaust gas uptake	450mm and above	Carbon steel SCH. 20	Butt welded, sleeve joint or flanged	-	-
	500mm and below	Welded steel plate (THK:6 mm)			
Ship side valve/distance piece for shipside nozzle	50mm and above	Carbon steel SCH. 80	-	#Nodular cast iron or cast steel	-
	40mm and below			Bronze	

7.12 PIPES AND FITTINGS – CONT'D

7.12.2 PIPING MATERIALS AND APPLICATION – CONT'D

Table 1- Piping Application Table – Cont'd

Air vent & sounding for independent tanks	All sizes	Carbon steel (SCH., 80) Galv. : except for oil tanks	Steel flanged or sleeve joint	- Bronze	5
Air vent & sounding for hull-structured tank	All sizes		Steel Flanged or sleeve joint	- Bronze	5
	65 mm to 80 mm	Carbon steel SCH., 80 Galv. : except for oil tanks			

Notes :

1. Fittings of 10mm and below in nominal diameter shall be, in general, of cast bronze.
2. Joints of 10mm and below in nominal diameter shall be, in general, of bite compression type fitting using brass materials.

3. Sleeve joint may be used for low pressure lines (up to 10kg/cm2) and pipe connections at hull block joint parts.

Table 2 Butterfly Valves

Use	Size	Material	
		Body & Seat	Joint
General service (10 kg/cm^{2}G and below)	50mm and over	Cast iron body lined with synthetic rubber seat	Flangeless (Wafer)
Sea suction & overboard discharge (attached on hull)	50mm and above	Cast steel or nodular cast body lined with synthetic rubber seat	Flange

8 - CONTROL SYSTEM

8.0 GENERAL

Remote operation shall be so designed that the propulsion plant shall be operated from the wheelhouse with one man bridge operation.

One (1) control room shall be arranged in the engine room, where the control of the main engine and switchboard shall be installed.

The machine side control of main engine shall be provided for emergency use.

The instrument gauge and alarm shall be arranged in good order for safety operation and easy maintenance.

Automatic combustion control and equipment concerned with boiler shall be arranged adjacent to the boiler.

Automatic controllers and control valves shall be provided on principal systems for safety operation and easy maintenance.

When the measuring value of the Main Engine and Generator is high or low from the predetermined value, a buzzer shall sound and the alarm indication shall flicker for the operator's attention.

An engine officer calling alarm system shall be fitted to each engine officer's cabin to act for a purpose to call a watch-keeper for watches or in emergency. Refer to Section 9.

The alarms shall activate suitable audible and visible alarms throughout the engine room, engine control room as well as the wheelhouse, only as per Class requirements.

8.0.1 INSTRUMENTS

All instruments shall be of suitable construction for maximum operating value, and shall be of graduations in metric units.

Temperature sensor for remote reading and supervision shall be of the electric type.

Thermometers and temperature sensor for monitoring of fluid temperature only shall be equipped with pockets of suitable materials or shall be element exchangeable type.

Local pressure gauges shall be vibration resistant and Maker's Standard type.

Remote level indication and pressure indication shall be of the pneumatic or electric type.

8.0.2 CONTROL VALVES

In general, local control loops for temperature, pressure and level control shall be of the pneumatic cylinder type or diaphragm type, but for some minor purposes, wax type or self contained type valves may be used.

All pneumatic control loops shall have air filter regulators.

8.1 CONTROL STATION LAY-OUT

8.1.1 ENGINE CONTROL ROOM

An enclosed engine control room shall be arranged as follows :

- E/R control console with main engine manoeuvring devices, auxiliary service instruments, etc.
- Main switchboard.
- Group starter panel for essential motors.
- A package type unit cooler.

The above panels shall be combined or divided into suitable sections depending on developing of detail design.

Two (2) doors shall be provided for access to the control room from the engine room.

The floor of the control room shall be of electrically insulated material.

Sound proof and thermal insulation for engine control room shall be ensured.

8.1.2 NAVIGATION CONTROL SPACE

Following equipments shall be provided in wheelhouse.

Bridge control console
Measuring instrument panel
Control switch panel
Chart table
Radio table

8.2 SCHEDULE OF AUTOMATION AND REMOTE CONTROL

8.2.1 MAIN ENGINE CONTROL

The main engine remote control system shall be of electric type.

The starting, stopping and speed setting of the main engine shall be controlled by control levers mounted at the engine control room console.

8.2 SCHEDULE OF AUTOMATION AND REMOTE CONTROL – CONT'D

8.2.1 MAIN ENGINE CONTROL – CONT'D

Emergency trips and turning interlock shall be provided as protecting and safety devices.

Automatic control of engine revolutions shall be achieved by mechanical hydraulic governor.

Automatic start and stop device of auxiliary blowers shall be provided.

8.2.1.1 LOCAL CONTROL

A simple emergency control lever and limit switch for indication of emergency manual control shall be provided on engine side for emergency use, with which the engine can be controlled mechanically in case the remote control system has failed.

8.2.1.2 REMOTE CONTROL FROM ENGINE CONTROL ROOM

The manoeuvring lever and reverse lever corresponding to the manoeuvring devices on engine shall be installed in the engine control room console.

These levers respectively operate the pneumatic valves which control cylinders connected to the manoeuvring mechanism of engine by means of air pressure signal.

8.2.1.3 PROTECTING AND SAFETY DEVICES

1) Emergency Trip

Under the following conditions, main engine shall be automatically stopped with an alarm according to Class requirement.

A manual emergency trip system shall be independent of the remote control system.

Emergency trip system shall be independent of the remote control system.

2) Turning Interlock

While the turning gear is engaged, a starting pilot air valve for starting shall be locked or as per Maker's standard.

3) Automatic Slow - Down

Main engine speed shall be manually reduced on request to slow "RPM" on following conditions.

- High scavenge air temperature (fire detection)
- High oil mist in crankcase

8.2 SCHEDULE OF AUTOMATION AND REMOTE CONTROL – CONT'D

8.2.1.3 PROTECTING AND SAFETY DEVICES – CONT'D

3) Automatic Slow – Down – Cont'd

- Low piston coolant pressure
- High piston coolant outlet temperature
- Cylinder oil non-flow
- High cylinder coolant outlet temperature
- High exhaust gas outlet temperature per cylinder

By-pass switch of this system except high crankcase oil mist shall be provided in the engine control console.

8.2.1.4 STARTING

Program for three (3) starting attempt device shall be provided.

8.2.2 THERMAL GENERATOR PLANT

8.2.2.1 COMBUSTION CONTROL

The boiler shall be equipped with automatic combustion control system to start/stop automatically fuel and air supply to the furnace to maintain a pre-set steam pressure. The fuel oil shall be regulated by the automatically operated control valve.

The control equipment of automatic combustion control, forced draft fan and water level gauge shall be fitted on the boiler side.

Remote water level gauge shall be fitted also in the engine control room console.

8.2.2.2 FEED WATER CONTROL

The feed water flow to the boiler shall be controlled by the automatically operated feed water regulator to maintain the water level within the predetermined limit.

8.2.2.3 STEAM PRESSURE CONTROL

A steam dump valve shall be provided for boiler and arranged so that should the steam pressure be over the pre-set value, the excess steam is led to dump cond. / drain cooler.

8.2.2.4 SAFETY DEVICE

The boiler shall be automatically shut-off by cutting off the fuel oil to burner according to the requirement of the Classification Society and Maker's standard.

A manual emergency boiler shut-off means shall be provided on boiler control panel and engine control console.

8.2 SCHEDULE OF AUTOMATION AND REMOTE CONTROL – CONT'D

8.2.3 ELECTRIC GENERATING PLANT

8.2.3.1 DIESEL GENERATORS

1) General

The generator engine shall have remote speed control from the engine control room by governor control switch on main switchboard and also controlled at engine side.

Lub. oil temperature control system shall be provided for each diesel engine according to Maker's standard.

Fresh water temperature control for generator engines shall be performed by cooling water system of the generator engines.

Automatic shut-down at overspeed, critical levels of a lub. oil pressure and a cooling water outlet temperature shall be provided for diesel generator engines.

Local engine control panel with necessary alarms, indication lamps and control switches shall be provided.

Busbar and other equipment capacity should be sufficient for three gensets.

2) Automatic Operation Of Generators

(1) General mode Of control

Diesel engine for generator shall be manually started by compressed air.

(2) Mode Of Generator Control

Following conditions will manually start up a stand-by generator.

(a) Black out on main bus-bar
(b) Low voltage on main bus-bar
(c) High voltage on main bus-bar
(d) Low frequency on main bus-bar
(e) ACB abnormal trip on generator in service.
(f) Over current of generator in service

The stand-by generator will act as follows under above conditions : -

Condition (a) or (e) :

The stand-by generator shall be manually started and connected to the main bus-bar.

8.2 SCHEDULE OF AUTOMATION AND REMOTE CONTROL – CONT'D

8.2.3 ELECTRIC GENERATING PLANT – CONT'D

8.2.3.1 DIESEL GENERATORS – CONT'D

2) Automatic Operation Of Generators – Cont'd

(2) Mode Of Generator Control – Cont'd

Condition (b), (c) or (d) :

The stand-by generator will start and be connected to the main bus-bar after generator ACB in service has been tripped by signal that the stand-by generator is up to the normal speed.

Condition (f) :

The stand-by generator will start, synchronise and connect manually to the main bus-bar and run in parallel by manual control load sharing.

The preference trip system shall be initiated and trip the non-essential loads.

(3) Synchronizing and Load Sharing Modes.

(a) Manual synchronizing and manual load sharing:

When "Manual" position is selected for the stand-by generator, the generator can be started remotely from the engine control room and connected manually to the main bus-bar.

The manual synchronizing shall be available by synchroscope, synchronizing lamps, and relevant control and governor switches of the prime movers.

The manual load sharing shall be available by means of governor control switches.

The stopping of any generator is available by stop switch.

8.2.3.2 EMERGENCY DIESEL GENERATOR

Alarm lamps shall be mounted locally on the engine control panel for the indication of the following abnormal conditions.

- High cooling water temperature
- Low lub. oil pressure
- Overspeed

The engine shall be tripped on over speed and low lub oil pressure condition.

8.2 SCHEDULE OF AUTOMATION AND REMOTE CONTROL – CONT'D

8.2.4 AUXILIARY SYSTEMS IN THE ENGINE ROOM

The following auxiliaries shall be manually changed over to the stand-by one, in the event of a low pressure and/or no voltage of the running pump.

However, the initial start shall be performed at the machinery side, in connection with operation of the associated valves.

- M/E jackets cooling F.W. pumps
- Main cooling S.W. pumps
- Main lubricating oil pumps
- M/E F.O circulating pumps
- M/E F.O supply pumps
- G/E F.O supply pumps
- Boiler feed water pumps

Stand-by selector switch for manual change-over shall be provided in each starter panel.

8.2.4.1 COOLING WATER SYSTEM

The main engine cooling fresh water temperature shall be automatically regulated by pneumatic cylinder or diaphragm operated three way valve controlling the fresh water by-pass flow around the cooler.

The diesel generator engine cooling fresh water temperature shall be thermostatically controlled by a wax expansion type three-way valve or thermostatic three way valve (Maker's standard).

8.2.4.2 BOILER FEED WATER SYSTEM

A salinometer with alarm in engine control room shall be fitted on boiler feed water line.

8.2.4.3 LUB. OIL SYSTEM

The main engine lub. oil temperature shall be automatically regulated by pneumatic cylinder or diaphragm operated valve controlling the lub. oil by-pass flow around the cooler (Engine Maker's standard).

The diesel generator engine lub. oil temperature shall be automatically controlled according to the Maker's standard.

The temperature of influx oil to main L.O. purifier shall be thermostatically controlled by a self-contained direct acting two way valve on steam inlet side of lub. oil heater.

8.2 SCHEDULE OF AUTOMATION AND REMOTE CONTROL – CONT'D

8.2.4.4 FUEL OIL SYSTEM

Alarm and recirculation of oil feed to purifier upon loss of seal shall be provided for H.F.O purifier according to Maker's standard. Feed oil shall be recirculated by three way shifting valve.

Auto timer shall be provided for H.F.O purifiers so that auto sludge discharging may be performed.

Indicating flow meters with counter shall be locally installed, one (1) for H.F.O to main engine and one (1) for M.D.O to auxiliary engines.

The temperature of influx meter oil to H.F.O purifiers shall be thermostatically controlled by a pneumatic diaphragm operated two way valve.

One (1) set of automatic viscosity equipment without viscosity recorder shall be provided for main engine. Viscosity shall be controlled by two way valve on inlet side of heaters. (Viscosity indicator shall be installed on engine control console).

The heavy fuel oil transfer pump in engine room shall be automatically stopped by the level switch on the heavy fuel oil settling tank.

The temperature in the heavy fuel oil settling and service tanks shall be regulated by a self-contained direct acting steam control valve on the heating steaminlet line of tank.

The marine diesel oil transfer pump shall be automatically stooped by the level switch on the MDO settling tank.

Remote level measuring for H.F.O bunker / settling/service tank and M.D.O bunker / service tank shall be provided on engine control console.

8.2.4.5 COMPRESSED AIR SYSTEM

The main air compressor shall be automatically started and stopped by means of a pressure switch on the main air line and shall be stopped automatically in case of lub. oil low pressure and discharge air high temperature.

8.2.4.6 SCAVENGE AIR SYSTEM

The auxiliary blowers shall be automatically started and stopped from the engine control room console.

8.2 SCHEDULE OF AUTOMATION AND REMOTE CONTROL – CONT'D

8.2.4.7 OTHER SYSTEMS

The fresh water pump shall be automatically started and stopped by a pressure switch arranged on the fresh water hydrophore unit.

Sludge pump shall be automatically stopped by a level switch on incinerator waste oil tank.

The oily bilge pump shall be automatically stopped by a level switch fitted at the E/R aft bilge well.

8.3 INSTRUMENTATION

8.3.1 ENGINE TELEGRAPH

One (1) set of push button type engine order telegraph system shall be provided, and consist of: -

1 - Transmitter with receiver, bell in the wheelhouse
1 - Receiver with gong at machine side
1 - Receiver/reply transmitter with bell in engine control room console
1 - Non reply type receiver (Telegraph position indicator)
2 face type in wheelhouse

The engine telegraph has the following divisions.

- Ahead	Full
	Half
	Slow
	Dead slow
	Stop
- Astern	Dead slow
	Slow
	Half
	Full

Sub-telegraph:

The sub-telegraph has the following divisions.

- Finished with engine
- Stand-by
- At sea

Three (3) position push button switches for order and pilot lamps are installed in the bridge, and three push button switches with pilot lamps are installed at the engine control panel.

8.3 INSTRUMENTATION – CONT'D

8.3.2 PROPELLER SHAFT REVOLUTION INDICATOR

One (1) set of pick-up type , propeller shaft revolution indicating system shall be provided and installed at the following places :

One (1)	-	Pick-up type on shaft after gearbox.
One (1)	-	Flush type indicator with an illumination light on wheelhouse front wall with separate dimmer switch on bridge control console.
Two (2)	-	Surface type indicators with an illuminating light and a dimmer switch on the bulkhead of both wings.
One (1)	-	Flush type indicator and counter on the engine control room console.
One (1)	-	Flush type indicator on bridge control console with an illumination light and a dimmer switch.
One (1)	-	Electric type indicator at main engine machine side.
One (1)	-	Surface type indicator at C/Eng. day room.

8.3.3 RUDDER ANGLE INDICATORS

One (1) set rudder angle indicator system of resistance type shall be provided.

One (1) drip proof transmitter connected to the rudder stock by levers shall be fitted in the steering compartment.

One (1) Three face type indicator beneath wheelhouse front ceiling center shall be installed with a separate dimmer on bridge control console.

One (1) Flush mounting and water tight type indicator shall be installed with an illumination light and a dimmer switch on both bridge wings.

Two (2) Wall mounting and watertight type indicator shall be installed with an illumination light and a dimmer switch on both bridge wings.

8.4 FIRE DETECTION SYSTEM

A fire detection system shall be fitted in the engine room and all stairways, corridors, escape routes within accommodation spaces.

The detectors shall be of ion or thermal type dependent on location of installation and of addressable type

The fire detecting elements shall be distributed so as to guard all potential fire outbreak points in the engine room and shall be of type that will not cause false alarms signaled by dust, oil vapor or heat normally present in the machinery space.

8.4 FIRE DETECTION SYSTEM – CONT'D

The fire detector system shall be capable of being tested.

The audible fire alarm for the engine room shall be distinguished from all other alarms.

One (1) fire alarm indicator/control panel shall be installed in the wheelhouse.

A fire control station shall be arranged on the main deck fire control room and fitted with following : -

- A releasing of CO2 system for the engine room and bow thruster room.
- Fire alarm zone indication panel.
- One sound powered telephone.
- Other safety devices as per rule.
- Remote start/stop push button with running lamp for emergency fire pump.

8.5 CONTROL STATIONS

8.5.1 ENGINE CONTROL ROOM CONTROL PANEL

One (1) engine control room control panel shall be provided.

The following instruments and equipment shall be installed on the engine control room control console.

Manoeuvring lever
Telegraph receiver
Sub-telegraph
Alarm buzzer
Telegraph bell
Buzzer stop push button
Flicker stop push button
Buzzer test push button
Lamp test push button
M/E run switch with cover
M/E emergency stop switch with cover
Propeller shaft revolution indicator
Propeller shaft revolution counter
M/E turbo charger tachometer
M/E fuel pump mark indicator
Telephones
Electric clock
Lever gauges
Pressure gauges
Rudder angle indicator
Alarm panel as per Maker's Standard & Classification
Boiler emergency
Stop push button

8.5 CONTROL STATIONS – CONT'D

8.5.2 ALARM SYSTEM

Main engine and auxiliary engines shall be provided with alarm system as per Class and Maker's standard requirement.

Engine room alarms shall be of different nature for engine room, CO2 release, general alarm etc. Also, the turret light colour shall be different for each type of alarm.

8.6 CONTROL AND SUPERVISING PANEL IN NAVIGATION SPACE

Console and panels incorporating electric equipment shall be provided and installed in the wheelhouse as specified below.

8.6.1 BRIDGE CONTROL CONSOLE

The following instruments and equipment shall be installed on the bridge control console:

Emergency main engine stops
Telegraph lever
Sub-telegraph
Propeller shaft RPM indicator
Alarm lamps
Alarm buzzer and stop push button
Flicker stop push button
Lamp test push button
Buzzer test push button
Dimmer switches for instrument lights
Whistle controllers – (3 Nos.)
Master switch for general alarm
Start/Stop push button with running lamp for emergency fire pump
Telephones
Wind speed and direction indicator
Echo sounder recorder

8.6.2 MEASURING INSTRUMENT PANEL

One (1) measuring panel shall be provided at the upper part on wheelhouse front wall center and the following instruments shall be mounted with corresponding dimmer fitted on bridge control console.

Propeller shaft revolution indicator
Electric crystal clock
Ship speed indicator
Clinometer

8.6 CONTROL AND SUPERVISING PANEL IN NAVIGATION SPACE – CONT'D

8.6.3 CONTROL SWITCH PANEL

One (1) control switch panel shall be provided in a suitable position in the wheelhouse and the following devices shall be mounted: -

Navigation light indicator
Group control switches for signal lights
Group control switches for flood lights

8.6.4 CHART TABLE

One (1) chart table shall be provided in the wheelhouse and the following instruments shall be mounted.

Course recorder
Master clock with slave clock control panel
Echo sounder recorder
Time signaling speaker
Radio direction finder
Speed log indicator master panel
Navtex
DGPS

9 - ELECTRICAL EQUIPMENT AND SYSTEM

9.0 GENERAL

The electrical installation shall be in accordance with the latest Classification and relevant authority requirements.

If any items in the machinery or hull specification necessitate the installation of electrical equipment not mentioned in this specification, such equipment shall be provided by Builder in accordance with similar equipment mentioned in this section.

The types and construction of electrical equipment incorporated or packed with the appliance shall be in accordance with the maker's standards unless specially described, and may be changed by their maker's type or model changes.

All electrical equipments to be Class approved were necessary.

All conductors, switchgear and accessories shall be of such size as to be capable of carrying, without their respective ratings being exceeded, the maximum current which can normally flow through them.

The distance between live parts of different potential and between live parts and the case of other earthed metal, whether across surfaces or in air, shall be adequate for the working voltage under the conditions of installation.

Insulating materials and insulated windings shall be resistant to moisture, sea air and oil vapour in tropical conditions. The design of all equipment shall provide for accessibility to all parts requiring inspection.

Enclosing cases for electrical equipment, junction boxes, etc., shall be of adequate mechanical strength and rigidity to protect the contents and to prevent distortion under all likely conditions of service.

In general, cable terminals shall be of solderless type.

All electrical systems and equipment shall be easily accessible and clear of flammable materials.

In general, voltage, frequency and phase shall be as follows :

- Generator	:	450V, 60Hz, 3 Ph
- Power	:	450V, 60Hz, 3 Ph
- Heaters	:	450V, 60Hz, 3 Ph or
	:	240V, 60Hz, 1 Ph
- Galley and laundry equipment	:	450V, 60Hz, 3 Ph or
	:	240V, 60Hz, 1 Ph
- Main lighting	:	240V, 60Hz, 1 Ph
- Emergency lighting	:	240V, 60Hz, 1 Ph
- Transient emergency lighting	:	DC 24V

9.0 GENERAL – CONT'D

- Navigation and radio equipment : 450V, 60Hz, 3 Ph or 240V, 60Hz, 1 Ph or 3 Ph.
- Control and monitoring : 450V, 60Hz, 3 Ph or 240V, 60Hz 1 Ph or DC 24V.
- Intercommunication system : 240V, 60Hz, 1 Ph or DC 24V

9.0.1 OPERATING CONDITIONS

A) Temperatures

In general, electric equipment shall be designed for the following ambient temperatures.

32 Degree C : Sea water
35 Degree C : Air

Where ambient temperature is in excess of the above described values, the total temperature for which the equipment are rated, shall not exceed the values specified by the rules.

B) Voltage and Frequency

All electric equipment shall function at variations of:

Frequency : +/- 2.5 % at rated voltage
Voltage : + 6 %/-10 % at rated frequency

9.0.2 INSPECTION AND TESTS

Electric equipment shall be inspected and tested in accordance with the Rules, the Regulations and the Builder's practice.

A) Maker's Shop Test

Shop test for generators and main switchboard shall be carried out at the maker's shops under attendance of the Owner's representatives and necessary test records shall be submitted to the Owner.

B) On-Board Tests

At the completion of installation, the electric equipment shall undergo the inspections and/or the tests in accordance with the Rule, the Regulations and the Builder's practice.

The inspections and/or tests shall be as follows :

a) Generator and Switchboard

The electric loads for testing of generators on-board shall be generally performed using on shore water tank.

9.0 GENERAL – CONT'D

9.0.2 INSPECTION AND TESTS

B) On-Board Tests – Cont'd

a) Generator and Switchboard – Cont'd

(1) Load test (100% for 1 hour).
(2) Test for instantaneous fluctuation of voltage and frequency (the load equal to the motor of largest capacity is thrown in, and is suddenly thrown off).
(3) Parallel running test with combination of the generators. The test for shifting the load from one (1) diesel generator to another set shall be carried out and vice versa.
(4) Protective relay test for generator.
Over-current trip, reverse-power trip, and undervoltage trip for each generator shall be demostrated.

b) Motor

Motors, together with their associated control gear shall be run under normal operating conditions to make sure of the performance.

c) Lighting Equipment

On-off tests shall be carried out for all lighting equipment, including navigation, signal and search lights.
Exposure to rain water test shall be performed for all the deck lights to check water integrity.

d) Interior Communication and Navigation Equipment

Interior communication and navigation equipment shall be tested to ascertain the specified function.

All navigational equipments shall be mounted on suitable vibration resistant pads.

e) Radio Equipment

To obtain the safety radio certificate, tests and inspections of radio equipment shall be given by the testing authority, in accordance with the requirements of International Convention for the Safety of Life at Sea (SOLAS).

f) Insulation Equipment

Insulation resistance shall be measured for the electric systems.

9.0 GENERAL – CONT'D

9.0.2 INSPECTION AND TESTS

B) On-Board Tests – Cont'd

g) Voltage Drops

Voltage drops shall be measured for several circuits which are subject to the maximum voltage drop in normal service.

9.0.3 APPLICATION OF ELECTRIC EQUIPMENT

A) Air Circuit Breaker (ACB)

Air circuit breaker shall be used for protection of the generators.

B) Moulded Case Circuit Breaker

Moulded case circuit breaker shall be used for protection of feeder circuits and fitted with magnetic instant trip, thermal trip, shunt trip coil and/or under voltage trip coil depending on each application.

C) Fuses

Automatic fuses shall be used for protection of feeder circuits, control circuits, alarm circuits and indicating circuits, etc.

D) Meters

The meters fitted on the motor control gears, main switchboard, etc., shall be of maker's standard types and sizes.

E) Lamps and Lamp Holders

a) Incandescent Lamps

Incandescent lamps shall be of Vacuum tungsten filament type or gas-filled tungsten filament type.

Bulb glasses shall be clear or frosted inside according to their respective applications.

b) Indicating lamps, Pilot lamps, etc.

Indicating lamps, pilot lamps, etc. and lamp holders fitted on switchboard, motor control gear, etc. shall be of maker's standard types.

9.0 GENERAL – CONT'D

9.0.3 APPLICATION OF ELECTRIC EQUIPMENT – CONT'D

E) Lamps and Lamp Holders – Cont'd

c) Fluorescent Lamps

Fluorescent lamps shall be of hot cathode straight line tube type and the start of the lamps shall be done by the glow start lamps or the switches.

The color of fluorescent lamps shall be white.

9.0.4 COLOUR SCHEME AND PAINTING

In general, the electric equipments shall be painted and finished in accordance with Maker's standard.

Main switchboard, emergency switchboard console, starters, control panel, distribution boards.

Standard color of indicating lamps :

Power	White
Running	Green
Stand-by	Yellow
Alarm	Red
Space heater ON	Orange

9.0.5 NAME PLATES

(a) Shall be in English

(b) Material of plates : -

For rotating machines	:	Non - corrosive metal plate
For controller and panel	:	Enclosed space; plastic plate.
	:	Exposed space; non -corrosive metal plate.
For others	:	Maker's standard

9.1 ELECTRIC POWER SUPPLY EQUIPMENT

9.1.1 MAIN ALTERNATORS

Three (3) sets of synchronous A.C. generators driven by diesel engines shall be installed in the engine room.

Manual paralleling arrangement for the generators shall be provided.

Synchronising of the generators shall be possible from the engine control room.

9.1 ELECTRIC POWER SUPPLY EQUIPMENT – CONT'D

9.1.1 MAIN ALTERNATORS – CONT'D

As for the details of prime movers, see Machinery Specification.

A) Particulars :

No. of sets	:	Three (3)
Rated output	:	450 kW
Rated voltage	:	A.C. 450V
Frequency	:	60 Hz
No. of phase	:	3
Power factor	:	0.8(lagging)
Rev. per minute	:	1200
Rating (Rotor & Stator)	:	Class "B"
Enclosure	:	IP 23

B) Service Condition :

		No. Of Set(s) Running
Normal sea going	:	One (1) X 600 kW shaft alternator
Manoeuvring	:	Two (2) x 450 kW in parallel
Unloading	:	Three (3) x 450 kW in parallel
Rest in port	:	One (1) x 99 kW emergency generator

C) Construction, Installation And Associated Apparatus :

As per manufacturer standard.

a) Construction And Installation

The diesel generators shall be of the cylindrical rotary field type, semi-enclosed drip-proof and self ventilated construction.

Generators shall be star connected without earthing of neutral point.

The generators shall be installed with their rotor shafts in the fore and aft. direction.

b) Bearings

The bearing of diesel generator shall be of single, bracket type on both sides (forward & aft) and arranged for self contained ring lubrication.

c) Alternator Protection

Means shall be provided to prevent the ill effects of flow of currents circulating between the shafts and the bearing in accordance with the maker's standards.

9.1 ELECTRIC POWER SUPPLY EQUIPMENT – CONT'D

9.1.1 MAIN ALTERNATORS – CONT'D

C) Construction, Installation And Associated Apparatus : - Cont'd

c) Alternator Protection – Cont'd

Resistance bulb (PT 100 ohm) shall be fitted (double set) for detecting stator winding temperature.

d) Space Heaters

Each generator shall have a single phase sheathed wire type space heater to prevent the condensation of moisture when the generator is not in use.

The space heater circuits shall be interlocked with the generator air circuit breakers.

The manual switch for the space heater shall be fitted on the main switchboard.

The lamps indicating that the space heaters are energized shall be fitted on the main switchboard.

Thermostat shall not be provided.

D) Excitation

The generators exciting system shall be of self- exciting brushless type with automatic voltage regulators.

Insulators of exciting generators and current transformers of exciting device shall be in accordance with the maker's standard.

The main rectifiers, potential current transformer, etc. shall be housed in a steel plate enclosure and installed on the generator.

The automatic voltage regulator shall be adjusted manually by the voltage setting rheostat on the main switchboard.

E) Parallel Operation

Damper winding and current compensating unit shall be provided so that generator might be capable of running continuously in parallel with each other. Auto loading sharing and auto synchronizing with three generators shall be possible.

(F) Controls and operation

Refer to Section 8.

9.1 ELECTRIC POWER SUPPLY EQUIPMENT – CONT'D

9.1.2 SHAFT GENERATOR

One (1) Shaft Generator shall be installed.

The generator shall be driven by the reduction gear PTO.

The Shaft Generator shall be arranged to supply main switchboard in normal sailing condition.

The Shaft Generator shall have capacity to cover the normal sea-load of the vessel with tank heating, air-condition, ballast pumps and tank washing pump operating simultaneously.

The shaft generator shall be capable of parallel operation with any of the diesel engine driven alternators described above for a brief period for load transferring.

Particulars

Raged Output	: 600 kW
Rated Voltage	: AC 450
Frequency	: 50 Hz
No. of Phase	: 3
Power Factor	: 0.8 lagging
Rev. Per Minute	: 1200

9.1.3 EMERGENCY GENERATOR

One (1) set of emergency/generator driven by radiator cooled diesel engine shall be provided in the emergency generator room.

The emergency generator can also be used as a harbour set and a selector switch shall be provided to indicate whether the generator is in the emergency or harbour mode.

Space heater shall be provided for the emergency generator.

The emergency generator shall not be arranged to operate in parallel with the main generators.

The generator shall be automatically started by battery in the event of voltage failure of normal A.C. 450V system and be manually stopped in the emergency generator room.

Secondary starting facility shall be provided in accordance with Maker's standard.

9.1 ELECTRIC POWER SUPPLY EQUIPMENT – CONT'D

9.1.3 EMERGENCY GENERATOR – CONT'D

Particulars :

Rated output	:	99 kW
Rated voltage	:	AC 415V
Frequency	:	50 Hz
No. of phase	:	3
Power factor	:	0.8 (lagging)
Revolution per minute	:	1500
Insulation class	:	"F"
Enclosure	:	IP 23
Rating	:	100% continuous
Excitation	:	Brushless

9.1.4 TRANSFORMERS

One (1) bank of four (4) sets of 30 KVA A.C. 450/240V, single phase, air cooled , dry type transformers shall be provided for normal 240V consumers in machinery space and accommodation. (Connection shall be delta-delta).

One (1) set of 15 KVA A.C. 450/240V, three phase, air cooled dry type shall be provided for ship's forward 240V consumers.

One (1) bank of three (3) sets of 7.5 KVA A.C. 450/240V, single phase, air cooled dry type shall be provided for emergency use. (Connection shall be delta-delta).

All transformers shall be self ventilated, class "B" or "H" insulation, drip proof type.

9.1.5 TRANSFORMER RECTIFIER

One (1) step-down transformer-full wave bridge rectifier shall be installed in the navigation light switch panel. It shall be of the open type rated for an input of 240V, 3 phase, 60 Hz, with an output of 24V D.C. This transformer rectifier shall be the normal supply to the navigation lights.

It shall be a minimum 7.5 KW.

9.1.6 SHORE CONNECTION DEVICE

Provision shall be made to connect a 300A, 450 volt, 3 phase, 60 Hz, supply from shore to the emergency switchboard.

A drip proof shore supply switch fuse box shall incorporate a triple pole moulded case circuit breaker, phase sequence indicator, KWH-meter and terminals for portable shore cables.

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

9.1 ELECTRIC POWER SUPPLY EQUIPMENT – CONT'D

9.1.7 CONVERTOR

One (1) convertor 240V /A.C to 24V/D.C of suitable capacity shall be supplied.

9.1.8 STORAGE BATTERIES

General Use Battery

One (1) set of storage batteries shall be installed in the battery room for instrumentation of engine part, low voltage interior communication system, transient emergency light etc.,

Particulars

Type	:	Lead acid type
Rated voltage	:	D.C. 24V
Capacity	:	300 AH
Rating	:	10 hours discharge

One (1) set of storage batteries for the start of emergency generator together with battery charger.

One (1) set of storage batteries for radio equipment together with battery charger. (As per Maker's standard).

9.2 DISTRIBUTION AND EQUIPMENT

9.2.0 GENERAL

The power distribution system shall be of radial configuration, with floated neutral, three (3) wire three (3) phase supply in general.

Motors for engine room auxiliaries shall be fed from the main switchboard via group starter panels as far as practicable.

Feeder cables to steering gear motors shall be fed on different routes well apart from each other.

Galley equipment and deck fans, etc. shall be fed from distribution boards which are connected to the main switchboard.

Nautical instrument, interior communication equipment and radio equipments shall be connected to distribution board fed from emergency switchboard, but gyro compass, auto pilot, radars and radio station shall be directly connected to the emergency switchboard.

Lighting system shall be separated into deck part lighting system and engine room lighting system, and lighting fixtures shall be connected to distribution boards fed from main switchboard or emergency switchboard.

9.2 DISTRIBUTION AND EQUIPMENT – CONT'D

9.2.0 GENERAL – CONT'D

Navigation lights shall be connected to navigation light indicator panel which is capable of being fed from the main switchboard or directly from the emergency switchboard.

9.2.1 MAIN SWITCHBOARD

General

The main switchboard shall be self-supported, steel plated and dead front type.

Generator circuit shall be protected with three pole air circuit breaker, and feeder circuit shall be protected with three pole moulded case circuit breaker (no-fuse breaker).

In general, insulating material in the main switchboard shall be as per maker's standard.

The main switchboard shall consist of substantial angle steel framework and steel plate and shall be enclosed with following :

- Hinged doors for access to inside equipment
- Louvre boards for ventilation
- Bottom shall remain open for cable leading
- Surface of panel shall be finished with epoxy paint
- A metal hand rail covered with insulating material shall be provided as necessary in front and rear of the switchboard.

Floor in front and rear of the main switchboard shall be covered with insulating sheet.

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

Power Cables : 660 volts
Control Cables : 220 volts

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.

Provision for synchronizing and paralleling of all main generators shall be arranged.

All bolts, screws, etc. used in connection of current carrying conductors shall be adequately locked with locknuts and spring washers.

9.2 DISTRIBUTION AND EQUIPMENT – CONT'D

9.2.1 MAIN SWITCHBOARD – CONT'D

The entire bus bar system including supports and insulation shall be designed to withstand the short circuit thermal and magnetic stresses to maximum estimated fault level on main bus bar.

Bus bar shall be of hard drawn high conductivity copper.

When the generators are loaded over preset value for preset duration, non-essential loads shall be preferentially tripped.

Consumers on 415V distribution sections shall be symmetrically arranged as far as practicable.

All instruments shall be red marked for normal value on dials.

Interlocking between shore power connection and main generator and emergency generator shall be fitted.

A) Air Circuit Breakers (draw out type)

Air circuit breakers shall be of motor operated type and controlled by a control switch, and additionally a manual operating handle shall be provided.

The air circuit breaker to have an over current trip device for long time and short time inverse action and shall have magnetic coils for instantaneous trip and under voltage trip.

Generator shall be protected against reverse power with reverse power relay connected to under voltage trip device.

All three (3) phases of the light transformer shall be equally loaded as far as practicable.

The air circuit breaker shall be capable of maintenance at front of the main switchboard.

The air circuit breaker shall have sufficient interrupting capacity against short circuit current.

B) Bolted Bus Link

The bolted bus link shall be provided in order to isolate bus bar between generator bus bar and feeder bus bars.

Main bus bars shall be fitted with removeable bolted links between two (2) generators at each end between generators and group starter section.

9.2 DISTRIBUTION AND EQUIPMENT – CONT'D

9.2.1 MAIN SWITCHBOARD – CONT'D

C) Moulded Case Circuit Breakers

Moulded case circuit breaker shall be with an instantaneous magnetic trip device, inverse time thermal over current trip device.

The breakers shall have interrupting capacity enough against short circuit current.

All moulded case circuit breakers shall be of plug-in type, so that the breakers may be removed from panel front without de-energizing the main bus.

Moulded case circuit breaker for preferential or emergency stop shall have under voltage trip coil or shunt trip coil.

D) Meters

Voltmeter, ammeter, and wattmeter shall be of moving iron type or maker's standard and frequency meter shall be of pointer indicating type or maker's standard.

The meters shall be of Class 1.5 and shall have scale of the following range with red color mark at rated value.

Voltmeter	:	0 to abt. 120% of rated voltage
Ammeter	:	0 to abt. 130% of rated current
Wattmeter	:	- 15% (reverse power) to abt. 130% of rated wattage.
Frequency meter	:	45 - 55 Hz

E) Name Plates

Name plates indicating service of panels and feeders shall be provided on panels.

In name plates for feeders, name of feeder, frame size, setting value of trip and, in case of moulded case circuit breaker, size of cable shall be written.

F) Pilot Lamp

Pilot lamp shall be of Maker' standard.

9.2 DISTRIBUTION AND EQUIPMENT – CONT'D

9.2.1 MAIN SWITCHBOARD – CONT'D

Panel Arrangement

The main switchboard shall consist of three diesel generator panels, one synchronizing panel, two 450V feeder panels and one 240V feeder panel.

The generator panels and synchronizing panel shall be positioned between 450V feeder panels so that either of essential motors may be energized from one feeder panel even if the other feeder panel is damaged.

9.2.1.1 GENERATOR SECTION

Each generator section shall be equipped with following :

1 - Air circuit breaker (draw out type)
1 - Ammeter with a change over switch
1 - Voltmeter with a change over switch
1 - White lamp for generator running
1 - Green lamp for air circuit breaker ON
1 - Space heater on-off switch
1 - Orange lamp for space heater ON
1 - Voltage adjuster
1 - Reverse power relay
1 - Over current relay for preferential trip
1 - Start/stop switch
1 - Running hour meter
1 - kW meter
1 - Caution plate

9.2.1.2 SYNCHRONIZING PANEL

1 - Automatic synchronising apparatus
1 - Automatic load sharing apparatus
1 - Synchroscope
3 - Synchronizing lamps
2 - Frequency meters
2 - Voltmeters
1 - Trip reset switch
1 - Selector switch for voltmeter and frequency meter
3 - Governor control switches
3 - Air circuit breaker control switches
1 - White lamp for shore source receiving
1 - Red lamp for high voltage
1 - Red lamp for low frequency
1 - Red lamp for low voltage
1 - Red lamp for preferential trip
3 - Red lamps for air circuit breaker non-close
3 - Red lamps for air circuit breaker abnormal trip

9.2 DISTRIBUTION AND EQUIPMENT – CONT'D

9.2.1.2 SYNCHRONIZING PANEL – CONT'D

1 - Lamp test switch
1 - Auto-man synchronizing selector switch
1 - Stand-by generator selector switch
6 - Red lamps for insulation level low alarm for AC 450V feeder panel, AC 240V feeder panel, emergency 450V feeder panel, emergency 240V feeder panel, ship's forward 240V light and DC 24V distribution board

9.2.1.3 450V FEEDER PANELS

1 - Insulation resistance meter

Necessary number of feeder breakers

9.2.1.4 240V FEEDER PANEL

1 - Ammeter (for transformer) with a change over switch
1 - Voltmeter with a change over switch
1 - Insulation resistance meter

Necessary number of feeder breakers.

9.2.2 EMERGENCY SWITCHBOARD

General

The emergency switchboard of dead front, drip proof and front maintenance type shall be installed in emergency generator room.

The construction, device and instrument shall be similar to main switchboard.

The emergency switchboard consists of following panels.

- Emergency generator section with an automatic transfer function
- AC 450V emergency feeder section
- AC 240V emergency feeder section

The emergency loads listed below normally shall be energized from the main generating plant through moulded circuit breaker.

9.2.2.1 EMERGENCY GENERATOR SECTION

The generator section shall be provided with following devices :

1 - Running hour meter
1 - Three pole air circuit breaker
1 - Moulded case circuit breaker for normal-emergency source transferring
1 - Voltmeter with a selector switch

9.2 DISTRIBUTION AND EQUIPMENT – CONT'D

9.2.2 EMERGENCY SWITCHBOARD – CONT'D

9.2.2.1 EMERGENCY GENERATOR SECTION – CONT'D

1 - Ammeter with a selector switch
1 - Frequency meter
1 - Wattmeter
1 - White lamp for generator running
1 - Red lamp for air circuit breaker OFF
1 - Green lamp for air circuit breaker ON
1 - Orange lamp for space heater ON
1 - Space heater control switch
1 - Shore connection device (refer to Section 9.1.5)

9.2.2.2 AC 450V EMERGENCY FEEDER SECTION

The feeder panel shall be provided with the following devices :

1 - Insulation resistance meter

Required number of feeder breakers for : -

- Steering gear (one set)
- Charger for battery
- Transformer for emergency use
- Radars
- Gyro compass
- Radio station
- Emergency fire pump
- One (1) reversible E/R fan
- Such other emergency consumers as required by Rule, if any.

9.2.2.3 AC 240V EMERGENCY FEEDER SECTION

The feeder panel shall be provided with the following devices :

1 - Ammeter with a selector switch for reading each phase current of the emergency transformer secondary circuit.
1 - Voltmeter with selector switch
1 - Insulation resistance meter

Required number of Feeder Breaker for : -

- Distribution boards for emergency lights
- Navigation lights panel
- Distribution board for AC interior communication and navigation equipment
- Engine control console
- Fire alarm control panel

9.2 DISTRIBUTION AND EQUIPMENT – CONT'D

9.2.3 D.C 24V SWITCHBOARD

One (1) battery switchboard shall be provided for charging and discharging of battery and distributing DC 24V source to battery light and interior communication equipment.

The battery switchboard shall be of dead front and self-supporting type and of such arrangement that one battery may be float charged. Charging voltage shall be manually controlled by tap changing of transformer primary side.

Particulars shall be as follows :

No. of set : One (1).
Primary voltage : AC 450V, 3 PH., 60Hz.
Max. charging voltage : 40V.

The board shall be fitted with the following instruments and devices : -

1 - Voltage adjuster
1 - DC voltmeter
1 - DC ammeter for discharging current
1 - DC ammeter for charging current
1 - Source pilot lamp
1 - Insulation resistance meter

Necessary number of feeder circuit with fuses.

9.2.4 DISTRIBUTION BOARDS, CONNECTION BOXES AND BRANCH BOXES

Distribution board fitted in engine room, steering gear compartment, stores and other similar places shall be of drip proof type.

Distribution boards situated in accommodation spaces where the board is surrounded by inflammable material, a layer of non-hygroscopic, non-flammable material shall be fitted.

Distribution boards in accommodation shall be of non-water tight flush mount type according to their locations.

Distribution boards for 450V, power circuit shall be provided with moulded case circuit breakers or miniature circuit breakers or as per Class requirements.

Distribution boards for 240V, lighting and communication circuits shall be provided with moulded case circuit breakers or miniature circuit breakers or as per Class requirements.

All these boards shall be fitted with name plate describing each branch circuit.

9.2 DISTRIBUTION AND EQUIPMENT – CONT'D

9.2.4 DISTRIBUTION BOARDS, CONNECTION BOXES AND BRANCH BOXES – ……..CONT'D

In general, branch boxes shall be used for branching the final lighting circuits.

Connection boxes shall be used for connecting multi-conductor interior communication cables.

Connection boxes and branch boxes shall be of drip-proof or waterproof construction depending on their locations and made of non-corrosive material for exposed deck, and of welded steel sheet, cast iron and/or synthetic resin elsewhere.

Cable penetration for the distribution boards in machinery space shall be normally arranged on the bottom part with securing device. Penetration where required drip proof, shall be fitted with cable gland.

9.2.5 SOCKETS AND 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 fluxes shall not be used.

A) Socket Outlets shall be of JIS Standard :

   a) Synthetic resin.
   b) Non-water tight type in cabins, public spaces, inner passages, lockers and similar spaces.

      Water-tight type in the other spaces.

B) Socket outlet on exposed space on upper deck shall be protected with steel box from mechanical damage.

C) In general, socket outlet shall be of three pole type, one pole of which to serve as earthing connection for metal frames of portable appliance.

9.2.5.1 INSTALLATION

A) In each inner passage and public room, suitable numbers of socket outlets for electric cleaner shall be fitted and one(1) for miscellaneous purpose shall be fitted in the wheelhouse on both port and starboard sides. All sockets shall have individual switch controls.

B) One (1) each socket outlet of two pole blade type for the electric shaver shall be fitted on mirror light in cabin toilet.

9.2 DISTRIBUTION AND EQUIPMENT – CONT'D

9.2.5.1 INSTALLATION – CONT'D

C) Two (2) single socket outlets shall be fitted in each cabin, for desk lights, etc. One of them, however, shall be combined with outlet of antenna multi-coupler.

D) One (1) double socket outlet shall be fitted in each day room for highest officer class and each office.

E) Two (2) spare receptacles shall be provided in galley.

F) Two (2) single socket outlets shall be fitted in engine control room.

G) Socket outlet for portable light, A.C. 240V, 60W shall be provided in spaces as follows : -

a) AC 240V, Water-Tight Type :

Store and workshop in E/R, steering gear room, bosun store, air conditioning unit room and emergency D/G room.

b) AC 240V, Non-Watertight Type :

Wheelhouse and radio equipment area.

H) Five (5) socket outlets of water tight type shall be fitted in suitable position in the engine room for portable lights.

Two (2) in numbers near each hatch entrance with switch control.

Or as per Builder Practice.

9.2.6 LIGHTING SWITCHES

A) Switches used for lighting branch circuits shall be of synthetic resin framed.

B) Switches fitted in cabins, public rooms, inner passages, lockers and similar spaces, shall be non watertight type and ones fitted in other places shall be watertight type.

C) Switches used for lighting branch circuits shall be double pole type.

D) Switches shall be of flush mounting type as far as practicable.

E) Switches for bed lights and desk lights shall be fitted on the lighting fixtures themselves.

9.2 DISTRIBUTION AND EQUIPMENT – CONT'D

9.2.6 LIGHTING SWITCHES – CONT'D

F) Switches for ceiling lights in the room having separate day/bed section shall be of two-way single pole type and ceiling lights shall be switched on and off at two stations and one of them shall be fitted near the entrance door and the other near bed.

For ceiling lights in other cabins and rooms, one switch shall be fitted at entrance door.

G) For engine room lights, inside and outside passage lights in accommodation, breakers on distribution boards shall be used as switches.

H) Switches fitted on exposed space on the upper deck shall be protected with steel box from mechanical damage.

I) Switches for explosion-proof lights shall be of double pole type and have key handle for maintenance.

9.2.7 SWITCH PANELS

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

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

The radio switch panel shall obtain from the radio battery via the radio charging panel. It shall be fitted with indication lights, ampere and voltage meters, after voltage meters, fuses, circuit breakers and alarm indicator.

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

This panel shall be fitted with a built-in transformer rectifier 240V A.C./24V D.C. indicators, switches, buzzers, fuses, failure alarm indicator and change-over switch. Main supply is obtained from 240/3/60 A.C. supply and emergency from the 24V D.C. emergency switchboard.

9.3 ELECTRIC MOTOR AND CONTROL GEAR

9.3.0 GENERAL

Motors, in general shall be rated AC 450V, 3 Ph except small motors which are rated AC 240V, 3 Ph or 1 Ph.

Motors shall be of design and construction as specified below, however, motors which are a part of maker's standard package unit for galley, laundry equipment, control air dryer, workshop machinery, domestic service or relatively small motors should be excepted from the following requirements.

9.3 ELECTRIC MOTOR AND CONTROL GEAR – CONT'D

9.3.0 GENERAL – CONT'D

Control gears shall be of design and construction as specified below, however, the control panels which have unique design for particular function shall be of maker's standard including control voltage.

9.3.1 MOTORS

A) In general, motors shall be of semi-enclosed drip-proof type (IP23).

Motors for 7.5 kW and below and located under the engine room low floor totally or half shall be totally enclosed type (IP44), motors exposed to weather and for E/R vent fan shall be weather tight type (IP 56).

B) All motors shall be of squirrel cage rotor, induction type unless specially noted.

C) Motor windings shall be of Class "B" or "F" insulation according to motor size.

D) Rating of all motors shall be continuous rating except motors for the following : -

An hour	:	Turning gear
Half an hour	:	Engine room over head crane
200% 30 seconds	:	Steering gear
100% one (1) hour	:	
25% continuous	:	
Maker's standard	:	Provision derrick
	:	Windlass and mooring winch
	:	Lifeboat davit
	:	Cargo hose handling crane

E) Bearing of motors shall be ball bearing and those of vertical type motor shall be radial ball bearings or angular contact bearings considering thrust load.

Pre-lubricated sealed type bearing shall be used as far as practicable depending upon maker's standard.

All ball bearings except sealed type shall be greased with greased nipple.

Space heater for following motors shall be provided : -

- Main cool s.w. pump
- Main lube oil pump
- Ballast pump
- Main and working air compressor

9.3 ELECTRIC MOTOR AND CONTROL GEAR – CONT'D

9.3.1 MOTORS – CONT'D

Space heater for following motors shall be provided : - Cont'd
- Bilge, fire and G.S. pump
- Motors of 100 kW and above

F) Running hour meter shall be provided on the cargo pumps (3 Nos.) only.

9.3.2 CONTROL GEAR

A) Arrangements and construction of starters shall be as follows : -

The starters for vital services shall be assembled in a group starter panel as far as practicable and located at the side of the main switchboard.

The other ones shall be located near the respective motors and shall be built into drip-proof enclosed steel cubicle with hinged door.

When starters contained in the group starter panels are located far from corresponding motors, a push and lock type stop button shall be provided at motor side except motors for fans.

Selection switch of stand-by pumps in Section 8 shall be installed on each starter.

Starters for motors of less than 15 HP shall be D.O.L type and Star-delta type for motors above 15HP.

B) Starters shall be of magnetically operated type, in general, and shall be equipped with the following devices :

a) Starters For Motors Above 0.5 KW
- 1 - Disconnecting switch or M.C.C.B.
- 1 - Magnetic contactor
- 1 - Thermal over current relay (for three phases)
- 1 - White source lamp
- 1 - Green running lamp
- 1 - Start and stop push button

b) Starters For Motors Above 0.2KW And Up To 0.5KW
- 1 - Magnetic contactor
- 1 - Thermal over current relay (for three phases)
- 1 - Start and stop push buttons

c) Motor of 0.2 kW and below shall be manually operated by line switch.

In addition to the above, starters for motors of 7.5kW and above, and for vital service, shall be provided with an ammeter.

9.3 ELECTRIC MOTOR AND CONTROL GEAR – CONT'D

9.3.2 CONTROL GEAR – CONT'D

B) Cont'd……

d) Starting method of motor shall be cross-the-line start type, however compensating starting method may be adapted not to cause voltage drop on the main generator more than 15% of rated voltage when starting the largest motor.

e) Control circuit voltage shall be AC 240V in general, but shall be of maker's standard, if necessary.

f) Pilot lamps on starters shall be of maker's standard.

g) Starters for motors of steering gear and those for vital services shall be provided with low voltage release protection to permit these motors being restarted automatically on restoration of power, and starters for other motors shall be provided with low voltage protection.

9.3.3 SPECIAL CONTROL PROVISIONS

A) Turning Gear

Turning gear shall be controlled remotely by a portable push button box with 15 meter flexible cable and receptacles shall be fitted, each one at upper floor and lower floor in the engine room.

B) Steering Gear

Steering gear motors shall be able to be operated both in the steering gear compartment and wheelhouse, control / watching devices shall be provided in the wheelhouse and steering compartment with indicating lamps in the wheelhouse and engine control room.

C) Emergency Stops

(a) For Fire

Fans and fuel oil pumps shall be stopped in case of fire.

For all ventilating fans in the engine room, all fuel oil pumps in the engine room one (1) stop push button box shall be fitted and additionally one (1) stop push button box in the wheelhouse.

For ventilating fans in accommodation except small fans, one (1) stop push button box shall be fitted in the wheelhouse and one (1) at the fire control station.

9.3 ELECTRIC MOTOR AND CONTROL GEAR – CONT'D

9.3.3 SPECIAL CONTROL PROVISIONS – CONT'D

C) Emergency Stops – Cont'd

b) Preferential Trip

Non-vital motors and consumers shall be automatically tripped, when generators become overloaded, by means of shunt tripping or under voltage trip coil of no fuse breakers on the main switchboard or on group starter panels.

9.4 LIGHTING

9.4.0 GENERAL

The normal lighting shall be fed from A.C. 240V, 60Hz, 3 Ph supply system and in general fluorescent lights shall be fitted throughout accommodation and engine room.

A system of emergency lighting shall be fitted at each cabin, stairs, exits, passageways, lifeboat station, liferaft stations, wheelhouse, chart space, secondary fire pump space and engine room normally fed from 240V supply but arranged to be fed automatically from the 240V emergency generator on failure of main supply.

For transient emergency illumination, battery light shall be provided and shall be automatically switched on in the event of failure of normal A.C. power.

Machinery space light shall be arranged/supplied in such a manner that the failure of any one branch circuit shall not cause entire space to black out.

9.4.1 LIGHTING FIXTURES

The lighting fixtures fitted in the spaces exposed to weather shall be water-proof and shall have the bodies of brass plate or stainless steel.

The lighting fixtures fitted inside shall be non-water-proof or waterproof according to their respective locations and shall have cast iron or sheet steel plate bodies finished by the corrosion resistant paints.

Lighting fixtures for fluorescent lamps shall have sheet steel plate bodies with suitable finish.

Lighting fixtures fitted under the risk of mechanical damages shall be protected with guards for incandescent lights and polycarbonate globes for fluorescent lights.

9.4 LIGHTING – CONT'D

9.4.1 LIGHTING FIXTURES – CONT'D

Steel guards shall be used for the lamps fitted indoors in store spaces and brass guards for the lamps exposed to weather. Mesh cover if available shall be fitted.

Lighting fixtures in space where inflamable gas is likely to accumulate, shall be of explosion proof type.

9.4.2 LIGHTING CONTROL

a) Floodlights, Funnel Lights

Floodlights for deck illumination, shall be controlled from the wheelhouse.

b) Lifeboat Lights

Lifeboat lights shall be controlled with the switches fitted on the bridge panel in the wheelhouse.

c) Engine Room Lights

The lights installed in the engine room shall be controlled from the distribution boards in the engine room.

d) Ceiling Lights

In general, ceiling lamps in the cabins, the stores, etc., shall be operated by double pole switches located close to the entrance doors.

The ceiling lamps in the rooms having separate day/bed section shall be operated from the entrance and the bed by single pole change-over switches.

e) Bed Lamps, Desk Lamps, Etc.

Bed lamps and desk lamps shall be operated by a switch fitted to each lighting fixture.

f) Passage Lamps

Inside and outside passage lamps shall be operated by M.C.C.B. fitted on the lighting distribution boards which are mounted on the walls of the cable duct of the respective or adjacent decks.

9.4 LIGHTING – CONT'D

9.4.2 LIGHTING CONTROL – CONT'D

g) Navigation Lights and Signal Lights shall be controlled as follows

1) Remote control from wheelhouse

Navigation light
N.U.C. (Not-under-command) light
Anchor light
Morse signal light
Steering light
Dangerous cargo light

2) Local control

Daylight signal light

9.4.3 GENERAL LIGHTS

Illumination level in general shall be in accordance with the following standard.

The standard illumination level shall be an average figure measured before delivery of the vessel as specified below : -

A) Cabin and Spaces in Accommodation :

At center part between lamp and wall and/or between lamps in cabins and spaces at a height of 85cm above floor.

B) Machinery Spaces :

At suitable working and/or passage space between rather larger machines at a height of 85cm above floor.

9.4 LIGHTING – CONT'D

9.4.3 GENERAL LIGHTS

C) Illuminations

Illumination (Average)	Cabins or Spaces
300 LUX	On the desk of office
200 LUX	On the desk of chart space Office Galley Engine control room Workshop Mess rooms Cargo control room
100 LUX	Chart space Radio space Laundry room Changing room Cabins Hospital Wheelhouse Engine room Steering gear compartment Bathroom Toilets Inner passages Cargo manifold area Bow thruster room
50 LUX	Windlass/mooring winch operating area Bosun store Lockers and stores
20 LUX	Outer passage around accommodation space
10 LUX	Passage of main deck

9.4 LIGHTING – CONT'D

9.4.3.1 CEILING LIGHTS

Kind	Fluorescent light (FL)			Incandescent light (IL)		FL or IL
Protection	GLOBE			Globe + Guard	Globe	Globe + Guard
Enclosure	Non-water tight		Drip proof	Watertight	Watertight	Explosion proof
Wattage		40W 20W	40W 20W	60W	60W	60/100W 20W
Application	Captain class cabins	Junior office class cabins	Galley	Cold provi-chamber		Battery room (IL)
	Officers mess room		Reefer machinery space	Outer passage	Small lockers and stores (N.W.T)	Paint room (IL)
	Senior officer class cabins	Crew and petty officer class cabins	A/C unit room Engine room	Engine room lower floor (bilge well) Bow thruster room		
		Office Cargo Control Room	Work-shop steering gear compt	Funnel inside		
	Wheelhouse and chart space		Laundry changing room dry prov. store			
	Radio space Hospital		Bosun store			
	Engine control room Inner passage		Large lockers and stores			

Fluorescent lamps shall be provided all round the accommodation superstructure and of recessed type.

9.4 LIGHTING – CONT'D

9.4.3.2 DESK LIGHTS

15W fluorescent light, non-watertight without globe and bulkhead mounting type shall be provided in each crew's cabin.

15W fluorescent light, table stand type or similar construction as above shall be provided in officer class cabins.

9.4.3.3 BED LIGHTS

8W fluorescent light, non-watertight without globe and bulkhead mounting type shall be provided over the bed head of each cabin.

9.4.3.4 MIRROR LIGHTS

15W fluorescent light, drip proof with globe and bulkhead mounting type shall be provided for illumination of toilet or bathroom and shall be controlled by switch fitted at the entrance.

9.4.3.5 INSTRUMENT LIGHTS

Instrument lights shall be provided for magnetic compass, propeller shaft revolution indicator, rudder angle indicator and other nautical instruments in wheelhouse, and fed through dimmer switch.

9.4.3.6 CHART LIGHTS

Two (2) sets of 40W chart lights with an adjustable arm and a dimmer switch shall be fitted over chart table.

9.4.3.7 WORKSHOP LIGHTS

Each one spot light of 100W shall be fitted at lathe, grinder and drilling machine in the workshop.

9.4.3.8 SIGHT GLASS LIGHTS

Necessary numbers of illumination lights for sight glasses and level gauges shall be fitted at suitable position.

9.4.3.9 SIGNAL LIGHT FOR REF. CHAMBERS LIGHTS

One (1) group switch panel with lamp which shows on and off of ref. chamber's lights shall be fitted.

9.4.3.10 DECORATIVE WALL LIGHTS

One (1) incandescent wall light shall be provided for captain, senior officer's and officer mess room.

9.4 LIGHTING – CONT'D

9.4.4 TRANSIENT EMERGENCY LIGHTS

A system of transient emergency lighting D.C. 24V shall be provided and fed automatically from storage battery on failure of A.C. main power supply. The light shall be combined in general light.

Chart space	:	5W 1
Wheelhouse	:	5W 1
Engine control room	:	10W 2
Beside main generator	:	10W each one
Back of main switchboard	:	10W 2
Emergency generator room	:	10W 1
Radio equipment space	:	10W 1

One (1) 20W, D.C. 24V incandescent of fluorescent lamp shall be fitted under the ceiling in the radio table and supplied from the radio battery.

9.4.5 FLOODLIGHTS

9.4.5.1 HALOGEN TYPE FLOODLIGHTS

4 - 700W for main deck illumination on navigation bridge front
8 - 400W for main deck illumination
  2 – On fore mast forward
  2 – On fore mast aft
  4 – On main deck derrick masts (P&S)
2 - 400W for poop deck aft illumination at accommodation deck aft
4 - 400W for engine room illumination
2 - 400W for funnel illumination

9.4.5.2 INCANDESCENT FLOODLIGHTS

2 - 300W for name board illumination
2 - 500W on navigation bridge front
2 - 500W for windlass illumination on forward lamp pole

9.4.5.3 BOAT LAUNCHING LIGHT

1 - 300W at poop deck
1 - 75W sealed beam type at poop deck (DC 24V)

9.4.5.4 SEARCH LIGHTS

2 - 100 W search lights, swivel mounting type shall be provided, one at each navigation bridge wing (commonly used for accommodation ladder illumination).

9.4.6 PORTABLE LIGHTS

AC 220V 60W :

5 - Watertight with 15m cord (Intrinsically safe).
5 - Non watertight with 10m cord.

9.4.7 NAVIGATION LIGHTS AND SIGNAL LIGHTS

In normal condition, navigation lights, anchor lights and the N.U.C. lights shall be supplied with the source of AC 240V from the main switchboard, and in emergency shall be supplied from the emergency switchboard automatically.

Voltage of day signal light shall be DC 24V, and DC 24V source shall be supplied from DC 24V storage battery for the vessel's general service.

Other signal lights shall be supplied with source of AC 240V.

9.4.7.1 NAVIGATION LIGHTS

Double tier lens, 24V D.C.

a) Two (2) masthead - white (60W), one each on fore mast and radar mast.
b) One (1) port - Red (60W).
c) One (1) starboard - Green (60W).
d) One (1) stern - White (40W).
e) One (1) Navigation light indicator panel of graphic type in wheelhouse

All lights shall have "Non Function" alarms / Indicators.

All navigation lights shall be controlled by a 6-way indicator panel fitted in the wheelhouse. The supply shall be taken normally from the 240/3/60 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.

9.4.7.2 SIGNAL LIGHTS

a) Two (2) - 40W anchor light (white), one each at bow and stern.
b) Three (3) - 40W NUC lights (2 red and1 white), on radar mast.
c) One (1) - Dangerous cargo light (red).

9.4.7.3 MORSE SIGNAL LIGHT

1 - 80W morse signal light on radar mast.
3 - Keys, one each in wheelhouse and bridge wings.

9.4.7 NAVIGATION LIGHTS AND SIGNAL LIGHTS – CONT'D

9.4.7.4 DAYLIGHT SIGNAL LIGHT

1 - 60W portable type daylight signal light (150mm Aldis MKV type) with portable battery pack.
3 - Receptacles of DC 24V.

9.4.7.5 STEERING LIGHT

1 - 20W steering light (blue), on aft part of fore mast.

9.5 INTERIOR COMMUNICATION AND ALARM EQUIPMENT

9.5.1 INTERIOR COMMUNICATION SYSTEM

9.5.1.1 AUTOMATIC TELEPHONE

One (1) automatic exchange telephone system shall be provided.

The system shall be operated on A.C. 240V., 1 Ph of the vessel's source or D.C. 24V on failure of the vessel's source.

Exchanger

Auto telephone exchanger of twenty (20) stations capacity, electronic type capable of three (3) simultaneous talking/or calling and with a means for announcement through public address system from the telephone shall be provided and installed.

Telephones

A) Desk Type :

One (1) each telephone set shall be provided as follows : -

All private rooms excluding crew's room.
Radio room.

B) Console Mounting type :

Wheelhouse
Engine control room
Cargo control room

C) Wall MountingType :

W.T. (Watertight)

Galley
Steering gear room with semi-telephone booth

9.5 INTERIOR COMMUNICATION AND ALARM EQUIPMENT – CONT'D

9.5.1 INTERIOR COMMUNICATION SYSTEM – CONT'D

9.5.1.1 AUTOMATIC TELEPHONE – CONT'D

C) Wall MountingType : Cont'd

W.T. (Water Tight)

Engine room workshop
Engine room (M/E local control station) with semi-telephone booth

N.W.T (Non Water Tight)

Officers' lounge
Crew's mess room
Hospital

The telephone in engine room, in workshop and one of two in engine control room shall be connected to a common circuit and they have same calling number.

9.5.1.2 SOUND POWERED TELEPHONE

One (1) set
- 7 - Branch Sound Powered Telephone System, comprising.
- 2 - Flush mounted type telephone for wheelhouse and engine control room.
- 3 - Table top telephone for captain's and C/E's cabins.
- 2 - Wall mounted type telephone connection box.
- 2 - Flush mounted type telephone for engine control room and cargo control room.
- 1 - Wall mounted type telephone with sub-receiver for steering gear compartment.
- 1 - Signal relay box.
- 1 - AC bell for engine-room outside ECR.
- 1 - AC Amber rotating light for operation outside engine control room.
- 7 - Number card.
- 1 - Instruction manual.
- 2 - Receptacles, each one at main deck fore and aft.
- 2 - Receptacles, each one at main deck port/stbd at gate location.

9.5.1.3 INTRINSICALLY SAFE TELEPHONE SYSTEM

One (1) set of intrinsically safe sound powered telephone system shall be provided as follows.

Deckhouse entrance : Wall mounting type in telephone booth.

9.5 INTERIOR COMMUNICATION AND ALARM EQUIPMENT – CONT'D

9.5.1 INTERIOR COMMUNICATION SYSTEM – CONT'D

9.5.1.3 INTRINSICALLY SAFE TELEPHONE SYSTEM – CONT'D

Engine room : Wall mounting type in telephone booth.
Cargo control room : NWT console mounting type.

Calling signal for telephones in deckhouse entrance shall be by air horn and that of engine room to be by bell and rotating light when the station is selected from the others.

9.5.2 PUBLIC ADDRESS SYSTEM

A public address system of 50W output shall be provided.

A) Main Unit

Main unit shall be installed in radio space.

B) Control Panel

The panel shall be fitted with microphone and monitor speaker and able to control all speakers on-board for broadcasting to out-board, talk back and emergency construction. The panel to be provided in the wheelhouse. The control panel to be equipped with following speaker exchange switches :

1) Compass deck
2) Main deck fore and aft
3) Engine room
4) Cabins and corridor
5) Emergency (cabin, corridor and engine room)

The system shall be arranged to operate in the following orders of priority :

1st - Control panel in the wheelhouse.
2nd - Broadcasting or page from the telephone.
3rd - Broadcasting or entertainment programs.

C) Speaker

1 - 30W loudhailer with rotating handle on compass deck.
5 - 5W water-proof speaker.
Both wings of navigation bridge
Galley
Steering gear room
Workshop

2 - 10W water-proof speaker
Engine room

9.5 INTERIOR COMMUNICATION AND ALARM EQUIPMENT – CONT'D

9.5.2 PUBLIC ADDRESS, TALK BACK/ENTERTAINMENT SYSTEM

9.5.2.1 PUBLIC ADDRESS SYSTEM

C) Speaker – Cont'd

2 - 10W water-proof, portable speaker
Upper deck fore
Upper deck aft

8 - 2W speaker
a) Single face type with volume controller
Captain's day room
Chief engineer's day room
Officer's mess room
Crew's mess room
Hospital
Wheelhouse
Engine control room
Cargo control room

b) Double face type with volume controller in accommodation inner passage (total 6).

Microphone :

3 - Portable type with cable
Navigation bridge wing (common use for both wings)
Main deck fore
Main deck aft

D) Functions

Functions of the system shall be as follows :

a) Broadcasting or page for search of person shall be able to be done from phones.

b) Talk back between the wheelhouse or navigation bridge wings and upper deck fore/aft, from the control panel in wheelhouse.

c) Broadcasting for entertainment, from a radio receiver and a tape recorder.

9.5 INTERIOR COMMUNICATION AND ALARM EQUIPMENT – CONT'D

9.5.2 PUBLIC ADDRESS, TALK BACK/ENTERTAINMENT SYSTEM – CONT'D

9.5.2.2 ENTERTAINMENT SYSTEM

TV Receiver and Video

The following shall be provided in each mess room : -

a) 1 - 21 inch color TV (multi type).
b) 1 - Video only in officers mess with internal cable connection to crew mess room and Master and Chief Engineer cabins.

9.5.2.3 ANTENNA AND INTERNAL CABLE CONNECTIONS

These shall be provided for television to Master, Chief Engineer, Officers Mess Room and Crews Messroom. AM/FM Radio Antenna cabling shall be provided in all cabins including both mess rooms.

9.5.3 CALLING ALARM SYSTEM

9.5.3.1 ENGINE CREW CALLING SYSTEM IN ENGINE ROOM

One (1) set of three (3) position switch (CALL/OFF/PATROL) shall be provided in engine control room.

Audible and visual alarm shall be incorporated machinery alarm in Engine Room.

The horns also shall be activated on telephone call when the switch is positioned to "PATROL".

9.5.3.2 ENGINE OFFICER CALLING ALARM SYSTEM

Followings shall be provided.

1 - Seven (7) position switch in engine control room.
7 - Calling alarm panel with red lamp, a buzzer and a buzzer stop button, each one in Chief Engineer's room, 2nd Engineer's room, 3rd Engineer's room, Officers' mess/lounge.

9.5.3.3 HOSPITAL ALARM

Followings shall be provided :

1 - Portable push button in hospital.
2 - Buzzers, each one in wheelhouse and 2nd Officer's room.

9.5 INTERIOR COMMUNICATION AND ALARM EQUIPMENT – CONT'D

9.5.4 SHIP'S ALARM SYSTEM

As for alarm of engine room equipment, refer to Section 8.

9.5.4.1 GENERAL ALARMS

Alarm shall be operated on DC 24V or A.C. 240V Emergency Supply.

Audible and visual alarms shall be incorporated with fire alarm in E/R.

1 - Master switch in wheelhouse
10 - Bells shall be provided as follows :
- 2 - Inner passage on main deck
- 2 - Inner passage on poop deck
- 2 - Inner passage on accommodation deck
- 2 - Inner passage on boat deck
- 1 - Bow thruster room
- 1 - Wheelhouse

7 - Bells with red lamp, each one in galley, engine control room, cargo control room, emergency generator room, workshop and steering gear compartment.

9.5.4.2 FIRE ALARMS

As below or as per Class requirement.

Alarm bells for general alarm shall be used for fire alarm through a relay that rings the bells intermittently at predetermined intervals.

Fire alarm system shall be combined with the fire detection system.

Alarm contact make shall be provided as follows :

1 - On wheelhouse console
1 - In engine control room
1 - At engine room entrance on main deck
3 - At stair case door and exit on boat deck
3 - At stair case door and exit on accommodation deck
3 - At stair case door and exit on poop deck
4 - At vicinity of stair way on E/R
1 - Bow thruster room
1 - Emergency dig room
1 - Fire control station

Three (3) air horns (ABT 800 Hz) and three (3) red colour strobe lights shall be provided in engine room and one (1) air horn (abt. 800 Hz in the cargo pump room.

9.5 INTERIOR COMMUNICATION AND ALARM EQUIPMENT – CONT'D

9.5.4 SHIP'S ALARM SYSTEM – CONT'D

9.5.4.3 REFRIGERATION CHAMBER RESCUE ALARM

Alarm shall be operated on DC 24V or A.C. 240V emergency supply.

Illumination ON-OFF switch in each ref. chamber.

12cm bell with lamp in galley and wheelhouse.

9.5.4.4 CO_2 RELEASE ALARM

One (1) CO_2 release alarm switch in CO_2 release pull box.

One (1) set each of bell with lamp in engine control room, workshop, purifier space and steering gear compartment.

Three (3) horns (abt 600 Hz) in engine room open space.

Alarms shall be operated on D.C. 24V or A.C. 240V emergency supply.

9.6 NAVIGATION EQUIPMENT

9.6.1 NAVIGATION AIDS

9.6.1.1 MAGNETIC COMPASS

One (1) wet type standard magnetic binnacle compass with reflecting mirror shall be installed on the compass bridge deck.

Accessories shall be provided as per Maker's standard.

One (1) spare bowl shall be provided.

Magnetic compass shall be adjusted at sea trial.

9.6.1.2 GYRO COMPASS/AUTO PILOT

A) Steering Control System

One (1) set of combined type gyro-compass autopilot shall be installed in wheelhouse and repeaters shall be fitted as follows :

1 - Steering stand with master compass
1 - Bearing repeater for front wall of wheelhouse
1 - Bearing repeater for bridge wings port and starboard
1 - Steering repeater for steering gear room
2 - Display unit in radar
1 - Course recorder

9.6 NAVIGATION EQUIPMENT – CONT'D

9.6.1 NAVIGATION AIDS – CONT'D

9.6.1.2 GYRO COMPASS/AUTO PILOT – CONT'D

A) Steering Control System – Cont'd

One (1) gyro-pilot system with dual electric control type of follow-up and non-follow up shall be fitted in wheelhouse.

Steering stand shall be equipped with audible alarm for excessive deviation from normal course of ship.

B) Course Recorder

One (1) course recorder shall be installed in the wheelhouse.

C) Power Source

The gyro compass and auto pilot shall be operated on AC 240V, supplied directly from the emergency switchboard.

9.6.1.3 CLEAR VIEW SCREENS

Two (2) clear view screens shall be fitted at wheelhouse front side windows.

9.6.1.4 WINDOW WIPERS

Three (3) horizontal wind screen wipers shall be fitted at the wheelhouse front centre windows.

9.6.1.5 WHISTLES

Two (2) whistles shall be provided, one(1) air horn (24V DC) on the radar mast and the other electric horn on the fore mast.

One (1) whistle control system with a time controller, operated on AC 240V, single phase shall be provided in the wheelhouse console.

One (1) push button shall be provided in the wheelhouse and one (1) on each wing of the navigation bridge deck.

The control device shall be used for both whistles.

The whistle light shall be commonly used with morse signal light.

9.6 NAVIGATION EQUIPMENT – CONT'D

9.6.1 NAVIGATION AIDS – CONT'D

9.6.1.6 MISCELLANEOUS

a) One (1) set Automatic/Identification System (A.I.S.).

b) One (1) set Voyage Data Recorder (V.D.R)

c) One (1) set Deckhead mounted Panasonic type rudder angle indicators plus two repeaters.

d) Four (4) 500W Cargo lights.

e) One (1) set Signal shades.

9.6.2 SEARCHING EQUIPMENT

9.6.2.1 ECHO SOUNDER

One (1) echo sounder with recorder shall be provided with one (1) transducer fitted at the bottom of engine room.

One (1) digital display unit with depth alarm shall be provided in chart space.

Particulars :

Depth range	:	About 400m
Output	:	Maker's standard
Power source	:	AC 240V

9.6.2.2 DOPPLER SPEED LOG

One (1) Doppler speed log, single axis with one transducer shall be provided.

One (1) set of speed distance transmitter shall be provided and one (1) speed indicator shall be provided in wheelhouse front with a dimmer switch.

Range of speed	:	0 - 15 knots
Power source	:	AC 240V

Speed signal for ARPA, oil pollution monitor shall be provided.

9.6 NAVIGATION EQUIPMENT – CONT'D

9.6.2 SEARCHING EQUIPMENT – CONT'D

9.6.2.3 RADARS

Two (2) sets of rasterscan type, marine radars shall be provided and principal particulars as follows :

	3 cm Radar	10 cm Radar
Frequency	X-band	S-band
Output	25-50 kW pep	25-50 kw pep
Scope diameter	12 inches	16 inches
Scanner	96 naut. Mile	64 naut. Mile
Power source	AC 220V	
Display	ARPA	ARPA

Inter switching unit and performance monitor shall be provided.

Both Radars shall have daylight viewing, be gyro stabilized and fitted with electronic bearing indicator (EBI) and variable range marker (VRM) functions.

9.6.2.4 ANEMOMETER AND ANEMOSCOPE

One (1) set of selsyn AC generator type anemometer shall be provided.

1 - Transmitter on wheelhouse top.
1 - Wind velocity and direction indicator with illumination in wheelhouse.

Power supply : A.C. 240V

9.6.2.5 ELECTRIC CLOCKS

One (1) electric clock system with 24 slave clocks shall be provided. Electric power shall be fed from the DC 24V supply system.

1 - Chronometer Quartz type.

1 - Master clock with slave clock control panel in chart space.

3 - 3 hand type clocks, each one in following places; engine room, wheelhouse (with illumination) and cargo control room.

6 - 2 hand type slave clocks, each one in following places;

	Decoration type :	Officer's mess room
		Captain's day room
		Chief engineer's day room
	Ordinary type :	Deck office
		Crew's mess room
		Galley (W.T.)
4 -	Double face type :	Each one (1) at inside passage.

9.6.3 NAVIGATION

9.6.3.1 DIGITAL GLOBAL POSITION SYSTEM (D.G.P.S)

One (1) set off DGPS Navigator with printer shall be provided.

Power supply : AC 240V

9.7 COMMUNICATION EQUIPMENT

Communication equipment shall be provided according to Classification/Flag State/ SOLAS/IMO requirements with amendments for GMDSS (A1, A2 and A3) with additional equipment including:

a) Two (2) sets VHF/DSC radio telephones with built in VHF/DSC watch receivers.

b) Two (2) sets radar transponders (SART).

c) One (1) satellite EPIRB (406 MHz).

d) One (1) set Navtex Receiver (518 KHz) (with automatic printing of navigation and meteorological warning broadcast).

e) One (1) set MF/HF Radio Receiver.

f) One (1) set INMARSAT-C MES with built in EGC receiver.

g) Three (3) sets VHF/FM 2-Way radios.

h) Three (3) robust, intrinsically safe, battery operated, portable VHF radios for use in daily operational communication.

i) Two (2) air band transceivers (one portable) with spare batteries and battery charger shall be provided.

j) One (1) set Loud hailer.

9.8 CABLE AND CABLE INSTALLATION

9.8.1 ELECTRIC CABLE

In general, electric cable shall be of JIS marine cable, which has been approved by the Classification Society, except special cable.

660V cable shall be used for A.C. 450V circuit and 250V cable for A.C. 240V and D.C. 24V circuit.

(A) General use cable (construction)

Tinned, annealed copper wire, stranded, colored or numbered for distinguishing core and with plastic filler.

9.8 CABLE AND CABLE INSTALLATION – CONT'D

9.8.1 ELECTRIC CABLE – CONT'D

(A) General use cable (construction) – Cont'd

Electric cable in general shall be ethylene propylene rubber insulated, PVC sheathed and galvanized steel wire braided cable.

Electric cable on exposed deck shall be PVC covered cable.

Electric cable for lighting circuit in accommodation space shall be ethylene propylene rubber insulated PVC sheathed 2 core cable (TPY).
(One core shall be used for earthing)

Single, double or triple core cable shall be used in general, and multi-core (5 to 33 cores) cable shall be used for communication circuit and control circuit.

Sizing of the cables shall be as per the Classification Rule requirement.

(B) Special cables

Application of special cable shall be as follows:

Application	Kind of cable
Microphone circuit, radio equipment circuit, etc. which is deemed to have radio interference by induced current	Twist cable of PVC insulated, shielded, PVC sheathed and steel wire braided cable.
Radio high frequency circuit	Coaxial cable
Inner connection of main switchboard	PVC insulated flexible wire (SYP) and polyethylene insulated flexible wire (SCP)
Inner connection of battery switchboard, alarm panel and other measuring instrument panels	PVC insulated wire (SY)
Portable appliances	Rubber insulated and polychloroprene sheathed flexible cable (PNP)
Desk lights	PVC insulated flexible wire (TYP)

9.8.2 CABLE INSTALLATION

9.8.2.0 GENERAL

A) Electric cable shall be laid avoiding places of high temperature and high humidity and shall be protected in the place where it is likely to receive mechanical damage.

9.8.2 CABLE INSTALLATION – CONT'D

9.8.2.0 GENERAL – CONT'D

B) Cables run in groups shall be supported with cable trays or ladders.

Hangers shall be fitted with proper space from hull structure as to easily permit painting of the hull structure.

C) Cables shall be fixed with galvanised steel or stainless steel ties.

D) Where cables penetrate watertight deck or bulkhead, watertight cable gland or approved type compound shall be applied.

E) Where cables penetrate non watertight deck, coaming or cable pipe without cable gland shall be used for protection of the cable.

F) Where cables penetrates firetight deck or bulkhead, cable gland or coaming shall be used for protection of the cable, and filled with fire-retarding compound where necessary.

G) Cable runs shall be so arranged as to prevent the propagation of fire by using fire stop of which method shall be approved by Classification Society.

9.8.2.1 INSTALLATION OF CABLE

A) Where paneling is applied over the hull structure in accommodation, concealed wiring shall be carried out as far as practicable, and exposed wiring shall be carried out at all other spaces.

B) Exposed cable in cabins with panelling shall be covered with decorative cover.

Where cable is exposed to the danger of some mechanical damage, it shall be protected with steel plate, galvanized steel pipe (SPP), flexible cable conduit or other equivalent means.

C) Cable on exposed deck between the deck house and the main deck forward shall be protected with galvanized steel pipe, and several expansion boxes shall be fitted.

D) Cable along the mast shall be protected with galvanized steel pipe (SPP) or painted steel plate or shall be installed inside of mast with cable hangers.

Earthing shall comply with the Classification Rule requirement.

The insulation shall be removed from the cable ends in a suitable manner. All protective sheaths shall be removed for at least 10 mm from the end of the insulation.

9.8.2 CABLE INSTALLATION – CONT'D

9.8.2.1 INSTALLATION OF CABLE – CONT'D

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 to suit cable size 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 shall be colour coded or labelled at regular intervals.

9.8.2.2 CABLE COLOURS

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

RED	:	PHASE ONE
YELLOW	:	PHASE TWO
BLACK	:	NEUTRAL

9.8.2.3 CABLE TRAY / SUPPORTS

As per Builder practice only and Class.

Cables shall be secured by approved brass/copper/stainless steel saddles onto G.I trays.

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 weather or mechanical damage shall be run suitably supported in waterpipe with soldered unions.

Waterpipe shall be perfectly 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. If necessary ventilating openings shall be provided, preferably at the highest and lowest points of the pipe, so as to permit air circulation and to eliminate the possibility of water accumulating at any part of the pipe run.

9.9 TOOLS AND OUTFIT

9.9.1 ELECTRIC WELDER

One (1) electric AC arc welder of the following particulars shall be fitted in the workshop :

Type		Drip-proof type
Voltage		
	Primary	AC 450V
	Secondary	AC 35V
Output		300A
Control		Machine side control

And the following shall be supplied as accessories :

1 - Handshield
1 - Helmet
1 - Hammer
1 - Wire brush
1 - Leather gloves
1 - Flexible cable each of connecting metal
Each 5kg – welding rods of 3, 4 and 5mm dia.

One (1) source terminal of primary voltage shall be provided to bosun store.

9.9.2 TESTING PANEL

One (1) testing panel shall be installed in workshop. The panel shall be of wall mounted type and shall have the following instruments and devices.

(A) 1 set x test terminals
450V A.C. 3 Ph, 60 Hz, 10A
240V A.C. 1 Ph, 5A
24V D.C. 5A

(B) 1 set x A.C. voltmeter with a selecting switch for A.C. 450V and A.C. 240V.

(C) 1 set x D.C. voltmeter for D.C. 24V.

(D) 1 – Breaker

(E) 1 – Source pilot lamp

9.9 TOOLS AND OUTFIT – CONT'D

9.9.3 TOOLS AND MEASUREING EQUIPMENT

9.9.3.1 MEASURING EQUIPMENT

1 - DC 500V portable megger (100 meg-ohm, transistor type).
1 - Portable AC voltmeter/ammeter of clamp-on type.
1 - Portable DC voltmeter (minus 3V-0-plus 3V).
2 - Standard hydrometers (1.1 – 1.3).
2 - Thermometers (0 C – 100 C).
1 - Breaker (1 lit.)

9.9.3.2 TOOLS

1 - Soldering iron (100W, AC 240V) with two spare heating elements.
1 - Soldering iron (40W, AC 240V) with two spare heating elements.
1 - Plier (20 cm).
1 - Nipper (15 cm).
1 - Adjustable spanner.
3 - "+" screw drivers, each one of 5, 10 and 15 cm.
3 - "-" screw drivers, each one of 5, 10 and 15 cm.
1 - Jack knife.
1 - Leather band with sack for tool.
1 - Rubber glove (for 450V).
1 - Set of tools for battery consisting of :
    1 - Funnel
    1 - Electrolyte bucket
    1 - Tool for fixing terminals