MARITIME ADMINISTRATION GUIDELINE SPECIFICATIONS FOR MERCHANT SHIP CONSTRUCTION

EXECUTIVE SUMMARY

Prepared by the
Office of Ship Construction
November 1995

Provided as a service of the
National Maritime Resource and Education Center
(NMREC)

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MERCHANT SHIP CONSTRUCTION
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PREFACE

The "Executive Summary of the Maritime Administration Guideline Specifications for Merchant Ship Construction" is intended to be a stand-alone document provided to the maritime industry as a service of the National Maritime Resource and Education Center (NMREC). It is intended to be a guide for the preparation of specific ship specifications in the same manner as the Guideline Specifications, but in less detail.

These Specifications can be used as starting points for the preparation of construction specifications for any type of ship. No parts of these Specifications are intended to be mandatory. The Owner and Contractor are, therefore, free to use as much or as little of these Specifications as they consider appropriate to suit their mutual needs.

The "Maritime Administration Guideline Specifications for Merchant Ship Construction" are intended to provide guidance to the maritime industry for the preparation of specifications for building competitive commercial ships in the United States of America for domestic or export markets. They cover all aspects of potential contract work, but may require modifications, as appropriate, to the ship design being contemplated.

It is the intent of these Specifications to define a ship powered by a slow speed diesel engine and built to international standards. They provide for the construction of a ship to soundly conceived engineering practices to ensure that the completed ship will conform to the intended purpose/mission.

These documents are not intended to restrict design features of construction, materials, equipment, systems, etc., to those that are specifically delineated herein. Substitutions consistent with Regulatory Body(ies) requirements and basic international standards of quality are acceptable.

It is requested that MARAD be notified of any errors herein. Also, comments and suggestions for improving these Specifications and updating to the latest vessel design practices and developments in international standards will be welcomed, for inclusion in future editions. Please use the comments sheets provided and address your suggestions to:

Maritime Administration
Office of Ship Construction
Division of Naval Architecture
MAR-724 Room 2109
400 Seventh Street, SW
Washington, DC 20590-0001

November 1995

COMMENTS/SUGGESTIONS FORM FOR THE EXECUTIVE SUMMARY

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PART I - HULL

SECTION 1

GENERAL

1.1. DEFINITIONS

"Contract" means the shipbuilding contract between the Owner and the Contractor and includes these Specifications and the accompanying Contract Drawings.

Wherever the terms "Classification Society(ies)" or "Regulatory Body(ies)" are used, they shall be read, if appropriate, interchangeably.

"Provide" means "furnish and install".

"Approved" means approval by the Owner or Regulatory Body(ies).

"Marine grade" means material that is suitable for the marine environment.

"CRES" means corrosion resistant steel.

"AC" means alternating current.

"SOLAS" means the International Convention for Safety of Life at Sea, and all Protocols and Amendments as appropriate.

1.2. GENERAL SPECIFICATIONS REQUIREMENTS

The ship shall be constructed with the principal characteristics set out herein and in compliance with all applicable requirements of the vessel flag of registration, Classification Society, and Regulatory Body(ies). In addition, the ship shall meet the most recent issues including all amendments of the following rules and regulations:

(a) Classification Society, as appropriate

(b) U.S. Coast Guard regulations, as appropriate, or, U.S. Coast Guard regulations applicable to non-U.S.-Flag vessels

(c) International Convention for the Safety of Life at Sea (SOLAS), 1974, and Protocol of 1978, including all subsequent amendments

(d) International Convention for the Prevention of Pollution from Ships (MARPOL), 1973, Protocol of 1978, including all subsequent amendments

(e) International Convention on Load Lines, 1966

(f) International Tele-communication Convention, and Radio Regulation, 1974 and 1982

(g) International Regulations for Preventing Collision at Sea, 1972

(h) International Convention on Tonnage Measurement of Ships, 1969

(i) International Labor Organization

(j) International Electricity Commission

(k) Suez Canal and Panama Canal Regulations

(l) U.S. Public Health Service requirements, as appropriate

(m) All other rules and regulations, as appropriate

All necessary certifications and/or documents covering the approval and indicating compliance shall be obtained by the Contractor.

The Contractor shall be ISO 9000 registered.

Where requirements of the Contract Drawings and/or these Specifications are in excess of Regulatory Body(ies) requirements, the Contract Drawings and/or these Specifications shall prevail.

Unless specifically stated otherwise in the Contract, work in excess of the Contract Drawings and these Specifications, which is required by any Regulatory Body(ies) requirement, law, or change in any existing Regulatory Body(ies) requirement or law, shall be included in the Contract work and Contract price if such requirement or change was published and effective 30 days prior to the date of execution of the Contract (in the case of a negotiated Contract), or 30 days prior to bid opening (in the case of a competitive bid Contract). When any such new requirement or change in an existing requirement is published prior to the preceding date but becomes effective after such date, work required by the new requirement or change shall also be included in the Contract work and Contract price if: (1) the publication occurs prior to the preceding date, (2) the effective date of the new requirement or change occurs before the actual delivery date of the vessel, or (3) compliance with such new requirement or change is necessary to obtain the approval of any Regulatory Body(ies).

1.3. PRINCIPAL CHARACTERISTICS

Length Overall _____ m
Length Between Perpendiculars _____ m
Beam, Molded _____ m

Depth, Molded	_____	m
Draft, Summer Freeboard	_____	m
Draft, Design Full Load, Molded	_____	m
Light Ship Weight	_____	t
Total Deadweight at Full Load Draft	_____	t
Total Displacement at Full Load Draft	_____	t
Liquid Cargo Volume	_____	m^3
Segregated Ballast Volume	_____	m^3
Fuel Oil Volume	_____	m^3
Lube Oil Volume	_____	m^3
Number of Cargo Tanks	_____	
Number of Segregated Ballast Tanks	_____	
Type of Machinery	_____	
No. of Propeller(s)	_____	
Shaft Power	_____	kW
Propeller Revolutions	_____	rpm
Speed	_____	kts
Fuel Consumption at Sea at 85% MCR	_____	t per day
Fuel Consumption in Port	_____	t per day
Endurance at Full Load Draft	_____	nautical miles
Gross Tonnage	_____	
Net Tonnage	_____	
Container Capacity	_____	TEU
Bale Cubic	_____	m^3

Accommodations	Licensed	Unlicensed	Total
Deck Department	_____	_____	_____
Engine Department	_____	_____	_____
Stewards Department	_____	_____	_____
Other	_____	_____	_____
Total Accommodations	_____	_____	_____

1.4. DRAWINGS

The ship shall be constructed per these Specifications and the following Contract Drawings:

Lines
General Arrangement Drawings and Profiles
Machinery Arrangement Drawings, Sections, and Elevations
Midship Section
Energy Balance Diagram

1.5. WEIGHT AND CENTER OF GRAVITY

The Contractor shall submit for approval an independently prepared estimate of light ship weight and center of gravity. Departures from the

approved estimate shall thereafter be accounted for. At the time of delivery the estimated light ship weight and center of gravity shall be in reasonable agreement with the deadweight survey or inclining results.

1.6. STABILITY AND SUBDIVISION

The ship must meet all applicable IMO and Regulatory Body(ies) requirements for intact stability, and for damage stability and subdivision, including those of SOLAS. The Contractor shall prepare a Trim and Stability Booklet which sets forth the stability data necessary to permit safe and efficient handling of the ship.

1.7. VIBRATION AND NOISE

Special attention shall be given in the design and construction of the vessel to minimize vibration and noise. Sound insulation and isolation shall be provided as necessary to keep noise levels within practical limits. Guidance on the performance of sound surveys is given in ISO 2923, "Acoustics - Measurement of Noise on Board Vessels"; guidelines for acceptance criteria of noise levels in normally manned spaces is given in the Annex to IMO Resolution A.468 (XII), "Code On Noise Levels On Board Ships".

1.8. HEADROOM

Clear headroom shall be as high as practical.

1.9. ACCESS AND MAINTENANCE REQUIREMENTS

The structure and layout of the machinery and equipment shall be designed and constructed to permit ready access to all parts for operation, inspection, maintenance and repair, and consideration for removals with minimum disturbance of other structure or equipment.

1.10. INSPECTION

See provisions of the Contract(s).

1.11. MATERIALS AND WORKMANSHIP

All material, machinery, and equipment shall be of new manufacture and shall be in compliance with all applicable requirements of the Classification Society(ies). Spare parts and service shall be readily obtainable.

All machinery, structure, and outfit shall be designed to withstand the resultant forces from the at-sea ship conditions described in the Specifications.

(a) Asbestos

There shall be no asbestos in any form installed on the ship.

1.12. HULL PROTECTION DURING OUTFITTING PERIOD

Rigid control of welding and electrical grounding shall be maintained for the protection of the hull, stern tube, and other hull appendages. The Contractor shall adequately protect the underwater part of the hull prior to ship delivery.

1.13. LAUNCHING AND DRYDOCKING

The Contractor shall be responsible for the satisfactory launching of the ship.

If at any time prior to formal acceptance of the ship there is warrantable reason for believing the underwater portion of the ship to have been seriously impaired, the Contractor shall place the ship in drydock and adequately inspect, repair, clean, and paint the damaged areas at its own expense.

1.14. DELIVERY

The Contractor shall deliver the ship per the Contract, after successful sea trials and an Acceptance Survey, ready to receive cargo.

SECTION 2

STRUCTURE - HULL

2.1. GENERAL

The use of high tensile or notch tough steel shall be as indicated in the Contract Drawings. All materials used in the fabrication of the hull shall be in accordance with Regulatory Body(ies) requirements.

2.2. WORKMANSHIP

All workmanship shall be of a standard of quality consistent to ensure that the requisite tightness is obtained, exposed surfaces are smooth, proper fit and alignment accomplished, and stress concentrations minimized.

All surfaces shall be reasonably fair, without buckles, kinks, or other surface irregularities in excess of the tolerances given in ASTM F1053/ F1053M, "Standard Guide for Steel Hull Construction Tolerances (Metric)".

2.3. TESTING AND INSPECTION OF WELDS

All testing and inspection shall be to the satisfaction of the Regulatory Body(ies).

2.4. WELDING

Unless noted otherwise, all steel construction shall be of welded design. The weld sizes and types shall be per Regulatory Body(ies) requirements.

2.5. STEM

The shell plating and seams shall present a flush exterior surface below the deep waterline.

2.6. STERN FRAME

The stern frame shall be of streamline configuration indicated on the Contract Drawings with scantlings as prescribed by Classification Society(ies).

2.7. RUDDER AND CARRIER

The rudder shall be streamlined in horizontal section and of the type, area and contour suitable for the intended service. Positive hardover stops shall be provided to limit the travel of the rudder. The whole of

the rudder shall be made watertight by welding, and tested. The internal surfaces shall be coated with a suitable protective compound.

2.8. MOLDING AND RUBBING STRIPS

Smooth welded steel, extra heavy or double extra heavy pipe molding, or half-round bars shall be fitted in way of and for a generous distance each side of mooring fittings.

2.9. BILGE KEELS, WHEN FITTED

The bilge keels shall be of scantlings and extent as shown on Midship Section or Lines Drawing. The body of the bilge keel shall be designed to tear away under destructive stress without damaging the shell connection.

2.10. DOUBLE BOTTOM - ENGINE ROOM

Double bottoms shall be fitted as shown on the Contract Drawings.

2.11. WEB FRAMES

The extent, location, and scantlings of the web frame shall be as indicated on the Contract Drawings.

2.12. DECK GIRDERS

Girders shall be provided as indicated on the Contract Drawings.

2.13. PILLARS AND STANCHIONS

Pillars and stanchions shall be fitted to properly support structural loads.

2.14. BULKHEADS

Bulkheads shall be provided with continuity and with tightness to provide hull integrity. All watertight steel bulkheads forming boundaries shall be proven watertight by appropriate test before paint, insulation, or other covering is provided.

2.15. DEEP TANKS

Structure within cargo oil tanks shall be minimized; it shall permit easy drainage and cleaning.

2.16. DECKS

Decks shall be provided with continuity and with tightness as necessary to provide hull integrity. Weather Decks and all interior steel decks shall be proven tight.

Coamings, not otherwise specified by Regulatory Body(ies), shall be above the plate or top of the deck covering and fitted at all deck openings in trunks that are not otherwise protected by hatch covers.

2.17. FOUNDATIONS

Foundations shall be designed to act as complete supports against vertical and racking loads independent of the casing, frame, bedplate, or other part of the supported unit. They shall be designed to withstand the resultants of the static and dynamic loads due to the roll, pitch, list and trim called out in these Specifications.

2.18. TRUNKS

The minimum size of access trunks shall be per the Specifications. Where trunks pierce decks, the deck cuts shall have rounded corners.

2.19. BREAKWATER

A steel plate breakwater shall be fitted across the Weather Deck as indicated in the Contract Drawings.

2.20. CARGO HATCH COAMINGS

The coamings for the Weather Deck hatches shall be of steel.

2.21. STRUTS AND BOSSINGS

Extended propeller shafts shall be properly supported.

SECTION 3

HOUSES, INTERIOR BULKHEADS, AND MISCELLANEOUS STRUCTURES

3.1. GENERAL

The applicable parts of SECTION 2, STRUCTURE - HULL, shall apply here, in addition to the following.

The boundaries of all deckhouses shall be of watertight construction and shall be hose tested for tightness per Regulatory Body(ies) requirements. Casings, houses, bulkheads, and other surfaces, shall be reasonably fair, without buckles, kinks, or other objectionable surface irregularities in excess of the tolerances given in ASTM F1053/F1053M, "Standard Guide for Steel Hull Construction Tolerances (Metric)". Casings and deckhouses shall have rounded outside corners.

All welded non-structural steel bulkheads shall be of lightest practicable structure. Non-structural steel or joiner bulkheads surrounding wet spaces shall have all welded steel coaming extending above the deck covering.

3.2. INTERIOR BULKHEADS

Outside corners of interior steel bulkheads in way of living and working spaces shall be rounded so they do not present a hazard to personnel.

The boundaries of gas or odor producing spaces shall be continuously welded and fumetight. The periphery of other divisional steel bulkheads shall also be continuously welded or sealed with an approved compound unless the periphery is covered by sheathing, ceiling, or deck covering so as to make it effectively light, dust, and sound tight.

3.3. BULWARKS AND WINDSHIELDS

Bulwarks and windshields shall be provided as shown on the Contract Drawings and as required by Regulatory Body(ies).

3.4. CHAIN LOCKERS

Chain lockers shall be constructed in locations as indicated on the Contract drawings.

The bitter end connections shall be located at top of the lockers, in protected but accessible locations to permit emergency release of the chain. The bitter end connection shall be designed for shear failure under a runaway chain load equal to the breaking strength of the anchor chain.

SECTION 4

SIDEPORTS, DOORS, HATCHES, AND MANHOLES

4.1. GENERAL

Closures shall be appropriate to the location, use and watertight integrity of the space served, and shall be equivalent in strength to the adjacent structure.

All mechanical parts shall be equipped with rugged non-corrodible bearings and pins and shall be provided with means for proper lubrication.

4.2. SIDEPORTS

Watertight sideport doors and fittings shall fit flush with the outer shell of the vessel when closed. Doors shall be complete with strongbacks, hinges, dogs, dog wrenches, gaskets, ring bolts, and holdback arrangements.

4.3. DOORS

(a) General

Exterior doors shall have watersheds over them, where not otherwise protected.

(b) Sizes

Door heights (headroom) and widths (clear openings), and coaming heights shall be as identified in the ship specifications.

(c) Watertight and Weathertight Doors

Except when otherwise allowed by the Regulatory Body(ies), all watertight doors shall be per ASTM F1196, "Sliding Watertight Door Assemblies", and ASTM F1197, "Sliding Watertight Door Control Systems". When allowed by the Regulatory Body(ies), other watertight doors shall be per ASTM F1069, "Doors, Watertight, Gastight/Airtight and Weathertight, Individually Dogged, For Marine Use, Class A or Class B".

Weathertight doors shall be per ASTM F1069, "Doors, Watertight, Gastight/ Airtight and Weathertight, Individually Dogged, For Marine Use, Class D". Sliding type wheelhouse doors shall have stainless steel tracks and rollers.

(d) Joiner Doors

Joiner doors shall be per ASTM F821, "Doors and Frames, Steel, Interior, Marine" and shall satisfy test requirements contained in IMO Resolution A.754.

(e) Non-tight Doors

Non-tight doors shall be per ASTM F1070, "Doors, Non-tight, For Marine Use".

(f) Gastight and Fumetight Doors

Gastight and fumetight doors shall be per ASTM F1069, "Doors, Watertight, Gastight/Airtight and Weathertight, Individually Dogged, For Marine Use, Class C".

(g) Fire Doors

These shall be similar in appearance to doors in adjacent areas and meet the Regulatory Body(ies) requirements.

(h) Elevator and Dumbwaiter Trunk Doors

These shall be similar in appearance to doors in adjacent areas.

(i) Wire Mesh or Expanded Metal Doors

Wire mesh or expanded metal rectangular doors shall be per ASTM F1072, "Expanded-Metal Doors".

(j) Refrigeration Space Doors

Refrigerated store space doors and frames shall be of fire retardant light weight fiberglass or stainless steel construction. They shall be an approved marine type, factory aligned, with frame and single seal. Refrigerated doors forming part of a fire protection boundary shall meet the Regulatory Body(ies) fire protection requirements. There shall be a latch and opening device so arranged that the door can be opened from the inside and outside by handle.

4.4. CARGO HATCH COVERS

(a) General

Hatch covers shall meet the requirements of the Classification Society(ies) rules and any special requirements of SECTION 2.

(b) Quick-Acting Hinged Hatch Covers for General Cargo Ships

Actuation shall be by remote control, with control stations located so that the operator can readily observe the hatch cover operation when any section is opened and the remaining section is overstowed with cargo.

For containership(s), raised weathertight hatch covers on the Weather Decks shall be designed to provide container stowage corner fittings which will not interfere with opening and closing of covers. Hatch covers that open both forward and aft shall have no interference between fore and aft sections when one section is opening or closing and the other is loaded to capacity.

Design criteria for flush weathertight covers shall be similar to the raised type except that covers shall be fitted flush with surrounding deck plating with any wheel tracks, hinges, and other fittings, below the deck level. Covers shall stow entirely within the deck opening.

Non-tight hatch covers shall be similar to the flush weathertight type, except that dogging, gasketing, and drains shall be omitted.

'Tween Deck oiltight covers shall be fitted flush with the surrounding deck plating.

(c) Welded Steel Pontoon Hatch Covers (Alternate for Containerships)

Covers shall be provided with fittings which permit stacking and securing of containers and lifting by the container crane automatic spreaders.

(d) Welded Steel Pontoon Hatch Covers (Alternate for LASH Type Barge Carriers)

Lift-off one-piece pontoon hatch covers shall be provided complete with all fittings required for lifting by the lighter crane automatic spreader, stacking on top of each other or on top of a lighter forward or aft of the open hatch, securing themselves against movement under the most severe dynamic conditions and for securing a lower tier of lighters by their bottom corners.

(e) Side Rolling Hatch Covers (Alternate for OBO Ships)

The covers shall have parting joints on centerline and shall roll outboard port and starboard on wheels and tracks. Covers shall be rolled outboard by mechanical or hydraulic means.

(f) Feeder Hatches (Alternate for OBO Ships)

Watertight feeder hatches shall be fitted over the upper wing tanks intended for grain stowage. Feeder openings shall be fitted along the lower edge of the wing tank bulkheads to allow grain to feed into the center holds during grain unloading operations.

4.5. ACCESS HATCHES

All access hatches shall be as shown on the Contract Drawings, with coamings, oiltight, watertight, or non-tight covers as required.

4.6. MANHOLES

Manholes shall be provided for access to all tanks, voids, and other spaces without previously specified openings, in location and of the type that the spaces may require. Manholes shall be oiltight, watertight, or non-tight, as required. Bolted watertight and oiltight manholes shall be per ASTM F1142, "Manhole Cover Assembly Bolted, Semi-flush, Oiltight, and Watertight" or ASTM F1143, "Manhole Cover Assembly, Raised, Oiltight, and Watertight".

Hinged watertight and oiltight manholes, shall be per ASTM F1144, "Manhole Cover Assembly, Bolted Hinged, Semi-Flush, Oiltight, and Watertight".

4.7. SCUTTLES

A watertight scuttle, with rollers, operable from both sides, shall be fitted on Weather Deck over each rope stowage space.

SECTION 5

HULL FITTINGS

5.1. AIRPORTS, FIXED LIGHTS, WINDOWS

(a) General

All glass shall be heat treated. All fixed rectangular windows shall be per ISO 3434, "Shipbuilding and Marine Structures - Heated Glass Panes for Ships' Rectangular Windows", and shall be tested and certified as passing IMO Fire Test A.754.

(b) Windows

Wheelhouse front windows shall be sloped aft at bottom for protection against reflections. The opening type windows shall be weathertight. Vertical sliding windows shall be fitted with window pockets of non-corrodible material. A minimum of three fixed windows, including the centerline windows, shall be electrically heated. Windows shall be per ISO 3903, "Shipbuilding and Marine Structures - Ships' Ordinary Rectangular Windows".

(c) Fixed Lights

No fixed light is to be fitted in a position so that its sill is below a line drawn parallel to the freeboard deck at side and having its lowest point 2.5 percent of the breadth above the load waterline, or 500 mm whichever is greater.

5.2. WINDOW WIPERS

Automatic window wipers shall be fitted on the heated Wheelhouse windows. A window washing installation shall be provided for each wiper-equipped window.

5.3. LADDERS AND STAIRWAYS

(a) General

Ladder and stair tread spacing shall be provided in accordance with a given, consistent formula.

Interior stairways, lifeboat, and life raft embarkation ladders, and pilot ladders shall be according to regulations. Lifeboat ladders shall be provided such that a person in a stretcher can be easily embarked into the survival craft.

(b) Accommodation Ladders

The accommodation ladders shall be per ISO 5488, "Shipbuilding - Accommodation Ladders". They shall reach above light operating draft at an angle of 50° and shall have upper platforms of the 180° rotating type, feathering or curved non-skid type treads, and all other equipment necessary for operation. Winch controls for power operation shall be located so operator has clear view of ladder overboard.

(c) Inclined Ladders

Inclined ladders shall be of steel, bolted to the structure so as to allow relative motion between supporting fastenings at head and foot. Where they are attached to deck coamings, the coamings shall be cut away to eliminate a tripping hazard.

(d) Vertical Ladders

Steel vertical ladders shall be provided under escape windows and airports as necessary, elsewhere for access as necessary.

Vertical ladders shall be constructed per ASTM F840, "Standard Specification for Ladders, Fixed, Vertical, Steel, Ship's", Type 1. Where subject to damage in cargo holds, ladders shall be per ASTM F840, "Standard Specification for Ladders, Fixed, Vertical, Steel, Ship's", Type III.

Where practicable, ladders may be constructed of separate rungs per ISO 9519, "Shipbuilding and Marine Structures - Rungs for Dog-Step Ladders" and welded to the structures. All vertical ladders shall be bolted in place except for individual rungs welded to the structure.

(e) Cargo Hold Ladders (for General Cargo Ships)

There shall be one vertical ladder at each end or at each side near the end of each cargo hatch just clear of the hatch opening, and in each hatch trunk, in diagonally opposite corners extending in an unbroken vertical line to bottom of hold. They shall be per ASTM F840, "Standard Specification for Ladders, Fixed, Vertical, Steel, Ship's", Type II. Access shall accord with IMO Resolutions A.272 (VIII), "Recommendation on Safe Access to and Working in Large Tanks" and A.330 (IX), "Recommendation on Safe Access to and Working in Large Cargo Holds of Bulk Carriers".

(f) Cargo Hold Ladders (Alternate for OBO Ships)

Vertical access ladders in holds shall be 20 mm square or round bar rungs recessed in transverse bulkhead vertical flutes to preclude damage by bulk cargo handling equipment, and welded to the structure.

(g) Cargo Hold Ladders (Alternate for Bulk Oil Ships)

Access to cargo oil tanks shall be by inclined ladders with intermediate non-skid platforms.

(h) Pilots' Ladders - Hoist or Manual

(1) The pilots' powered ladder shall be per ISO 799, "Shipbuilding - Pilot Ladders", or,

(2) A manual ladder shall be provided as per IMO Resolution A.667 "Pilot Transfer Arrangements".

(i) Stairways, Platforms, and Landings

Stairways, platforms, and landings shall be as shown on the Contract Drawings.

5.4. RAILS

Railings shall be located as shown on the Contract Drawings and as required by Regulatory Body(ies) and be per ISO 5480, "Shipbuilding - Guardrails for Cargo Ships".

Portable guard rails of closed link chain and stanchions shall be provided around all low coamings or flush hatches, and elsewhere as necessary for protection of personnel.

Storm rails and hand grabs shall be fitted to bulkheads in all exterior and interior passage areas, and elsewhere, as necessary.

5.5. MOORING FITTINGS

Mooring fittings shall be provided as shown on the Contract Drawings and shall be of steel construction. Bearing surfaces shall be smooth.

Towing bitts as required shall be recessed in the hull.

5.6. PADEYES

Padeyes shall be provided on Weather Decks as necessary for securing deck cargo.

5.7. CLEATS AND STOPPERS

Cleats and/or stoppers shall be provided as required for securing cargo handling running rigging and for other general deck use. Cleats shall be per ASTM F1074, "Standard Specification for Cleats, Welded Horn Type".

5.8. RAMPS

Portable steel ramps shall be provided in way of side ports, refrigerated cargo space doors, ship store space doors, and other irregular deck spaces where lift trucks or other wheeled vehicles are used. Surfaces shall be non-skid.

SECTION 6

DECK COVERINGS

6.1. GENERAL

The Contractor shall provide deck coverings per the ship specification Schedule of Deck Coverings, SECTION 6.13. Preparation of surfaces and use of underlayment to receive deck coverings shall be per the manufacturer's instructions. Deck coverings (including cove base) shall be provided per the manufacturer's instructions for the intended environment. Prior to procurement of the deck coverings the Contractor shall provide the Owner with samples of coverings from which the Owner can make specific selections.

6.2. GRATINGS

Steel gratings shall be galvanized. Wood gratings shall be slatted type. Fiberglass gratings shall have a highly slip-resistant walking surface. Aluminum gratings shall be constructed of 6063-T6 aluminum alloy.

6.3. UNDERLAYMENT

Underlayment shall be approved by the Owner and installed per the manufacturer's instructions.

6.4. CERAMIC TILE (NON-SKID)

Unglazed ceramic mosaic tile shall be non-skid type and provided over an approved underlayment. A ceramic cove base shall be provided.

6.5. QUARRY TILE (NON-SKID)

Quarry tile shall be a non-skid type with a cove base, and provided over an approved underlayment.

6.6 TERRAZZO TYPE EPOXY

Epoxy shall be a non-skid, resin system consisting of a two component epoxy resin binder and properly graded marble aggregate, finished with clear resin coats. A cove base and an underlayment shall be provided.

6.7 LATEX MASTIC

Latex mastic shall be a system consisting of resin mixed with dry components, properly graded aggregates, and mineral oxide pigments. A cove base and an underlayment shall be provided.

6.8. VINYL TILE

The vinyl tile shall be as specified.

6.9. CARPET

Carpet that is acceptable to Regulatory Body(ies) shall be provided over a fire retardant urethane cushion.

6.10. STAIR TREADS

Treads on interior stairways shall be covered with resilient deck material similar to that on adjoining decks. Tread edges shall have nosings of cast aluminum, non-skid, abrasive filled.

6.11. SAFETY TREADS

Safety treads shall be of the fiberglass reinforced resin or metal abrasive insert type. Each shall be weather resistant with a non-skid surface. Treads shall be located at the head and foot of all inclined ladders, both sides of entrance doors having coamings, in way of all refrigerated space doors, and approximately the entire area of each step on inclined ladders.

6.12. RUBBER MATTING, RIBBED

Rubber matting shall be provided in front and rear of all switchboards, control consoles, group control boards, and over deck areas on which personnel stand when servicing or turning energized electrical equipment or when shock hazards exist.

6.13. SCHEDULE OF DECK COVERINGS

Schedule shall be as specified.

SECTION 7

INSULATION, LININGS, AND BATTENS

7.1. INSULATING MATERIALS AND INSTALLATION

(a) Insulating Materials

Insulating materials shall be approved by the Owner, and shall satisfy Regulatory Body(ies) requirements.

(b) Installation, General

All blanket insulation material shall be impaled on welded studs and held in place by "speed clips".

Where insulation material is installed in more than one layer, each following layer shall be staggered and hard against the preceding layer, bedded and jointed with adhesives per insulation material manufacturer's recommendations.

7.2. INSULATION AND SHEATHING, TANKS

The dry cargo hold side of distilled water tanks, cargo oil tanks, and fuel oil settling tanks shall be sheathed with lumber fastened on sleepers. Mineral fiber, blanket type insulation shall completely fill spaces between the sleepers. Wood sheathing shall be covered with galvanized sheet steel.

Vertical surfaces of water tanks and fuel oil settling tanks shall be sheathed and insulated with approved hard faced thermal fibrous glass insulating board.

Horizontal surfaces or decks over water tanks or fuel oil settling tanks shall be provided with equivalent insulation having sufficient load bearing characteristics as within accommodation and service spaces.

7.3. INSULATION, VENTILATION, AND AIR CONDITIONING DUCTS AND PIPING

Insulation of vent and air conditioning ducts and piping shall be as required by SECTIONS 12 and 75.

7.4. INSULATION, REFRIGERATED SPACES

(a) General

Refrigerated spaces shall be insulated so as to maintain the specified temperature without sweating on the warm side exposed surfaces of decks, bulkheads, or shell in way of the refrigerated spaces.

(b) Refrigerated Space Doors

Doors shall be as specified in SECTION 4.

(c) Hangers, Rods, Hooks, Shelving, and Spacers

They shall be supported on insulated flat bars in such a way that no load is placed on the sheathing.

(d) Thickness of Insulation

The minimum insulation thickness shall be per the Contractor's practice.

(e) Decks

The decks of each compartment shall be coated with an approved asphalt emulsion prior to providing the first course of either cellular glass, polyurethane or polystyrene material. The top of each course, including the final course, shall be coated with asphalt emulsion per manufacturer's recommendations. The insulation shall extend up the vertical sides above the final thickness of decking and be flush with the full thickness of the vertical insulation. The final layer of insulation shall be coated with asphalt emulsion prior to laying down a vapor seal membrane of felt paper. The finished decking over the felt paper shall be a layer of mastic composition coved up the sides and reinforced by galvanized wire mesh. A coved curbing shall be provided.

(f) Bulkheads, Linings, and Overhead Ceilings

For bulkheads and deck overhead the insulation shall be of material specified in SECTION 7.1. This insulation, together with lining and ceilings, shall be supported by a system of fire retardant furring and framing.

(g) Refrigeration Spaces and Cooler Rooms

Each compartment or group of compartments shall be so insulated that it may operate at its specified temperature independent of all other compartments and without condensation on adjacent structure under the specified humidity conditions.

7.5. INSULATION, TEMPERATURE

All insulation thicknesses shall be per the Contractor's practice.

All living, working, and public spaces which have a common boundary with heat producing spaces shall be insulated on the heated side.

Boundaries between air conditioned and non-air conditioned spaces shall be thermally insulated.

Boundary surfaces of all spaces which are heated or air conditioned, and which are exposed to the weather or are adjacent to unheated spaces shall be covered with thermal insulation.

Galley and pantry surfaces shall be insulated.

Machinery space surfaces shall be insulated.

7.6. FIRE SAFETY INSULATION

Insulation shall be fitted to suit the Regulatory Body(ies) requirements for fire safety within accommodation areas, control stations, and service areas.

7.7. INSULATION, ACOUSTICAL AND SOUND

Sound absorption shall be provided in Passenger Public Rooms, Wheelhouse, Mess Rooms and Lounges, Lobbies, and similar spaces.

7.8. SHEATHING

(a) General

Sheathing of insulating board or sheet metal shall be attached to all surfaces required to be insulated. Portable sections of sheathing shall be provided where required for accessibility in way of wiring, ducts, piping, air conditioning controls, filters at unit air conditioners, and other accessories.

(b) Insulating Board

For joiner linings and ceilings, see SECTION 25.

(c) Sheet Metal

Where sheathing and insulation are subject to damage the sheathing shall be of galvanized sheet metal. Galley and pantry spaces shall be sheathed with satin finish stainless steel.

7.9. BATTENS AND SPARRING

(a) Dry Cargo Spaces

Cargo battens shall be of wood, dressed, and chamfered.

(b) Storerooms

All Storerooms shall have vertical wood sparring. Deck gratings where noted shall be as specified.

(c) Refrigerated Spaces

Vertical battens shall be provided on the lining of all refrigerated spaces to prevent stowage contact with the lining and to permit proper circulation of cooling air.

(d) Cooler and Diffuser Rooms

Vertical portable wood cribbing between Cooler Rooms and refrigerated cargo spaces shall be provided.

SECTION 8

KINGPOSTS, BOOMS, MASTS, AND DAVITS

8.1. GENERAL

Kingposts, booms, masts, gaffs, staffs, and davits shall be as shown on the Contract Drawings and per applicable Regulatory Body(ies) requirements.

All moving parts shall be fitted for pressure-grease lubrication or shall be fitted with pre-lubricated, sealed anti-friction bearings and grease retaining seals of a type proven in service.

8.2. KINGPOSTS AND VANG POSTS

Kingposts shall be freestanding under all design loading conditions. Kingposts and top trusses shall be of the most efficient shapes practicable, with minimum weight and/or lowest center of gravity.

8.3. BOOMS AND FITTINGS

Every effort shall be made to arrange stowage of heavy lift booms in a vertical position with hooks and lower cargo tackle secured at deck level. Boom steps for light booms shall be steel of the bracket flanged hanger type, with gooseneck and pin. Pivot pins shall be steel, and bushings shall be bronze. The heavy lift boom shall be mounted on a steel pedestal at centerline of the ship. Boom rests with linings and positive securing devices shall be provided.

8.4. MASTS

Masts, yards, spreaders, and gaffs, with platforms and brackets shall be provided as necessary for all navigation, communication, and signal equipment. They shall be of steel pipe and plate and be designed to be completely self-supporting with all equipment in place.

8.5. JACK AND ENSIGN STAFFS

The staffs shall be constructed of galvanized steel pipe and shall be hinged at the deck. They shall be fitted with trucks of halyard sheaves, light brackets, cleats, braces, and any other necessary fittings.

8.6. DAVITS

Portable davits shall be fitted as shown on the Contract Drawings, with provisions for stowage in the area of use. Davits shall be provided as required at the bosun's store hatch, and for handling accommodation ladders, and shall stow flush with the hull when not in use. 5

SECTION 9

RIGGING AND LINES

9.1. GENERAL

All rigging and pertinent fittings shall be provided to produce a thoroughly workable installation complete for the service intended and as necessary to facilitate maintenance and repair. All cargo rigging except the heavy-lift gear shall be rigged for single whip burtoning before delivery of the ship.

9.2. RUNNING RIGGING

Wire rope for cargo hoists except heavy lift shall be black preformed improved plow steel. Wire rope for topping lifts, vangs, schooner guys and heavy lift hoists, shall be preformed improved plow steel, galvanized or aluminized. Fixed length pendants shall be galvanized or aluminized improved plow steel. Cargo hoists shall be of sufficient lengths to reach all areas of the lowest holds served, with a minimum of four turns of wire rope remaining on the winch drums.

9.3. BLOCKS

(a) General

Blocks shall be of marine quality.

(b) Light Booms

Where doubling-up of cargo falls is anticipated, cargo blocks shall be of the deep throated type to allow passage of a spliced eye over the sheave. Lower cargo blocks shall have anti-toppling guards, and shall have sufficient weight to overhaul the maximum number of parts used with the block. Fairlead blocks shall be fitted with anti-toppling features where required.

(c) Heavy-lift Booms

All bearings shall be anti-friction type.

SECTION 10

GROUND TACKLE

10.1. HAWSE PIPES

Steel hawse pipes with built-in washdown system shall be provided for the anchors. Their design shall ensure positive starting of the anchors and overhaul of the chain upon release under ordinary conditions of list and trim.

10.2. CHAIN PIPES

Chain pipes shall extend from the windlass bedplate to the approximate center of the chain locker, with large bellmouths on bottom and deck bolsters as supplied or recommended by the windlass manufacturer on top.

10.3. ANCHORS

Approved Classification Society(ies) certified stockless anchors shall be provided.

10.4. CHAINS

Anchor chains of steel stud link shall be provided in equal lengths, one for each anchor. The length of the chain and the grade of material shall be to Regulatory Body(ies) requirements.

10.5. CHAIN STOPPERS

Chain stopper pawls of the riding tongue type shall be provided.

10.6. HAWSERS

Hawsers shall be fitted to mooring and first-line-ashore winches specified in the Machinery List. Additional fiber hawsers shall be supplied so that total number equals approved Classification Society(ies) recommendations.

10.7. RAT GUARDS

Rat guards per ASTM F1099, "Rat Guards, Ships" shall be provided for each hawser and spring line.

10.8. HEAVING LINES

One nylon heaving line shall be provided for each hawser and spring line.

SECTION 11

PIPING - HULL SYSTEMS

11.1. GENERAL

All piping systems covered by this SECTION shall be complete with the necessary valves, fittings, and appropriate hardware, for proper operation, including a sufficient number of flanges or unions to facilitate removal, and as approved by Regulatory Body(ies).

Pipes conveying steam or liquids shall not be led overhead through the Emergency Generator Room, Chart Room, Battery Lockers, Radio Room, Refrigerated Spaces, Stores, Dry Cargo Holds or in the vicinity of Switchboards; nor pipes conveying liquids, in food preparation spaces, Mess Rooms, Dispensary, and similar spaces, where avoidable. Where this is not practical, the piping shall have all joints welded or brazed.

11.2. SCUPPERS AND DRAINS

(a) General

Scuppers and drains shall be per ASTM F994, "Standard Specification for Design and Installation of Overboard Discharge Hull Penetration Connections".

All scupper valves shall be arranged to open and close in a fore and aft direction at the ship's side and shall be located for easy access for the removal of the clapper and hinge pin. Skin gate valves shall be located outboard of each scupper.

All drain pipes shall be led as direct as possible. They shall be pitched to about 20 mm per meter when draining aft, 33 mm per meter when draining forward and 42 mm per meter when draining athwartship. They shall be provided with a sufficient number of accessible cleanout connections not less than 40 mm for clearing the drain pipes by use of plumber's snake, or with steam or water hose. Deck and fixture drain lines shall be arranged so as to provide positive drainage when the ship is under design conditions of list, up to 5^{o} port and starboard, and trim at sea or in port.

(b) Plumbing Drains

Drains from lavatories, showers, and sinks shall have traps and accessible cleanout connections.

Fixture and deck drains in spaces normally used for Dispensary or Hospital services shall be independent of other drains.

(c) Interior Deck Drains

Space drains below the Main Deck, when it is not practical to drain overboard by gravity, unless otherwise noted, shall be provided with drain wells as required, or discharge to drain wells below. Drain wells shall be drained by the bilge system or salt water eductors.

(d) Weather Deck Drains

The total capacity of the drainage system shall be sufficient to drain all decks, without progressive accumulation of water, at a rainfall rate of 13 mm per hour.

(e) Miscellaneous Drains

Deck drains shall be provided for efficiently draining the Steering Gear Flat, Bosun's Stores, Anchor Windlass Room, Hawser Room, Cargo Holds, Marine Sanitation Device space, Machine Shop, and similar spaces.

11.3. SOUNDING TUBES, VENTS, AND OVERFLOWS

(a) General

Sounding tubes shall be provided for all tanks including those having level indicators. Location of each sounding tube shall be approximately the same as for level indicating device except where access is inadequate.

11.4. EQUALIZER PIPES

Equalizer pipes, where required, shall be provided to eliminate unsymmetrical flooding as necessary to meet requirements for stability control. The ends of the equalizer pipes shall be fitted with oiltight cover plates and stowage provided for the same when tanks are used for dry cargo.

11.5. CHAIN LOCKER DRAINS

The chain locker shall drain into a sump tank constructed below the chain locker.

11.6. GARBAGE CHUTE

One garbage chute may be provided from the Garbage Room where environmental laws permit.

Flushing connections, controlled by one valve, shall be fitted at the top of the chute.

11.7. SEA CHESTS

Sea chests anodes, where required, shall be sacrificial zinc or aluminum alloy.

Suction sea chests shall be arranged and located so as not to take in air trapped under bilge keels or from emergence, on a 30° roll of the ship at minimum operating draft, and to avoid pickup of effluent from overboard discharges.

All suction sea chests shall be fitted with vent lines from the top of the chest terminating in the weather with goosenecks.

SECTION 12

AIR CONDITIONING, HEATING, AND VENTILATION

12.1. GENERAL

Particular attention should be directed toward designing air conditioning, heating, and ventilation systems to reduce airborne and structure borne sound transmission to the maximum extent possible. Acoustic dampening shall be accomplished by proper equipment layout, insulation, sound dampening devices, and proper balancing of air flows in the various spaces.

12.2. SYSTEMS

(a) General

Systems shall be complete including filters, fans, preheaters, cooling dehumidifying coils, reheaters, air mixing boxes, duct work, terminals, closures, louvers, dampers, thermostatic controls, drains, insulation (acoustic and thermal), vapor sealing and lagging, label plates, and operating instructions, necessary for satisfactory operation and performance.

(b) Air Conditioning

(1) Design Criteria

Air conditioning systems design shall be per the applicable portions of ISO 7547, "Air-Conditioning and Ventilation of Accommodation Spaces On Board Ships - Design Conditions and Basis of Calculations", ISO 8864, "Air-Conditioning and Ventilation of Wheelhouse On Board Ships - Design Conditions and Basis of Calculations", ISO 9099, "Air-Conditioning and Ventilation of Dry Provision Rooms On Board Ships - Design Conditions and Basis of Calculations", and ISO 8862, "Air-Conditioning and Ventilation of Machinery Control-Rooms On Board Ships - Design Conditions and Basis of Calculations" with all Annexes. However, the following design temperatures are recommended for use in the calculation of ventilation and air conditioning loads for vessels operating in warm or tropical climates.

Design shall satisfy all applicable Regulatory Body(ies) regulations, and shall be based on the following conditions:

Summer Temperatures and Humidities

Outside Air: +35°C and 70% relative humidity.

Indoor Air: +24°C and 50% relative humidity.

Winter Temperatures

Outdoor Air: -20°C

Inside Air: +20°C

NOTE - All temperatures stated are dry bulb temperatures.

(2) Classes of Air Conditioning Systems

In general, air conditioned spaces shall be served by central systems with cooling being provided by chilled water or direct expansion coils and heating provided by steam or electric heaters.

(c) Heating and Ventilation

Spaces not air conditioned shall be heated and/or ventilated.

Heating and ventilation load calculations shall be based on outside temperatures of 35°C dry bulb at 70 percent relative humidity in summer and -20°C dry bulb in winter. Designs of the systems shall be per the applicable portions of ISO 9943, "Shipbuilding - Ventilation and Air-Treatment of Galleys and Pantries with Cooking Appliances", ISO 9785, "Shipbuilding - Ventilation of Cargo Spaces Where Internal Combustion Engine Vehicles May Be Driven - Calculation of Theoretical Total Airflow Required", and ISO 8861, "Shipbuilding - Engine Room Ventilation of Diesel-Engined Ships - Design Requirements and Basis of Calculations" with all Annexes. Design shall satisfy all applicable Regulatory Body(ies) requirements.

The Galley, Pantries, and Laundries shall have a slight negative pressure to confine heat and odors generated therein.

The air change for Galley and Main Pantry is based upon mechanical exhaust. The mechanical supply shall equal the exhaust quantity minus the make-up air available from surrounding spaces. The Galley's exhaust system should be ducted directly to the weather near the top of the house.

Heating shall be provided for spaces as required by duct heaters, convector heaters, or individual unit heaters.

Mechanical ventilation should be provided to all non-air conditioned spaces, wherever necessary, to maintain the required air change.

12.3. CARGO HOLD

Ventilation

(a) Breakbulk

Those portions of the cargo holds suitable for carrying dry cargo, including hatch trunks and dry cargo deep tanks, shall be mechanically ventilated with independent systems for each cargo hold.

(b) Roll-On/Roll-Off (RO/RO)

Ventilation for RO/RO type vessels shall be provided in sufficient quantity to dilute the concentrations of carbon monoxide (CO) to a maximum of 50 ppm on a time weighted average.

12.4. REFRIGERATED CARGO SPACES

Refrigerated cargo spaces shall be provided with a mechanical fresh air supply system and natural foul air exhaust system.

12.5. STEAM HEATING AND AIR CONDITIONING WATER SYSTEMS

(a) Steam Heating Systems, Where Required

A 241 kPa system shall be provided to supply steam to heating coils, convectors, unit heaters, finned pipe heating elements, commissary equipment, and cargo hold dehumidification equipment, if required.

(b) Air Conditioning Water and Drain System

Chilled water shall be supplied to cooling coils from the air conditioning refrigeration plant.

The air conditioning chilled water system shall be the two pipe, reverse return, self-balancing type.

12.6. CONVECTORS, FIN-PIPE ELEMENTS, UNIT HEATERS, ELECTRIC HEATERS, BLAST HEATERS, WATER COILS, AND AIR MIXING UNITS

These items shall be as identified in the Specifications.

SECTION 13

FIRE DETECTION AND EXTINGUISHING

13.1. FIRE AND SMOKE DETECTION SYSTEMS

A fixed fire and smoke detection system shall be provided throughout the machinery and accommodation spaces as required by Regulatory Body(ies).

13.2. EXTINGUISHING SYSTEMS

(a) General

Fixed fire extinguishing systems may be selected from the following types for protection of spaces as indicated below:

Accommodation Areas and Main Deck	- Sea Water Fire Main
Engine Room	- Sea Water Fire Main - Foam - Carbon Dioxide - Water Spray
Auxiliary Internal Combustion Engines	- Carbon Dioxide - Dry Chemical - Foam - Water Spray - Sea Water Fire Main
Paint Lockers and Auxiliary Stores	- Water Spray - Foam - Carbon Dioxide - Dry Powder (in Paint Lockers)

This does not preclude dual extinguishing systems such as required in Engine Room or on Main Decks (i.e., sea water in conjunction with a foam system).

(b) Water System

Fire pumps as required by the regulations shall be provided with at least one pump located outside the Engine Room. Source of power for the two pumps shall be completely independent of each other. Water system shall meet all requirements of Regulatory Body(ies) and shall protect machinery spaces and accommodations and working spaces in the House and Weather Decks.

(c) Carbon Dioxide Extinguishing System

The carbon dioxide smothering system for the machinery spaces shall be arranged for total flooding of the Engine Room above and below floor plates.

NOTE: Appropriate warning sign shall be provided to ensure that all closures and ventilating systems are secured and personnel evacuated from stricken areas before carbon dioxide is released.

(d) Foam Extinguishing Systems

For bulk cargo vessels which carry liquid petroleum products in cargo tanks, a deck foam extinguishing system shall be provided for the protection of all cargo tank spaces where required by Regulatory Body(ies).

(e) Water Spray Extinguishing Systems

Where permitted in specified areas, a water spray extinguishing system may be provided in lieu of the carbon dioxide system specified herein.

13.3. RESCUE AND BREATHING APPARATUS

Firemen's outfits shall be provided as required by Regulatory Body(ies).

Fire axes shall be provided as required. Sand, safety belts, life line, flame safety lamps, and other equipment required by Regulatory Body(ies) shall be provided and stowed.

SECTION 14

PAINTING

14.1. GENERAL

The paints employed in a given coating system shall be from the same manufacturer unless otherwise specified. Each coat of paint shall be compatible with the coat of paint which it will cover, including preconstruction primers (including weld through type) that are to be retained as part of the final coating system. All surface preparation requirements and coatings applications shall be per the manufacturer's instructions. Abrasive blasting finishes are defined in ISO 8501-1, "Preparation of Steel Substrates Before Application of Paints and Related Products".

Painting Schedule shall be as shown in the Specifications.

SECTION 15

NAVIGATING EQUIPMENT

15.1. DETAILS OF EQUIPMENT

(a) Magnetic Compass, Liquid

The standard compass shall be per ISO 449, "Shipbuilding - Magnetic Compasses and Binnacles, Class A". It shall be positioned per ISO R694, "Positioning of Magnetic Compasses in Ships" and tested per ISO 2269, "Shipbuilding - Class A Magnetic Compasses, Azimuth Reading Devices and Binnacles - Tests and Certification".

(b) Bells

A fog bell shall be provided at the bow, and a fog gong at the stern.

All bells shall be constructed per ASTM F956, "Standard Specification for Bell, Cast, Sound Signalling", provided complete with mounting brackets, clappers, striking lanyards, and other miscellaneous hardware.

The fog bell shall be engraved or etched with the name of the ship and the year of completion and shall be mounted in the forward part of the ship.

The watch bell shall be complete with sheaves, toggle, and other accessories, as necessary for striking the bell from within the Wheelhouse.

(c) Clinometers

Clinometers shall be of an approved bubble-in-tube type, one in the Wheelhouse and one in the Machinery Space.

(d) Barometers

Barometers shall be non-recording aneroid type, one in the Wheelhouse and one in the Captain's Office.

(e) Rudder Course Board

A course board modified to read "True", "Standard", and "Gyro" rudder, shall be provided in the Wheelhouse for manually recording the ship's course instructions.

SECTION 16

LIFESAVING EQUIPMENT

The Contractor shall provide all lifesaving equipment necessary to meet the latest requirements of the Regulatory Body(ies).

Care shall be taken that the arrangement in the area of the boat does not interfere with the boat itself and its launching equipment.

Arrangement shall be such that the appliance operator is able to watch all the operations.

Care shall be taken that the lifeboats are kept clear of all vents, discharges, gangways, and ladders, or adequately shielded to prevent spilling onto the lifesaving equipment.

All ferrous fittings of boat gear and boat handling equipment including blocks, fairleads, and shackles shall be hot dipped galvanized, or inorganic zinc coated.

SECTION 17

COMMISSARY SPACES

17.1. GENERAL

A complete messing system shall be furnished in compliance with the Regulatory Body(ies) requirements and the equipment shall be of good commercial design modified as needed to suit shipboard conditions. Stowage shall be provided for all portable equipment, including china, glassware, silverware, utensils, trays, and spare parts.

17.2. MATERIALS AND WORKMANSHIP

All heated equipment shall have automatic controls. Surfaces which come in contact with food and drink shall be CRES. All welding including field joints shall be flush, ground smooth and polished on exposed surfaces. No solder or rivets shall be used.

17.3. TOPS

Tops of all dressers, counters, and drain boards shall be constructed of CRES.

17.4. BASES

All bases shall be of CRES construction throughout and shall be mounted on a platform to be provided by the Contractor.

17.5. PLATFORMS

Platforms for the installation of equipment and dressers shall be provided. Deck covering material shall be coved up to the platform.

17.6. SINKS

Sinks shall be constructed of CRES.

17.7. STEAM TABLE (IF PROVIDED)

Steam table tops shall be constructed of CRES. Steam table hot water pans shall be of CRES.

17.8. DRY HEAT FOOD TABLE (IF PROVIDED)

Electrically heated hot food table shall have stainless steel body, with optional equipment to suit Owner.

17.9. RACKS, MISCELLANEOUS

CRES pot and thaw racks of rigid construction shall be provided. CRES stationary dish, cup, and glass racks shall be installed on bulkheads.

17.10. REFRIGERATORS

Galley, Pantry, and Mess Room reach-in and under-dresser type refrigerators shall be CRES exterior and interior.

17.11. SHELVES

Overhead shelves shall be constructed of CRES.

17.12. OVERHEAD CABINETS

Overhead cabinets shall be constructed with CRES body and sanitary sloping top. Front shall be fitted with CRES doors equipped with suitable latches.

17.13. TILTING BINS

Tilting bins shall be of CRES and provided in enclosures similar to enclosed bases.

17.14. LIST OF MANUFACTURED COMMISSARY EQUIPMENT

Provide the equipment as specified in the Specifications.

SECTION 18

UTILITY SPACES AND WORKSHOPS

18.1. GENERAL

Each space shown on the Contract Drawings shall be completely furnished by the Contractor with items shown and as specified.

18.2. LAUNDRIES

Provide the items identified in the Specifications.

18.3. UTILITY SPACES

(a) Slop Chest

Galvanized steel shelving shall be arranged in tiers. A dutch door with shelf shall provide access to the space.

(b) Bonded Stores Locker (If Provided)

The locker shall be outfitted with shelving three-high, arranged with grids for stowing alcoholic beverages.

(c) Garbage Room

The Garbage Room shall be outfitted with four garbage cans with covers. Hot and cold fresh water facilities shall be provided for washing and scrubbing cans and washing down the space. A trash compactor shall be provided.

(d) Containerized Marine Incinerator

Provide one complete Containerized Marine Incinerator system per ASTM F1323, "Standard Specifications for Shipboard Incinerator" or IMO Annex 8DE3535, "Standard Specification for Shipboard Incinerators".

18.4. WORKSHOPS

Provide the items identified in the Specifications.

SECTION 19

FURNITURE AND FURNISHINGS

GENERAL

Each space shown on the Contract Drawings shall be fitted out complete, by the Contractor, as required herein or as indicated on the Contract Drawings. Any and all spaces shown on the Contract Drawings, but not specifically mentioned in the Specifications, shall be suitably furnished and fitted complete as specified for a similar space.

Fixed furniture shall be secured to decks or bulkheads.

Furniture shall be of good commercial marine quality.

SECTION 20

PLUMBING FIXTURES AND ACCESSORIES

Provide marine grade plumbing fixtures and accessories specified herein.

Except as otherwise specified, all trim for fixtures and all accessories shall be chrome plated cast or forged brass and shall be of matching design for uniformity.

Fixtures which are liable to injury by excessive bolt tightening shall be mounted with concussion washers between fixtures and metal supports.

Grab rods shall be provided at all showers, bath tubs, and water closets.

A complete schedule of plumbing fixtures shall be provided by the Contractor for approval by the Owner prior to any procurement and installation of any fixtures.

SECTION 21

HARDWARE

Provide the hardware items described in the Specifications. 5

All hardware covered herein shall be of the commercial marine type.

SECTION 22

PROTECTIVE COVERS

All protective covers shall be made of commercial marine grade coated nylon cloth. 5

Provide covers for all items described in the Specifications.

SECTION 23

MISCELLANEOUS EQUIPMENT AND STOWAGE

Provide the equipment and stowage described in the Specifications.

Bins, racks, shelves, and other stowage devices, shall be designed and arranged to suit the material and equipment to be stowed.

Spaces not specifically mentioned but which normally require stowage devices, shall be suitably equipped in keeping with the requirements for similar spaces.

SECTION 24

NAME PLATES, NOTICES, AND MARKINGS

Provide name plates, notices, and markings as described in, and for the items identified in, the Specifications.

Name plates and notices shall be plastic, metal photo or engraved on metal.

Lettering shall be clear and concise with a minimum of abbreviations.

SECTION 25

JOINER WORK AND INTERIOR DECORATION

25.1. GENERAL

Where ceiling and/or linings shall be made in portable sections and, where necessary for frequent access or inspection, they shall be provided with approved hinged access panels with latch fastenings. The panels shall be of sufficient size to provide accessibility for service and shall be unobtrusive. The design of joiner work shall be such that sharp edges are avoided. Outside corners shall be rounded.

25.2. CONSTRUCTION AND FINISH

The construction of the joiner work shall be of such design as to conceal conveying items, including electric cables, wiring boxes for switches and receptacles, vent and air conditioning ducts, and piping.

Concealed furring, hangers, molding, and framing used in the erection of bulkheads, linings, and ceilings, shall be of galvanized or phosphate treated steel. Fasteners shall be zinc coated or corrosion resistant steel. Exposed framing and moldings shall be finished to blend with the color of the bulkhead finishes in the spaces where installed.

Heavy items against joiner bulkheads and linings shall be supported by independent strength members, other than the bulkhead and lining panels. Materials for built-in wardrobes shall be of the same material as the room in which they are located.

Curtains shall be lined and weighted. Curtains shall traverse; shall have 100 percent fullness in width and shall overlap. All curtains, unless otherwise noted, shall extend beyond the window trim. Linings shall be opaque.

Upholstery seating shall be covered with flame-resistant cloth fabric, of high wear resistance. Cloth shall be inherently flame-resistant or shall be treated for flame-resistance.

Alternate materials or joiner systems, including asbestos-free core products meeting the intent and requirements of this SECTION and which have been certified and approved by the Regulatory Body(ies), will be acceptable.

SECTION 26

STABILIZATION SYSTEMS

Provide stabilization system(s) as described in the Specifications. 5

SECTION 27

SHIP STORES, CONTAINER STOWAGE, AND HANDLING (IF PROVIDED)

The ship's dry and refrigerated stores may be carried in containers as shown on the Contract Drawings. They shall be built to the same structural requirements as cargo containers of the same type and size and shall be fitted for lifting and securing with standard container handling gear. In addition, necessary services for the containers shall be provided, including electric supply for lighting and refrigeration plant power, deck drains in way of refrigerated containers, and sufficient ventilation to carry off heat generated by electric machinery and compressor.

SECTION 28

PLANNING AND SCHEDULING, INSTRUCTION BOOKS, AND OTHER DOCUMENTS

28.1. GENERAL

The Contractor shall prepare a Drawing and Correspondence Procedure which sets forth the procedure for handling all material specified in SECTION 28 of the Specifications. A pro forma Drawing and Correspondence Procedure shall be submitted to the Owner for review and comment.

28.2. PLANNING AND SCHEDULING

The Contractor shall perform planning and scheduling functions as required to establish an orderly and systematic construction program and to facilitate completion of the Contract work.

28.3. DRAWINGS AND PURCHASE (TECHNICAL) SPECIFICATIONS

The Contractor shall obtain the required approval of all drawings, purchase (technical) specifications, calculations, and other technical documents necessary to perform the Contract work.

28.4. REPORTS

The Contractor shall submit to the Owner a Monthly Progress Report on the status of structural steel.

28.5. INSTRUCTION BOOKS

Instruction books and drawings covering operating and maintenance instructions for all major systems as identified in the Specifications shall be submitted by the Contractor for approval.

28.6. ENGINEER'S OPERATING MANUAL

The Contractor shall prepare an Engineer's Operating Manual based on the design and construction data. The Manual shall be prepared in preliminary form and be submitted to the Owner for approval sufficiently in advance of ship completion to permit completion and delivery of the finished Manuals to the ship not later than the delivery date of the ship.

28.7. ALLOWANCE LIST AND BUILDER'S RECEIPT

The Contractor shall prepare for the Owner's approval complete Allowance Lists of all portable and readily removable equipment, tools, and spares required to be on board at time of the ship's delivery. The Contractor

shall also perform and record a joint physical inventory at the time of the ship's delivery.

28.8. MACHINERY AND EQUIPMENT IDENTIFICATION LIST

The Contractor shall supply for each vessel an identification list giving nameplate data, including serial number and the Regulatory Body(ies) certification data where applicable, of each piece of machinery and equipment on the ship.

28.9. FINAL DRAWINGS (TRACING)

(a) Tracings and Microfilm

All Contractor's Drawings shall be brought up to date and stamped "Final - As Built" with all alterations necessary to reflect the ship as finally constructed.

28.10. DRAWINGS AND CHARTS FOR MOUNTING

One graphic metal photo process or equal chart of each of the drawings identified in the Specifications shall be mounted in suitable locations in the ship as directed by the Owner.

28.11. DRAWINGS (PRINTS) FOR OWNER'S OFFICE USE AND FOR FILING ABOARD SHIP

Drawings and documents as identified in the Specifications shall be provided.

Stowage for all on board drawings and manuals shall be provided.

SECTION 29

DECK, ENGINE, AND STEWARD DEPARTMENT OUTFITTING EQUIPMENT AND PORTABLE TOOLS

5

The Owner will provide all outfitting equipment and portable tools for the areas and items identified in the Specifications, which shall be installed or stowed by the Contractor prior to delivery.

MARITIME ADMINISTRATION
GUIDELINE SPECIFICATIONS FOR
MERCHANT SHIP CONSTRUCTION
EXECUTIVE SUMMARY

PART II - MACHINERY

Office of Ship Construction

November 1995

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PART II - MACHINERY

SECTION 50

MAIN AND AUXILIARY MACHINERY - *SLOW SPEED DIESEL (ONLY)*

50.1. GENERAL

It is the intent of the following Specifications to describe the machinery plant, including all necessary auxiliaries, for the ship described in SECTION 1.

The engine shall be able to operate continuously at maximum continuous rating and be capable of starting, stopping and maneuvering while burning heavy fuel oil with the following composition:

Viscosity - up to 700 cSt @ 50°C
Vanadium - up to 600 ppm
Sodium - up to 200 ppm
Sulfur - up to 5% by wt
Carbon Residue - up to 15% by wt
Ash - up to 0.15% by wt

The guaranteed fuel and lubricating oil consumption of the main diesel engine shall be in accordance with the terms of the construction contract.

50.2. GENERAL DESCRIPTION

The main propulsion system shall consist of: a single acting, two stroke, crosshead, turbocharged, directly reversible slow speed marine diesel engine driving a propeller through a solid coupling and forged steel shafting. The engine shall be designed for normal operation with properly conditioned heavy fuel. Diesel fuel may be used for starting and low power operation, if desired.

Electric power shall be supplied by a minimum of three medium speed diesel driven generators. During normal cruising at sea operation one generator shall be operating with the others acting as standby. In addition, one emergency high speed diesel driven generator shall be provided. Other arrangements using a line shaft or main engine driven generator or a steam turbine generator using steam from an auxiliary boiler are acceptable alternatives.

A centralized Control Room shall be provided in or adjacent to the machinery space and shall be equipped with engine controls and all necessary monitoring and recording equipment. Controls, monitoring, and recording equipment shall meet requirements of Regulatory Body(ies) for unattended Engine Room operation. The Control Room shall be air-conditioned, with either two compressor systems, or compressor with crossover from compatible SS A/C system.

50.3. LIST OF MACHINERY

The List of Machinery in no way is intended to relieve the Contractor from responsibility of the proper selection of required equipment and for seeing that it will carry out the intent of the specifications. The Contractor shall submit calculations and data to the Owner, when required, to assure that individual components will satisfy such intent.

Specification Section, Item and Number Required

SECTION 51 -- MAIN ENGINES

Main Propulsion Engine - 1

SECTION 53 -- MAIN SHAFTING, BEARINGS, AND PROPELLER

Line Shafts (number as required)
Tail Shaft - 1
Line Shaft Bearings (number as required) (split roller bearings are also acceptable)
Stern Tube Bearings - 1 or 2 (including the outboard and inboard seals)
Propeller - 1
Shaft Coupling

SECTION 55 -- DISTILLING PLANT

Fresh Water Distiller - 2 (or equivalent Reverse Osmosis Unit)

SECTION 56 -- FUEL OIL SYSTEM

H.F.O. Centrifuge Purifier - 2 (each to be interchangeable)
H.F.O. Purifier Heater - 2
H.F.O. Steam Heater - 2
H.F.O. Suction Strainer (coarse) - 1
H.F.O. Service Discharge Strainer (fine) (heatable if desired) - 1
H.F.O. Service Discharge Filter - 1
H.F.O. Deaerating Tank (heatable and insulated) or Return Pipe - 1
Heavy Oil Settling Tank, Heatable and Insulated - 2
Heavy Oil Day Tank, Heatable and Insulated - 2
Diesel Oil Purifier - 1
Diesel Oil Storage Tank Suction Strainer - 1
Diesel Oil Day Tank - 1
Fuel Oil Flow Meter - 1 (with bypass arrangement)
Heavy Oil Viscometer System - 1 (with manual bypass)

Specification Section, Item and Number Required

SECTION 57 -- LUBRICATING OIL SYSTEM

Lube Oil Purifiers - One for each generator engine and one for main engine.
Main Engine Lube Oil Purifier Heaters - 2
Main Engine L.O. Suction Strainers (as required)
Main Engine L.O. Coolers - 1
L.O. Temp. Control Valves - 1 (with bypass)
Main Engine L.O. Discharge Strainer - 1
Main Engine L.O. Sump Tank - 1
Main Engine L.O. Storage Tank (number as required)
Cylinder Lubricating System
Main Engine L.O. Settling Tank - 1
Daily Service Tank: Cylinder Lubricating System - 1 (Gravity Tank)
Pressure Reduction Valve (for 2 pressure system, if installed) (Some installations use separate pump for cam shaft lube.)
Auxiliary Engines L.O. Storage Tank - 1 or more

SECTION 58 -- SEA WATER SYSTEMS

Sea Water Heater and Drain Cooler (if provided) - 1
Forepeak Ballast Eductor (if provided) - 1
Cargo Tank S.W. Eductor - 1 (if provided)
Sea Water Suction Filters - 2
Water/Oil Separator - 1

SECTION 59 -- FRESH WATER SYSTEM

Engine Jacket Water Cooling System - (Closed Type)
Expansion Tank - 1
Engine Jacket Water Heater - 1
Engine Jacket Water Cooler - 1, or more if desired
Air Separator - 1
Automatic Temperature Control Valve, Jacket Water - 1
Piston Fresh Water or Lube Oil Cooling System (if installed) (closed type)
Fresh Water or Oil Drain Tank - 1
Central Fresh Water Cooler - 1 or more if desired
Automatic Temperature Control Valve - 1 (with bypass)
Fuel Valve Cooling System (if installed) (closed type).
Expansion Tank - 1
Temperature Control Valve - 1 (with bypass)
Fuel Valve (Injector) Cooler - 1 if required.
Storage Type Hot Water Heater (Domestic Service) - 1 (Provisions for auxiliary heating with electric coil shall also be included.)
UV Purifiers (as required)

Specification Section, Item and Number Required

Chlorinators (as required)
Fresh Water Hydropneumatic Tank - 1

SECTION 60 -- CONDENSATE SYSTEM

Drain and Inspection Tank with Vent Condenser - 1
Excess Steam Condenser - 1

SECTION 61 -- STEAM GENERATING PLANT

Waste Heat (Exhaust Gas) Boiler - 1 (if fitted)
Auxiliary Oil Fired Boiler - 1 or more as required

SECTION 64 -- ENGINE ROOM VENTILATION

Supply Fans - 2 or more as required
Exhaust Fans - 2
Exhaust Fan (Purifier Room) - 1
Exhaust Fans (Paint Locker) - 2

SECTION 65 -- AIR CONDITIONING MACHINERY

Air Conditioning Compressors - 2
Air Conditioning Condensers - 2
Air Conditioning Receivers - 2

SECTION 66 -- SHIP'S SERVICE REFRIGERATION

Refrigerated Stores Compressors - 2
Refrigerated Stores Condensers - 2
Refrigerated Stores Receivers

SECTION 67 -- CARGO REFRIGERATION

Refrigerated Cargo Compressors
Refrigerated Cargo Condensers
Refrigerated Cargo Receivers

SECTION 68 -- LIQUID CARGO SYSTEMS

Cargo Tank Cleaning Heater (Butterworth) - 1 (Plate type heater is also acceptable.)
Cargo Tank Cleaning Heater Drain Cooler - 1 (May also be integral part of Tank Cleaning Heater.)
Cargo Coil Hot Water Heater - 1 (if fitted)

Specification Section, Item and Number Required

SECTION 70 - SEWAGE DISPOSAL SYSTEM

Sewage Holding Tanks - 2
OR
Sewage Treatment Plant and a Holding Tank - 1

SECTION 71 -- TANK LEVEL INDICATORS

Heavy Fuel Oil Storage, Settling and Day Tanks
Fresh Water Tanks
Distilled Water Tanks
Lube Oil Sump Tank(s)
Diesel Oil Service Tanks and Storage Tanks
Liquid Cargo Tanks (if provided)
Clean Ballast Tanks
Sewage Holding Tanks

SECTION 72 -- COMPRESSED AIR SYSTEM

(Diesel) Starting Air Compressors - 2
Ship Service Compressor - 1
Control Air Compressor - 1
Diesel Engine Starting Air Receivers - 2 or more
Ship's Service Air Receiver - 1
Control Air Receiver - 1
Control Air Dehydrator - 1
S.S. Air Dehydrator - As Required

SECTION 73 -- PUMPS - See TABLE 50-1 (pages 50-7 and 50-8)

SECTION 74 -- PIPING

Whistle - 1

SECTION 76 -- AUXILIARY DIESEL ENGINES

Ship Generator Diesel Engines - 3
Emergency Diesel Generator - 1
Emergency Diesel Fire Pump (if fitted)
Main Cargo Pump Diesels (if provided)

SECTION 78 -- MISCELLANEOUS TANKS

Clean Waste Locker - 1
Oily Waste Can - 1
Kerosene Tank - 1

Specification Section, Item and Number Required

Heavy Fuel Sludge Tank - 1
Main Engine Coolant Tank - 1
Main Engine Coolant Drain Tank - 1
Reserve Feed Tank - 1
Tailshaft Bearing Drain Tank - 1
Tailshaft Bearing Head Tank - 1
Condensate Storage Tank - 1

SECTION 80 -- ENGINEERS' AND ELECTRICIANS' WORKSHOPS, STORES, AND REPAIR EQUIPMENT

Workbenches (as required)
Lathe
Drill Press
Pedestal Grinder
Bench Grinder
Power Hacksaw
Electric Pipe Threader - 1 (capable of metric and SAE)
Electric Hoists (in addition to main engine overhaul crane)
Storerooms and Storage Area (as required)
Lifting Gear (as required)
Electric Welding Machine
AND
Gas Welding Unit

SECTION 81 -- DECK MACHINERY

Steering Gear - 1
Anchor Windlass (as required)
Lifeboat Winch (as required)
Accommodation Ladder Winch (as required)
Mooring Winches

SECTION 85 -- INSTRUMENTS AND MISCELLANEOUS GAGEBOARDS -- MECHANICAL

Gageboards
Mechanical Instruments
Telephone Hoods
Log Desks

SECTION 88 -- GENERATOR

Ship's Service Generators - 3
Emergency Diesel Generator - 1

Specification Section, Item and Number Required

SECTION 89 -- SWITCHBOARDS

Main Switchboard - 1
Emergency Switchboard - 1
Group Control Centers (as required)

TABLE 50-1
PUMPS

NO. UNITS	SERVICE	TYPE	DRIVE	CAPACITY $M^3/HR.$ (GPM)	HEAD kPa (PSIG)	rpm	DRIVER kW (HP)	FLUIDS PUMPED
2	Main S.W. Service	Vert. single stage centrifugal	Motor					
As req'd	Aux. S.W. Service	Vert. or Horiz. 1 stage centrifugal	Motor					
2	Exhaust Gas Boiler Feed	Vert. or Horiz.	Motor					
1	Bilge	Vert. or Horiz. 1 stage centrifugal	Motor					
1	General S.W. Service and Washdown	Vert. or Horiz. 1 stage centrifugal	Motor					
1	Emergency Fire (outside Engine Rm)	Vert. or Horiz. 1 stage centrifugal	Motor					
1	Bilge and Ballast	Vert. or Horiz. 1 stage centrifugal	Motor					
As req'd	Priming	Horiz. centrifugal w/water seal	Motor					
1	Fire: Engine Room	Vert. or Horiz. centrifugal	Motor					
2	Engine Fresh Water Cooling	Vert. single stage centrifugal	Motor					
2	Fuel Valve Cooling (if required)	Vert. or Horiz. single stage centrifugal	Motor					
2	Piston Water Cooling (if required)	Vert. single stage centrifugal	Motor					
2	Potable Water	Horiz. 1 stage centrifugal	Motor					
1 or 2	Hot Water Recirculating	Vert. or Horiz. single stage centrifugal	Motor					

NO. UNITS	SERVICE	TYPE	DRIVE	CAPACITY M^3/HR. (GPM)	HEAD kPa (PSIG)	rpm	DRIVER kW (HP)	FLUIDS PUMPED
1 or 2	Oil Fired Boiler Feed Pumps	Vert. or Horiz. single stage centrifugal	Motor					
As req'd	Distilling Plant Feed	Horiz. 1 stage centrifugal	Motor					
As req'd	Brine Overboard	Ejector	Motor					
As req'd	Desalination Condensate	Ejector	Motor					
As req'd	Air Cond. Chilled Water Circ.	Vert. 1 stage centrifugal	Motor					
As req'd	Air Cond. Chilled or Hot Water Circ.	Vert. 1 stage centrifugal	Motor					
As req'd	Sewage	Vert. 1 stage centrifugal	Motor					
As req'd	Liquid Cargo (if req'd)	Vert. or Horiz. (submersible)	Motor or Diesel					
2	L.O. Service	Horiz. or Vert. Rotary	Motor					
1	F.O. Transfer	Horiz. or Vert. Rotary	Motor					
1	D.O. Transfer	Horiz. or Vert. Rotary	Motor					
2	F.O. Service (Booster)	Horiz. or Vert. Rotary	Motor					
2	Crosshead L.O. Service	Horiz. or Vert. Rotary	Motor					
2	Stern Tube L.O.	Horiz. or Vert.	Motor					
1	F.W. Transfer	Vert. or Horiz. Centrifugal	Motor					
2	F.O. Service (Supply)	Horiz. or Vert. Rotary	Motor					
1	Cylinder Oil Transfer	As Required	Motor					

SECTION 51

MAIN PROPULSION ENGINE - *SLOW SPEED DIESEL (ONLY)*

51.1. GENERAL DESCRIPTION

The main propulsion engine shall be a single acting, two stroke, crosshead, turbocharged, directly reversible slow speed marine diesel designed for normal operation with properly treated heavy fuel. The engine shall be of the long stroke, uniflow scavenged variety with a large exhaust valve. The engine shall be capable of being started and maneuvered on heavy fuel. Diesel fuel may be used for starting and low power operation if desired.

The engine shall operate satisfactorily at the specified maximum continuous rating (MCR), and be capable of starting, stopping, and maneuvering while burning properly treated heavy fuel oil with the following composition:

Viscosity	Up to 700 cSt @ 50° C
Vanadium	Up to 600 ppm
Sodium	Up to 200 ppm
Sulphur	Up to 5% by wt
Carbon	Up to 15% by wt
Ash	Up to .15% by wt

The engine shall be provided with all the necessary instruments and controls for stopping, starting, reversing and maneuvering from the Engine Room control console; and locally at the engine; and from the pilot house.

The engine shall be provided complete with all attached and unattached auxiliaries and in full compliance with the requirements of the Classification Society, including the requirement for operation with an unattended machinery space.

SECTION 53

MAIN SHAFTING, BEARINGS, AND PROPELLER - *SLOW SPEED DIESEL (ONLY)*

53.1 SHAFTING

(a) General

The approved arrangement of shafting and bearings shall be free of all serious torsional, flexural, and longitudinal vibrations at all speeds within the operating range. The stern tube bearing and seals should preferably be provided by the same vendor. Marine Power Plant Practices SNAME T&R Bulletin 3-49, or other similar publications, should be consulted.

(b) Line Shafting

The line shafting shall be of solid forged steel, ABS Grade 2, 3, or 4.

(c) Tailshaft

The tailshaft shall be of solid forged steel, ABS Grade 2, or as otherwise permitted by ABS.

Suitable means shall be provided for the removal and relocation of the aft section of line shafting; withdrawal of the tailshaft inboard; and removal of the propeller.

53.2. ALIGNMENT

The Contractor shall prepare calculations to determine:

(a) Bending Moment, Shear and Deflection

(b) Table of bearing reactions for the cold static, hot static and hot running conditions.

(c) Table of bearing influence numbers.

53.3. STERN TUBE OIL SYSTEM

An independent propeller shaft bearing lubricating oil system shall be provided for the stern tube bearing.

53.4. MAIN THRUST BEARING

Included with main engine.

53.5. PROPELLER

(a) General

The propeller shall be right handed (for single screw ships). Unless otherwise specified in the contract, the Contractor will be responsible for developing the propeller design. 5

SECTION 55

DISTILLING PLANT - *SLOW SPEED DIESEL (ONLY)*

55.1. GENERAL

The distilling plant capability shall be provided to adequately meet all the fresh water needs of the vessel. (If redundancy is of prime importance, a reverse osmosis system may also be used.)

The distilling unit shall be a main engine jacket water circulated type, specifically designed for shipboard application and shall be capable of unattended, automatic operation after being put on the line locally. The unit shall be complete in all respects, with required heat exchangers, vapor separators, condenser, feed and ejector pumps, distillate pump, brine and vacuum ejectors, valves, instrumentation, and controls.

A standard salinity panel with alarms and meter shall be located at the distiller. This unit shall also provide a remote alarm for the salinity system at the Control Room.

SECTION 56

FUEL OIL SYSTEM - *SLOW SPEED DIESEL (ONLY)*

56.1. GENERAL

In accordance with the general requirements set forth herein, the ship shall be provided with a complete heavy fuel oil system and a diesel oil system covering bunkering, storage, transferring, treating, and discharge of the appropriate fuel.

56.2. TANKS

Tanks shall be provided as required by the needs of the system and shall include the following:

(a) Heavy fuel storage tanks.

(b) A mixing tank.

(c) A sludge drain tank.

(d) One diesel oil service tank.

(e) Diesel oil storage tanks.

(f) H.F.O. settling tanks.

(g) H.F.O. day tank.

56.3. FUEL OIL BUNKERING CONTROL STATION

The monitoring of all the fuel oil tanks and the remote control of the fuel oil transfer pump during bunkering, transferring, and discharging of fuel oils shall occur from a central control station in the machinery space.

56.4. FUEL OIL BUNKERING

Port and starboard bunkering stations for both heavy and diesel oil shall be provided outside the Machinery Space.

56.5. FUEL OIL CONDITIONING SYSTEM

A complete heavy fuel oil conditioning system, including purifiers, heaters, and filters, shall be provided.

56.6. FUEL OIL SERVICE SYSTEM

The main engine fuel service system shall be provided as per the engine manufacturer's recommendations.

56.7. FUEL OIL HEATERS

Two final or service fuel oil heaters, one operating and one standby, shall be provided.

56.8. FUEL OIL AND DIESEL OIL STRAINERS AND FILTERS

All strainers or filters for fuel oil and diesel oil service shall be of all steel construction. Level of filtration shall be per the engine manufacturer's recommendations.

56.9. FUEL OIL METERS

Meters to indicate consumption shall be fitted in both the fuel oil and diesel oil systems.

SECTION 57

LUBRICATING OIL SYSTEMS - *SLOW SPEED DIESEL (ONLY)*

57.1. GENERAL

Under normal conditions lube oil shall be supplied to the main engine under pressure by one of the lubricating oil service pumps. A second pump shall act as a stand-by and shall automatically restart in the event of a drop in pressure below that required in the system.

57.2. MAIN ENGINE LUBRICATING SYSTEMS

The main engine shall be fitted with lubricating oil and cylinder oil systems complete with all necessary pumps, coolers, filters, tanks, valves, piping, fittings, and instrumentation as recommended by the engine manufacturer.

The oil supply shall consist of at least two independent lubricating systems because of a minimum of two different oil qualities required. Each system shall serve independently its respective engine components.

57.3. TANKS

Tanks shall be provided of the type, capacity and general location as recommended by the equipment manufacturers.

All tanks in the system shall be provided with approved oil level indicators, sounding tubes, ventilation, manholes, cleanout holes, internal ladders as required and all necessary connections and fittings.

57.4. LUBRICATING OIL COOLERS

(a) Main Engine Lubricating Oil Coolers

Provide as required.

(b) Auxiliary Equipment Lubricating Oil Coolers

Provide as required.

57.5. LUBRICATING OIL PURIFIERS AND HEATERS AND FILTERS

Provide as required.

57.6. STRAINERS

Provide as required.

57.7. PIPING

Provide as required.

57.8. DIESEL GENERATOR LUBE OIL SYSTEM

Each diesel generator set shall have a completely independent and self contained lube oil system.

57.9. TURBOCHARGER LUBE OIL SYSTEM

The main engine turbochargers shall be equipped with a lube oil system as per the manufacturer's recommendations. It may be integral with the main engine lube oil system or separate as required.

SECTION 58

SEA WATER SYSTEMS

58.1. GENERAL

The ship shall be provided with sea water systems for the following services:

Jacket water heat exchanger, main and aux. engines (if S.W. cooled)
Central Fresh Water Cooling System Heat Exchangers (if applicable)
Sea water service
Fire main/Tank cleaning system
Clean ballast
Bilge
Distilling plant (or Reverse Osmosis)
All condensers
Boiler water test sample cooler
Other Services as required.

SECTION 59

FRESH WATER SYSTEM

59.1. GENERAL

Complete fresh water systems shall be provided for engine cooling, boiler feed system, domestic, and sanitary services consisting of tanks, pumps, heaters, coolers, gages, piping, valves, fittings, and other appurtenances necessary to meet the need of the ship in compliance with requirements of the Regulatory Body(ies) and applicable SECTIONS of the Specifications.

59.2. COLD FRESH WATER SYSTEM

Cold fresh water shall be supplied for all potable, domestic, and sanitary purposes, including any system or unit of equipment requiring usage of fresh water for make-up, cooling, cleaning (washdown) or priming. The cold water supply to showers and lavatories shall not exceed 35°C.

59.3 HOT FRESH WATER SYSTEM

Hot fresh water shall be supplied to all domestic fixtures, systems or units of equipment requiring usage thereof. The hot water system shall be of the continuous recirculating system.

SECTION 60

FEED AND CONDENSATE SYSTEMS - *SLOW SPEED DIESEL (ONLY)* (IF FITTED)

60.1. GENERAL

A feed and condensate system shall be provided.

The system is based on one vertical exhaust gas boiler and one oil fired boiler packaged unit. Consideration will be given to other system configurations.

SECTION 61

STEAM GENERATING PLANT - *SLOW SPEED DIESEL (ONLY)* (IF FITTED)

61.1. GENERAL

One oil fired, (auxiliary), fully automatic boiler shall be provided as shown on the Machinery Arrangement Contract Plans. This boiler shall be capable of burning heavy fuel oil 700 Cst @ 50°C, or diesel oil.

One vertical tube exhaust gas (waste heat) boiler shall be provided as shown on the Machinery Arrangement Contract Plans.

Each boiler shall be designed for continuous operation and shall be complete, factory assembled (where practical), units of the manufacturer's standard design in current production. The design of the units shall have been proven satisfactory for the service intended.

This equipment shall be supplied complete with fuel pump, forced draft fan, boiler feed pumps, and waste heat boiler circulating pumps; all instrumentation, controls, and alarms; all mountings and integral piping with fittings; motors, motor controllers, and integral wiring with fittings; insulation bed plates and mounting brackets, special tools, and equipment as required.

SECTION 62

AIR INTAKE, EXHAUST UPTAKE, AND FORCED DRAFT SYSTEMS - *SLOW SPEED DIESEL (ONLY)*

62.1. GENERAL

The ship shall be provided with efficient air supply and exhaust systems for the main diesel engine, ship's service diesel generators, emergency generator, and steam generating equipment. Systems design shall be in accordance with applicable portions of ISO 8861, "Shipbuilding - Engine-Room Ventilation in Diesel-Engined Ships - Design Requirements and Basis of Calculations", and all Annexes.

Combustion air for the main engine shall be filtered separately in a smaller filter house and led to the engine via ducts and silencers; or alternately, all Engine Room air shall be filtered eliminating separate ducting.

62.2. MAIN ENGINE EXHAUST SYSTEM

The exhaust gases from the engine's turbo-chargers shall be led through a waste heater boiler, and silencer spark arrestor to the atmosphere.

62.3. OIL FIRED BOILER UPTAKE

The oil fired boiler uptake shall be led as directly as possible to the stack.

62.4. S.S.D.G. EXHAUST

The exhaust shall exit through spark arresting silencers to the stack.

SECTION 63

STEAM SYSTEMS - *SLOW SPEED DIESEL (ONLY)*

63.1. GENERAL

Auxiliary steam piping shall be installed as required. The systems shall be complete with all valves, traps, fittings, reducing stations, gages, thermometers, and any other equipment necessary for safe and efficient operation of the plant.

63.2. AUXILIARY STEAM SYSTEM

The auxiliary steam piping system shall be supplied from the auxiliary boiler or waste heat boiler outlet connection at boiler pressure. The system shall be designed to deliver steam at specified pressures and temperatures to the following:

1. Soot Blowers
2. Distilling Plant
3. Shore Steam
4. Fresh Water Heater
5. Main Engine Cooling Water Heating
6. H.F.O. Heaters
7. H.F.O. Purifier Heaters
8. H.F.O. Day Tank
9. H.F.O. Bunker Tank Heating Coils
10. Galley
11. Lube Oil Purifier Heaters
12. Lube Oil Purifier Sludge Tank Heating Coils
13. Ship's Heating
14. Steaming Out for Sea Chest and Sewage Tank
15. Cargo and Deep Fuel Oil Storage Tank Cleaning System (if provided)
16. Air Conditioning Converter
17. Slop Tank Heating Coils
18. Elsewhere as Required

SECTION 64

MACHINERY SPACE VENTILATION

64.1. GENERAL

A mechanical ventilation system shall be provided for the machinery space. The system shall consist of motor driven two speed supply and single speed exhaust fans with suitable Weather Deck inlets and outlets and all necessary duct work to supply the ventilation needs of the machinery space plus combustion air for the main engines, diesel generators, and auxiliary boiler. Air velocity in main trunks or ducts shall not exceed 18 meters per second unless specifically approved.

64.2. AIR SUPPLY

Fresh air supply to the fans for the machinery space shall be taken from separate intakes designed for minimum entrance loss, located so as to avoid short circuiting of exhaust air or stack gas.

64.3. AIR EXHAUST

The exhaust fans shall draw air from the top of the machinery space and discharge it direct to the atmosphere through non-restrictive louvered openings directed aft and protected from the weather. Automatic, non-return dampers shall be mounted in the discharge ducting of each exhaust fan operating in parallel.

SECTION 65

AIR CONDITIONING REFRIGERATION EQUIPMENT

65.1. GENERAL

Cooling shall be supplied by means of circulating chilled water to air cooling coils installed in the ventilation systems supplying conditioned air to the spaces defined in SECTION 12.

The machinery providing the chilled water shall use a refrigerant of a non-ozone depleting substance. The use of R-22 is acceptable as an interim measure until other systems are developed.

Direct expansion systems are also acceptable.

65.2. REFRIGERATING MACHINERY

There shall be two separate identical, refrigerant circuits so arranged and valved that the chilled water of either circuit, or both circuits (as needed), may be utilized to serve the load. Both circuits will be needed to serve the maximum load.

SECTION 66

SHIP'S SERVICE REFRIGERATION

66.1. GENERAL

(The following Specifications shall be complied with when the ship's stores refrigeration spaces are of the permanently installed type with the machinery located in the Engine Room. Consideration will be given to other arrangements such as portable refrigerated boxes with self-contained, air-cooled condensing units.

A ship's service refrigerating system designed for the direct expansion of refrigerant of a non-ozone depleting substance, shall be provided for the compartments indicated on the arrangement plans. The use of R-22 is acceptable as an interim measure until other systems are developed.

66.2. REFRIGERATING MACHINERY

(a) Compressors

Two air cooled multi-cylinder, single acting, marine type, compressors shall be provided. (Screw type compressors are also acceptable.) Each compressor shall have ample capacity to "pulldown" the refrigerated compartments to design temperatures within 72 hours after loading.

Arrangements whereby the combined capacity of the two compressors shall be adequate to pull the box temperatures down to the design conditions within 72 hours after loading are also acceptable. In this case, each compressor shall have ample capacity to maintain the refrigerated compartment design temperatures after "pulldown", and their refrigerant piping systems shall be independent of one another.

SECTION 67

CARGO REFRIGERATION - DIRECT EXPANSION SYSTEM

67.1. GENERAL

The plant shall be so designed and installed that the cargo refrigeration system will be controlled from the Engine Room at the Refrigeration Control Board and, except for emergencies, there will no need for personnel to enter the cargo refrigeration compartments or Fan Rooms while at sea.

67.2. REFRIGERATING MACHINERY

Cross connections with the units described in SECTIONS 65 and 66 shall be provided where practical and advantageous.

67.3. DEFROSTING

Defrosting of the air cooler units shall be accomplished by electric heating elements built into the units and controlled from the Refrigeration Control Board.

SECTION 68

LIQUID CARGO SYSTEM (IF INSTALLED AND APPLICABLE)

68.1. GENERAL - PETROLEUM TANKER

The liquid cargo handling system shall be installed to carry liquids (described in the Table of Liquid Cargos) in the tanks as indicated in the Capacity Tables. Liquid cargo systems designed for the carriage of petroleum products shall be suitable for loading and discharging petroleum products according to MARPOL 73/78. See SECTION 70 for pollution abatement requirements. The liquid cargo handling system shall be fitted with a vapor recovery system which meets Regulatory Body(ies) requirements.

68.2. CARGO TANK CLEANING SYSTEM - PETROLEUM TANKER

A sea water cargo tank cleaning system, complete with heater, drain cooler, chemical tank and all necessary piping and fittings shall be provided. The fire pump in the machinery space shall provide sea water to the heater and pump from and to the chemical mixing and storage tank. A common tank cleaning main, completely independent of the liquid cargo and ballast system piping, shall be provided. Recirculation of the chemically treated water from the tanks shall be accomplished by the liquid cargo pumps.

68.3. TANK HEATING SYSTEM - PETROLEUM TANKER

The liquid cargo tanks shall be heated by steam coils passing through fresh water filled hotwells located beneath the tanks. The steam inlet to the tanks shall be controlled by an adjustable thermostatic valve sensing the liquid cargo's temperature.

68.4. INERT GAS AND VAPOR RECOVERY SYSTEM - PETROLEUM TANKER

a. General

The distribution of the inert gas shall suit the cargoes being carried and shall be in accordance with Regulatory Body(ies) requirements. The vessel shall be fitted with a complete vapor recovery system, in accordance with Regulatory Body(ies) requirements, designed to return vapor from high vapor pressure cargoes to shore during cargo loading.

SECTION 69

CARGO HOLD DEHUMIDIFICATION SYSTEM

69.1. GENERAL

If cargo hold dehumidification is specified the following shall apply:

A complete automatically operated dehumidification system(s) shall be provided for preventing moisture damage to, or condensation of moisture on, cargo and internal structures of the dry cargo holds. Units using granular solid desiccant such as silica-gel, shall be furnished with replenishment desiccant equal to 15 percent of the unit's capacity and shall have satisfactory means of compensating for settling of the desiccant to prevent process air bypassing the desiccant.

69.2. DEHUMIDIFICATION UNITS

(a) Individual Hold System

The dehumidifier shall be of non-cycling absorption type having a single rotary desiccant bed capable of continuous operation, fully automatic, complete with reactivation heaters, roughing filters, motors, fans, desiccant drive unit, access panels, desiccant bed and all auxiliary components.

SECTION 70

POLLUTION ABATEMENT SYSTEMS AND EQUIPMENT

70.1. GENERAL

It is the general intent of this SECTION to specify appropriate pollution control measures to be taken in the design and operation of all merchant ships in order to protect and enhance the quality of the marine environment from ship-generated pollutants, such as oil, sewage, garbage and smoke.

70.2. BILGE, BALLAST AND CARGO/BALLAST SYSTEMS

(a) General

All bilge and ballast systems shall be so arranged as to assure that all oily bilge or ballast water will be discharged either overboard, through an approved Regulatory Body oily water separator, or directly into a designated slop tank which can later be decanted to 15 ppm or to a shore ballast reception and treatment facility.

(b) Oily Water Separators

Provide as required.

(c) Oil Content Meters

Provide as required.

(d) Shore Connection

Discharge stations shall be fitted for the bilge and ballast system on the Main Deck, port and starboard, to enable oily bilge and ballast water to be piped to shore facilities.

(e) Overboard Discharge Piping

Overboard discharge piping from oil/water separators and "load-on-top" operation shall be fitted with at least two shut-off valves as close to the shell as possible.

(f) General Cargo Vessel

A 100 percent segregated ballast system shall be provided.

70.3. SEWAGE TREATMENT AND LIQUID WASTE DISPOSAL SYSTEMS

(a) General

Any vessel equipped with toilets, showers, lavatories, laundries or a galley shall be provided with suitably sized holding tanks to retain the sewage and liquid waste while in port or in restricted waters.

(b) Sewage Treatment Plant

Where sewage treatment plants are used to handle human body wastes only, holding tanks shall also be provided to handle other wastes (grey water).

70.4. STACK EMISSION

(a) General

All stack emissions shall meet air purity standards established by the ports of call of the vessel.

(b) Smoke Indicator

Each boiler shall be equipped with a combination visual-photoelectric smoke indicator which shall clearly indicate the absence or presence of smoke.

70.5. INERT GAS SYSTEMS

All tankers over 101,600 t and having tank sizes greater than 10,000 m^3 shall be equipped with an approved inert gas system to prevent tanker casualties from fire and explosion.

70.6 VAPOR RECOVERY SYSTEMS

Vapor recovery systems are required for all U.S. Flag and foreign flag vessels which trade in the U.S. waters as cited in 46 CFR Part 39.

70.7. COLLISION AVOIDANCE RADAR

All tankers must be equipped with a collision avoidance radar system which complies with the requirements of SECTION 94.3 of this Specification.

SECTION 71

TANK LEVEL INDICATORS

71.1. GENERAL

Tank level indicators of a type designed for marine service shall be provided to serve the following tanks:

All Fuel Oil Tanks
All Fresh Water Tanks
All Lube Oil Sump Tanks
All Diesel Oil Service Tanks (including Emergency Generator Diesel(s))
All Liquid Cargo Tanks (where provided)
All Clean Ballast Tanks
All Sewage Holding Tanks

SECTION 72

COMPRESSED AIR SYSTEMS

72.1. GENERAL

Three complete compressed air systems shall be provided: diesel engine starting, ship service, and control air service.

72.2. COMPRESSORS

Motor driven compressors shall be provided: two for diesel engine starting and one for ship service systems. The compressors shall be of the two-stage, single-acting air or water cooled with an air or water cooled intercooler (if required).

The control air compressor should be of the oil free liquid ring type.

72.3. AIR RECEIVERS

There shall be a minimum of four receivers, two or more receivers for diesel engine starting, one for ship service air, and one for the control air system.

72.4. SHIP SERVICE AIR PIPING

The ship service air system shall be supplied from the ship service air receiver and shall distribute air to the following locations as needed:

Machinery space for general service, in addition to those listed below
Each deck in machinery casing for general service
On Main Deck at forward and aft ends of main deckhouse
Winch Motor Generator Rooms, after deckhouse if fitted, and each winch house
Ship Service Generators
Hydropneumatic pressure tanks
Fuel Injector Testing Unit
Lubricating oil purifier workbench
Steering Gear Room
Shaft Alley
Engineer's Workshop
Electrician's Shop
Emergency Generator Room
Refrigerating machinery
Diffuser Rooms, if fitted
Fan Room
Elsewhere as required

72.5. CONTROL AIR PIPING

The reduction of the moisture content of the control air shall be accomplished by passing the air through a self-contained, refrigerated air cooler via a check valve with a discharge air temperature of 2°C.

SECTION 73

PUMPS

73.1. GENERAL

All pumps shall be of a high commercial marine standard.

The pumps shall be as specified in the Machinery List.

73.2. CENTRIFUGAL

(a) General

Centrifugal pumps shall be selected to operate at, or near, the maximum efficiency point on the head-capacity curve. The pumps shall have non-overloading power characteristics and the driver rated power shall at least equal the maximum power requirement of the pump at rated speed without allowance for a service factor.

73.3. ROTARY PUMPS

(a) General

Rotary pumps shall be of the helical-screw, herring-bone-gear, vane or cam type. Preferably pumps shall be direct coupled to drivers but where necessary may be provided with reduction gears.

SECTION 74

GENERAL REQUIREMENTS FOR MACHINERY PRESSURE PIPING SYSTEMS

74.1. SYSTEM DESIGN

System piping and associated components shall be designed to provide adequate flow to auxiliary equipment. The use of automatic-type regulators and/or restrictive devices, such as orifices, in lines servicing auxiliary components, such as heat exchangers, shall be permissible for obtaining and maintaining operational conditions, providing such appurtenances do not impose undue restrictions, such as large pressure drops (necessitating increase in pumping power) and destructive erosion conditions.

74.2. INSTALLATION

Piping installation shall permit: free passage along walkways and ladderways; free access to perform shipboard operational and routine maintenance; free access for, and to perform, cargo handling; and free access to all doors, hatches and openings covered by portable plates. Where impracticable for piping to be clear of removable plates, piping shall be made portable for easy access.

74.3. RESTRICTIONS

No piping shall pass through refrigerated, medical, and/or predominantly electrically equipped spaces, unless directly associated with and/or servicing such spaces. Such piping shall be of one length throughout unless installation dictates otherwise. Necessary joints shall be either welded or brazed sleeved joints or otherwise shielded as approved.

SECTION 75

INSULATION - LAGGING FOR PIPING AND MACHINERY

75.1. GENERAL

Where surface temperatures are normally between 52°C and 66°C and the omission of insulation will not adversely affect operational efficiency, non-metallic lagging only may be applied, where necessary, to protect personnel from contact with hot metal surfaces.

Insulated and fabric-lagged surface temperature shall not exceed 66°C; metal or metallic type lagging surface temperature should not exceed 52°C when in areas susceptible to personnel contact.

Piping and units of equipment with design internal temperature of 150°C and over or 10°C and under shall be insulated from their supports or the supports insulated from the structures to which they are attached where the heat transmitted may be objectionable on the other side of the structure.

75.2. ALTERNATIVE INSULATION REQUIREMENTS

For alternative practices in insulating piping and machinery, the contractor may adhere to the materials, thicknesses and installation requirements provided in the standard document ASTM F683, "Standard Practice for Selection and Application of Thermal Insulation for Piping and Machinery".

SECTION 76

DIESEL ENGINES DRIVING GENERATORS

76.1. SHIP SERVICE GENERATOR ENGINE(S)

At least three medium speed diesel engines or a combination of two medium speed diesel engines and one power take-off (PTO) from the main diesel engine or shafting shall be provided for driving the ship's service generators. The engines shall be capable of driving their generators continuously at the generator's specified rating. The engines shall be capable of burning heavy fuel oil or diesel oil.

Each diesel engine driving the ship's service generators shall be capable of automatically assuming the ship's service electrical load within 30 seconds after running generator failure in a single step.

Each diesel engine with its generator shall be mounted on a common bed plate. It shall have a normal continuous capacity at its marine rating sufficient to meet the rating of its generator. It shall be a non-reversing, single acting, two or four cycle, inline or V-type, engine designed to operate on heavy fuel oil as specified herein.

76.2. EMERGENCY GENERATOR ENGINE

The high speed diesel engine driving the emergency diesel generator shall be of the single acting, mechanical injection, two or four stroke cycle, inline or V type, direct-connected to the generator and mounted on a common cast or fabricated steel sub-base isolated from the ship's structure by suitable vibration isolators.

The cooling system shall be of the self-contained, fresh water, closed circulation type complete with radiator, fan, and attached fresh water pump. It shall be of adequate capacity to permit continuous operation of the engine at rated power with cooling air temperatures up to 38°C.

SECTION 78

TANKS - MISCELLANEOUS

Miscellaneous containers and tanks not listed elsewhere in the Specifications and required for general servicing of machinery shall be provided.

The following are miscellaneous tanks to be provided in approved locations:

1 - kerosene tank approximately 285 L
2 - clean waste lockers 0,5 m^3
2 - oily waste cans 0.5 m^3
1 - engineer oil tank approximately 40 L

SECTION 79

LADDERS, GRATINGS, FLOOR PLATES, PLATFORMS, AND WALKWAYS IN MACHINERY SPACES

79.1. GENERAL

Ladders, walkways, floors, and platforms shall be provided, as necessary, for convenient access to and operation of all machinery, apparatus, and controls and for entrance to and escape from the machinery spaces.

79.2. LADDERS

Ladders in frequent use shall lean fore and aft and shall be inclined sufficiently for each use. Maximum ladder inclination shall be 55^{o}.

79.3. GRATINGS

Portable open gratings shall be used for machinery space walkways, platforms, and floors only where specifically required for ventilation and continuous visibility purposes.

79.4. FLOOR PLATES

Solid floor plating, whether fixed or portable, in way of traffic, operating and maintenance working areas, shall be 4.5 mm raised pattern non-skid plate.

79.5. HANDRAILS AND STANCHIONS

Except in way of electrical equipment, such as switchboards, where non-conducting material must be used, handrails shall be 25 mm steel pipe and shall be galvanized in locations where subject to corrosion. Handrails supported from bulkheads or other surfaces shall have a clear hand space of at least 63 mm.

SECTION 80

ENGINEERS' AND ELECTRICIANS' WORKSHOPS, STORES, AND REPAIR EQUIPMENT

80.1. ENGINEERS' WORKSHOP

The Engineers' Workshop shall be outfitted with the following independent electric motor-driven tools:

Lathe
Drill Press
Grinder (Pedestal) (Wet and Dry)
Power Hacksaw
Pipe Threader

80.2. ELECTRICIANS' WORKSHOP

The following motor-driven tool shall be provided:

Grinder (Bench)

80.3. WELDING EQUIPMENT

A manual shielded metal arc welding unit of sufficient capacity to perform necessary repairs to machinery and equipment may be provided and stored in a clean, dry well-ventilated space in an approved manner.

Gas cutting and welding equipment shall also be provided.

80.4 WORKBENCHES

As required.

SECTION 81

HULL MACHINERY

81.1. GENERAL

In general, all hull machinery assemblies located in the weather shall be provided with watertight housings, and where located below deck, with drip-proof protected housings, unless otherwise specified. Deck machinery may be powered directly by electric motors, dedicated hydraulic systems or a central hydraulic system.

81.2. STEERING GEAR

(a) General

The steering gear shall be of the two or four cylinder, electro-hydraulic type, the ram driving the crosshead through a Rapson slide. The crosshead hub shall be of split construction and keyed to the rudder stock with dual torque keys.

Consideration of direct drive electric steering gears will be given.

Consideration shall be given to the installation of a rotary vane type of steering gear.

There shall be two independent power sources, each of which shall be capable of handling the rudder.

81.3. WINDLASS

(a) General

There shall be provided one or more anchor windlass(es) for bower anchor handling and warping duty.

81.4. CAPSTAN

Each capstan shall consist of a vertical head of the smooth barrel type mounted on the Weather Deck, driven by a vertical shaft connected to a power unit which shall be located on the deck below.

81.5. ACCOMMODATION LADDER WINCHES

Provide as required.

81.6. CARGO HATCH COVERS (HINGED)

Provide as required.

81.7. CARGO HATCH COVERS (SLIDING OR PONTOON)

Provide as required.

81.8. TOPPING, VANG AND SCHOONER GUY WINCHES, WHERE FITTED

Provide as required.

81.9. CARGO WINCHES, IF FITTED

Provide as required.

81.10. WARPING WINCHES

Provide as required.

81.11. CONSTANT TENSION MOORING WINCHES (IF FITTED)

Provide as required.

81.12. ENGINEER'S PLATFORM HOIST

Provide as required.

81.13. BOW THRUSTER

(a) General

Each lateral thruster shall be of the controllable pitch type driven by a constant speed non-reversing motor through a spiral bevel gear right angle drive. (Hydraulic, fixed pitch types will also be considered.)

81.14. CRANES

Crane design shall conform to Classification Society(ies) requirements and be so approved and tested.

SECTION 82

HEAT EXCHANGERS

82.1. PLATE TYPE HEAT EXCHANGERS

Generally, all liquid-to-liquid exchangers shall be of the plate type except where otherwise specified and in cases of very minor exchangers. Plate material shall be titanium of sea water services and 316 stainless steel for other applications.

82.2 SHELL TUBE TYPE HEAT EXCHANGERS

All shell tube type heat exchangers shall be of the finned or bare tube type. Where tubes are secured on tube sheets by rolling, they shall be rolled by an electronically controlled method. A number of spare tube expanders shall be provided on the ship for all heat exchangers utilizing the same size and type of tube.

Zinc or other suitable sacrificial anodes shall be fitted in the inlet heads (other than heads of copper-nickel alloy) of all heat exchangers which are sea water cooled. Magnesium or soft iron will be acceptable as an alternate to zinc.

Tubes and tube sheets of tubular heat exchangers in salt water service shall be of 90-10 copper-nickel alloy. Fabricated covers of 90-10 copper-nickel alloy plating are acceptable.

SECTION 85

INSTRUMENTS AND MISCELLANEOUS GAGE BOARDS - MECHANICAL

85.1. GENERAL

The necessary miscellaneous instruments, gages, indicators, gage boards, thermometers, instrument panels, mountings, and test equipment, shall be furnished for all machinery, equipment, apparatus, and piping systems as specified in the various sections as required for proper operation. All instruments, components, mountings, and fittings specified herein shall be in accordance with the applicable Regulatory Body(ies) requirements.

SECTION 86

SPARES - ENGINEERING

86.1. SPARE PARTS - GENERAL

The Contractor shall provide aboard ship spare parts in accordance with the minimum requirements of the Regulatory Body(ies) involved, and which have such requirements. Spare parts in addition to those required by the Regulatory Bodies shall be selected by the Owner and furnished by the Contractor in accordance with provisions and the monetary amount set forth in the applicable Contract. At the discretion of the Owner, these latter spares shall be stored either onboard or delivered ashore to a location designated by the Owner.

86.2. SPARE PARTS BOXING

All spare parts applying to a particular unit of equipment shall be assembled in a spare parts box or boxes of such a size so that the weight of any one box with its contents shall not exceed approximately 90 kg.

SECTION 87

ELECTRICAL SYSTEMS, GENERAL

The system presented herein is based on low voltage (low voltage is defined as 500 or 600 volt for IEC and IEEE respectively). For those applications where medium voltage is desired, then it will be incumbent upon the Contractor to properly select the equipment and design the system using the information contained in SECTIONS 87, 88, 89, 90, and 91 as a functional guide.

The design of the electric plant including generators, motors, and controllers shall be coordinated to insure that the voltage dip, when starting the motor with the highest starting current, shall not exceed 20 percent of rated voltage. Contractor shall perform calculations to determine minimum voltage dips at the main and emergency switchboards.

Attention shall be directed to the design of electrical and electronic circuits, particularly those containing transistors, diodes and other solid state devices, with regard to protection from transient voltage spikes of the type normally encountered in shipboard power distribution systems. Devices, such as solid state transient voltage suppressors, shall be provided in such equipment as required.

All electrical equipment shall be supplied with nameplates on the equipment.

SECTION 88

GENERATORS

88.1. SHIP SERVICE GENERATORS

(a) General

Three ship service generators shall be provided to meet specifications for the distribution system outlined in SECTION 90. The rating of the ship service power plant shall be sufficient to ensure the operation of auxiliary services, indispensable for the propulsion and the safety of the ship, passengers and crew and preservation of the cargo, even when one generating set is out of service; in accordance with IEC or IEEE requirements.

88.2. EMERGENCY GENERATOR

(a) General

The diesel engine driven generator shall be selected to meet specifications for the distribution system outlined in SECTION 90, for continuous operation in an ambient temperature of 50°C. Stator and rotor insulation shall be Class B or Class F.

SECTION 89

SWITCHBOARDS

89.1. GENERAL

(a) Structure

Switchboards shall be freestanding dead front type units. Sheet metal or fiber glass barriers shall be provided to form separate individual compartments for power circuit breakers.

(b) Enclosures

Enclosures, bolted to the switchboards and made of reinforced expanded metal or wire mesh, shall be provided extending from the ends of the switchboards to the ship's structure with doors arranged for locking.

(c) Switchboard Instruments

Instruments shall preferably have white dials with black markings. Red marks shall be placed on instrument scales to indicate rated voltage, current, and kilowatts of the circuit into which the instruments are connected.

(d) Air Circuit Breakers

Air circuit breakers when used shall meet the applicable requirements of the latest IEEE or IEC recommended Standards.

(e) Bus Bars and Connections

All bus bars shall be made of hard drawn commercial copper.

(f) Control Switches

Switches provided for instrument transfer or control functions shall be of the rotary type.

(g) Relays and Contactors

Relays which have sensitive characteristics and precision mechanism and/or adjustments shall be housed in moisture and dustproof cases.

(h) Indicator Lights

Indicator lights shall be flush mounted.

89.2. ENGINE ROOM CONTROL CONSOLE

The ship service generator and distribution switchboard should preferably be located in the immediate vicinity of the Engine Room control console with the switchboard instrumentation completely readable from the operating position.

89.3. SHIP SERVICE GENERATOR AND DISTRIBUTION SWITCHBOARD

(a) General

The ship service generator and distribution switchboard shall be arranged for operation of generator circuit breakers and for distribution of power.

89.4. EMERGENCY GENERATOR AND DISTRIBUTION SWITCHBOARD

(a) General

This switchboard located in the Emergency Generator Room shall be arranged for the control of the emergency generator and shall provide automatic transfer equipment and distribution and battery charging facilities as required for proper operation of the emergency electric plant.

SECTION 90

ELECTRICAL DISTRIBUTION

90.1. GENERAL

Typically the primary AC distribution system shall be a 3 phase (3 or 4 wire) insulated system capable of continuously monitoring the insulation level to ground (earth).

Fixed electrical appliances, except for certain small commissary type equipment such as domestic size refrigerators and toasters, shall have means provided to make permanent connections to ship cables.

90.2. DISTRIBUTION VOLTAGES

The nominal voltage for the primary AC distribution system shall be 460 volts and 60 Hz or 380 volts and 50 Hz depending upon future deployment of the ship. Secondary distribution voltage for items such as but not limited to, lighting and receptacles, shall be 115 or 220 volts.

Power equipment in general, including the principal galley equipment, shall operate on, nominal supply (460 or 380 volts), 3 phase.

The transformers energized through the emergency switchboard shall also supply the interior communication, battery charging, electronic and navigation equipment.

The general alarm system and power failure alarm panel shall operate on DC obtained from either of the two I.C. storage batteries. Battery voltage shall be determined by system voltage drop restrictions.

90.3. CABLE CALCULATIONS

(a) Power

Generator and tie feed, power and lighting feeder, and branch cable computations shall be based on demand load factors as specified by the Regulatory Body(ies). Allowable voltage drop for power circuits should not exceed 5 percent.

90.4. SHORE CONNECTION

A 3 phase shore connection feeder shall be provided from the main switchboard to a single shore connection box of adequate capacity located so as to be readily accessible to shore cables from either side of the ship with minimum interference with deck activities.

90.5. CATHODIC PROTECTION SYSTEM

Provide an impressed current cathodic protection system to protect the submerged hull and appendages against corrosion. Control and power supply components shall be solid-state, static type of sufficient capacity to provide not less than 86 milliamperes per square meter of wetted area. The number and dissolution rate of the anodes shall be such that this output can be maintained for at least 10 years without replacement of anodes. The number of anodes shall be as recommended by the manufacturer, but shall be not less than six.

SECTION 91

AUXILIARY MOTORS AND CONTROLS

91.1. GENERAL

Heaters shall be provided within all motor and control enclosures subject to accumulation of condensation and wide variation of temperature such as refrigerated space air cooler fan motors and controls and fire pump motor and controls.

91.2. MOTORS

All motors shall be of the same manufacturer, in so far as practicable and shall be of commercial marine quality.

All motors rated over .186 kW shall be AC squirrel cage induction type designed for 460 or 380 volt, 3 phase, 60 or 50 Hz, continuous duty, with Class B or F insulation, unless otherwise specified. Motors of .186 kW rating and less may be designed for operation on 115 or 220 volt, single phase.

91.3. CONTROLLERS

All controllers shall be of the same manufacture, in so far as practicable and shall be of commercial marine quality.

Generally, all integral motor power controllers shall be across-the-line magnetic type, with master switches mounted at the controller door and with provision for control by protective thermal sensors where provided on the motor.

SECTION 92

LIGHTING

92.1. GENERAL

The ship shall be lighted throughout with incandescent and fluorescent fixtures in accordance with applicable standards and recommendations, e.g., Illuminating Engineering Society publication entitled "Recommended Practice for Marine Lighting RP-12", or IEC standard publication 92-306 "Equipment Luminaries and Accessories".

92.2. EMERGENCY LIGHTING

Emergency lighting, as specified in SECTION 88 shall be energized from the emergency lighting and power system.

92.3. ILLUMINATION LEVELS

Lighting fixtures shall be provided in numbers, sizes and arrangement in order to maintain in service at least the average lumens/m^2 recommended by applicable standards.

Illumination for the Engine Room Control Console shall be greater than the minimum level necessary to maintain a visual gradient with the alarm, signal and indicating lights, to readily recognize the information cues from the normal operating positions.

92.4. LIGHTING IN ACCOMMODATIONS

Flush mounted lighted fixtures shall be provided and all wiring shall be concealed where lined ceilings, acoustical or marine veneer ceilings and/or bulkheads are installed.

92.5. EXTERIOR LIGHTS

(a) General

Lights on the Bridge Deck and in other areas which cause interferences to navigation shall be controlled by switches located in the Wheelhouse. Exterior lights, required at sea and visible from ahead, shall be shielded.

92.6. NAVIGATING AND SIGNAL LIGHTS

A running and anchor light system in compliance with applicable International and Inland Rules of the Road and Regulatory Body(ies) requirements shall be provided so as to permit compliance with the Rules.

92.7. MISCELLANEOUS

Bracket fans in working spaces that are not air conditioned shall be 40 cm oscillating, quiet blade, marine type suitable for direct connection to the ship's wiring system without the use of portable cords and outlets. Control switch shall be mounted in the base and shall be readily accessible.

Window wipers shall be provided in the Wheelhouse. Wiper motors shall be 115 or 220 volt AC and each shall be controlled by a separate rheostat and cut-off switch at wiper.

SECTION 93

COMMUNICATIONS

93.1. GENERAL REQUIREMENTS

The plan development and the installation of all equipment, including antennas, shall be accomplished under the guidance of authorized representatives of the respective equipment manufacturers. All final checks and adjustments shall be made by authorized representatives of the manufacturer of the particular equipment involved, and where possible, prior to the official ship's trials.

93.2. COMMUNICATIONS EQUIPMENT (U.S. FLAG ONLY)

The following suite of communications systems shall be provided in accordance with Regulatory Body(ies) requirements.

(a) Communications Suite Including Global Maritime Distress and Safety System (GMDSS):

* Very High Frequency (VHF) Two-way transceiver with:
  - o Digital Selective Calling (DSC) on Channel 70 (156.525 MHz).
  - o Radio Telephone on Channel 6 (156.300 MHz), Channel 13 (156.650 MHz), and Channel 16 (156.800 MHz).
  - o General Radiotelephony (156.000 to 157.000 MHZ).
* VHF Dedicated Watch Receiver with DSC on Channel 70 (156.525 MHz).
* NAVTEX International Receiver for Maritime Safety Information.
* SafetyNET INMARSAT (Enhanced Group Call Type) Dedicated Standard C with distress call feature initiated from the helm.
* Medium Frequency (MF) and High Frequency (HF) Single Side Band (SSB) 400 watt Transceiver (1.605 to 27.5 MHz).
  - o DSC dedicated watch keeping on 2187.5 kHz.
  - o DSC watch keeping capability on 4207.5 kHz, 6312.0 kHz, 12577.0 kHz, and 16804.5 kHz. All must be available; however, watch-keeping can select one of these at a time in addition to the 2187.5 kHz watchkeeping.

- o DSC on 2187.5 kHz.
- o Transmission and reception of general radio communications including voice and direct printing telegraphy.
- o Means of initiation of an alert from the helm.

* INMARSAT voice and data two way communications system over satellites.

93.3. FACSIMILE

A facsimile recorder capable of reproducing weather charts and other documents received by radio on standard 483 mm sheets, shall be provided in the Radio Room.

SECTION 94

NAVIGATION

94.1. ECHO DEPTH SOUNDER

The echo depth sounder equipment shall provide direct readings at a visual indicator and at a recorder.

The indicator shall be located in the navigation control section of the bridge control console.

94.2. ELECTRONIC POSITION FIXING

(a) Loran C shall be provided complete with the appropriate antenna for the receiver, taking due care to avoid electromagnetic interferences with the Loran C signals from other electronics. The Loran C antenna shall not be used for any transmissions of radio signals.

(b) Differential Global Positioning System (DGPS), satellite navigation shall be provided.

94.3. RADAR/COLLISION AVOIDANCE SYSTEM

A radar system including a collision avoidance display Automatic Radar Plotting Aids (ARPA) and alarm systems shall be provided.

94.4. RADIO DIRECTION FINDER

A radio direction finder shall be provided.

94.5. STEERING CONTROL SYSTEM

A dual control steering system, providing control in three separate modes (automatic through gyro compass input; full-follow-up hand electric; and emergency non-follow-up) employing two independent steering transmission systems, shall be provided.

94.6. RUDDER ANGLE INDICATOR

An electric rudder angle indicator system capable of accurately indicating the position of the rudder shall be provided.

94.7. WIND SPEED AND DIRECTION INDICATOR

A wind speed and direction indicator shall be provided with direct indicating instrumentation mounted in the Chart Room or Wheelhouse.

94.8. SPEED LOG

A speed and distance system shall be provided with readout display mounted in the Wheelhouse or in Wheelhouse console.

94.9. DOPPLER DOCKING SYSTEM

A system shall be provided which is capable of providing ship's velocities and direction, with respect to the ocean bottom, at low ship's speed in relatively shallow water and with high resolution.

94.10. SEARCH AND RESCUE/HOMING

Provide the GMDSS required 406 MHz Satellite Emergency Position Indicating Radio Beacons (EPIRB) with integral 121.5 MHz homing beacon and flashing light as defined in the RTCM SC110 - Recommended Standards for 406 MHz EPIRB. Two units shall be provided with at least one being an automatic float-free assembly.

SECTION 95

INTERIOR COMMUNICATIONS

95.1. SHIP CONTROL SYSTEMS

(a) Telephones - General

Telephones at locations exposed to the weather shall be provided with watertight enclosures and electric heating elements to prevent condensation of moisture within the unit.

(b) Sound Powered Telephone Systems

A sound powered telephone circuit in accordance with Regulatory Body(ies) requirements shall be provided for emergency communications between the following locations:

Wheelhouse
Engine Room (Central Control Room)
Steering Gear Room
Emergency Diesel Generator Room

(c) Automatic Telephone system

Provide an automatic telephone system consisting of a centrally located automatic switchboard connected to telephones, in all important locations such as:

Wheelhouse
Engineering Spaces
Steering Gear Room
Cargo Control Stations
Primary Deck Machinery Stations, such as but not limited to
Anchor Windlass and Deck Cranes
Staterooms and Day Rooms
Officers' and Crews' Mess
Recreation Rooms
Port and starboard gangway locations
Galley
Various Offices

(d) Shore Side Telephone Outlets

A watertight telephone connection box shall be provided on the inside of bulwark in a protected location by the gangway, port and starboard, for connection to shore telephone lines.

(e) Public Address System

An intercommunication system shall be provided for transmission of voice announcement from the Wheelhouse to appropriate stations around the ship depending on type of ship and service. The public address system can be a part of the automatic telephone system.

(f) Crane Loudspeaker System (If Installed)

A loudspeaker system for clear spoken communication from the crane operator to workers beneath the crane, comprising a unidirectional fixed microphone, control and solid state amplifier located in the crane cab within easy reach of the operator, shall be provided for each crane.

(g) Bridge Control Console - Navigation Control System

The navigation control section of the bridge control console shall consolidate all associated navigational aids and communications shall be constructed in general accordance with the requirements for the bridge control console as described in SECTION 99.

95.2. ALARM SYSTEMS

(a) General Alarm

In compliance with Regulatory Body(ies) and SOLAS requirements, a general alarm system shall be provided, with approved warning devices in spaces where people may be at any time.

(b) Fire Detecting System

A fire detecting system shall be provided in conjunction with SECTION 13.

(c) Steering Gear Alarms

Alarms shall be provided on the Engine Room control console for each steering motor and feeder circuit breaker.

(d) Emergency Generator Diesel Engine Alarms

A visual and audible alarm panel for the diesel engine shall be provided in the Emergency Generator Room.

95.3. SHIP SERVICE SYSTEMS

(a) Ship's Entertainment System

(1) The radio entertainment system shall consist of separate or combination AM/FM receivers with matching loudspeakers, with an AM frequency coverage of 540 kc to 30 mc and FM frequency band, 98 to 108 mc, provided in the Officer's Lounge, Passenger's Lounge, and Crew's Lounge.

(2) The television entertainment system shall consist of television receivers provided in the Officer's Lounge, Passenger's Lounge, and Crew's Lounge.

(b) Hospital Call System (If Provided)

A Hospital call bell system shall be provided with an annunciator in the Wheelhouse or in an alternate specified manned space.

(c) Ship's Electric Clock System

An electric clock system shall be provided consisting of a master control in the Chart Room and bulkhead mounted secondary clocks with shatterproof lenses provided in the following spaces:

Captain's Office
Chief Engineer's Office
Ship's Office
Galley
Crew Mess Room
Wheelhouse
Radar and Gyro Room
Recreation Spaces
Officer's Mess and Lounge
Engine Room Control Console
Chart Room, where not integrated with Wheelhouse

(d) Refrigerated Stores' Boxes Call System

(e) Engineer's Assistance Needed Alarm System

95.4. CARGO AND SHIP'S REFRIGERATION CONTROL BOARD (If Installed)

A refrigeration control board shall be provided in the Engine Room convenient to the Engine Room control console. It shall provide for the remote control and monitoring of the cargo refrigeration system and

monitoring of ship's service refrigeration, air conditioning and liquid cargo temperatures.

SECTION 96

STORAGE BATTERIES

96.1. GENERAL

Storage batteries shall be of the nickel cadmium alkaline type or the nickel iron alkaline type to suit the specific application.

96.2. I.C. BATTERIES

Duplicate sets of storage batteries shall be provided for supplying power to the interior communication services, one serving as standby for the other.

96.3. RADIO BATTERIES

Radio batteries or Uninterrupted Power Supply (UPS) with internal battery backup shall be provided with the radio communications equipment and shall be of a capacity to suit SOLAS and applicable society standards.

96.4. EMERGENCY DIESEL GENERATOR STARTING BATTERIES

If the emergency diesel generator is provided with an electric starter, batteries provided should be of sufficient capacity to suit current standards.

SECTION 98

TEST EQUIPMENT, ELECTRICAL

98.1. PORTABLE INSTRUMENTS

The instruments listed below shall be procured by the Contractor and stored aboard the vessel. Instruments shall be complete with carrying cases, batteries, and test leads as applicable.

1 - Insulation resistance tester, 500 volts, hand operated.

1 - AC clamp type volt-ammeter with minimum of four current and two voltage scale ranges, minimum high ranges 300 amperes and 600 volts.

2 - AC-DC volt-ohm-milliammeters.

1 - Portable tube tester, roll-cart type.

1 - Transistor/FET tester capable of in-circuit testing.

The above list is not all inclusive. Alternate or additional instruments shall be considered.

98.2. TEST RECEPTACLES

Combination interlocking switch and receptacles, rated 20 amperes, shall be provided on the bulkhead above a workbench in the Electric Workshop to provide the primary and secondary AC and DC power supplies for testing purposes.

SECTION 99

CENTRALIZED ENGINE ROOM AND BRIDGE CONTROL - *SLOW SPEED DIESEL (ONLY)*

99.1. GENERAL

A centralized Engine Room and Bridge Control System shall be furnished providing centralized remote control and information display of the machinery plant. The plant shall respond automatically to either Bridge or Engine Room throttle control over the complete range of plant operation without the intervention of the engineering watch personnel. The centralized Engine Room control shall permit the operator to observe all the important operating conditions and initiate functions from the console as specified herein.

99.2. AUTOMATION AND CONTROL

An enclosed remote Engine Control Room is to be located in the machinery space and fitted with an Engine Room control console which shall include the following instruments and equipment:

- Maneuvering lever for main propulsion engine
- Telegraph receiver
- Sub-telegraph
- Remote monitoring and control of auxiliary equipments
- Alarm buzzer and telegraph bell
- Buzzer and flicker pushbuttons (acknowledge and test)
- M/E emergency stop and shutdown/slowdown override switches with cover
- Telephones
- Duty engineer selection switch
- CRP controls, if applicable
- Pressure and temperature gauges
- Engineer's quarters calling alarm system
- Bilge/ballast/fuel oil control and monitoring systems
- Complete power management system and electrical switch gear
- Fire alarm pushbutton
- Color CRT graphic displays for the integrated monitoring, control and alarm system specified below
- Printers

Console mounted gauges shall include starting and control air pressure, main engine oil, scavenge air, turbo-charter RPM indicator, and cooling water pressure, cooling sea water pressure, fuel oil pressure before and after the filter fuel rack and pitch control (if provided) indicators, and engine lube oil and cooling water and exhaust temperature. Gauges for auxiliary machinery system shall also be provided. Console gauges may be driven by the CPU but shall be discrete analog displays.

The Control Room shall have a full view of the machinery space over the control console and shall be fitted with adequate shelves, desks, chairs, and other furniture.

An integrated monitoring, control, and alarm system is to be provided for the machinery plant in order to comply with Class requirements for periodically unattended machinery space (UMS) operation.

The system shall be microprocessor based and shall be furnished by a single manufacturer. Adequate reliability shall be ensured through the use of distributed or duplicated microprocessors. The master microprocessor in the Engine Control Room shall be replicated with a "hot standby" unit. Changeover from operating to standby processors is to be automatic with an alarm to alert operators. The data bus provided for transmission of signals to the Engine Control Room shall be capable of continued functioning with a break anywhere in the bus.

The system shall include:

1. Remote monitoring of temperatures, pressures, flows, levels, and other process variables.

2. A complete power management system for remote monitoring and control of the electrical power system, including:

   Manual remote start/stop of auxiliary generator sets
   Automatic start/stop and synchronizing of generator sets
   Monitoring of critical parameters when diesel engine is running
   Resets from keyboard of all shutdowns, start failures, and synchronizing time-outs
   Automatic load sharing (balanced/unbalanced)
   Load-depend start/stop
   Blackout monitoring and load shedding/blocking of heavy consumers

3. Remote monitoring and control for auxiliary equipment including:

   Automatic start-up of standby pumps in case of pressure drop and sequential start-up after black-out
   Display of system pressures, temperatures, etc.
   Alarm of off-design parameters

4. Running status indication and cumulative running hour monitoring for all equipment.

The remote operator control stations, located in the ECR console shall consist of two redundant functional operator control panels (keyboard) with 19" (minimum) color CRT displays for remote monitoring and control.

Engineers' cabins, wheelhouse, and public rooms (officers' mess and officers' lounge) to be equipped with panels for indication of critical and general alarms and Engineer's Assistance Needed alarm.

The system shall also be provided with an uninterruptible power supply (UPS) unit with at least 30 minutes battery back-up and with two dot matrix printers, one for alarm and one for log. A full self-diagnostic program to be included in the system for input/output signals that will give alarm on monitor and printer of control system malfunctions.

Sufficient individual CRT screens to logically organize and display the above information shall be included.

SECTION 101

TEST AND TRIALS - *SLOW SPEED DIESEL (ONLY)*

101.1 GENERAL

All shop tests, ship installation tests, dock trials, and sea trials shall be scheduled and completed to demonstrate compliance with the requirements of the Specifications and shall be in accordance with the Classification Society(ies) requirements.

The scope of dock and sea trials shall be to Contractor's standard practice. The Contractor shall prepare complete reports on all sea trials, dock trials, and events required by this SECTION. The trials shall not be considered complete until they have been documented in a comprehensive and concise report by the Contractor.

101.2 PROGRESSIVE SPEED LEVELS

At fully loaded and normal ballast condition, with clean bottom in deep-sea, the vessel's speed shall be determined at engine loads of 1/2 MCR, 3/4 MCR, NCR (90% MCR), and MCR using heavy oil. The revolutions of the propeller at trial condition shall be restricted to the maximum rpm allowed by the main engine vendor, in which case the output of main engine may not reach the specified maximum continuous rating.

101.3 ENDURANCE AND FUEL CONSUMPTION TRIALS

Two hours continuous run at normal continuous rating in the full load* condition shall be carried out and followed by 4 hours continuous run using heavy fuel oil at normal continuous rating. The rate of fuel consumption shall be measured during the above two runs for comparison purposes with guaranteed fuel rate measurement performed during engine shop trials.

101.4 MANEUVERING TRIALS AND TESTS

The following maneuvering trials and tests shall be conducted:

a. Ahead Steering Gear Test

b. Circle Test

**Where it is not practical to reach a "fully loaded condition" at the time of sea trials, a maximum practical draft shall be used. Within 6 months of delivery of the ship, this information shall be obtained, and the results appended to the trial report called for in Item 101.1. above.*

c. Zig-Zag Maneuvering Test

d. Crash Stop Astern Test

e. Crash Stop Ahead Test

f. Inertia Test

g. Astern Steering Test

h. Spiral Maneuver per SNAME T&R Bulletin No. 3-47

i. Fire and Foam Tests

j. Torsional Vibration Test to Determine First Critical and Measured Stress on the Line Shaft

k. Anchor Windlass Test