



IV- ELECTRIC PART



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SECTION 1 GENERAL

1.1 GENERAL

The Specification are intended to set forth the electrical equipment to be installed and the work to be executed for the construction of the Vessel.

The arrangement of the electrical equipment throughout the Vessel shall be such as to provide ready and safe access to all parts required inspection, maintenance and repair as far as practicable.

All electrical equipment and cable shall be so located that as far as practicable it is not exposed to risk of mechanical injury or damage from water, steam, oil or excessive heat. Where unavoidably exposed to such risks, the equipment shall be suitably protected or enclosed.

1.2 SUPPLY SYSTEM

1.2.1 Standard voltage and number of phase

| | |
|---|--|
| Generator | AC 450 V three-phase system |
| Power | AC 440 V three-phase system |
| Heater of large capacity (if fitted) | AC 440 V three-phase system |
| Lighting feeder | AC 100 V three-phase system |
| Lighting branch circuit | AC 100 V single-phase system |
| Emergency light | AC 100 V single-phase system |
| Interior communication | AC 100 V single-phase and /or DC 24 V system |
| Navigation equipment | AC 440 V three-phase and AC 100 V three-phase and/or AC 100 V single-phase system and/or DC 24 V system |
| Radio equipment | AC 100 V single-phase and/or DC 24 V system |

Small appliance motors such as refrigerators and drinking water fountains, and small heating apparatus may be connected to the 100 V system instead of the 440 V system.

Emergency AC 100 V system in this Specification is used as the meaning of the power source supplied from main generators by way of the AC 100 V feeder panel in normal condition or emergency generator in case of malfunction of main generators via the AC 100 V system of the emergency switchboard.



1.2.2 Standard frequency

A frequency of 60 Hertz (Hz) shall be applied for AC power supply system.

1.2.3 Wiring

The wiring shall be of three-wire insulated system for AC three-phase circuit, and of two-wire insulated system for AC single phase and DC circuits.

All systems shall be insulated from hull throughout the vessel except earth detecting circuits, secondary circuits of potential and current transformers, and necessary circuits of electronic equipment may be earthed at the switchboard, panels or equipment.

1.3 ENVIRONMENT CONDITION

Electrical equipment shall operate satisfactorily under all conditions with the vessel at the following conditions from the normal.

| | | |
|---------------------|--|---------|
| Ambient temperature | 0 ~ 45°C for closed spaces by designing condition for spaces above 45°C or less than 0°C. -25°C ~ 45°C for on weather decks | |
| Inclination of ship | Transversely | : 22.5° |
| | Rolling | : 22.5° |
| | Longitudinally | : 10° |
| | Pitching | : 10° |

1.4 FUSE

Where fuses are used for circuit overcurrent protection, cartridge non-renewable type approved by the Classification Society shall be installed.

Special type fuses for electronic equipment shall be manufacturer's standard type.



1.5 MARK, ARRANGEMENT OF BUS BAR AND CONNECTION

Bus bar and connection of electrical equipment shall be clearly marked with the following lettering or colours, and shall be arranged as follows :

1.5.1 AC system

| <u>Source side</u> | <u>Load side</u> | <u>Colour</u> | <u>Arrangement</u> | | |
|--------------------|------------------|---------------|--------------------|--------|-------|
| Phase R | Phase U | Red | Left | Top | Front |
| | | | ↓ | ↓ | ↓ |
| Phase S | Phase V | White | | | |
| | | | ↓ | ↓ | ↓ |
| Phase T | Phase W | Blue | Right | Bottom | Back |

1.5.2 DC system

| <u>Pole</u> | <u>Colour</u> | <u>Arrangement</u> | | |
|--------------|---------------|--------------------|--------|-------|
| Positive (+) | Red | Left | Top | Front |
| Negative (-) | Blue | Right | Bottom | Back |

1.6 TEST

1.6.1 General

All electrical equipment, in general, shall be carried out the shop and/or onboard tests according to the requirements of the Classification Society and/or the Builder's standard.

After installations onboard are finished, all electrical equipment shall be tested, and shall be demonstrated their satisfactory operation and conditioned by the procedure mentioned below.

As for the tests of electrical equipment on sea trial, refer to the description in
I - GENERAL PART.



1.6.2 Shop test at manufacturer's work

(1) Generator and vital motor

Temperature test

Characteristic test

Over speed test

High voltage test

Insulation resistance test

After the above tests have been finished, generator shall be sent to the prime mover manufacturer, coupled to it's own prime mover and tested according to the test schedule for the prime mover.

(2) Switchboard

Temperature test

High voltage test

Insulation resistance test

Function test

(3) Other electrical equipment

In general, electrical equipment for which there are no applicable requirements of the Classification Society shall be tested according to manufacturer's standard.



1.6.3 Test on board

(1) Circuit

Electric circuits insulated from earth except interior communication and low voltage circuits shall be thoroughly measured their insulation to earth by DC 500 V megger and recorded together with the resistance values.

(2) Generating set and associated switchboard

Insulation resistance test

Generating sets and associated switchboard shall be carried out the following confirmation test applying water load (Power Factor : 1.0).

Individual running test

Parallel running test

(3) Motor

Motors shall be demonstrated to direction of rotation and speed, prior to sea trial or in port according to the machinery side schedule.

(4) Navigation equipment

Navigation equipment shall be tested or calibrated on sea trial or in port.

(5) Other electrical equipment

Other electrical equipment shall be demonstrated in satisfactory operation before delivery.



1.7 COLOUR OF ELECTRIC EQUIPMENT

Bare metal surfaces of electric equipment shall be painted with rustproof paint and finishing paint, except those specially treated and rendered corrosion free or corrosion resistant materials may be left without paint.

Standard colour scheme of finishing paints for electrical equipment metal surfaces shall be as follows :

| Equipment | Munsell No. Hue value/chroma | Colour |
|---|---------------------------------|------------------|
| Generators Motors Switchboard Group starter panels Wheelhouse group panel Panel boards Other Panels Starters Transformers Switch boxes | 7.5BG 7/2 | Light blue green |
| Equipment for emergency operation | 5R 4/13 | Red |

Lighting fixtures, interior communication equipment, navigation equipment, radio equipment and some of equipment for emergency operation shall be painted in accordance with manufacturer's standard.



SECTION 2 ELECTRIC SOURCE

2.1 GENERAL

The generating plant shall consist of three (3) 600 kVA (480 kW) main diesel generators and one (1) 90 kVA (72 kW) emergency diesel generator.

The number of generators in operation shall be as follows :

| Ship's condition | Number of generator |
|--|-----------------------------|
| Normal sea going | Diesel generator × 1 set |
| Maneuvering (Entering into port and departing from port) | Diesel generator × 2 sets |
| Unloading and loading in port | Diesel generator × 3 sets |
| Rest in port | Diesel generator × 1 set |
| At emergency | Emergency generator × 1 set |

Above determined generator capacity and combination of each ship's condition shall be calculated in compliance with “ ELECTRIC POWER TABLE ” .

AC 100 V system shall be supplied through 450/105 V transformer.

The capacity of the emergency generator shall be sufficient to supply the emergency power according to the requirements of the 1974 SOLAS Convention (including 2000 Amendment).



2.2 MAIN DIESEL GENERATOR

Generators shall be installed in engine room with their shafts in a fore and aft direction of the vessel.

2.2.1 Particulars of generator

| | |
|-----------------|--|
| Number of set | 3 sets |
| Rated output | 600 kVA (480 kW) |
| Speed | 900 min ⁻¹ |
| Frequency | 60 Hz |
| Number of phase | 3 ϕ |
| Power factor | 0.8 (Lagging power factor) |
| Rating | 100 % loading continuous |
| Voltage | AC 450 V |
| Type | Horizontal, synchronous and revolving field type |
| Enclosure | Enclosed drip proof |
| Cooling | Self-ventilated |
| Exciter | Brushless type |
| Insulation | Class F |

Other particulars of the main diesel generators shall comply with the manufacturer's standard.

2.2.2 Bearing and lubrication

Each generator shall have one (1) bearing of end bracket type.
The bearing shall be of sleeve type with oil ring self lubrication.

A rod thermometer shall be provided for bearing, and a sight glass shall be provided for each generator.



2.2.3 Characteristics

Characteristics of main diesel generators shall be able to run in parallel.

Exciting system of the generator shall be of static exciter type.

Exciting system for static exciter consisting of current transformer, silicon rectifier and other necessary fittings according to manufacturer's standard shall be installed on the generator.

The voltage regulation of the generators with their voltage regulator shall be such that at all loads from zero (0) to full load, the voltage at rated power factor is maintained under steady condition within ± 2.5 % of the rated voltage.

The maximum voltage drop shall not exceed 15 % when a current equal to 80 % of full load current at any power factor between zero (0) and 0.4 lagging is suddenly drawn .

The voltage shall be restored to within -3 % of the final steady voltage within 0.6 second.

2.2.4 Space heater

A space heater of suitable capacity shall be installed in each generator frame to prevent the condensation of moisture when the generator stops.

The heaters shall be supplied from AC 100V system in the main switchboard.

2.2.5 Governor motor

An efficient governor motor shall be installed on each prime mover for adjusting its speed.

The governor motors shall be controlled from the main diesel generator circuit through control switches on the main switchboard.

2.2.6 Prime mover

Refer to the description in **III - MACHINERY PART**.



2.2.7 Automatic control of diesel generator

- (1) Remote starting of diesel generator and automatic starting of stand-by diesel generator

Remote control starting apparatus for the diesel generator engine shall be installed on main switchboard. Starting push button switches shall be installed on the main switchboard.

After pressing the push button switches, the diesel engine shall be subsequently started by compressor air.

1st stand-by generator shall be started automatically when the main bus of the main switchboard becomes no-voltage.

If 1st stand-by generator is not started normally, 2nd stand-by generator shall be started automatically.

As for detail of this system, refer to the description in **III - MACHINERY PART**.

- (2) Automatic operation of synchronizing apparatus

Not fitted

- (3) Automatic power and frequency control

Not fitted



2.3 EMERGENCY GENERATOR

Emergency generator shall be installed in emergency generator room.

The emergency generator shall be automatically started in case of failure of main power supply and shall be manually stopped at machine side when main power supply is restored after a blackout.

The emergency generator shall not be able to operate in parallel with main generators.

2.3.1 Particulars of emergency generator

| | |
|-----------------|---|
| Number of set | 1 set |
| Rated output | 90 kVA (72 kW) |
| Speed | 1,800 min ⁻¹ |
| Frequency | 60 Hz |
| Number of phase | 3 ϕ |
| Power factor | 0.8 (Lagging power factor) |
| Rating | 100 % load continuous |
| Voltage | AC 450 V |
| Type | Horizontal, synchronous and revolving field type |
| Enclosure | Enclosed drip proof |
| Cooling | Self-ventilated |
| Exciter | Brushless type |
| Insulation | Class F |

Other particulars of the emergency generator shall comply with the manufacturer's standard.

2.3.2 Space heater

A space heater of suitable capacity shall be installed in the generator to prevent the condensation of moisture when the generator stops.

The heater shall be supplied from emergency AC 100 V system in the emergency switchboard.

2.3.3 Prime mover

The prime mover of the generator shall be of air cooled diesel engine and cell motor starting.



2.4 STORAGE BATTERY

2.4.1 Emergency battery

One (1) set of storage battery shall be installed in battery room for the low voltage interior communication and navigation system.

Particulars of the battery shall be as follows :

| | |
|---------------|-----------------------------------|
| Capacity | 200 Ah at 10 hours discharge rate |
| Rated voltage | DC 24 V |
| Type | Lead acid type (SS-200) |

2.4.2 Radio battery

Refer to the description in **SUBSECTION 10.2 MF/HF RADIO INSTALLATION.**

2.4.3 Emergency generator starting battery

Two (2) sets of storage battery shall be installed in emergency generator room for starting of the emergency generator.

Particulars of each battery shall be as follows :

| | |
|---------------|-----------------------------------|
| Capacity | 150 Ah at 20 hours discharge rate |
| Rated voltage | DC 24 V |
| Type | Lead acid type (N-150) |

The battery boxes for above storage batteries shall be made of FRP.



2.5 TRANSFORMER

Transformers for supplying electric power to lighting, small power equipment, communication, etc. shall be installed.

Each transformer shall be of dry type, natural air-cooled and drip proof construction and class H insulation, and located in dry space free avoiding from dripping water and moisture.

Transformers shall be rated as follows :

- (※) 1 - Three-phase bank consisting of three (3) 25 kVA 450/105 V single-phase transformers in a common box for regular lighting, small power equipment, communication, etc., installed in engine room.
- 1 - 7.5 kVA 440/105 V single-phase transformer for the Suez canal searchlight, lighting and floodlights on fore part of weather deck, installed in boatswain store.
- 1 - 10 kVA 440/105 V single-phase transformer for lighting and floodlights on middle part of weather deck, installed in deck crane house.
- 1 - 10 kVA 440/105 V single-phase transformer for lighting and floodlights on after part of weather deck, installed in deck crane house.
- (※) 1 - Three-phase bank consisting of three (3) 7.5 kVA 450/105 V single-phase transformers for emergency service in emergency generator room.

Three (3) sets of single-phase transformers shall be connected in \triangle - \triangle .

When one (1) transformer is out of service, the other two (2) transformers connected in V - V shall be able to supply necessary power under load control.

The transformer marked (※) shall have each one or more glands per one phase for primary and secondary cable respectively.



SECTION 3 DISTRIBUTION EQUIPMENT

3.1 GENERAL

One (1) main switchboard shall be provided for main generator control and power distribution.

Panel boards shall be provided in suitable positions for supply of power to the various power, heating, lighting, communication and navigation equipment circuit throughout the Vessel.

Each distribution circuit, in general, shall be protected against over-current and short circuit current by a moulded case circuit breaker with inverse time delay over-current trip and instantaneous trip devices fitted on the switchboard or panel board.

The circuit breakers, whose interrupting capacity is less than the maximum possible short circuit current at the point of installation, shall be backed up by a moulded case circuit breaker or current limiting fuses of suitable interrupting capacity and rating.

Back up moulded case circuit breakers shall have instantaneous trips only, but the back up breakers used as feeder breakers shall also have inverse time delay over-current trip.

Insulation mat shall be provided in front and rear side of main switchboard and group starter panel in the engine control room.



3.2 MAIN SWITCHBOARD

3.2.1 General

The main switchboard shall be installed in engine control room, and shall consist of three (3) generator panels, generator operation panel, 440 V feeder panel, 100 V feeder panel and group starter panel.

The main switchboard bus bars shall be subdivided into two (2) parts which shall normally be connected by the disconnecting device except for bolted links.

3.2.2 Installation and construction

The main switchboard shall be of dead front box frame construction, and shall have hinged front panels that can be opened without disturbing the meters, pilot lamps, etc. mounted on them.

The both sides of the main switchboard shall be protected by sheet steel plated, and the rear side shall have removable sheet steel covers so that it may be inaccessible to other than qualified persons.

Non-conducting hand rails at the front and the rear shall be provided.

Each circuit on the board shall be distinctly marked by engraved resin make label giving the name of each circuit, size of circuit breaker element and cable size.

Breakers, switches, etc. shall be arranged so that they may be easily manipulated.



3.2.3 Fitting part

(1) Generator air circuit breaker

Circuit breakers for generators shall be of motor charging operated trip free air circuit type having long time delay trip, short time delay trip, instantaneous over-current trip and under voltage trip features.

Each circuit breaker shall be provided with necessary interrupting capacity against short circuit current.

(2) Feeder circuit breaker

Feeder circuits emanating from feeder panels of the main switchboard shall be protected by moulded case circuit breakers with inverse time delay thermal trip and instantaneous magnetic trip features.

At least two (2) circuit breakers of 100 A frame size, one (1) is for 440 V feeder and the other is for 100 V feeder, shall be reserved as the spare for the main switchboard.

(3) Meter

Voltmeters, ammeters, wattmeters, etc. shall be of class 1.5 (error : within 1.5 % of full scale) and marked with a red line on their respective scales indicating rated value on circuit or machinery to which they are connected.

Voltmeters shall be calibrated up to about 120 % of their rated value and ammeters up to about 130 %.

Wattmeters shall be capable of indicating 15 % reverse power.

(4) Fuse

Control and instrument circuits shall be protected by fuses except circuits where the opening of the fuse might introduce a hazard in operation, such as circuit breaker tripping control circuits.



(5) Pilot lamp

Globe colours of pilot lamps shall be designed to indicate operating conditions of the basis of the following :

| | | |
|-------------|---|-----------------------------|
| Milky white | : | Power device |
| Red | : | Air circuit breaker “ OFF ” |
| | | Shore power “ ON ” |
| Orange | : | Space heater “ ON ” |
| Transparent | : | Synchronizing lamp |
| Green | : | Air circuit breaker “ ON ” |

(6) Bus bar

All bus bars shall have sufficient current capacity for continuous operation, and provision shall be made for withstanding mechanical strains caused by electromagnetic force of large motor starting current or short circuit current.

All bus bars shall be made of commercial copper, and shall be provided with silver surfaced contacts.

Bus supports shall be of moisture resistant and laminated phenolic material.

(7) Wiring

The type of wiring of instrument and control circuit shall be as follows :

660 V single core heat - resisting polyvinyl chloride insulated control wires
(Type SYP 75°C)

660 V single core heat - resisting cross linked polyethylene insulated flexible wires (Type SCP 85°C)



3.2.4 Generator panel

Each generator panel shall be provided with the following devices :

- 1 - Three-pole air circuit breaker
- 1 - Relay for preference tripping system
- 1 - Reverse power relay

Meter and switch :

- 1 - Voltmeter with change over switch to read the each phase voltage and one phase voltage of main bus
- 1 - Ammeter with change over switch to read the current of phase of the generator
- 1 - Set of automatic voltage regulator with voltage adjuster

Shore power shall be read with one set of each kind meters (Voltmeter and Ammeter).

Indicator lamp :

- 1 - Space heater indicator lamp for the generator
- 1 - Generator running indicator lamp
- 2 - Air circuit breaker indicator lamp : each one (1) for “ON” and “OFF”

Preferential tripping system shall be arranged so that the generator or generators become over-current, the following auxiliaries shall be interrupted and essential service shall be maintained by generator which shall be remained in operation.

Air conditioning refrigerating machine,
Air conditioning supply fan,
Hydraulic oil pump for deck machinery,
Ballast pump,
Bilge & ballast pump,
and other non-essential auxiliaries, if necessary

Preference tripping shall be set at about 105 % expressed as a percentage of the rated current of the generator.



3.2.5 Generator operation panel

Generator operation panel shall be provided with following devices :

Meter and switch :

- 3 - Three-phase wattmeter
- 1 - Frequency meter for generator with generator select switch
- 1 - Frequency meter for bus with “BUS - OFF - SHORE” select switch
- 1 - Synchroscope with change over switch to indicate phase difference between generator and bus
- 1 - Set of synchronizing lamps (Total 3 lamps)
- 3 - Governor control switch
- 3 - Air circuit breaker control switch
- 3 - Diesel generator stand-by select switch
- 3 - Diesel generator start push button switch with running indicator lamp
- 3 - Diesel generator stop push button switch
- 1 - Control mode “MANUAL - AUTO” change over switch
- 1 - Lamp test switch

Indicator lamp :

- 3 - Diesel generator “READY TO START” indicator lamp
- 3 - Diesel generator “1ST STAND-BY” indicator lamp
- 3 - Diesel generator “2ND STAND-BY” indicator lamp
- 1 - Emergency generator “RUN” indicator lamp
- 1 - Emergency generator “STAND-BY” indicator lamp
- 1 - DC 24 V control power source indicator lamp



3.2.6 440 V feeder panel

The 440 V feeder panel shall be provided with the following devices and instruments :

Required number - Three-pole moulded case circuit breaker for AC 440 V load

1 - Three-pole moulded case circuit breaker for shore power

The circuit breaker shall be interlocked with the main generator circuit breakers to prevent paralleling.

1 - Shore power pilot lamp

1 - Insulation resistance meter for earth monitor

3.2.7 100 V feeder panel

The 100 V feeder panel shall be provided with the following devices and instruments :

Required number - Three-pole moulded case circuit breaker for AC 100 V load

1 - Ammeter for reading each phase of power transformer secondary circuit

1 - Voltmeter for reading each phase of power transformer secondary circuit

1 - Insulation resistance meter for earth monitor

3.3 PANEL BOARD

All panel boards shall be of metal cases with front door, and in general shall be of drip proof wall mounted type.

The panel board shall be provided with two-pole or three-pole moulded case circuit breaker of plug-in type to protect each branch circuit.

The panel board shall have paper name plates with a vinyl case on the rear side of the front door giving name of each circuit, size of circuit breaker element and cable size.

The panel board for electric equipment of wheelhouse shall be included in wheelhouse group panel installed in wheelhouse.

Refer to the SUBSECTION **8.8 WHEELHOUSE GROUP PANEL**.



3.4 EMERGENCY SWITCHBOARD

One (1) emergency switchboard shall be installed in the emergency generator room.

The emergency switchboard shall be energized from the main switchboard while main generator is in normal operation.

And once the emergency switchboard bus bar become no-voltage, the emergency switchboard shall be recovered electric source by the emergency generator.

The emergency switchboard shall be provided with the following devices and instruments.

3.4.1 Generator panel

- 1 - Air circuit breaker
- 1 - Ammeter with a change over switch
- 1 - Voltmeter
- 1 - Three-phase wattmeter
- 1 - Frequency meter
- 1 - Generator engine running indicator lamp
- 1 - Air circuit breaker indicator lamp : "ON"
- 1 - Air circuit breaker indicator lamp : "OFF"
- 1 - Space heater "ON" indicator lamp
- 1 - Set of automatic voltage regulator with voltage adjuster
- 1 - Indicator lamp for power supply from M.S.B.
- 1 - Test switch for periodic testing for emergency generator system
- 1 - Change over switch for voltmeter and frequency meter

For emergency generator starting battery :

- 1 - Charge voltage controller
- 1 - DC voltmeter
- 1 - DC ammeter
- 1 - "TRICKLE" or "QUICK" charge select switch
- 1 - Charge power indicator lamp



3.4.2 440 V feeder panel

Required number - Three-pole moulded case circuit breaker

3.4.3 100 V feeder panel

Required number - Three-pole moulded case circuit breaker

- 1 - Ammeter for reading each phase of power transformer secondary circuit with a change over switch
- 1 - Voltmeter for reading each phase of power transformer secondary circuit with a change over switch
- 1 - Insulation resistance meter for earth monitor

3.4.4 Feeder circuit for electric apparatus

The following electric apparatus shall be fed from the main supply on the normal condition and when the main supply fails, they shall be automatically fed from the emergency supply.

As for emergency lighting, refer to the description in SUBSECTION **7.7 EMERGENCY LIGHTING**.

a) AC 440 V apparatus

No.1 steering gear
Emergency fire pump
~~High expansion foam liquid pump~~
Em'cy air compressor
Battery charging and discharging panel
Free fall life boat davit winch
~~Em'cy generator room exhaust fan~~

b) AC 100 V apparatus

MF/HF radio installation
Nautical and intercommunication equipment
Navigation light
Emergency light
Instrument and alarm system



3.5 BATTERY CHARGING AND DISCHARGING PANEL

3.5.1 Emergency battery

One (1) battery charging and discharging panel shall be of the dead front construction and floor mounted type, and shall be installed in electric room.

The battery charging shall be floating charge system and the battery shall be kept at a highly charged condition at all times except immediately after discharge.

Manual boost charging facility is also included.

The panel shall be supplied from emergency AC 440 V three-phase system and provided with the following devices and instruments :

- 1 - 30 A silicon rectifier
- 1 - Silicon dropper
- 1 - Transformer
- 1 - Pilot lamp for charge source
- 1 - Voltmeter with change over switch to read the voltage of battery side and load side
- Each 1 - Ammeter to read the current of charging side and load side
- 1 - Disconnecting switch for charge source
- 1 - Charge voltage controller
- 1 - Set of earth detecting lamps with test switch for checking DC 24 V system
- Required number - Two-pole moulded case circuit breaker for 24 V load
- Required number - Fuse

The silicon rectifier shall be of dry and natural cooling type.

3.5.2 Radio battery

Refer to the description in SUBSECTION **10.2 MF/HF RADIO INSTALLATION**.



3.6 SHORE CONNECTION BOX

One (1) 440 V shore connection box shall be of wall mounted drip proof of metal cabinet type with front door, and shall be installed in **emergency generator room**.






The box shall be provided with the following devices :

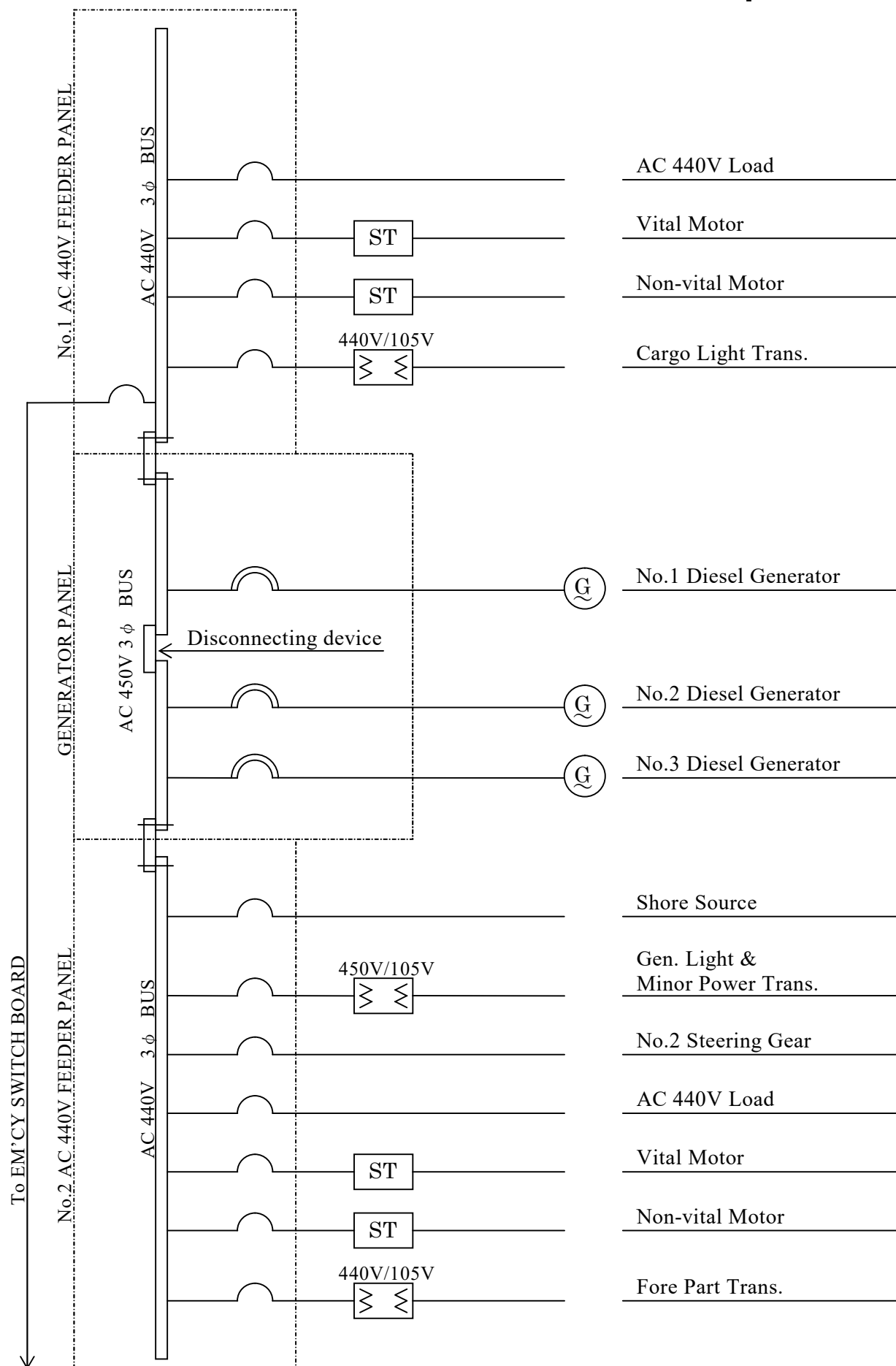
- 1 - Three-pole 400 A frame 400 A element moulded case circuit breaker
- 1 - Phase sequence indicator consisting of two (2) lamps
- 1 - Set of terminals for 440 V three-phase shore power cable

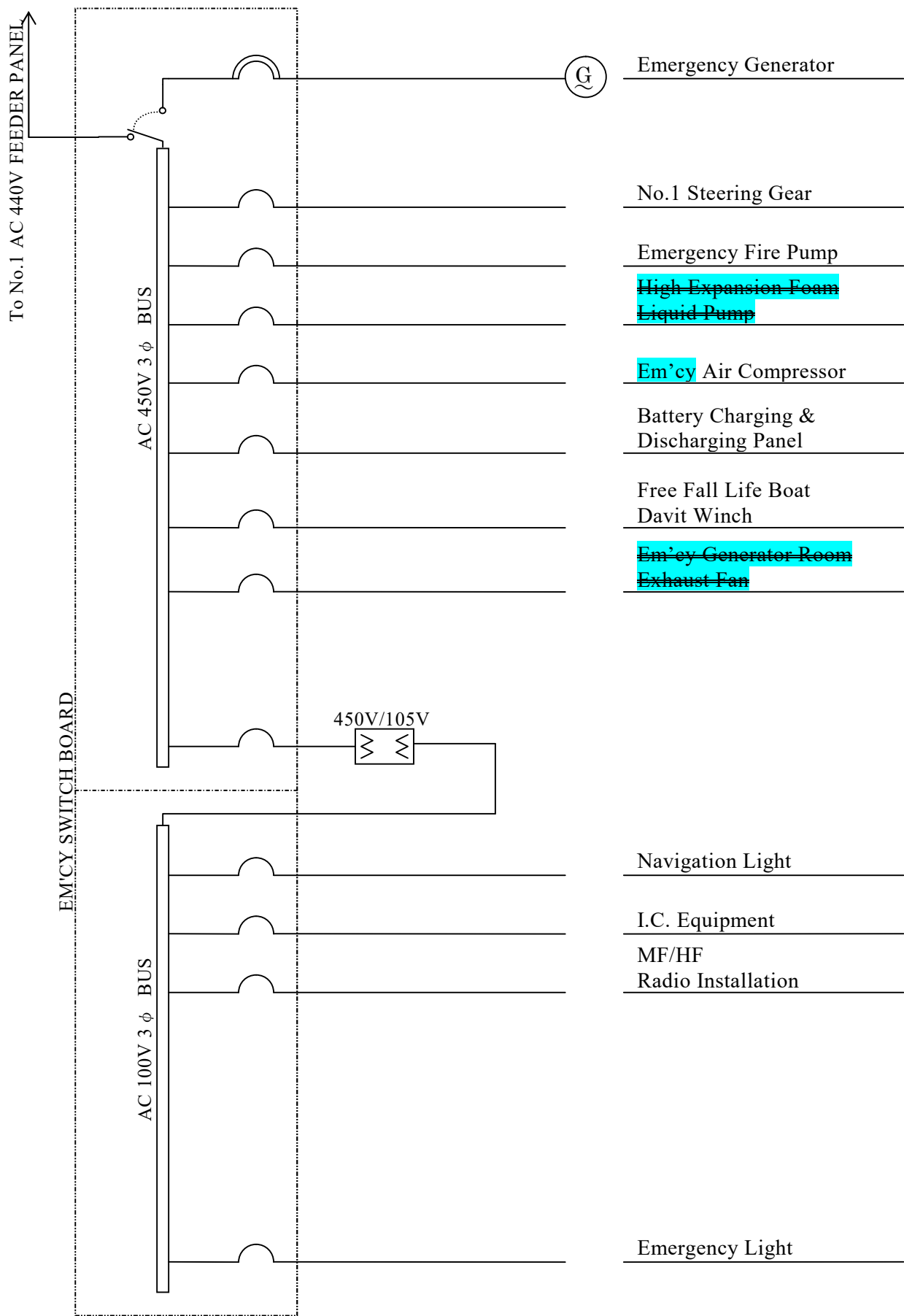
3.7 ELEMENTARY DIAGRAM OF MAIN DISTRIBUTION

Refer to the next page.

Abbreviation and symbol in this diagram shall be as follows :

| | |
|---|-----------------------------|
|  | A.C. generator |
|  | Air circuit breaker |
|  | Molded case circuit breaker |
|  | Transformer |
|  | Starter |







SECTION 4 ELECTRIC CABLE AND INSTALLATION

4.1 GENERAL

All cables throughout the Vessel shall be of JIS (Japanese Industrial Standard) or equivalent standard without flammability criteria of IEC 60332-3 Category A.

Installation method for preventing propagation of fire on electric cables which approved by the Classification Society shall be carried out.

All cables shall be installed in compliance with the requirements of the Classification Society.

4.2 CABLE APPLICATION

The type of cables throughout the Vessel shall be selected in compliance with the following table to match to their locations.

| Cable location or purpose | Type of cable |
|---|--|
| Main distribution and general use except mentioned below | PYC |
| Part exposed directly to weather, refrigerating provisions chamber and battery room | PYCY |
| Portable fixtures in living quarters | Y insulated Y sheathed flexible cord |
| Portable fixtures and appliance outside living quarters | P insulated N sheathed flexible cord |
| Electronic apparatus circuit etc. | PYC or TTYC |
| General use in living quarters | PYC or PY |
| Microphone circuit, echo sounder, etc. | PYCS |



Remarks :

(1) Abbreviations

Insulation (First letter)

| | | |
|----|---|---|
| P | : | EP rubber |
| Y | : | Polyvinyl chloride |
| SR | : | Silicone rubber |
| TT | : | Telephone and instrumentation use (Polyvinyl chloride insulated) |
| FR | : | Fire resisting type in accordance with IEC 60331 |

Sheath (Second letter)

| | | |
|---|---|---------------------------|
| Y | : | Polyvinyl chloride sheath |
| L | : | Lead sheath |
| N | : | Chloroprene sheath |

Armoring (Third letter)

| | | |
|---|---|------------------|
| C | : | Steel wire braid |
|---|---|------------------|

Protective covering (Fourth letter)

| | | |
|---|---|--------------------|
| Y | : | Polyvinyl chloride |
| S | : | Shield |

- (2) In general, flexible cords for portable fixture shall be provided with an earth continuity conductor, which shall be effectively connected to the earth terminal of the receptacle.
- (3) Special cables such as compensating cables, shield cables, coaxial cables, etc. shall be used where necessary.



4.3 CABLE INSTALLATION

4.3.1 General

Cables shall be located so as to avoid spaces where excessive heat and moisture may be encountered.

Cables which are liable to be exposed to mechanical damage shall be protected by suitable means.

Wiring throughout the Vessel shall be carefully arranged to eliminate fire risks.

4.3.2 Cable support

Cables shall be supported on metal hangers placed with the clear from steel hull structures to permit painting except that cables may be installed directly on wooden walls or other non-rusting materials on which painting shall not be necessary for maintenance. Material of all cable hangers shall be of steel with corrosion resistant finish.

Cables shall be secured with steel hoops and steel buckles, except that cables shall be secured with stainless steel hoops and buckles on the exposed weather part and in the refrigerated provisions chambers.

Where cables pass through watertight decks or bulkheads, coaming with compound for cable penetration shall be employed.

Where cables pass through non-watertight bulkheads, beams or girders, suitable consideration shall be paid not to damage the cables.

Where cables pass through non-watertight decks, coaming for cable penetration may be used.

Where cables penetrate through fire protection divisions, the sealing material approved by the Classification Society should be applied.



4.3.3 Cable installation

Cables in accommodation, where lining panel is applied over the hull structures, shall be concealed as far as practicable.

The cables shall not be embedded in structural insulation.

If the cables are exposed in the rooms of all cabin, they shall be covered.

In general, the cables in engine room, locker room, etc. shall be exposed.

Branch cable way for the fore mast shall be protected by galvanized steel pipes up to a suitable height above the deck.

4.3.4 Cable and wire connection

All cables connected to the electric machinery shall be terminated at the proper terminals and/or plug/socket type cable connectors.

In addition, spring loaded type cable connectors shall be used for lighting fixtures and wiring fixtures such as junction boxes, etc.



SECTION 5 POWER EQUIPMENT

5.1 GENERAL

In general, the Specification described in this section shall be applied to motors, their controls and other power equipment made by the manufacturers decided in “**LIST OF SELECTED PRINCIPAL MANUFACTURERS**” .

The household service motors, motors attached to machines and their control equipment shall be constructed in accordance with manufacturer’s standard.

5.2 MOTOR

5.2.1 General

All motors shall be squirrel cage induction motors of International Electrotechnical Commission Standard Frame designed for AC 440 V three-phase 60 Hz, except the motors of 0.4 kW rating and less may be of AC 100 V single-phase or three-phase type.

All motors shall be rated for continuous duty unless otherwise specified.

5.2.2 Enclosure

In general, as regards enclosure application for each motor, refer to **5.2.a Application for enclosure and insulation class**.

Motors located on weather deck shall be of totally enclosed waterproof type except accommodation ladder and pilot ladder motor installed in a steel box, if provided.

5.2.3 Insulation

In general, as regards insulation application for each motor, refer to **5.2.a Application for enclosure and insulation class**.

However, application for enclosure and insulation class of motors with which the machinery and equipment are mounted shall be in compliance with the manufacturer’s standard.



5.2.a Application for enclosure and insulation class

TE : Totally enclosed with or without fan cooled
 EVDP : Enclosed ventilated drip proof
 B : Insulation class B
 F : Insulation class F

| Pole Output (KW) | 2P | 4P | 6P | 8P | Remarks |
|------------------------|---------|---------|---------|---------|---------|
| 0.4 | TE, B | TE, B | TE, B | TE, B | |
| ↓ | | | | | |
| 11 | | | | ↓ | |
| 15 | | | ↓ | TE, F | |
| 18.5 | | | TE, F | | |
| 22 | ↓ | ↓ | | | |
| 30 | TE, F | TE, F | | ↓ | |
| 37 | | | | EVDP, F | |
| 45 | | | ↓ | | |
| 55 | ↓ | ↓ | EVDP, F | | |
| 75 | EVDP, F | EVDP, F | | | |
| ↓ | ↓ | ↓ | ↓ | ↓ | |



5.2.4 Bearing

All motors shall be provided with ball bearing of international size.

For vertical motors, thrust bearing shall be fitted to take thrust in both directions.

Radial ball bearings may be deemed as thrust bearing provided they can take thrust for the expected service.

5.2.5 Lubrication

Lubrication of large capacity motors with open ball bearings shall be by means of pin type grease nipples.

Where grease nipples and relief plugs on the motors are inaccessible, they shall be extended by means of pipes so as to make them accessible.

The bearings shall be of the type designed to prevent leakage of grease to the motor windings.

For medium and small capacity motors, according to the manufacturer's standard, the bearings shall be of prelubricated ball bearing type.

Grease shall be in accordance with motor's manufacturer's standard.

5.2.6 Terminal box

All motors shall be provided with waterproof terminal boxes of cast iron or steel plate construction with gland and removable cover.

The terminal box shall contain solderless terminals of suitable size secured on an insulating board facilitating connection of cable.

5.2.7 Space heater

In general, space heater for motors shall not be provided.

If provided, abbreviation "SH" for space heater shall be described in **SUBSECTION 5.5 LIST OF MOTOR AND CONTROL.**



5.3 MOTOR CONTROL

5.3.1 General

(1) Starting system

All controls shall be magnetic type except that starters for non-essential motors of 0.5 kW rating and less may be manually operated by moulded case circuit breakers only.

In general, the starter shall be of the across-the-line type.

When the across-the-line starting of large motor causes running motors or the control relays to drop out due to the voltage drop occasioned by the starting current, the starters shall be of reduced voltage type.

(2) Construction

Starters located in engine room, in general, shall be assembled in a suitable number of group starter panels, and the other starters shall be of individual starter type.

(3) Low voltage feature

All controls except for non-essential motors of 0.5 kW rating and less shall be provided with low voltage protection or release features.

Steering gear motors, essential service motors and motors operated automatically shall be provided with low voltage release feature to permit the restarting automatically of these motors on restoration of power.

The others shall be provided with low voltage protection.

As regards low voltage feature application for each motor,
refer to **SUBSECTION 5.5 LIST OF MOTOR AND CONTROL**.

(4) Over-current protection

An ambient-compensated over-current relay of thermal type with two (2) current elements shall be provided for each starter.

The relay shall be of manual resetting type with a reset switch operated at inside of starter cabinet, except automatic resetting type for over-current alarm of steering gear motors.



(5) Potential of control circuit

The potential of control circuits, in general, shall be 440 V.

However for magnet valves, thermostats, complicated master switches, etc. which are not practicable to operate on 440 V, 110 V shall be employed by means of potential transformers.

(6) Line disconnecting switch

A three-pole disconnecting switch of outside operating type shall be provided for each starter.

Where the starter is situated near the switchboard or panel board to which the circuit is connected, the disconnecting switch may be omitted.

For group starter panel, this switch shall be moulded case circuit breaker which function both disconnecting means and motor branch circuit short circuit protective device.

(7) Master switch

Start and stop master switch, in general, shall be mounted on the front door of starter.

Where the starter is remote from the motor (out of sight of the motor), a local start and stop master switch shall be provided near the motor except for ventilating fan motors.

On the local master switch near the motor, provision shall be made for locking "OFF" position.



5.3.2 Group starter panel

The group starter panels shall be of dead front floor mounted or wall mounted type according to the size and/or the location.

The starter for each motor shall be built into a non-draw-out type enclosed metal cubicle with a hinged door, in such manner, the troubles in any cubicles shall not extend to the others and any cubicles may be repaired and/or checked safely with energizing the adjacent cubicles.

The starter arrangements shall be of front mounted type.

Each starter, in general, shall consist of the following components :

- Three-pole moulded case circuit breaker
- Three-pole magnetic contactor
- Thermal type over-current relay
- Start and stop master switch
- Running indicating light
- Source indicating light

5.3.3 Individual starter

Individual starters shall be mounted in drip proof sheet steel cabinets wall mounted or floor mounted type according to the size.

Each starter, unless of moulded case circuit breaker type starters, shall consist of the following components :

- Three-pole line disconnecting switch, unless otherwise specified
- Three-pole magnetic contactor
- Thermal type over-current relay
- Start and stop master switch
- Running indicating light
- Source indicating light



5.3.4 Emergency stop switch

In order to prevent the spread of fire, an emergency stop switch for engine part shall be provided for the following motors and located in the passage or changing room on the upper deck outside of the engine room and in fire station.

Engine room ventilating fan
 Fuel oil transfer pump
 Diesel oil transfer pump
 Lubricating oil transfer and lubricating oil purifier supply pump
 Fuel oil purifier
 M/E fuel oil circulating pump
 Fuel oil booster pump
~~Boiler marine gas oil burning pump~~
 Boiler MGO/HFO burning pump
 Boiler forced draft fan
 M/E auxiliary blower
 Package air conditioner
 (Engine control room)
 Incinerator
 Diesel generator fuel oil circulating pump
 Diesel generator diesel oil booster pump
 Main lubricating oil pump
 Lubricating oil purifier
~~Lubricating oil purifier supply pump~~
 Stern tube lubricating oil pump
 Diesel generator lubricating oil purifier
 Diesel generator lubricating oil purifier supply pump
 Motor for M/E hydraulic system
 Fuel oil shifter pump

In order to prevent the spread of fire, an emergency stop switch for deck part shall be provided on the wheelhouse group panel and in fire station for stopping the following ventilating fans.

Air conditioning supply fan
 Galley exhaust fan
 Sanitary space exhaust fan
~~Provisions store exhaust fan~~
 Package air conditioner
 (Galley)



These above switches shall be so located and protected (breakable plastic cover or equivalent) as to prevent unauthorized stopping of the equipment.

Emergency stop push button switch for Bilge pump and sludge pump shall be installed at both side of upper deck.

Emergency stop push button switch for Hydraulic oil pump for deck machinery shall be installed near the local control station.

~~Emergency stop push button switch for Emergency generator room exhaust fan shall be installed near emergency generator room.~~

5.3.5 Special control function

(1) Remote control

For the Steering gear motors, remote start and stop switches shall be installed in wheelhouse.

One (1) of Engine room ventilating fan shall be remotely operated from fire station.

For the Fire & general service pump, remote start and stop switches with running lamp shall be provided on wheelhouse group panel and in fire station.

The Turning gear motor shall have a portable start and stop switch with flexible cord so that the turning gear can be operated from any position inside the crank case and upper part of main engine.

(2) Running indication and stop alarm

Refer to the description in **III - MACHINERY PART.**

(3) Auto start and/or stop

Refer to the description in **III - MACHINERY PART.**



(4) Ammeter

The ammeter shall be provided on the starters in accordance with the motors and fans of 5.5 kW rating or more except manufacture's standard.

Furthermore, the ammeter shall be provided on each starter for M/E F.O. pump, M/E L.O. pump, D/G F.O. or D.O. pump, D/G water pump and S/T L.O. pump irrespective of motor capacity.

The ammeters shall be of class 2.5 (error : within 2.5 % of full scale) and marked with a red line on their respective scales indicating rated full load current of the motor.

The ammeters shall be calibrated up to about 130 % of their rated value, and furthermore shall have about 200 % extension scales.

5.4 SEQUENTIAL START OF VITAL MOTOR

Vital use motors shall be started sequentially in case of recovery of main bus voltage after the power failure.

5.5 LIST OF MOTOR AND CONTROL

Abbreviation in this list shall be as follows :

| | |
|-------|---|
| EVDP | Enclosed ventilated drip proof |
| TE | Totally enclosed with or without fan cooled |
| TEWP | Totally enclosed waterproof |
| V | Vertical |
| H | Horizontal |
| IND | Individual starter |
| GSP | Starter assembled in group starter panel |
| LVP | Low voltage protection |
| LVR | Low voltage release |
| o | Fitted |
| - | Not fitted |
| MB | Motor breaker |
| SH | Space heater |
| RH | Running hour meter |
| (M) | Pump & etc. manufacturer's supply |

Particulars in this list may be altered according to the manufacturer's standard and progress of detail design of auxiliary machinery by the Builder.

~~Mark (※) in this list means as follows :~~

~~(※1) Remote start/stop from fire station~~

5.5.1 Deck part

| Item | Use | No. of set | Output (kW) | Synchronous min | Type | Control type | Ammeter | Remarks |
|------|---|--------------|----------------|------------------|------------------|----------------------|--------------|-------------------------------------|
| 101 | Steering Gear | 2 | 11 | 1,800 | TE, H | IND, LVR | ○ | 50%×2 No.1: Y-△ Start |
| 102 | Electric Hyd. Oil Pump for Deck Machinery | 2 | 90 | 1,800 | EVDP, V | GSP, LVP | ○ | Y-△ Start SH |
| 103 | | | | | | | | |
| 104 | Pilot Ladder Winch | 2 | 3.7 | 1,800 | (M) | IND, LVP | — | |
| 105 | Accommodation Ladder Winch | 2 | 3.7 | 1,800 | (M) | IND, LVP | — | |
| 106 | Free Fall Life Boat Davit Winch | 1 | 17.3 | 1,800 | (M) | (M), LVP | — | Y-△ Start |
| 107 | Life Raft / Rescue Boat Davit Winch | 1 1 | 8.5 4 | 1,800 — | (M) (M) | (M), LVP (M), LVP | — | SH |
| 108 | Provision Refrigerating Machine | 2 | 3 | 1,800 | (M) | (M), LVP | — | Auto Start/Stop (LVR) |
| 109 | Air Conditioning Refrigerating Machine | 1 | 22 | 1,800 | (M) | (M), LVP | ○ | |
| 110 | Air Conditioning Supply Fan | 1 | 15 | 1,800 | TE, H | (M), LVP | ○ | |
| 111 | Galley Exhaust Fan | 1 | 0.75 | 1,800 | TE, V | IND, LVP | — | |
| 112 | Sanitary Space Exhaust Fan | 2 | 0.4 | 1,800 | TE, V | MB | — | |
| 113 | Provisions Store Exhaust Fan | 1 | 0.4 | 1,800 | TE, V | MB | — | |
| 114 | Provision Crane (2.5 ton) | 1 1 | 7.5 1.5 | 1,800 1,800 | (M) (M) | (M) (M) | — | |
| 115 | Provision Crane (0.9 ton) | 2 2 | 2.2 0.4 | 1,800 1,800 | (M) (M) | (M) (M) | — | |
| 116 | | | | | | | | |
| 117 | Emergency Fire Pump | 1 | 26 | 3,600 | TE, V | IND, LVP | ○ | Y-△ Start (×1) |



| Item | Use | No. of set | Output (kW) | Synchronous min | Type | Control type | Ammeter | Remarks |
|------|--------------------------------------|------------|-------------|-----------------|-------|--------------|---------|--------------------------------|
| 118 | Deck Crane | 4 | 115/270 | 1,800 | (M) | (M) | ○ | SH Cont./15%ED |
| 119 | Oil Cooler Fan for Deck Crane | 4 | 5.5 | 1,800 | (M) | (M) | — | |
| 120 | | | | | | | | |
| 121 | Galley Air Conditioner | 1 | 3.7 | 3,600 | (M) | (M), LVP | — | |
| 122 | | | | | | | | |
| 123 | | | | | | | | |
| 124 | High Expansion Foam Liquid Pump | 1 | 2.2 | 3,600 | (M) | (M), LVP | — | |
| 125 | | | | | | | | |
| 126 | | | | | | | | |
| 127 | | | | | | | | |
| 128 | | | | | | | | |
| 129 | | | | | | | | |
| 130 | | | | | | | | |
| 131 | | | | | | | | |
| 132 | | | | | | | | |
| 133 | Emergency Generator Room Exhaust Fan | 1 | 2.2 | 1,800 | TE, V | IND, LVP | — | Auto Start by E/G start signal |
| 134 | | | | | | | | |



5.5.2 Engine part

| Item | Use | No. of set | Output (kW) | Synchronous min | Type | Control type | Ammeter | Remarks |
|------|---|------------|-------------|-----------------|-------|--------------|---------|--|
| 201 | Turning Gear | 1 | 5.5 | 1,800 | (M) | (M), LVP | ○ | |
| 202 | Main Air Compressor | 2 | 30 | 1,800 | TE, H | GSP, LVP | ○ | Y-△ Start(No.1) Auto Start/Stop(LVR) |
| 203 | Emergency Air Compressor | 1 | 3.7 | 1,200 | TE, H | IND, LVP | — | |
| 204 | Cooling Sea Water Pump | 2 | 55 | 1,800 | TE, V | GSP, LVR | ○ | Auto Change |
| 205 | Main Air Comp. Cooling F.W. Pump | 2 | 1.5 | 3,600 | TE, H | GSP, LVP | — | Auto Start/Stop(LVR) |
| 206 | Jacket Cooling Fresh Water Pump | 2 | 22 | 1,800 | TE, V | GSP, LVR | ○ | Auto Change |
| 207 | Main Lubricating Oil Pump | 2 | 55 | 1,800 | TE, V | GSP, LVR | ○ | Auto Change |
| 208 | | | | | | | | |
| 209 | M/E Fuel Oil Circulating Pump | 2 | 3.7 | 1,200 | TE, H | GSP, LVR | ○ | Auto Change |
| 210 | Fuel Oil Booster Pump | 2 | 1.5 | 1,200 | TE, H | GSP, LVR | ○ | Auto Change |
| 211 | M/E Auxiliary Blower | 2 | 37 | 3,600 | (M) | (M), LVP | ○ | Auto Start/Stop (LVR) |
| 212 | Motor for M/E hydraulic system | 2 | | | | | | |
| 213 | Fuel Oil Transfer Pump | 1 | 5.5 | 1,200 | TE, H | GSP, LVP | ○ | Auto Start/Stop (LVR) |
| 214 | Diesel Oil Transfer Pump | 1 | 2.2 | 1,200 | TE, H | GSP, LVP | — | Auto Start/Stop (LVR) |
| 215 | Lubricating Oil Transfer and Lubricating Oil Purifier Supply Pump | 1 | 1.5 | 1,200 | TE, H | GSP, LVP | — | |
| 216 | | | | | | | | |
| 217 | | | | | | | | |



| Item | Use | No. of set | Output (kW) | Synchronous min | Type | Control type | Ammeter | Remarks |
|------|---|--------------|-----------------|------------------|------------------|---------------------|--------------|---------------------------------------|
| 218 | Fuel Oil Purifier | 2 | 7.5 | 1,800 | (M) | (M), LVP | ○ | |
| 219 | Lubricating Oil Purifier | 1 | 5.5 | 1,800 | (M) | (M), LVP | ○ | |
| 220 | Lubricating Oil Purifier Supply Pump | 1 | 0.75 | 1,200 | TE, H | GSP, LVP | — | Auto Stop |
| 221 | D/G Lubricating Oil Purifier | 1 | 3.7 | 1,800 | (M) | (M), LVP | ○ | |
| 222 | D/G Lubricating Oil Purifier Supply Pump | 1 | 0.4 | 1,200 | TE, H | GSP, LVP | — | Auto Stop |
| 223 | | | | | | | | |
| 224 | Boiler HFO/MGO Burning Pump | 1 | 0.75 | 3,600 | (M) | (M), LVP | — | |
| 225 | Boiler Forced Draft Fan | 1 | 2.2 | 3,600 | (M) | (M), LVP | ○ | |
| 226 | Boiler Feed Water Pump | 2 | 5.5 | 3,600 | TE, H | (M), LVP | — | Auto Start/Stop(LVR) Auto Change |
| 227 | Boiler Fuel Oil Heater | 1 | 6 | | (M) | (M) | — | |
| 228 | Boiler Pilot Burner Pump | 1 | 0.09 | 3,600 | (M) | (M), LVP | — | |
| 229 | | | | | | | | |
| 230 | Ballast Pump | 2 | 90 | 1,800 | EVDP, V | GSP, LVP | ○ | Y — Δ Start SH |
| 231 | Bilge and Ballast Pump | 1 | 50 | 1,800 | TE, V | GSP, LVP | ○ | |
| 232 | Fire and General Service Pump | 1 | 50 | 1,800 | TE, V | GSP, LVP | ○ | Start/Stop from W/H & Fire station |
| 233 | Bilge Pump | 1 | 0.75 | 1,200 | TE, H | GSP, LVP | — | Auto Stop |
| 234 | Sludge Pump | 1 | 1.5 | 1,200 | TE, H | GSP, LVP | — | |



| Item | Use | No. of set | Output (kW) | Synchronous min ⁻¹ | Type | Control type | Ammeter | Remarks |
|------|---|------------|-------------|-------------------------------|-------|--------------|---------|--------------------------------|
| 235 | Fresh Water Pump | 1 | 3.7 | 3,600 | TE, V | GSP, LVP | — | Auto Start/Stop (LVR) |
| 236 | Drinking Water Pump | 1 | 3.7 | 3,600 | TE, V | GSP, LVP | — | Auto Start/Stop (LVR) |
| 237 | Refrigerating Machine Cooling Sea Water Pump | 1 | 7.5 | 3,600 | TE, H | GSP, LVR | ○ | |
| 238 | | | | | | | | |
| 239 | Hot Water Circulating Pump | 1 | 0.4 | 1,800 | TE, H | IND, LVP | — | |
| 240 | Diesel Generator Fuel Oil Circulating Pump | 2 | 1.5 | 1,200 | TE, H | GSP, LVR | ○ | Auto Change |
| 241 | | | | | | | | |
| 242 | Diesel Generator Diesel Oil Booster Pump | 1 | 2.2 | 1,200 | TE, H | GSP, LVR | ○ | Auto Start by D/G start signal |
| 243 | Diesel Generator Lubricating Oil Priming Pump | 3 | 0.94 | 3,600 | (M) | GSP, LVP | — | Auto Start/Stop (LVR) |
| 244 | | | | | | | | |
| 245 | Stern Tube Lubricating Oil Pump | 2 | 0.4 | 1,200 | TE, H | GSP, LVR | ○ | Auto Change |
| 246 | | | | | | | | |
| 247 | Fuel Oil Shifter Pump | 1 | | | | | | |
| 248 | | | | | | | | |
| 249 | | | | | | | | |
| 250 | | | | | | | | |
| 251 | | | | | | | | |



| Item | Use | No. of set | Output (kW) | Synchronous min | Type | Control type | Ammeter | Remarks |
|------|--|-------------|-------------------|-------------------------|-------|--------------|---------|-----------------------|
| 252 | Engine Room Ventilating Fan | 2 | 7.5 | 1,200 | TE, V | GSP, LVR | ○ | Reversible |
| 253 | Engine Room Ventilating Fan | 1 | 7.5 | 1,200 | TE, V | GSP, LVR | ○ | |
| 254 | | | | | | | | |
| 255 | Engine Control Room Air Conditioner | 1 | 2.2 | 3,600 | (M) | (M), LVP | — | |
| 256 | Drilling Machine | 1 | 0.4 | 1,800 | (M) | (M), LVP | — | |
| 257 | Lathe | 1 | 2.2 | 1,800 | (M) | (M), LVP | — | |
| 258 | Grinding Machine | 1 | 0.75 | 1,800 | (M) | (M), LVP | — | AC 440V 3 φ |
| 259 | Overhead Travelling Crane | 1 2 | 2.2 0.2 | 900 1,800 | (M) | (M), LVP | — | |
| 260 | Fresh Water Generator | 1 1 | 0.75 5.5 | 3,600 3,600 | (M) | (M), LVP | — ○ | |
| 261 | Waste Oil Incinerator | 1 1 1 | 0.1 7.5 1.5 | 1,800 3,600 3,600 | (M) | (M), LVP | — | |
| 262 | Water Pressure Pump for Local Fire Fighting System | 1 | 6.3 | 3,600 | (M) | (M), LVP | ○ | Auto Start/Stop (LVR) |
| 263 | | | | | | | | |
| 264 | | | | | | | | |
| 265 | | | | | | | | |
| 266 | | | | | | | | |
| 267 | | | | | | | | |
| 268 | | | | | | | | |





SECTION 6 MISCELLANEOUS ELECTRICAL EQUIPMENT

6.1 COMMISSARY AND LAUNDRY EQUIPMENT

Electrical commissary and laundry shall be installed according to **II - HULL PART**.

The motors shall be of the manufacturer's standard and suitable for 440 V three-phase, except that motor of 0.4 kW rating and less may be designed for 100 V single-phase or three-phase.

The fixed heating equipment of large capacity shall be suitable for AC 440 V three-phase, and other equipment for AC 100 V single-phase.

6.2 ARC WELDER

Two (2) sets of arc welder of single-wire system, rating 300 A capacity, fixed type, shall be installed in engine room and No.2 deck crane house.

The arc welder shall be of AC 440 V single-phase transformer type and extension cable of 120 m length in total, i.e. 4 - 30 meters length.

6.3 RECEPTACLE FOR GENERAL PURPOSE

Receptacles for general purpose shall be installed as follows :

6.3.1 Capacity up to approximately 600 W

- 1 - Hospital
- 1 - Captain's day room
- 1 - Chief engineer's day room
- 1 - Radio instruments space
- Each 1 - Inner passage (each deck)



6.3.2 Capacity up to approximately 1.2 kW

- | | |
|-------------------------|-------------------------|
| 3 - Galley | 3 - Wheelhouse |
| 4 - Officer's mess room | 3 - Ship's office |
| 1 - Saloon | 3 - Meeting room |
| 4 - Crew's mess room | Each 1 - Each pantry |
| 1 - Crew's smoking room | |
| 1 - Work shop | |
| 1 - Engine control room | |

6.4 IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM

Impressed current cathodic protection system shall be installed as follows :

- 1 - Automatic power supply unit (450 A)
- 1 - Reference electrode
- 2 - Pt anode
- 1 - Propeller shaft grounding assembly with milli voltmeter
- 1 - Rudder grounding device

The system shall be supplied from AC 440 V three-phase system.

6.5 ELECTRIC HEATER

Two (2) sets of electric heater (1 KW) shall be installed in wheelhouse.

The system shall be supplied from AC 100 V single-phase system.

6.6 RECEPTACLE FOR 440 V EQUIPMENT

Receptacle with switch for 440 V equipment (AC 440 V 16 A 3 phase) shall be installed as follow :

- 1 - Air conditioning & Refrigerating machine room



SECTION 7 LIGHTING

7.1 GENERAL

7.1.1 General

The Vessel shall be illuminated throughout with fluorescent lamps designed for location and service requirements, except that stores, lockers, outside passages and weather deck shall be illuminated with incandescent lamps.

Mercury flood light shall be used for deck illumination and also for general illumination in engine room.

In general, fixtures and fittings shall be arranged for surface mounting and shall be of the following type depending upon their location.

| | |
|----------------------|---|
| Waterproof type | Spaces exposed to the weather, refrigerated provisions chamber, etc. |
| Non-waterproof type | Living quarters, wheelhouse, etc. |
| Drip proof type | Machinery spaces, galley, deck stores, laundry and other location exposed to heat or moisture |
| Explosion proof type | Battery room, paint & lamp store |

Fixtures and fittings shall be generally constructed to meet Japanese Industrial Standard (JIS) type and/or the Builder's standard.

Lighting shall be arranged so as to obtain the average illumination level which is in compliance with JIS standard (Recommended intensity of illumination) for accommodation and machinery spaces.



7.1.2 Lighting fixture and fitting

All construction of fixtures shall be made of cast iron or PVC except that corrosion resistant materials or materials with corrosion resistant finishes shall be used for fixtures exposed to the weather.

Fluorescent lamps shall be of preheat type, using starters (glow lamps) and their ballasts shall be of low power factor type.

Fiber-contained bakelite material may be used for switches, plug and receptacles, branch boxes, etc. and phenol resin material for those of non-waterproof type.

7.1.3 Lamp bulb and lamp holder

All lamp bulbs and lamp holders shall be used on JIS size as follows :

| <u>Kind</u> | <u>Lamp bulb</u> | <u>Lamp holder</u> |
|---|--------------------------------|--------------------|
| Incandescent lamp | 100 V lamps up to 250 W | E - 26 |
| | 100 V lamps above 250 W | E - 39 |
| Fluorescent lamps (straight tubes) | 10 W, 15 W, 20 W and 40 W | G - 13 |
| | Glow lamps | P - 21 |
| Mercury flood light lamps | 400 W and 700 W | E - 39 |
| Pilot lamps | 18 V incandescent lamps of 2 W | E - 12 |
| | 30 V incandescent lamps of 1 W | BA - 9S |

Where the mounting spaces do not permit the use of E-26 base lights, special illuminating lights mounted inside instruments may be B-15d base or other suitable size by using a transformer.

Lamp holders shall be of porcelain or other heat resistant material and shall be designed to prevent loosening of the lamp.



7.2 NAVIGATION AND SIGNAL LIGHT

7.2.1 Electric navigation light

A complete set of waterproof electric navigation lights shall be installed as follows :

- 2 - Masthead light
- 1 - Stern light
- 1 - Port side light
- 1 - Starboard side light

The navigation lights shall be controlled from navigation light indicator panel on wheelhouse group panel and shall be of duplicate 60 W or 40 W incandescent lamp type.

The navigation light indicator panel shall have a control switch for each running light, which shall cause audible and visible indication of the failure of any of the above-mentioned navigation lights in use.

The navigation light indication panel shall be supplied by two (2) separate feeders : one (1) from AC 100 V system and the other from emergency AC 100 V system.

7.2.2 Anchor light

Two (2) fixed electric anchor lights of waterproof single 40 W incandescent lamp type shall be provided, one (1) forward and one (1) aft, and shall be controlled from switches in the navigation light indicator panel.

7.2.3 Not under command light

Two (2) lamps and two (2) flexible cord with plugs for hanging type electric not under command lights of single 60 W incandescent red lamp shall be provided.

Provision for hanging this light shall be provided on the radar mast.

Two (2) receptacles for them shall be installed on lower part of the radar mast.

These lights shall be supplied from emergency AC 100 V system and controlled from a switch on wheelhouse group panel.

7.2.4 Maneuvering light

One (1) set of Maneuvering light (60 W incandescent lamp) shall be installed on radar mast.

This light shall be commonly used also for the air horn lamp emitter.

The light shall be supplied from AC 100 V single-phase system.



7.2.5 Daylight signaling light

One (1) set of 60 W incandescent portable daylight signaling light shall be provided as follows :

- 1 - Pistol type portable daylight signaling light with 10 m cord
- 1 - Battery charger
- 1 - Lamp case with battery
- 1 - Relay cord for connection between battery charger and battery

Each one (1) receptacle (total 2) shall be installed on the wall of both sides in wheelhouse and supplied from DC 24 V system.

One (1) receptacle for battery charger shall be installed in wheelhouse and supplied from emergency AC 100 V system.

7.2.6 Suez Canal signal light

One (1) set of fixed type Suez Canal signal lights (4 - red lamp, 5 - white lamp and 1 - green lamp) shall be installed on radar mast.

Each lamp shall be of 40 W incandescent lamp type and controlled from the switches on wheelhouse group panel.

Furthermore 40 W incandescent portable light (1 - red lamp) and a receptacle shall be provided on suitable position of stern.

The light shall be supplied from AC 100 V system.

7.2.7 Propeller warning light

Not fitted

7.2.8 Steering light

Two (2) 40 W fixed type blue lamps shall be installed on the fore mast, and controlled from wheelhouse.

One (1) dimmer switch shall be installed in wheelhouse.

The light shall be supplied from AC 100 V system.

7.2.9 Suez Canal searchlight

One (1) set of 3 kW Suez Canal searchlight shall be supplied by the Owner, and wiring of AC 100 V 3 kW capacity and junction box for the searchlight shall be installed on the upper deck.



7.2.10 Warning light

Not fitted

7.3 **LIGHTING - DECK ETC.**

7.3.1 Boat deck light

Three (3) 300 W incandescent flood lights shall be installed : one (1) for each space of lifeboat station, rescue boat station and after life raft station.

These lights shall be mounted on brackets so constructed that they can be swung inboard for deck lighting and outboard for overside lighting, and shall be rigidly locked in either position.

These lights shall be controlled from wheelhouse group panel, and shall be supplied from emergency AC 100 V system.

7.3.2 Boat preparation light

One (1) 60 W incandescent light shall be installed near the lifeboat.

The light shall be supplied from emergency AC 100 V system.

7.3.3 Life raft installation light

Total three (3) 60 W incandescent lights shall be installed near the life raft; one (1) for each life raft.

These lights shall be supplied from emergency AC 100 V system.

7.3.4 Life raft launching light

One (1) 300 W portable reflector type incandescent life raft launching light shall be installed.

One (1) receptacle shall be installed near the fore life raft and shall be supplied from emergency AC 100 V system.



7.3.5 Funnel flood light

Total two (2) 300 W incandescent flood lights shall be installed ; one (1) for each side of the funnel.

These lights shall be controlled from wheelhouse and supplied from AC 100 V system.

7.3.6 Accommodation ladder light

One (1) 300 W portable reflector type incandescent accommodation ladder light shall be installed.

Two (2) receptacles shall be installed at both side of gangway and supplied from AC 100 V system.

7.3.7 Deck light

The following flood lights for illumination on weather deck shall be installed.

- 1 - 500 W incandescent flood light on forward side of fore mast
- 2 - 500 W incandescent flood light on aft side of fore mast for windlass
- 2 - 700 W mercury flood light on aft side of fore mast
- 2 - 700 W mercury flood light on navigation bridge wings ; one (1) on each bridge wing
- 2 - 400 W mercury flood light on forward side of compass bridge deck
- 2 - 500 W incandescent flood light for aft mooring winch

These above lights shall be controlled from wheelhouse.

These lights shall be supplied from AC 100 V system.

7.3.8 Portable cargo light

Twelve (12) 300 W portable incandescent cargo lights and eight (8) 300 W portable special type (air tight) incandescent cargo lights shall be provided with 30 m flexible cord and plug respectively.

Receptacles for them shall be provided as follows :

Each 4 - for No.1 through No.5 cargo hold
(Total 20)

These receptacles shall be supplied from AC 100 V system.

7.3.9 Ship's name light

Not fitted



7.4 LIGHTING - ACCOMMODATION SPACE

Living quarters, commissary, sanitary and navigation spaces shall be generally illuminated by fluorescent lamp fixtures.

The lighting system shall be supplied from AC 100 V system.

7.4.1 Ceiling light

Ceiling lights, in general, shall consist of single or twin 20 W fluorescent lamp tubes, and shall be of surface mounted type or flush mounted type.

In general, the ceiling lights shall be installed with globe for all rooms.

7.4.2 Berth light

One (1) berth light of 10 W fluorescent lamp wall mounted type with globe shall be installed over the head of each berth except 15 W fluorescent lamp with globe for captain's room and chief engineer's room.

Berth light shall be supplied from emergency AC 100 V system.

7.4.3 Desk light

One (1) desk light of 6W LED lamp wall mounted type with receptacle and radio antenna outlet box without globe or stand type shall be provided on the writing desk in each room.

Three (3) bracket type 60 W incandescent chart table lamps with dimmer switch shall be installed over chart table.

7.4.4 Mirror light

One (1) mirror light with globe shall be installed for each mirror with wash basin, and wattage of the fluorescent lamp shall be of 10 W for cabin and/or 15 W for lavatory.

7.4.5 Passage light

Passage lights shall be arranged to be of surface mounted type.

Inside passage shall be illuminated by 20 W fluorescent lamp fixtures with globe and shall be controlled by breakers in distribution boards.

Outside passage shall be illuminated by 60 W incandescent lamp fixtures with globe and guard and shall be controlled by switches on wheelhouse group panel.



7.5 LIGHTING - MACHINERY SPACE

Machinery spaces and their stores shall be generally illuminated by 20 W fluorescent lamp tubes, except for local illumination where incandescent lamps shall be used.

Each fluorescent lamp fixture shall consist of single or twin lamp tubes.

Two (2) 400 W mercury flood lights shall be installed in engine room.

The ceiling lights of engine control room shall be of suitable 20 W fluorescent lamp with globe.

The lighting system shall be supplied from AC 100 V system.

7.6 LIGHTING - STORE ETC.

Stowage spaces shall be illuminated by **incandescent** lamp fixtures of pendant or bracket type.

One (1) explosion proof pendant lighting fixture of 60 W incandescent lamp with globe and guard shall be installed in battery room and paint & lamp store respectively.

Refrigerated provisions chambers shall be illuminated by waterproof 60 W incandescent lamp fixtures, and controlled by switches with red pilot lamp at the outside of the chambers.

The lighting system shall be supplied from AC 100 V system.



7.7 EMERGENCY LIGHTING

Emergency lighting shall be installed throughout the vessel to furnish proper illumination for guiding crew to lifeboat stations and to permit the operation of essential services.

Emergency lights shall be automatically supplied from emergency generator via AC 100 V system of emergency switchboard in case of normal AC 100 V failure.

Emergency lights of fluorescent or incandescent type may be commonly used with the general lighting fixtures.

Emergency lights shall be installed as follows :

- 1 - Wheelhouse
- 1 - Chart space
- 1 - Radio instruments space
- 1 - Hospital
- 1 - Galley
- 1 - Fire station
- 1 - Battery room (Explosion proof type)
- 1 - Captain's day room
- 1 - Chief engineer's day room
- 1 - Cabin bed space
- 1 - Chief officer's day room
- 1 - 1st engineer's day room
- 1 - Officer's & crew's shower room
- 1 - Officer's & crew's W.C.
- 1 - Ship's office
- 1 - CO₂ bottle room
- 1 - Meeting room
- Each 1 - Public space
- 1 - Electric room
- Suitable number - Accommodation passage & stair way
- 3 - Steering gear room
- 1 - Emergency fire pump room
- 2 - Engine control room
- 1 - Emergency generator room
- 1 - Gymnasium
- 1 - Fireman outfit locker
- Suitable number - Engine room
- About 6 - Passage of near the lifeboat, rescue boat and life raft
(2 for each space)
- About 3 - Escape trunk



One (1) receptacle shall be installed at the rear of main switchboard.

Furthermore suitable numbers of emergency light supplied from radio battery shall be installed nearby MF/HF remote controller, VHF radio telephone and INMARSAT standard-C (EGC).

7.8 PORTABLE LAMP

Eight (8) waterproof 60 W incandescent portable lamps with globe, guard and hook shall be supplied.

Each lamp shall have 15 m three (3) core flexible cord and plug.

Two (2) non-waterproof 60 W incandescent portable lamps with guard and hook shall be provided.

Each lamp shall have 15 m three (3) core flexible cord and plug.

These portable lamps shall be used in machinery spaces, stores, lockers and other necessary spaces, and supplied from AC 100 V system.

7.9 SWITCH

Switches shall be of double and single pole tumbler type with quick make and break action, and shall be of surface mounted type or flush mounted type.

Switching of lights connected to the ship's service lighting system, in general, shall be local, i.e. one (1) switch for lights in space or room shall be located at inside of each entrance, except outside of each entrance for battery room, paint & lamp store and galley.

Weather deck lights, flood lights, passage lights and machinery space lights, in general, shall be divided into suitable groups and controlled by branch circuit breakers in lighting panel board.

Switches for berth lights, desk lights and 10 W mirror lights shall be built into their own fixtures.

7.10 RECEPTACLE

Receptacles, in general, shall be of three-pole type, one-pole of which shall serve as earth connection of metal frame of portable appliances except two-pole type for electric razor.

Receptacles shall be of surface mounted type or flush mounted type.

One (1) receptacle shall be installed in each mirror lighting fixture for using the AC 100 V electric razor.



SECTION 8 INTERIOR COMMUNICATION EQUIPMENT

8.1 ENGINE ORDER TELEGRAPH

8.1.1 Engine order telegraph

One (1) complete set of engine order telegraph system shall be installed as follows :

- 1 - Transmitter of built-in type on wheelhouse control stand
- 1 - Receiver of built-in type with a sounding device on the engine control console in engine control room
- 1 - Receiver of single face wall mounted type (with reply), near main engine emergency maneuvering station
- 1 - Gong in engine room
- 1 - Telegraph indicator in wheelhouse
- 1 - Telegraph logger for recording order and their times (Hour, minute, 1/2 minute) shall be installed on wheelhouse control stand

Dials of the maneuvering lever shall be eleven (11) orders as follows :

| | | |
|-----------------|------------------|------|
| Ahead dead slow | Astern dead slow | stop |
| slow | slow | |
| half | half | |
| full | full | |
| nav. full | emergency full | |

The system shall be supplied from emergency AC 100 V single-phase system.

8.1.2 Sub engine telegraph

One (1) complete set of sub engine telegraph system of lamp type shall be installed on wheelhouse control stand and engine control console in engine control room.

The units shall be three (3) orders consisting “ Finished with engine”, “Stand-by” and “Rung up”.

The system shall be supplied from emergency AC 100 V single-phase system.



8.2 MAIN ENGINE REVOLUTION INDICATOR

One (1) complete set of main engine revolution indicator system of contactless type shall be installed as follows :

- 1 - Transmitter in main engine
- 1 - 200 mm diameter indicator of wall mounted type with an EL illumination in wheelhouse and a dimmer switch attached to the body
- 1 - 150 mm square indicator of built-in type on engine control console in engine control room
- 1 - 110 mm square or digital indicator of built-in type on wheelhouse control stand
- 1 - Main engine revolution counter of built-in type on engine control console in engine control room
- Total 2 - 200 mm diameter indicator of wall mounted type with an EL illumination on both bridge wings outside of wheelhouse and a dimmer switch attached to the body
- 1 - 150 mm diameter indicator of flush mounted type in chief engineer's day room

8.3 RUDDER ANGLE INDICATOR

One (1) complete set of rudder angle indicator system of synchronous motor type shall be installed as follows :

- 1 - Transmitter connected to rudder stock through lever
- 1 - 200 mm diameter indicator of wall mounted type with an EL illumination in wheelhouse and a dimmer switch attached to the body
- Total 2 - 200 mm diameter indicator of wall mounted type with an EL illumination on both bridge wings outside of wheelhouse and a dimmer switch attached to the body
- 1 - 110 mm square indicator of built-in type on engine control console in engine control room

The indicator shall have maximum indicator of 40° right and left respectively, and shall be graduated in 1° .

The system shall be supplied from emergency AC 100 V single-phase system.



8.4 COMMON BATTERY TELEPHONE

One (1) system of common battery telephone system shall be installed as follows :

Built-in type

- 2 - Wheelhouse control stand,
engine control console in engine control room

The system shall be supplied from DC 24 V system.

8.5 AUTOMATIC EXCHANGE TELEPHONE

One (1) complete set of automatic exchange telephone system (with paging) shall be installed as follows :

- 1 - Automatic telephone exchanger in cable trunk (~~D-deck~~)

The electric exchanger shall have capacity of 40 lines and 12 simultaneous talking path.

The exchanger shall be supplied from emergency AC 100 V single-phase system and DC 24 V system.

Paging systems shall be connected public addresser.

Telephones as follows :

Built-in type and noise cancel type

- 2 - Wheelhouse control stand,
engine control console in engine control room

Desk type and noise cancel type

- | | |
|--|---|
| <ul style="list-style-type: none"> 8 - Radio instruments space, senior office's class day room(2), crew's smoking room, | <ul style="list-style-type: none"> captain class day room(2), saloon, tally office |
|--|---|

Desk type

- | | |
|---|---|
| <ul style="list-style-type: none"> 21 - Hospital, senior office's class bed room(2), all petty officer's cabin(3), owner's room, able seaman(3), | <ul style="list-style-type: none"> captain class bed room(2), all junior's cabin(4), officer's spare room(2), pilot's room, oiler(3) |
|---|---|



Wall mounted type and noise cancel type

5 - Gymnasium, ship's office,
mess room(2), meeting room

Wall mounted type

1 - Fire station

Wall mounted drip proof and noise cancel type

2 - Steering gear room(※), galley

Wall mounted drip proof type with sub receiver and noise cancel type

1 - Main engine emergency maneuvering station(※)

(※) mark indicate telephone with 120 mm bell.

The following pairs of telephones shall be connected in parallel.

Captain's day room - Captain's bed room

Chief engineer's day room - Chief engineer's bed room

Chief officer's day room - Chief officer's bed room

1st engineer's day room - 1st engineer's bed room

8.6 PORTABLE TELEPHONE

Not fitted

8.7 SHORE TELEPHONE

Not fitted



8.8 WHEELHOUSE GROUP PANEL

One (1) wheelhouse group panel of dead front and steel frame construction type shall be installed in wheelhouse.

The following equipment specified in the other sections shall be included in the wheelhouse group panel.

Such equipment in wheelhouse not included in the wheelhouse group panel shall be of wall and surface mounted type.

- Feeder switches for electrical equipment on the bridge wings etc.
- Control switches for flood lights on the fore mast, bridge wings etc.
- Control switches with pilot lamps for navigation light
- Control switch for general emergency alarm system
- Emergency stop switch for accommodation fans
- Air horn control panel
- Dimmer switch for magnetic compass
- Fire alarm panel
- Steering gear alarm panel
- Start/stop push button switch with running indicator lamp for Fire & general service pump
- Master clock

8.9 WHEELHOUSE CONTROL STAND

One (1) wheelhouse control stand of dead front and steel frame construction type shall be installed in wheelhouse.

The control stand shall be included the following equipment.

- Transmitter of engine order telegraph
- Transmitter of sub engine telegraph
- Telegraph logger
- Main engine revolution indicator
- Common battery telephone
- Automatic exchange telephone
- Dimmer switch
- Indicator & alarm lamps



8.10 SIGNAL BELL

Four (4) systems of signal bell and buzzer shall be installed as follows :

1 system - From refrigerated provisions chamber to galley

One (1) 120 mm bell with a red pilot lamp shall be provided in galley, and each one (1) waterproof switch in meat room, fish room, vegetable room and lobby respectively.

The system shall be supplied from emergency AC 100 V single-phase system.

1 system - From engine control room to engine room

Five (5) electric horns with a flash light in engine room and one (1) switch in engine control console in engine control room.

These electric horns shall be commonly used in following cases.

- i) in case of occurrence of calling bell of common battery telephone or auto exchange telephone in unmanned engine control room.
- ii) in case of occurrence of alarm in engine room.
- iii) in case of calling engineers in engine room.

The system shall be supplied from AC 100 V single-phase system.

1 system - From engine control room to engineer's passage or room and public rooms

Each one (1) buzzer with red pilot lamp shall be provided in engineer's passage or room and public rooms and one (1) switch on engine control console in engine control room.

The system shall be supplied from DC 24 V system.

1 system - From hospital to wheelhouse

One (1) 120 mm bell with lamp or buzzer with lamp shall be installed in wheelhouse and one (1) push button switch shall be provided at bed side in hospital.

The system shall be supplied from emergency AC 100 V single-phase system.



8.11 STEERING ALARM

In addition to the steering alarms on the engine control console in engine control room described in **III- MACHINERY PART**, the following alarm and running indicator for the steering gear motors and hydraulic oil tank shall be provided on the wheelhouse group panel.

- 2 - Over load alarm lamp, one for each motor
- 2 - No voltage alarm lamp, one for each motor
- 2 - Hydraulic oil tank level alarm lamp
- 2 - Phase fail alarm lamp, one for each motor
- 2 - Running indicator, one for each motor
- 2 - Hydraulic lock alarm lamp
- 1 - Buzzer for alarm

The system shall be supplied from DC 24 V system.

8.12 GENERAL EMERGENCY ALARM

One (1) complete set of general emergency alarm system shall be installed as follows :

- 1 - Control switch “Auto” and “Manual” on wheelhouse group panel
- 1 - Control switch for auto mode in ship’s office
- About 29 in total - 120 mm bell in steering gear room, engine control room, engine workshop, main passage in living quarter (about 12), stair way (5), galley, pantry (2), gymnasium, laundry, shower room (2), W.C. (2)
- About 36 - Buzzer in cabin (29), tally office, hospital, ship’s office, mess room (2), saloon, crew’s smoking room, meeting room
- About 3 - Air horn in engine room
- About 3 - Rotating light (red) in engine room

The above sounding equipment and flash light may be altered according to detail design based on SOLAS and class rules.

The switch shall be clearly identified by lettering “GENERAL EMERGENCY ALARM” on a suitable background.

The bell and air horn shall be sounded as the general emergency alarm which consists of seven short blasts followed by one long blast by auto mode switch on wheelhouse group panel.

The bell and air horn shall be used commonly for described in SUBSECTION **8.15 FIRE ALARM**.

The system shall be supplied from emergency AC 100 V single-phase system.



8.13 PUBLIC ADDRESS AND DOCK ANNOUNCING

One (1) complete set of public address system and dock announcing system of press-to-talk shall be installed as follows :

- 1 - Amplifier with control panel, a monitor speaker and a hand microphone in wheelhouse

Total capacity of the above amplifier and booster shall be decided in compliance with speakers of emergency announcements.

Portable microphone

- 3 - For common use on bridge wings front wall, upper deck forward, aft mooring station

Speaker

- 1 - 50 W waterproof fixed type on compass bridge deck
- 3 - 5 W waterproof type, each one (1) on both bridge wings (2) and at the muster station (1).
- 2 - 10 W waterproof portable type on upper deck forward and aft mooring station
- 1 - 5 W drip-proof type in galley
- About 36 - 2 W without volume control in

| | |
|------------------------------------|-----------------------------|
| radio instruments space | captain class day room (2), |
| senior office's class day room(2), | officer's mess room, |
| crew's mess room, | saloon, |
| crew's smoking room, | ship's office, |
| gymnasium, | passages (about 15), |
| stair way (about 7), | engine control room, |
| tally office, | meeting room |

The above speaker arrangement may be altered according to detail design based on SOLAS and class rules.

Waterproof type receptacle for microphone

- 2 - For both bridge wings front wall

Waterproof type receptacle for microphone and speaker

- 3 - For upper deck forward, aft mooring station, steering gear room

The system shall be supplied from emergency AC 100 V single-phase system and DC 24 V system.



8.14 AIR HORN

One (1) complete set of horn system shall be installed as follows :

- 1 - Air horn on the radar mast
- 1 - Air horn on the fore mast
- 1 - Time controller in wheelhouse group panel
- 3 - Free sound push button switch, on wheelhouse front wall and both bridge wings

Maneuvering light described in SUBSECTION **7.2 NAVIGATION AND SIGNAL LIGHT** shall be interlocked with horn operation, and shall be used as lamp emitter.

The system shall be supplied from emergency AC 100 V single-phase system.

8.15 FIRE ALARM

One (1) complete set of fire alarm system shall be installed as follows :

- 1 - Fire alarm panel with main buzzer in wheelhouse group panel
- 1 - 120 mm bell in captain's day room
- Suitable number - Push button in wheelhouse, engine control room, engine room entrance, passage
- Suitable number - Fire detector in inner passage in accommodation space and engine room
(Smoke type and temperature type)

The fire detector (smoke type and flame type) shall be commonly used with the detector for local fire fighting system.

The bell and air horn shall sound continuously and be used commonly for described in SUBSECTION **8.12 GENERAL EMERGENCY ALARM**.

The system shall be supplied from AC 100 V single-phase system and DC 24 V system.



8.16 CO₂ FLOODING ALARM

One (1) system of CO₂ flooding alarm shall be installed as follows :

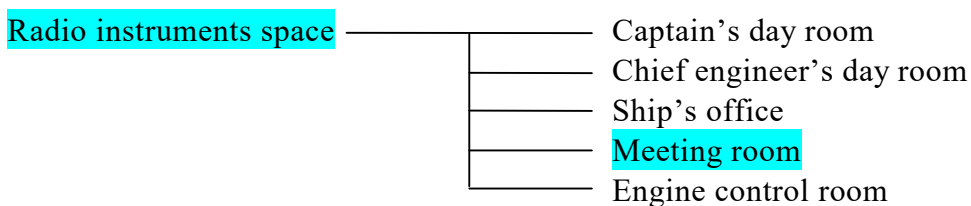
- 5 - Baby motor siren in engine room
- 1 - 120 mm bell in engine control room

Above alarm equipment may be altered in accordance with manufacture's standard.

The system shall be supplied from emergency AC 100 V single-phase system.

8.17 LAN SYSTEM

Wiring for LAN cable (100/10 BASE-T category 5) shall be carried out in the following space.



It is possible to communicate between ship and shore (E-mail) from the personal computer (PC) connected with INMARSAT - FB in radio instruments space.

The personal computer and HUB shall be provided by the Owner.



SECTION 9 NAVIGATION EQUIPMENT

9.1 GYRO COMPASS

One (1) complete set of gyro compass shall be installed as follows :

- 1 - Master compass in steering stand
(The device shall be supplied from emergency AC 100 V single-phase system and DC 24 V system.)
- 1 - Steering repeater built into steering stand
- 2 - Bearing repeater with pedestal, each one (1) on both bridge wings
- 1 - Azimuth circle for the above bearing repeaters
- 1 - Bearing repeater with bracket in wheelhouse front
- 1 - Bearing repeater with bracket in steering gear room
- Each 1 - Repeater signal to built into RADARS, AIS and VDR

One (1) heading monitor shall be provided on the auto pilot stand by detecting deviation of the heading information between the master gyro compass and the magnetic compass.

9.2 MAGNETIC COMPASS

One (1) magnetic compass of 165 mm reflector type with spare bowl shall be provided.

A dimmer switch of separate type for the magnetic compass shall be installed in wheelhouse.

One (1) magnetic heading converter shall be provided.

The illumination lamp shall be supplied from emergency AC 100 V single-phase system.

9.3 STEERING CONTROL

One (1) complete set of double electric circuit type steering control equipment (Non-adaptive type / heading control) shall be installed as follows :

- 1 - Steering stand in wheelhouse
(The stand shall be of gyro automatic steering and electric hand steering with necessary switches, compass connections, contactors, etc., and connected with double wiring to steering control equipment.)
- 2 - Control & power box in steering gear room
(The box shall be supplied from AC 440 V single-phase system or three-phase system.)



9.4 ELECTROMAGNETIC LOG

One (1) complete set of electromagnetic log shall be installed as follows :

- 1 - Log mechanism at bottom of engine room
- 1 - Master apparatus in wheelhouse
- 1 - Speed and distance indicator on the table of chart space in wheelhouse
- 1 - Speed indicator of wall mounted type with an EL illumination in wheelhouse and a dimmer switch attached to the body

The speed indicator shall have maximum indication of 25 knots, and the scales shall be graduated in 0.5 knots.

The distance receiver shall be of maximum indication 9999.99 nautical miles.

The equipment shall be supplied from emergency AC 100 V single-phase system.

9.5 ECHO SOUNDER

One (1) complete set of echo sounder shall be installed as follows :

- 1 - Transducer of 200 kHz operating type at bottom of engine room
- 1 - Main display unit on the front wall in wheelhouse
(The displayed record shall be shown at least fifteen (15) minutes of soundings on LCD display.)

The equipment shall be supplied from emergency AC 100 V single-phase system and DC 24 V system.



9.6 RADAR AND TT

Two (2) complete sets of radar shall be installed as follows :

No.1 RADAR with TT

- 1 - Aerial unit with transceiver on the radar mast (12 feet)
 - Frequency band : S band
 - Maximum range : About 96 nautical miles
 - Peak power : About 30 kW
- 1 - Display unit of raster-scan type in wheelhouse
 - (Effective diameter : 320 mm corresponding 16 inches)
 - (Display size : 23.1 inches colour LCD)
- 1 - Performance monitor

The equipment shall be supplied from emergency AC 100 V single-phase system.

No.2 RADAR with TT

- 1 - Aerial unit with transceiver on the radar mast (6 feet)
 - Frequency band : X band
 - Maximum range : About 96 nautical miles
 - Peak power : About 25 kW
- 1 - Display unit of raster-scan type in wheelhouse
 - (Effective diameter : 320 mm corresponding 16 inches)
 - (Display size : 23.1 inches colour LCD)
- 1 - Performance monitor

The equipment shall be supplied from emergency AC 100 V single-phase system.



9.7 CLEAR VIEW SCREEN

Not fitted

9.8 ELECTRIC CONTROL CLOCK SYSTEM

One (1) complete set of marine use quartz crystal control electric clock system shall be installed as follows :

1 - Master clock and slave clock control equipment in wheelhouse

42 - Slave clock

Slave clocks shall be installed as follows :

Two (2) hands wall mounted type with an EL illumination and a dimmer switch attached to the body

1 - Wheelhouse

Three (3) hands wall mounted or built-in type

1 - Engine control room

Two (2) hands wall mounted decorative type

4 - Officer's mess room, saloon,
captain class day room(2)

Two (2) hands wall mounted type

| | |
|------------------------------------|------------------------------------|
| 34 - Captain's class bed room(2), | radio instrument space, |
| ship's office, | crew's mess room, |
| crew's smoking room, | all junior's cabin(4), |
| senior office's class day room(2), | senior office's class bed room(2), |
| officer's spare room(2), | all petty officer's cabin(3), |
| all crew's cabin(10), | crew's spare room, |
| pilot's room, | tally office, |
| hospital, | meeting room, |
| owner's room | |



Two (2) hands drip-proof wall mounted type

1 - Galley

Two (2) hands double face type

1 - Inner passage on upper deck

The hands of the two (2) - hands clock shall move at every 30 seconds.

The system shall be supplied from emergency AC 100 V single-phase system and DC 24 V system.

9.9 ANEMOMETER AND ANEMOSCOPE

One (1) complete set of anemometer and anemoscope shall be installed as follows :

1 - Propeller type transmitter on radar mast

1 - Anemometer and anemoscope, wall mounted type with an EL illumination in wheelhouse and a dimmer switch attached to the body

The equipment shall be supplied from emergency AC 100 V single-phase system.

9.10 ELECTRIC WIPER

Three (3) complete sets of following type wiper shall be installed on the front of windows in wheelhouse.

3 - Swing type

The equipment shall be supplied from emergency AC 100 V single-phase system.



9.11 DGPS NAVIGATOR

Two (2) sets of DGPS (Differential Global Positioning System) navigator shall be installed as follows :

- 2 - Receiver in chart space in wheelhouse
- 2 - Set of antenna equipment on compass deck
- 1 - Select switch

Output signal of two (2) GPS navigators through a select switch shall be connected to DSC equipment (No.1 VHF, No.2 VHF, MF/HF radio installation and INMARSAT standard-C), AIS, VDR, RADARS, **chart plotter**, gyro compass, electromagnetic log, NAVTEX receiver, electric clock, echo sounder, and ECDIS.

The equipment shall be supplied from emergency AC 100 V single-phase system and radio DC 24 V system.

9.12 CHART PLOTTER

One (1) set of chart plotter shall be installed as follows :

- 1 - Chart plotter in chart space

The chart plotter shall be connected with GPS navigator.

The equipment shall be supplied from emergency AC 100 V single-phase system.

9.13 LOADING CALCULATOR

One (1) set of loading calculator shall be installed in ship's office.
The loading calculator shall be of manufacturer's standard.

The equipment shall be supplied from AC 100 V single-phase system.



9.14 VDR

One (1) set of VDR (Voyage Data Recorder) shall be installed as follows:

- 1- VDR protective capsule for data recording on compass deck
- 1- VDR data processor unit for encoding and monitoring in wheelhouse
- 1- VDR data acquisition unit for data input output control in wheelhouse
- 4- VDR microphone unit for conversation collect in wheelhouse

The recording signal for VDR shall be of time, position, speed, bearing, alarm and Communication voice and etc, required by SOLAS, and necessary signal shall be connected from each equipment.

The system shall be supplied from emergency AC 100 V single-phase system.

9.15 ECDIS

One (1) complete set of ECDIS (Electronic Chart Display and Information System) without auto-tracking function shall be installed as follows :

- 1 - ECDIS of stand type in wheelhouse

The chart software shall be supplied by the Owner.

The system shall be supplied from emergency AC 100 V single-phase system.

9.16 BNWAS

One (1) set of BNWAS (Bridge Navigational Watch Alarm System) shall be installed.

The equipment shall be supplied from emergency AC 100 V single-phase system and DC 24 V system.



SECTION 10 RADIO EQUIPMENT

10.1 GENERAL

The following radio equipment shall be provided to meet the requirements for the operating of Global Maritime Distress and Safety System (GMDSS).

For maintenance requirements on the vessel engaged on voyages in sea areas A1, A2 and A3, the vessel shall be adopted as the condition both of duplication of equipment and shore-based maintenance.

10.2 MF/HF RADIO INSTALLATION

One (1) complete set of MF/HF radio installation shall be installed as follows :

- 1 - MF/HF radio installation of simplex operation in wheelhouse

The console shall be incorporated as the following units.

- 1 - 150 W MF/HF transmitter
- 1 - MF/HF receiver
- 1 - MF/HF DSC function
- 1 - MF/HF DSC watch receiver
- 1 - NBDP function
- 1 - Battery charger

The equipment shall be supplied from emergency AC 100 V single-phase system and DC 24 V system from radio battery.

Furthermore the following equipment shall be provided.

- 1 - MF/HF remote controller in wheelhouse
- 1 - RO printer in wheelhouse
- 1 - Complete set of accessories
(1 - tester, 1 set - tools, 1 - flash light)
- 1 - Radio battery in battery room
(DC 24 V 200 Ah at 10 hour discharge, lead acid type SS-200)
- 1 - Transmitter antenna (self-supporting type)
- 1 - Receiving antenna (whip type) on compass deck



10.3 VHF RADIO TELEPHONE

Two (2) complete sets of VHF radio telephone shall be installed as follows :

No.1 VHF RADIO TELEPHONE

- 1 - Transmitter receiver of simplex operation with control unit, DSC watch receiver and DSC function in wheelhouse
No. of channels ----- 54
- 1 - Printer in wheelhouse
- 2 - Antenna on radar mast and compass deck
- 2 - Receptacle for handset on both bridge wings
- 1 - Emergency spot light

The equipment shall be supplied from emergency AC 100 V single-phase system and DC 24 V system from radio battery.

No.2 VHF RADIO TELEPHONE

- 1 - Transmitter receiver of simplex operation with control unit and DSC function in wheelhouse
- 1 - Antenna on radar mast
- 1 - Emergency spot light

The equipment shall be supplied from emergency AC 100 V single-phase system and DC 24 V system from radio battery.



10.4 WEATHER FACSIMILE

One (1) complete set of weather facsimile recorder (10 inches) shall be installed in **radio instruments space** or wheelhouse.

One (1) whip antenna shall be installed on compass deck.

The equipment shall be supplied from the power source of the radio console or emergency AC 100 V single-phase system.

10.5 ANTENNA MULTI-COUPLER

One (1) complete set of antenna multi-coupler for broadcast radio receivers shall be installed as follows :

- 1 - Amplifier in **radio instruments space**
The amplifier shall be supplied from emergency AC 100 V single-phase system.
- Each 1 - Outlet box in all cabins and public rooms
- 1 - Antenna (whip type)

10.6 TELEVISION

Television receiver of international colour type shall be installed as follows :

- 1 - **Saloon** (42 inches LCD)
- 1 - Crew's smoking room (26 inches LCD)
- Each 1 - TV outlet in captain's day room and chief engineer's day room

Television antenna shall be of omnidirectional type.

The equipment shall be supplied from AC 100 V single-phase system.

10.7 DVD PLAYER

Two (2) sets of DVD player (multi region type) shall be installed as follows :

- 1 - **Saloon**
- 1 - Crew's smoking room

The equipment shall be supplied from AC 100 V single-phase system.



10.8 STEREO

Two (2) sets of stereo with CD player shall be installed as follows :

- 1 - Saloon
- 1 - Crew's smoking room

The system shall be supplied from AC 100 V single-phase system.

10.9 CABIN RADIO

Not fitted

10.10 INMARSAT

Two (2) complete sets of INMARSAT shall be installed as follows :

INMARSAT - FB

- 1 - Main unit in radio instruments space
- 1 - Antenna unit on compass deck
- 2 - Telephone set in radio instruments space and captain's day room
- 2 - Receiving buzzer in wheelhouse and A deck in passage
- 1 - Facsimile in radio instruments space

Each ID for 1st telephone, facsimile and data communication shall be got for INMARSAT - FB by the Owner.

The personal computer and printer shall be provided by the Owner.

The system shall be supplied from emergency AC 100 V single-phase system.



INMARSAT STANDARD-C

- 1 - Data terminal in wheelhouse
- 1 - Printer in wheelhouse
- 1 - Telex receiving buzzer in wheelhouse
- 1 - Remote distress button in wheelhouse
- 1 - Antenna unit on radar mast

The INMARSAT standard-C shall be included EGC (Enhanced Group Call) reception function.

Furthermore, the Ship Security Alert System shall be incorporated into INMARSAT standard-C and two (2) push button switches shall be provided.

The system shall be supplied from emergency AC 100 V single-phase system and DC 24 V from radio battery.

10.11 MARINE TELEPHONE

Not fitted

10.12 400 MHz TRANSCEIVER

One (1) complete set of 400 MHz transceiver for general use and fire-fighter's communication shall be installed as follows :

- 3 - Walkie-talkie (Explosion proof type)
- 3 - Spare battery pack
- 3 - Battery charger
- 1 - Ledge for battery charger in radio instruments space

The battery charger shall be supplied from AC 100 V single-phase system.



10.13 TWO WAY RADIO TELEPHONE APPARATUS

One (1) set of two way radio telephone apparatus shall be installed as follows :

- 3 - Walkie-talkie
- 3 - Battery charger
- 1 - Ledge for battery charger in radio instruments space
- 3 - Lithium primary battery pack

The battery charger shall be supplied from AC 100 V single-phase system.

10.14 SATELLITE EPIRB

One (1) set of satellite EPIRB shall be installed on bridge wing outside of wheelhouse.

10.15 NAVTEX RECEIVER

One (1) set of NAVTEX receiver shall be installed as follows :

- 1 - Receiver in wheelhouse
- 1 - Antenna equipment on compass deck

The system shall be supplied from DC 24 V system.

10.16 RADAR TRANSPONDER

Two (2) sets of radar transponder shall be installed in wheelhouse and free fall life boat.

10.17 AIS

One (1) set of AIS (Automatic Identification System) shall be installed as follows :

- 1 - AIS controller with display on the front wall in wheelhouse
- 1 - Antenna equipment on compass deck
- 1 - Pilot plug on the front wall in wheelhouse
- 1 - AC 100 V receptacle for P.C.

The signal for AIS shall be supplied from GPS navigator and gyro compass.

Output signal of AIS shall be connected to No.1, No.2 Radar TT.

The system shall be supplied from DC 24 V system.



10.18 SSAS

One (1) set of SSAS (Ship Security Alert System) shall be incorporated into INMARSAT standard-C as follows :

- 1 - Control unit
- 2 - Alert button

The equipment shall be supplied from the power source of the INMARSAT standard-C system.

10.19 SHIP SHORE COMMUNICATION SYSTEM

One (1) set of ship shore communication system shall be provided.
The system shall be capable of monitoring of the following data at shore side by using internet web site.

- Data logger data
- VDR data
- Loading computer data

The equipment shall be supplied from DC 24 V system.

10.20 FLEET PHONE

One (1) set of fleet phone shall be provided by the Owner as follows :

- 1 - Main unit in navigation locker
- 1 - Antenna equipment on radar mast
- 1 - Telephone set

The system shall be supplied from emergency AC 100 V single-phase system.



SECTION 11 ELECTRICAL SPARE PART AND TOOL

11.1 GENERAL

The following spare parts and tools for electrical equipment shall be furnished for the Vessel.

The number of spare parts shall be calculated on the basis of the sum of identical fitting parts of equipment for the Vessel supplied by each manufacturer.

The spare parts and tools shall be stowed in suitable steel boxes or wooden boxes and shall be protected against deterioration due to long term stowage on board the Vessel.

11.2 MAIN GENERATOR

| | |
|----------------------------------|-------------------------|
| Bearing | 1 for each 4 or less |
| Rectifier for exciter | 1 phase unit |
| Resistor | 1 for each kind |

11.3 SWITCHBOARD, CONTROL PANEL AND PANEL BOARD

| | |
|-----------------------------------|--|
| Operation Coil or shunt coil | 1 for each 1, up to a maximum of 10 |
| Contact | 1 for each 1, up to a maximum of number corresponding to 10 sets of each type breaker or contactor |
| Spring | 1 for each 1, up to a maximum of 10 |
| Moulded case type circuit breaker | 1 for each 10 or less, up to a maximum of 5 |
| Auxiliary relay | 1 for each kind |
| Resistor | 1 for each kind |
| Pilot lamp bulb | 1 for each 1, up to a maximum of 30 |
| Pilot lamp lens | 1 for each 10 or less, up to a maximum of 5 |
| Indicator lamp | 1 for each kind |
| Switch | 1 for each kind |
| Non-renewable fuse | 1 for each 1, up to a maximum of 20 |
| Fuse puller | 1 |



11.4 **MOTOR**

The following spare parts shall be furnished for motors which are installed as important use.

| | |
|---------|---|
| Bearing | 1 for each 4 or less, with a minimum of 1 set |
|---------|---|

However, spare parts of motors with which the machinery and equipment are mounted shall be in compliance with the manufacturer's standard.

11.5 **CONTROL EQUIPMENT**

| | |
|------------------------------|---|
| Operation coil or shunt coil | 1 for each 10 or less, up to a maximum of 2 |
| Resistor | 1 for each 10 or less, up to a maximum of 5 |
| Pilot lamp bulb | 1 for each 1, up to a maximum of 30 |
| Pilot lamp lens | 1 for each 10 or less, up to a maximum of 5 |
| Non-renewable fuse | 1 for each 1, up to a maximum of 20 |



11.6 LIGHTING

| | |
|---|---|
| Lamp bulb for navigating lights | 2 for each 1 |
| Incandescent lamp bulb for general lights | 1 for each 4 or less |
| Fluorescent lamp tube | 1 for each 10 or less, up to a maximum of 20 |
| Mercury lamp bulb | 1 for each 10 or less, up to a maximum of 20 |
| Pilot lamp bulb | 1 for each 1 |
| Glow lamp | 1 for each 10 or less, up to a maximum of 20 |
| Pilot lamp globe or lens | 1 for each 10 or less |
| Glass globe | 1 for each 10 or less, up to a maximum of 10 |
| Plastic globe | 1 for each 20 or less, up to a maximum of 10 |
| Lamp socket | 1 for each 20 or less, up to a maximum of 20 |
| Non-waterproof type switch | 1 for each 20 or less, up to a maximum of 10 |
| Non-waterproof type plug and receptacle | 1 for each 20 or less, and receptacle up to a maximum of 10 |
| Fuse case | 1 for each 10 or less, up to a maximum of 10 |
| Fuse element | 1 for each 1 |

11.7 INTERIOR COMMUNICATION EQUIPMENT

Spare parts for interior communication equipment shall be furnished in accordance with the manufacturer's standard.

11.8 ELECTRICAL NAVIGATION EQUIPMENT

Spare parts for electrical navigation equipment shall be furnished in accordance with the manufacturer's standard.



11.9 RADIO EQUIPMENT

Spare parts for radio equipment such as MF/HF radio installation, VHF radio telephone etc. shall be furnished in accordance with the manufacturer's standard.

11.10 ACCESSORY FOR STORAGE BATTERY

| | |
|-------------------------------------|---|
| Portable DC voltmeter 0 ~ +18 V | 1 |
| Hydrometer with spout 1.100 ~ 1.300 | 2 |
| Rod thermometer -20°C ~ 0 ~ +100°C | 2 |
| Syringe with plastic tube of 6 m | 1 |
| Plastic jug (2 liters) | 1 |
| Plastic funnel (148 φ) | 1 |
| Distilled water in can of 18 liters | 1 |
| Spout | 1 |

~~Furthermore, the battery charge for lifeboat batteries shall be provided as follows :~~

| | |
|---|--------------|
| Battery charger DC 12 V 25 A | 1 |
|---|--------------|

11.11 METER

| | |
|--|---|
| 500 V megger for reading from 0 to 100 M ohm | 1 |
| Clamp ammeter for reading from 0 to 300 A | 1 |
| Circuit tester | 1 |



11.12 TOOL AND MATERIAL

| | |
|-------------------------------------|-------------------------------|
| Screw driver of assorted size | 1 set (6 drivers in total) |
| Open ended spanner of assorted size | 1 set (6 spanners in total) |
| Cutting nipper | 1 |
| Cutting plier | 1 |
| Round nose plier | 1 |
| Adjustable angle wrench | 1 |
| Steel file | 1 |
| Jack knife | 1 |
| Electric soldering iron | 2 (1 - 60 W, 1 - 150 W) |
| Check lamp | 1 |
| Electric cable (TPYC-2.5) | 1 length (30 meters) |
| Electric cabtyre cord (H-TPNP-1) | 1 length (30 meters) |
| Vinyl tape | 6 |
| Solder | 1 roll |

11.13 ACCESSORY FOR ARC WELDER

| | |
|------------------|---------|
| Hand shield | 2 |
| Cover glass | 2 |
| Filter lens | 2 |
| Leather glove | 2 pairs |
| Electrode holder | 2 |