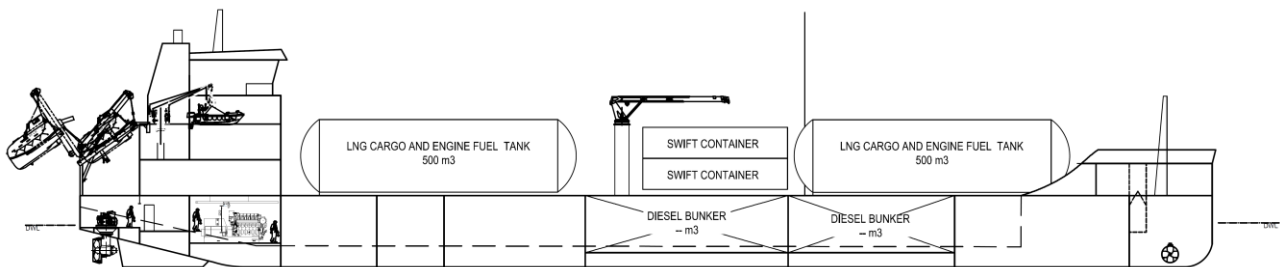


OUTLINE SPECIFICATION

LNG & DIESEL BUNKER SHIP



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1 SHIP GENERAL

The purpose of the vessel has been to design a highly flexible platform that enables the operator to:

- Start with a small number of LNG storage tanks and increase the number of LNG storage tanks as the market develops
- Transport a large amount of diesel bunker on-board enabling a diesel bunker trade in the beginning (more tanks than the shown can be installed if requested)
- Carry a number of 40" ISO gas containers on the upper deck enables the operator to provide LNG to ports very fast e.g. between a ferry departure and arrival. The containers are designated as "swift containers"
- The open deck installation allows a high degree of independent design of the top-side

The vessel shall be designed and constructed as an environmentally friendly, all welded steel ship with gas/diesel electrical twin thruster propulsion.

The engine room is located below the superstructure aft. The forward mooring platform is located on the foc'sle deck.

10 GENERAL DESIGN

MAIN DIMENSIONS

Length over all		95.3 m
Length between perpendiculars		93.10 m
Breadth moulded		18.0 m
Depth moulded		6.0 m
Design draft moulded		3.5 m
Scantling draft moulded		3.5 m
Air draft (from baseline)	Approx.	21.6 m

DEADWEIGHT

Deadweight at design draft	Abt.	2,082 t
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DECK HEIGHTS, CAMBER AND SHEER

Deck heights to be as shown on the General Arrangement. No camber will be arranged except for navigation bridge wings.

SPEED

The speed is subject to final power predictions but is expected to provide a service speed on 8-10 knots with 15% sea margin, on the design draught 3.5, in calm weather and with clean hull. For details of the propulsion platform, see Section 6.

CAPACITIES AND RANGE

Water ballast (100%)	Abt.	1,960	m ³
Diesel Oil, cargo (98%)	Abt.	1,987	m ³
Fresh water (100%)	Abt.	100	m ³

11 RULES, REGULATIONS AND CERTIFICATES

111 RULES & REGULATIONS

The vessel shall be designed, constructed and outfitted in accordance with the rules and regulations of American Bureau of Shipping (ABS) with the following base line class notation (additional notations may be added in final design).

ABS Unrestricted Navigation + A1 Liquefied natural gas carrier with independent tanks, GFS, ACCU, ICE-CLASS 1C

The Vessel to be registered in Sweden.

The following rules and regulations including any circular or amendments, which are in force at the date of signing the ship's contract, to be applied.

- Class Rules according to Class Notation
- Maritime Regulations of the Flag State
- International Load Line Convention
- International Convention for the Safety of Life at Sea, SOLAS
- International Convention for the Prevention of Pollution from Ships, MARPOL
- International Convention on the Control of Harmful Anti-Fouling Systems on Ships
- International Convention on Tonnage Measurement of Ships,
- International Telecommunication Union (ITU) Radio Regulations, including GMDSS rules
- International Labour Organisations Maritime Labour Convention
- MSC Requirements for Emergency Towing
- CSS CODEIMO Res. MSC337(91) Code on Noise Level on board Ships
- ISO 6954:2000, guidelines for the overall evaluation of vibrations in ships
- IMO NOx Tier II compliance for engines (engines fulfils TIER III in gas operation)
- EU Ultra low-sulphur Directive (Directive 2005/33/EC)
- INMARSAT Regulation
- IEC requirements for electrical installations in ships
- IMO Res. A 574 (XIV), Recommendation on General Requirements for Electronic Navigation Aids
- BNWAS – Bridge Navigational Watch Alarm System
- IGC-code

BUILDING QUALITY AND STANDARDS

The following standards to be used in relation to the construction of the vessel, as far as practicable unless specially described hereinafter.

- Industrial Standards (DIN, DS, Dansk Værftsstandard, JIS or ISO)
- Builder's standard
- Applicable Classification Society standards,
- Fire, safety, navigation and communication equipment to be EEC wheel marked.

2 HULL

20 GENERAL HULL WORK

The vessel's hull structure has to be designed in welded steel construction in accordance with the requirements of the Classification Society. Continuous welding has to be used throughout, except for dry rooms in the accommodation.

The Vessel shall have longitudinal framing as far as possible. Proper accessibility to all rooms, tanks and other spaces should be obtained.

Decks to be without sheer or camber.

The minimum allowed still water bending moment to be as required by the class rules.

201 HULL MATERIAL

Mild steel Grade A is used all over the ship.

Materials should be approved by the Classification Society. However, where scantlings do not need to be approved by the Classification Society, scantlings shall be in accordance with Builder's practice and the steel material shall be shipbuilding quality.

21 AFT BODY

The vessel to have transom stern.

21 ENGINE ROOM

Double bottom shall be arranged in engine room, fitted with floors at every frame, and side girders arranged in positions to suit the engine seatings. Construction has to be designed according to the guidelines of the engine manufacturer.

23 CARGO AREA

Oil cargo tanks is to be arranged according tank plan.

Watertight and oil tight bulkheads to be of corrugated type.

24 FORE BODY

A well-supported bulwark have to be arranged on the forward mooring deck in principle as shown on the General Arrangement Plan.

Openings for mooring fittings to be reinforced wherever necessary. Bulwark top to be fitted with steel top plate or bulb profile

Two (2) chain lockers to be arranged forward with sufficient capacity for self-stowage of chains.

Two (2) hawse pipes to be built and arranged in accordance with windlass arrangement on the forward mooring deck.

25 DECKHOUSE / SUPERSTRUCTURE

Internal steel walls in deck house to be of corrugated and/or plane type suitably stiffened. Steel walls to be arranged around rooms according to Class' and Regulatory Bodies requirements.

Engine casing outside to be constructed by plane steel walls with vertical stiffeners.

Deck plates in deck house may be arranged protruding the side walls. External free edges to be rounded.

26 HULL OUTFITTING

All tank and deck areas to be provided with sufficient drainage.

SEA CHEST

All sea chests are to be designed for efficient fouling control. Steel boundaries of sea chests to be according to class requirements.

Bilge Keels to be fitted in approx. 30% of the perpendicular length, in the water flow direction.

27 MATERIAL PROTECTION EXTERNAL

270 PAINT

Corrosion protection to be based on the following standards:

Design considerations (ISO 12944-3). Classification of environments (ISO 12944-2). Protective paint systems (ISO 12944-5).

PAINT SCHEME

Area	Type of Paint	No. of Coat	Total DFT.
Flat bottom (under bilge keel level)	Epoxy (abrasion resistant)	2	250
	Epoxy (tie coat)	1	100
	Self-polishing Antifouling * (Silyl acrylate copolymer)	2	250
Side bottom and boot top	Epoxy (abrasion resistant)	2	250
	Epoxy (tie coat)	1	100

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	Self-polishing Antifouling * (Silyl acrylate copolymer)	3	375
Topside	Epoxy	2	250
	Polyurethane	1	50
Deckhouse (outside)	Zinc Epoxy	1	60
	Epoxy	1	125
	Polyurethane	1	50
Cargo tanks, diesel	Epoxy coated, to be discussed with paint supplier		
Water ballast tanks	Epoxy IMO RESOLUTION MSC.215(82)	2	320
Fresh water tanks	Epoxy (solvent free) Certified by "Water Research Center" and/or "Norwegian Institute of Public Health"	2	300
Lubricating oil tanks	Epoxy	2	200
Cofferdams & Void spaces	Epoxy	2	200
Engine room & Accommodation	Alkyd (Or alternative paint)	2	120
Behind lining on exposed bulkheads	Epoxy (Or alternative paint)	1	125
Behind lining on protected bulkheads	No paint		
Inside of structural ventilation ducts.	Epoxy	2	250

Note *) Design lifetime of A/F paint system to be 5 years. The final paint scheme may have alteration in number of coats and dry film thickness in accordance with the specification of the Paint Manufacturer selected.

The underwater hull to be coated to a maximum average hull surface roughness of 120 microns.

The wheelhouse top to be painted in a white colour to decrease the heat absorption on the bridge.

278 CATHODIC PROTECTION

Sacrificial Al anodes in water ballast tanks, lifetime according to docking intervals, based on 5mA/m² and 50% ballast ratio.

Sacrificial Al anodes, lifetime according to docking intervals, on propulsion thruster, stern thruster, and sea suction chest.

An automatic self-adjusting impressed current cathodic protection system (ICCP) shall be provided for other hull protection. Current density to be about 35 mA/m².

3 EQUIPMENT FOR CARGO

LNG CARGO SYSTEM

The LNG cargo system consists of a highly flexible and scalable platform allowing a high degree of adjustment to the specific need of the operator.

The LNG cargo system is located on and above the upper deck.

LNG DESIGN PARAMETERS

The design parameters of the system shall be:

- Min LNG temperature: -163°C
- LNG design density: 500 kg/m³
- LNG normal density: 460 kg/m³
- Max pressure: 6 barg

Reference is made to the plant design specification made by Marine Service GmbH. The specification from Marine Service GmbH shall be further worked through in next project phase.

Note that the specification is confidential and cannot be delivered to third party.

DIESEL CARGO SYSTEM

DIESEL DESIGN PARAMETERS

- Density: 860 kg/m³
- Low sulphur diesel according to ISO8217-2010 DMA

31 CARGO HANDLING EQUIPMENT IN HOLDS AND ON DECK

312 CARGO CONTAINMENT SYSTEM

Four (4) diesel oil storage tanks are located below the main deck (more can be installed if requested).

351 LOADING/DISCHARGING PUMPS

Two (2) diesel oil transfer pumps to be installed in the pump room. The capacity of each shall be 350 m³/h.

352 LOADING/DISCHARGE SYSTEMS ON DECK

Diesel bunker valves to be located at the LNG bunker manifolds.

Diesel can be bunkered simultaneously with LNG.

Drop lines for bunkering of diesel into the ship to be installed.

381 SOUNDING, SURVEIL & OPERATION EQUIPMENT FOR CARGO SYSTEMS

CARGO DELIVERY BILLING

The delivered amount to be determined by sounding of the cargo tanks.

Optional bunker flow meters can be installed.

OTHERS

LIGHT

The deck areas where bunkering takes place shall be well illuminated.

4 SHIP EQUIPMENT

40 MANOEUVRING MACHINERY AND EQUIPMENT

401 RUDDER

The ship is equipped with two (2) steerable thrusters with integrated gearbox serving as rudders.

404 THRUSTERS

One (1) bow thruster:

- El-motor 690 kW with frequency drive
- Fixed pitch propeller, diameter app. 1.2 m

41 NAVIGATION & SEARCHING EQUIPMENT

411 RADAR PLANTS

The following equipment to be installed:

- 1 "X" band (9 GHz) radar with ARPA

412 GPS

The following equipment to be installed:

- 1 DGPS

413 NAUTICAL EQUIPMENT

The following equipment to be installed:

- 1 Gyro compass
- 1 Gyro compass repeater (for emergency steering stand)
- 1 Gyro compass repeater "pelorus stand" with azimuth circle
- 1 Magnetic compass
- 1 Spare magnetic compass
- 1 Autopilot with interface to the magnetic and gyro compass

414 ECHO SOUNDER, SPEED LOG

The following equipment to be installed:

- 1 Echo sounder
- 1 Speed log

417 NAUTICAL UTILITY EQUIPMENT, CLOCKWORKS, WEATHER FACSIMILE

The following equipment to be installed:

- 1 Anemometer
- 1 Weather facsimile
- 1 Bridge Navigational Watch alarm system (BNWAS)

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- 1 Voyage Data Recorder system
- 1 AIS system
- ECDIS, navigation station and planning station interfaced to DGPS, radar, echo sounder, speed log, compass, AIS and autopilot
- 1 Sextant
- 1 Inclinator
- 1 Aneroid barometer
- 2 Outdoor thermometers
- 4 Draught sensors; forward, aft, PS and SB amidships

42 COMMUNICATION SYSTEM

421 RADIO PLANT, GMDSS

The radio equipment to be supported by necessary auxiliaries for GMDSS sea area A1.

Radio station/GMDSS power supply as specified in section 866

422 LIFEBOAT RADIO TRANSMITTERS, EPIRBs

The following equipment to be delivered:

- 1 EPIRB float free
- 2 Radar transponders (SART)

424 VHF/UHF TELEPHONES

The following equipment to be delivered:

- 3 UHF portable radio telephones for on-board operation with battery and charger suitable for use on-board gas tankers

425 CALLING/CMDR/CREW CALL TELEPHONE PLANTS, WALKIE-TALKIES

The following equipment to be installed:

- Public address system with talk back system (include integrated fire and general alarm facility)
- Sound Powered Telephone (SPT) or Common Battery Telephone (CBT) system as required by Classification society

427 LIGHT & SIGNAL EQUIPMENT, LANTERNS, TYPHOONS

The following equipment to be installed:

- Navigational and signal lights according to International Regulations (COLREG) including control facilities in wheel house
- 1 Aldis signal Lamp (bridge)
- 1 Typhoon/Fog Horn
- 1 External sound reception system
- 1 Electronic Fog bell & gong system

43 ANCHORING, MOORING & TOWING EQUIPMENT

431 ANCHORS WITH CHAINS

Two (2) Spek type bow anchors (approx. 2,640 kg each) or equivalent high holding anchors.

Stud link chain cables, 40 mm, Grade 3, total length approx. 467.5 m. To be delivered in units of 27.5 m with shackle.

432 WINDLASSES AND MOORING WINCHES

On the foc'sle mooring deck two (2) electric driven mooring winches to be installed each with:

- One (1) declutchable cable lifter with hand-operated band brake
- One (2) mooring rope drums of split type with auto self-tension, one on each side of the cable lifter
- One (1) warping head of cast iron
- Two (2) chain stoppers.

One (1) electric driven mooring winch to be installed on foc'sle for transverse mooring with:

- Two (2) Single mooring rope drum of split type with auto self-tension
- One (1) warping head

Two (2) Electric driven mooring winches to be installed on upper deck aft, each with

- Two (2) single mooring rope drum of split type with auto self-tension
- One (1) Warping head

436 MOORING EQUIPMENT

Sizes and numbers of below equipment to suit arrangement, rope dimensions, applicable rules and necessity.

A sufficient number of fairlead, bollards and chocks rollers to be arranged.

Emergency towing arrangement, including Smith brackets, safe bit or similar to be arranged fore and aft.

44 REP/MAINT/CLEAN EQUIP WORKSHOP/STORE OUTFIT, NAME PLATES

444 CLEANING EQUIPMENT, GARBAGE CHUTES

One (1) multi-chamber dry garbage compression system shall be installed with three (3) chambers for sorting and compression of waste. One (1) of the three (3) chambers to be equipped with a glass crusher. Space to be allocated nearby for sorting of waste and storage of compressed volumes so that all garbage can be stored. The compactor shall be electromechanically driven, with a compacting of 80-90% for common garbage.

446 OUTFITTING IN STORE ROOMS & WORKSHOPS

Stores space is provided in the forecastle, at the casing entrance from aft mooring deck and in the engine room.

Engine workshop with bench for electrical work will be arranged in the engine room.

45 LIFTING & TRANSPORT EQUIPMENT FOR MACHINERY COMPONENTS

453 LIFTING GEAR

- Engines overhead crane beam with trolley according to engine maker's requirements
- Trolley and beam above separators
- Lifting eyes above heavy parts, marked with SWL and load tested

- Hinged hatch (app. 1,400 mm x 1,200 mm) shall be fitted aft of desk house in SB side for engine spares. A crane to be arranged for moving the spares through the watertight door opening.
- Crane for combined provision and rescue boat operation with a SWL of 6 t and outreach of 4m over the ships side SB to be fitted

5 EQUIPMENT FOR CREW

50 LIFE SAVING EQUIPMENT

All lifesaving appliances to be provided for minimum 12 persons.

The vessel to be equipped with one (1) totally enclosed freefall lifeboat facing aft mounted in a davit. The capacity shall be 12 persons. The lifeboats shall be of glass fibre reinforced plastic and equipped with a water-cooled diesel engine. Engine start shall be electrically battery powered with battery charged by solar panels.

One (1) rescue boat to be installed SB side operated by a common provision and rescue boat crane, see chapter 453 for crane details.

Inflatable life-rafts to be provided as required by regulations (IMO/SOLAS).

- Inflatable life rafts in GRP containers to be arranged in each side
- Additional life raft, with minimum capacity for 6 persons to be arranged on the forecastle deck

Personnel lifesaving appliances to be provided in accordance with the relevant Rules and Regulations

505 LOOSE FIRE EQUIPMENT

Firefighting apparatus and equipment to be provided in accordance with the relevant rules and regulations. A fire locker is located close to the ship's office with where the fire station is located.

51 ACCOMMODATION GENERAL

The accommodation consist of an upper deck level where the service functions are located together with 1-2 cabins. An A-deck floor where seven cabins are located and the deck serves as the private area. Between A-deck and wheel house technical spaces for HVAC and wheelhouse electronics are located with entrance from open deck.

CABINS:

- 2 Captain class (A), combined day-room/office and double-bed bedroom with private shower and toilet. Both located at the A-deck, one each side
- 6 Ordinary cabins (B), day room and single-bed with private shower and toilet. 5 cabins are located at the A-deck.

A 9th cabin can be included in the flex room on upper deck. The flex room is of equal size to the ordinary cabins and can be equipped according to owner's request e.g. as gymnasium, library, stores room or as a cabin. The 8th cabin can be changed to flex room if so is wanted.

OTHER SPACES:

- Wheelhouse
- Ship's office (deck office, engine control room and fire station)
- Laundry
- Galley
- Dry and cold provision located next to the galley
- Garbage room
- Mess & lounge (the lounge area is located adjacent to the mess as an open space)
- Emergency generator room
- Linen and other stores cabinets shall be located as needed

FURNISHING:

Accommodation lining shall be a combination of steel sheeted mineral wool bulkheads and painted steel bulkheads as appropriate. Ceilings shall be steel sheeted mineral wool panels. Decks to be covered with vinyl in general, however, painted in the gangway to the ship's office from open deck. Carpet to be installed in the cabins. Curtains to be fitted in cabins and public rooms. Suitable furniture of good quality to be installed.

ELECTRICAL CONSUMERS:

The following electrical equipment in the accommodation is to be of the highest energy class as specified in the Directive 2010/30/EU and related documents:

- Refrigerators
- Washing machines and dryers
- Dishwashers
- Ovens
- Televisions

517 INSULATION

The hull and house structures shall be insulated for heat, fire and/or noise purposes. However, in general insulation not to be provided where exposed steel wall is lined with lining panels of similar insulation capability.

The insulation material and construction shall meet the relevant rule and regulations. All insulation shall be felt-type of Builder's standard.

Light concrete or foam compound shall be laid under the deck composition where accommodation and alleyways is to be placed over heated tanks and the like.

53 STAIRWAYS AND LADDERS

Stairways shall be arranged inside the accommodation. One part will connect the accommodation upper deck floor with the engine room floor located below. The entrance is located close to the ship's office where the engine control room is located. One will connect the accommodation upper deck with the accommodation A-deck. One will connect the accommodation A-deck with the bridge deck.

Inclined steel ladders to be arranged on outside of the accommodation between exposed decks and platforms.

From upper deck cargo section an inclined steel ladder will lead to the cargo pump room.

Steel vertical ladders to be fitted to large size ventilators, masts, davits, void spaces etc. as well as access to cofferdams and tanks as needed.

Emergency escapes from rooms according to rules and as necessary for safe operation.

54 FURNITURE, INVENTORY AND ENTERTAINMENT EQUIPMENT

546 ENTERTAINMENT EQUIPMENT

The following equipment to be installed:

- In class (A) cabins: one (1) 40" flat screen TV with available HDMI connection, one (1) DVD/blue-ray player and one (1) stereo system with aux-connection
- In class (B) cabins: one (1) 22" flat screen TV with available HDMI connection, one (1) DVD/blue-ray player and one (1) stereo system with aux-connection
- One (1) set of combined TV (digital and analogue as appropriate in the region)/radio signal (FM, AM, SW) system with outlet in all accommodation cabins shall be installed
- In lounge: one (1) 50" flat screen with, available HDMI connection, connected to a DVD/blue-ray player. In addition a surround sound system shall be installed with aux-connection

All electrical appliances to be sufficiently fixed to the ship.

56 TRANSPORT EQUIPMENT FOR CREW & PASSENGERS

563 PROVISION CRANES & DERRICK

See chapter 453.

564 ACCOMMODATION LADDER AND PILOT LADDER

Accommodation ladders made in aluminium to be provided.

Rope pilot ladder to be arranged in both sides for access to upper deck.

57 VENTILATION, AIR-CONDITIONING AND HEATING SYSTEMS

GENERAL

The following ventilation systems to be provided:

- One (1) ventilation and air-conditioning system for accommodation including wheelhouse
- One (1) ventilation system for galley
- One (1) machinery space ventilation
- One (1) pump room ventilation
- One (1) workshop self-contained air-conditioning system
- Sundry ventilation air changes systems for other small spaces

571 ACCOMMODATION AND WHEEL HOUSE AIR-CONDITIONING

The accommodation to be ventilated, heated and cooled by a single pipe air conditioning system, which shall meet the national regulations applicable, and at least the following design conditions and requirements:

LNG BUNKER VESSEL

HEATING:	OUTSIDE AIR	- 20°C
	INSIDE AIR	+ 22°C
COOLING:	OUTSIDE AIR	+ 35°C
	REL. HUMIDITY	70 %
	INSIDE AIR	+ 27°C
	REL. HUMIDITY	50 %

The AHU to be equipped with enthalpy wheel and frequency converters on the supply and exhaust fans. The air filtration to be provided with a G4 filter installed in the AHU and a de-mister at the outer air intake. Manual closing devices to be installed at air intake and exhaust.

Fresh water for humidifier to be provided from the fresh water system via a dedicated sterilising device.

The cooling of the air-handling unit for the accommodation to be arranged with chilled water powered by two (2) cooling compressors with each 50% capacity. Cooling medium shall be R134A (ODP = 0 and GWP shall be below 1890).

Heating of the AHU shall be done electrical and/or with heat recovery from the engine cooling water. Cooling of chilled water with LNG evaporation energy via the heat exchange system shall be possible.

Separate exhaust system to be provided from toilets etc.

For the ceiling, mounted air inlets in each cabin one (1) 500W electric heater coil with manual temperature control to be installed.

GALLEY HVAC

One (1) separate air handling and conditioning unit designed for 100% fresh air supply for galley to be installed. Refrigerant to be provided from the chilled water system; hence, the refrigeration unit is common with the accommodation.

One (1) galley hood extraction fan to be provided taking suction from inside the galley hood. The fan to be installed in the garbage room in order to lower noise in the accommodation.

Heating of the AHU shall be done electrical and/or with heat recovery from the engine cooling water.

Manual closing devices to be installed at air intake and exhaust.

574 VENTILATION SYSTEM FOR THE ENGINE ROOM

Inlets to the engine room shall be fitted with water mist catchers. After the water mist catcher G4 filters to be provided.

The ventilation system will also supply to the switchboard room and be equipped with fire dampers allowing quick closing from outside the engine room.

Two (2) frequency controlled engine room fans to be provided in one duct. The fans to be controlled by the temperature and pressure in the engine room.

VFD driven fan motors to be equipped with PTC temperature sensor for winding temperature monitoring. The PTC temperature sensors for winding temperature monitoring to be compatible with the motors respective VFD.

SEPARATOR AREA VENTILATION

Ample mechanical point extraction ventilation arrangement to be provided for the separator.

WORKSHOP HVAC

The Workshop to be provided with a self-contained electrical air-handling unit located inside the workshop.

The estimated cooling capacity is 10 kW.

The refrigerant shall be R134A.

Point extraction from the welding area to be provided. The duct shall convey the air into the engine room where from it is lead to the top of funnel together with the engine room ventilation flow.

58 SANITARY SYST. W/DISCHARGES, ACCOMMODATION DRAIN SYSTEMS

581 SANITARY SUPPLY SYSTEMS

For freshwater supply, two (2) 100% FW booster pumps and one (1) 18-liter bladder type hydrophore tank to be provided. For constant system pressure control a frequency, controlling to be applied to the pumps.

Circulation of hot sanitary water (up to 85°C) takes place by two (2) times 100% pumps in a ring system. The capacity is estimated to 1 m³/h @ 0.3 bar. A calorifier of with 9 kW electrical heater and the possibility to use excess heat from the cooling water systems to be provided in the ring circulation system.

582 SANITARY DISCHARGE SYSTEMS

The sanitary discharge system for black water consists of a vacuum system to minimize water consumption and a gravity system for the grey water system. The vacuum system provides constant vacuum.

The black and grey water are led to a sewage-holding tank which is a structural tank. The vacuum system is served by two (2) pumps.

Piping must be arranged in order to allow grey water to drain directly overboard through a full bore valve.

From the sewage holding tank, the fluid is process into a sewage treatment plant from where it is discharged overboard.

The discharge from the galley to be provided with a grease trap before entering the sewage treatment system. The heated drain from the grease trap to be led by gravity to the sludge tank.

COOKING OIL COLLECTION

In order to comply with Marpol 73/78 Annex V from January 2013 space for a container of 40 liter containing used cooking oil to be reserved in the garbage area.

SEWAGE PLANT

A sewage treatment unit with two (2) times 100% discharge pumps designed for treatment of 1.11 kg BOD₅/day to be installed (equal to 13 persons).

6 MACHINERY MAIN COMPONENTS

60 DIESEL ENGINES FOR PROPULSION

601 MAIN ENGINE

Two (2) 4-stroke generator sets are installed for supplying power to the electrical propulsion system and auxiliary systems. The engines are of the dual-fuel type with integrated double wall piping designed for running on natural gas with pilot diesel fuel or running on diesel.

When running on natural gas the engines fulfils TIER III. The engines also serves as BOG removing devices.

ENGINE	Wärtsilä 6L20DF
SPECIFIED MAXIMUM CONTINUOUS RATING (SMCR)	1,100 KWm EACH ENGINE
NOMINAL REVOLUTIONS	1200 RPM
TURBOCHARGERS	1 pcs
NUMBER OF CYLINDERS	6 (six) each engine
FUEL	Natural gas or diesel. The engines are capable of running at low sulphur DO with a viscosity of minimum 1.8 cSt at engine inlet.
AMBIENT CONDITIONS FOR OUTPUT:	In accordance with ISO3046-1-2002, i.e. barometric pressure 100 kPa, air temperature 25°C, relative humidity 30% and charge air temperature 25°C

The engines to take air suction from the engine room.

63 PROPELLERS

631 FIXED PITCH PROPELLER

Two (2) steerable thrusters are installed each with a 4-bladed propeller with a diameter on approx. 1500mm. The blades are manufactures in accordance ISO484-1981 class 1 and the surface according to ISO484-1981 class 2.

Around each propeller a nozzle is installed. The nozzle is of steel welded construction.

INTERMEDIATE SHAFT BEARING

No bearings between electrical propulsion motor and the thruster unit is assumed to be needed.

65 MOTOR AGGREGATES FOR MAIN ELECTRIC POWER PRODUCTION

651 MOTOR AGGREGATES

Refer to chapter 601.

Power factor 0.8 with no power factor compensation. Two (2) generator rooms are available with one (1) generator in each room. As the dual-fuel, engines are of double-pipe design the generator rooms does not need to be sealed rooms.

66 OTHER AGGREGATES & GEN. FOR MAIN & EMERGENCY EL. POWER PRODUCTION

665 DIESEL ENGINE FOR EMERGENCY/HARBOUR GENERATOR

One (1) 4-stroke diesel engine running 1800rpm, Power factor 0.8 to be installed as emergency harbour generator. The power rating is subject to final electrical load balance.

7 SYSTEMS FOR MACHINERY MAIN COMPONENTS

70 FUEL OIL SYSTEM

The fuel oil system shall handle low sulphur diesel oil (DO) (<0.1%) with low viscosity (ISO8217-2010,DMA with 2 cSt).

701 FUEL OIL BUNKERING AND TRANSFER SYSTEM

Bunker diesel to be transferred from the cargo tanks surveyed by a flow meter by the separator pump. During bunkering to ships the line shall be closed by a manual valve located at a place where it can be surveyed.

OVERFLOW

All service tanks to be arranged with overflow via a common overflow pipe to a fuel oil overflow tank. The overflow tank is assumed empty when sailing.

702 FUEL OIL PURIFICATION PLANTS

FUEL SEPARATORS

The separator draw from bunker diesel tank and delivers the oil to the service tanks through the top by splashing directed to the side of the tank.

A fuel oil purification plant to be installed consisting of one (1) self-cleaning separator with automatic control. The separator is rated for diesel separation only.

SLUDGE HANDLING

Sludge from the separators to be collected in the sludge tank from where it can be discharged to shore by a dedicated pump.

703 FUEL OIL SERVICE SYSTEM

The system to be arranged as a pressurized fuel oil system serving the main engines when running on diesel. Two (2) fuel circulation pumps to be installed. The pumps are discharging into the engine through a double fine filter.

The pilot fuel is lead to the engines by gravity from same tanks.

Two (2) DO service tanks to be installed. Each tank to be sized for minimum 8 hours of operation and filled by the separator. The service tanks to be located 1.5m above the crankshaft in order to provide pressure for dead-ship start and pilot fuel.

A diesel oil cooler shall be installed. The possibility to use a small shell tank accepted by MARPOL 12A as diesel cooler shall be evaluated.

707 GAS FUEL SYSTEMS

The gas fuel supply system to the engines is a low pressure gas system designed for a pressure below 10 bar. A gas fuel room is located at the upper deck in which the evaporation equipment to be installed.

LNG FUEL SUPPLY SYSTEM FROM CARGO TANK

Liquefied LNG to be supplied to the conditioning module from one (1) of the gas cargo tank.

BOG from all cargo tank can be delivered to the engine plant via a compressor for BOG removal. The compressor shall be located in the LNG fuel room.

LNG FUEL SUPPLY SYSTEM TO MAIN ENGINE

The system shall deliver vaporized LNG to the main engines through an LNG vaporizer. The heat for evaporation is subtracted from the ships engine cooling water system or the HVAC via a glycol circuit.

The master shut-off valve is installed outside the gas fuel room located on the upper deck for easy and safe access from the deck.

Pilot fuel will be used as ignition of gas blend in the cylinder. Diesel will be used as pilot fuel in accordance with engine maker's requirements and the SOx emission regulation in the area.

When a gas supply alarm request a stop the engine will automatically switch from gas mode to diesel mode and continue operation uninterrupted.

For each DG a vertical enclosed gas valve unit cabinet forming a second gas tight barrier to be installed in the engine room close to the engine itself. The unit to filter the gas and adjust the supply pressure to the engine in accordance with the engine's load. In addition it to contain the block and bleed valves to effective shut-off the gas supply to the engine on request.

Nitrogen for the bleed function to be taken from the nitrogen bottle battery located in the equipment room.

VAPORIZER SYSTEM

The system is a low-pressure system. The system will vaporize LNG by a water/glycol based circulation system consisting of two (2) 100% circulation pumps. The fluid shall be heated by excess heat in cooling water and air-condition systems. The system shall prior to vaporizing the LNG also condition the low pressure gas to the temperature specified by the equipment maker. The system is installed in the gas fuel room on upper deck.

LNG PIPING

Double wall piping to be applied in the engine room. The annular space shall be vented by an extraction venting fan.

FUEL GAS VENTING SYSTEM

An extraction fan to take suction from the annular space in the double piping and from the gas valve units. The fan shall be located at the upper deck. The fuel gas system shall vent to vent mast in the cargo area in order to be away from the accommodation. The capacity of the fan shall be 30 air changes per hour.

The gas supply space shall be ventilated by a separate fan and facilitate a high degree of natural ventilation.

71 LUBRICATION OIL SYSTEM

MAIN ENGINES

The lubrication system is of the wet sump type. The lubrication oil pump shall be of the direct drive type.

One (1) pre-lubrication pump driven by an electrical motor to be installed for each engine.

SEPARATORS (LUB-OIL SYSTEM)

One (1) self-cleaning lub-oil separator designed for 95°C separation temperature to be installed serving both engines. The separator shall discharge sludge to the sludge tank. Intermittent separation is expected to be sufficient.

From each engine the wet sump oil can be drained to the renovating oil tank prior to separation. After separation the oil is stored in the renovated oil tank. Gravity to be utilized to/from engine.

72 COOLING WATER SYSTEMS

The centralised cooling water system consists of the following systems:

- SW-system: Sea water cooling system
- LT-system: Low temperature fresh water cooling system

721 SW COOLING SYSTEM

721 SW SYSTEM

SW SYSTEM FOR FW LT-SYSTEM

The FW LT-system is cooled in a box cooler. The box cooler is protected by an anti-fouling system.

722 FRESH WATER AND OTHER COOLING SYSTEMS

LT-SYSTEM

The heat transfer between the LT-system and the SW shall be via a box cooler sized for 15% fouling margin.

The LT system serves the DGs, HVAC system and electrical propulsion components.

The water is circulated to the DGs by the internal cooling water pumps in the engines where as two (2) 100% pumps are installed for circulation to the remaining system.

The system to be designed for 38°C.

One (1) electrical operated heater to be installed in the system for stand-by heating used when the engines cannot keep themselves sufficient warm. The running engine shall supply warm water to the stand-by engine.

One (1) cooling water drain tank to be installed for storing the inhibited cooling water during service. One (1) refill pump rated 5 m³/h @ 3 bar to be installed. The recovery system is installed in order to avoid large replacement of cooling water at sea.

One (1) expansion tank to be installed common for both engines.

73 COMPRESSED AIR SYSTEM

STARTING AIR SYSTEM

The system consists of three (2) piston type 30 bar air-cooled starting air compressors each of equal size.

Two (2) starting air vessels to be installed.

CONTROL /WORKING AIR SYSTEM

The 8 bar system consists one (1) pressure reduction station from the starting air system. One (1) buffer tank to be installed.

Air quality obtained by two (2) refrigeration driers and filters according to ISO8573-1:2010, 3-4-1 (+3°C dew point).

74 EXHAUST SYSTEMS & AIR INTAKES

743 EXHAUST GAS SYSTEMS FOR PROPULSION MACHINERY

Exhaust gas lines to be flexibly connected to the engine with stainless steel expansion pieces as necessary. Exhaust gas lines of the main engines to be fitted with silencer.

The exhaust of the gen-sets to be provided with silencers that lowers the external noise from the gen-sets to maximum 85 dB(A). The silencer noise attenuation to be designed based on the actual frequency spectrum for the auxiliary engine.

76 DISTILLED & MAKE-UP WATER SYSTEMS

761 FRESHWATER PRODUCTION

DRINKING WATER

Two (2) fresh water tanks are installed onboard each painted in a light colour to allow throughout inspection. The fresh water to be supplied via a bunker connection from shore. A silver ion dosing system to be installed.

77 MATERIALS, PIPING, VALVES, COUPLINGS AND COMPONENTS

770 MATERIALS SPECIFICATION

To be agreed upon in detailed design.

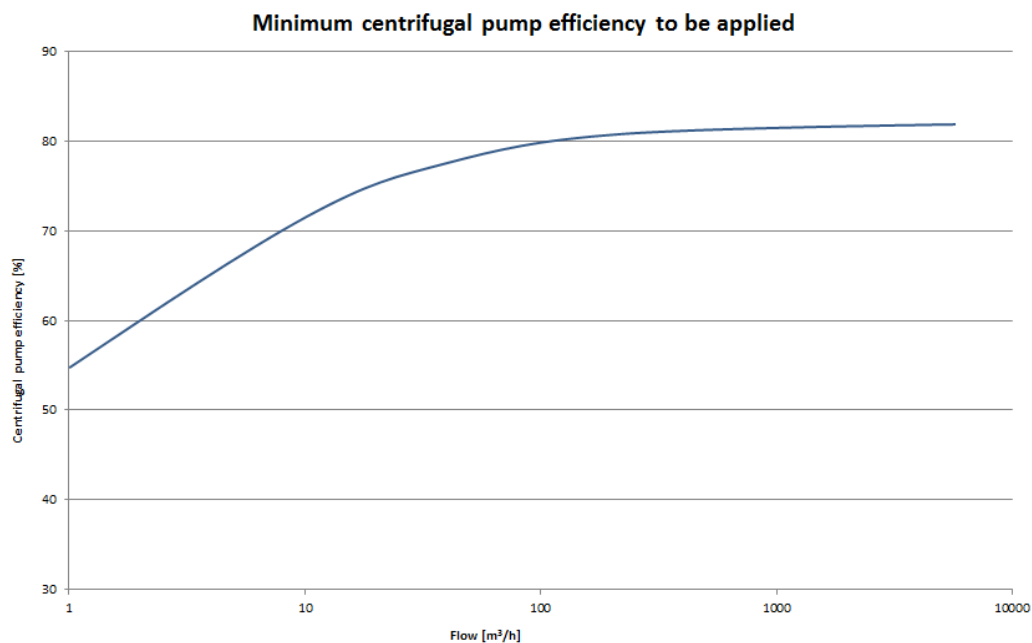
771 PIPING

No piping except fuel oil pipes to be routed through fuel tanks.
Ballast piping not to be routed through tanks with polluting fluids.

To protect the piping against winter conditions, fire line, compressed air and fresh water line outside engine room and accommodation to be supplied with drainage.

774 PUMPS

The centrifugal pumps the required efficiency at the design point to be in accordance with the following graph for main pumps (i.e. running more than 5 hours a day and above 8 kW):



78 MACHINERY AND CASING ARRANGEMENT

The engine room to be designed with double bottom.
Each DG will be located in a separate space allowing low noise transmitting, noise reduction at workplace during servicing of DG and allows gas engines to be isolated in own spaces (if so was installed).

79 ENGINE CONTROL, ALARM AND MONITORING

791 CONTROL CONSOLES

The main engine to be controlled from the deck office, from bridge or locally.

BRIDGE CONSOLES

Instruments, panels and controls for propulsion, manoeuvring, navigation, communication, fire detection, CAMS (see sect 792), voyage planning and administration to be integrated in the following consoles in wheelhouse:

LNG BUNKER VESSEL

- 1 Bridge Main Center Console
- 1 Bridge Alarm Console incl. CAMS workstation
- 1 Steering console
- 1 Radar console incl. ECDIS
- 1 Chart Table Aft incl. desk top working space
- 1 Wheel House Control Panel (WHCP) including power distribution switchboards
- 1 GMDSS radio station.
- 2 Bridge wing consoles suitable for open wings (outside, min. IP56 when in operation)

ENGINE CONTROL ROOM CONSOLE (IN SHIP'S OFFICE)

Instruments, panels and controls required in operating the main propulsion system etc. integrated in

- 1 engine control room console, and in natural extension of the console a desktop working environment with the CAMS workstations and administrative workstation(s).

DECK OFFICE (IN SHIP'S OFFICE)

Desktop and working space with workstation(s) for operations related to administration and cargo handling activities, i.e. ballasting, loading computer etc.

FIRE STATION (IN SHIP'S OFFICE)

Instruments and controls related to fire extinguishing (water mist, fire pumps etc.), fire detection, emergency stop and quick closing valves to be integrated in

- 1 Fire station control panel

792 COMMON AUTOMATION EQUIPMENT, ENGINE ROOM ALARM SYSTEMS

One Control, Alarm and Monitoring System (CAMS) to be installed for operation, control and monitoring of equipment installed onboard the ship.

The CAMS to be based on a distributed process control structure, which shall ensure high reliability, network redundancy, safe operation and a possible cable optimisation of the I/O interface.

CAMS stations to be installed in ship's office and on bridge.

During unmanned engine room operation, visual and audible alarm to be released on navigating bridge, in the cabin of the engineer on duty, and in mess and lounge (and other public spaces as per Class requirement). Alarms are displayed in an Alarm Extension System (AES) interfacing the CAMS. AES panels to be installed in the accommodations quarters for Officer's on duty and other public spaces as per Class requirement.

795 AUTOMATION EQUIPMENT FOR MOTORS

The diesel generators to have automatic start/stop and control from engine, CAMS, power management system (PMS) and Generator Control Panel (GCP).

797 AUTOMATION EQUIPMENT FOR OTHER MACHINERY COMPONENTS
MONITORING OF OIL/WATER INTERFACES

Oily contamination of engine cooling water system is to be monitored. Alarm required, where engine cooling water is used in fuel and lubricating oil heat exchangers.

8 SHIP COMMON SYSTEMS

80 BALLAST AND BILGE SYSTEM

801 BALLAST SYSTEM

The system to be served by two (2) ballast & bilge pumps.

The ballast system to be arranged to enable internal ballast water transfer between groups of tanks in order to gain trim and heel correction without intake of ballast water.

The ballast system is located in the pump room with no connection into the engine room.

HEELING SYSTEM

Heeling will be performed by transfer of water in between the ballast tanks. One (1) ballast & bilge pump to be used for heeling control. The control is automatic.

BALLAST WATER TREATMENT SYSTEM (BWTS)

The ballast water treatment system is optional as the limited operational area is expected not to request a ballast water treatment system. However, space is reserved in the pump room (ex-type requested).

One (1) sample point as close to the overboard discharge(s) as possible shall be installed. The sample point shall be in accordance with IMO MEPC 173(58).

Sampling of ballast water in tanks to be provided through the sounding pipes of ballast tanks.

803 BILGE SYSTEMS

BILGE IN ENGINE ROOM

The daily/dirty bilge system in the engine room consists of one electrically driven pump built on the bilge separator taking suction from the bilge wells in the engine room and discharging into the bilge water separator.

One (1) general service pump in the engine room will provide the direct suction of the engine room.

BILGE WATER SEPARATOR

One (1) bilge water separator to be installed. The system shall process the fluid to 15 ppm at a capacity of 5 m³/h.

BILGE SYSTEM FOR CARGO SECTION

The bilge system consist of the ballast & bilge pumps taking suction through a bilge valve register connected to the voids. The pumps will discharge overboard.

BILGE SYSTEM FOR FORWARD SPACES

An ejector driven system to be installed for serving the anchor chain lockers and deck store in forward ship.

One (1) bilge ejector with a capacity on 15 m³/h with motive water from the fire main line to be arranged.

81 FIRE EXTINGUISHING, DETECTION AND ALARM

811 FIRE DETECTION AND ALARM

An addressable fire detection system with one (1) main control panel (bridge) and one (1) slave panel in deck's office where the fire station is located to be installed. Fire detectors, in the accommodation including the cabins to be installed. Remaining ship is covered by fire detectors as required by Classification society.

General alarm and fire detection alarm system to be connected to the PA system. In engine room, pump room and in cargo areas an alarm, indication and sounder system (pictograms, sounders and beacons) in compliance with International Regulations to be installed. As required at each location the system includes (not limited to) fire alarm, general alarm, engine alarm, telephone call, fire extinguish release etc.

The location where the emergency/harbour generator set and the emergency switchboard are installed to be covered by means of a fire detections system similar to those required for unattended main and auxiliary machinery spaces as the emergency generator is used for port stay.

Bathrooms and toilets to include PA system loudspeaker.

813 FIRE/WASH DOWN SYSTEM, EMERGENCY FIRE PUMPS

The firefighting and deck wash system consists of sea water lines, stop valves hydrants, fire hoses with nozzles and other necessary means.

The system is served by the two (2) general service pumps located in the engine room and one (1) emergency fire pump located in a void in the cargo section.

815 FIRE FIGHTING SYSTEMS

ENGINE ROOM FULL PROTECTION

A high pressure water mist system, working with approx. 100 bar, to be installed covering the engine room. The fresh water for 30 minutes of operation will be stored in a dedicated tank next to the pumps in order to provide positive static pressure at the pumps.

CO2 EXTINGUISHING FOR GALLEY EXHAUST DUCT

The galley exhaust duct to be protected by a locally installed and operated CO2 system with fire dampers.

817 FIRE FIGHTING SYSTEMS WITH WATER SPRAY

LOCAL WATER MIST SYSTEM

In accordance with classifications and SOLAS's requirements, a local fire fighting and protection plant to be installed for local protection according to Class.

PAINT STORE FIRE EXTINGUISHING

The paint store to be protected with a water spray system connected to the fire main with a manually operated valve outside the paint store.

82 AIR & SOUNDING SYSTEMS FROM TANKS TO DECK

822 MANUAL SOUNDING SYSTEM

Manual sounding system according to Class rules.

823 AUTOMATIC/REMOTE SOUNDING SYSTEMS

Remote reading of all structural tanks to be displayed in CAMS.

85 COMMON ELECTRICAL & ELECTRONIC SYSTEMS

855 LOADING COMPUTER

The loading computer to be installed in the ship's office, see part 3.

86 ELECTRIC POWER SUPPLY

Power to be supplied by:

- Two (2) diesel generators serving propulsion and auxiliary purposes
- One (1) diesel generator serving emergency and harbour stay

A Load shedding system preventing over load of diesel generators to be installed. The system trips non-essential consumers as defined by Classification Society.

The electric generators to be of the three-phase synchronous brushless type with protection class IP44. Cooling is by closed air circulation and fresh water (double tube cooler and leakage detection).

For port stay, the emergency/harbour generator can be connected to the main switchboard.

ELECTRIC POWER GENERATION:

Generator: AC 690 V, 60 Hz, 3 phase

ELECTRIC POWER CONSUMERS:

Bow thruster: AC 690 V, 60 Hz, 3 phase

Power consumers: AC 690 V, 60 Hz, 3 phase

Smaller power units and domestic equipment: AC 230 V, 60 Hz

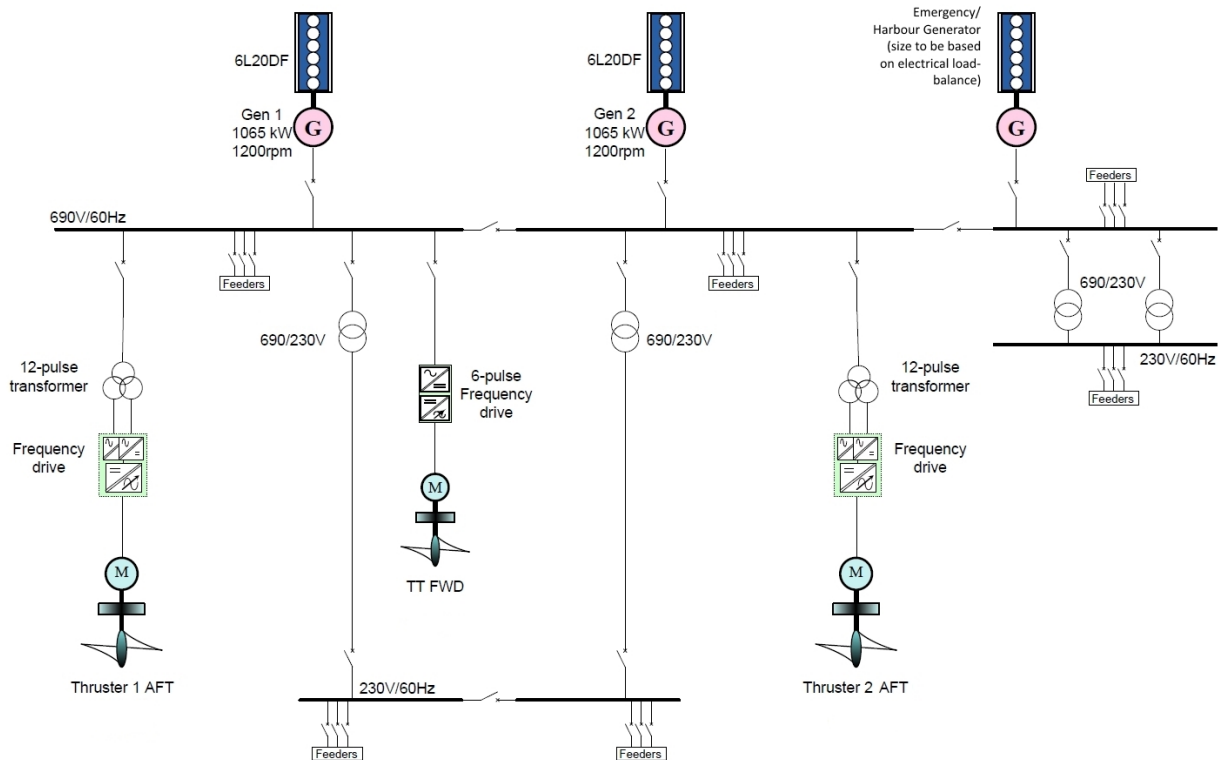
Lighting and plug socket connections: AC 230 V, 60 Hz

Galley AC 230 V, 60 Hz

Automation systems, etc. DC 24 V/AC 230 V, 60 Hz

Navigation and communication DC 24 V/AC 230 V, 60 Hz/AC 230 V UPS

Conceptual one line diagram of power setup:



865 TRANSFORMERS

The transformers are in general to comply with applicable parts of IEC 60076.

The vessel to be equipped with two (2) normal distribution 690V/230V transformers and 2x 12 pulse 690V/690V transformers with air/water –forced cooling.

The distribution transformers to feature, tapping +/- 2.5%, electric fans and anti-condensation heater.

The 12-pulse transformer to feature electric fans and anti-condensation heater.

The vessel to be equipped with two (2) emergency light transformers, 690V/230V.

The vessel to be equipped with one (1) 230V/230V galley transformer.

866 BATTERIES AND UPS

In general, classification society regulations regarding battery installations, location, temperature, ventilation and hazardous areas to be observed.

A 230 V UPS to be installed. A UPS dedicated to navigation and communication systems as required by class.

24VDC batteries and chargers of suitable capacity to be installed. Classification Society’s regulations regarding battery location and hazardous areas installations to be taken into consideration.

A separate 24VDC battery system including charger dedicated to radio station/GMDSS supply to be installed.

868 SHORE CONNECTION

A 690V shore connection to supply basic load during docking to be installed.

871 SWITCHBOARDS

The power system consists of a 690V switchboard and a 230V switchboard.

CB > 630A are withdrawable air circuit breakers (ACB) which can be motor operated, and CB < 630A are fix mounted and manually operated MCCB. Minor consumers and distribution boards to be with MCB.

Separate earth fault monitoring with alarm to CAMS in each distribution system at each galvanic isolation (e.g. at each secondary side of transformers and converters).

Degrees of ingress protection (IP) according to Classification society (following for guidance):

Engine room	min. IP22
Engine control room and switchboard room	min. IP22
Switchboard room	min. IP22
Exposed to weather (open deck)	min. IP56
Cargo holds	min. IP55
Accessories	Min. IP44

88 ELECTRIC CABLE INSTALLATION

Electric cables to be fire retardant (IEC 60332-3) and halogen-free (IEC 60754-1) with type approval of Classification Society. Fire resistant cables (IEC 60331) to be installed as required by classification society. As an EMC/EMI precaution power cables and instrument/control cables in general to be separated (minimum 100 mm or by metallic screen/plate).

Cable installations to/from frequency converters to be screened and installed with due consideration to/from other electric equipment (EMC/EMI).

Cables subject to mechanical damage and heat to be protected by suitable measures. All cables on open deck and in cargo holds to be armoured/screened.

Cable penetrations in exposed decks are to be enclosed in protective steel covers extending 0.5 m from the penetration or to the item, if this is closer.

89 ELECTRICAL CONSUMER SYSTEMS

891 ELECTRIC LIGHTING SYSTEMS FOR ENGINE ROOM

In general, the lighting fixtures to be equipped with LED light.

A sufficient number of 230V and 690V socket outlets to be distributed as part of the general lighting installation.

892 ELECTRIC LIGHTING SYSTEMS FOR ACCOMMODATION

In accommodation areas, lighting are to be of LED type.

A sufficient number of 230V socket outlets to be distributed as part of the general lighting installation.

893 ELECTRIC LIGHTING SYSTEMS FOR DECK AND CARGO AREA

Light fixtures to comply with relevant parts of IEC 60079.

In cargo area, floodlights to be provided for specific working areas in addition to the general lighting by LED light.

A sufficient number of 230V and 690V socket outlets to be distributed as part of the general lighting installation.

898 ELECTRIC MOTORS

Electrical motors to be in accordance with relevant part of IEC 60034 standard for motors with power rating between 0.75 kW to 375 kW. The motors to be IE1, standard energy efficiency.

Electrical motors to comply with relevant parts of IEC 60079.

Insulation to be Class "B" or Class "F" Following motors with built in heating element:

- Open deck motors
- Ventilators
- General service pumps
- FW pumps
- Oil pumps

Thermistors (PTC) in motors for compressors and as required.

Degrees of ingress protection (IP):

- Engine room IP44
- Exposed to weather IP56

899 ELECTRIC INVENTORY AND TOOLS

Electric measuring instruments and tools to be supplied according to classification requirements.

SPECIAL TOOLS

Special tools for normal maintenance and normal overhauling for electric equipment to be provided by client.