OUTLINE SPECIFICATIONS

for

DWT 13,000 Ton Class Methanol Fueled Product/Chemical Tanker

(TOTAL : 31 SHEETS INCL. A COVER)

INDEX

0. General

0.1 General Description

Type of ship

The Vessel shall be designed and constructed as ocean going oil product & chemical tanker.

The Vessel shall be of flush deck with bulbous bow, transom stern, forecastle deck, poop deck and a controllable pitch propeller(CPP) with a reduction gear driven directly by a four-stroke dual fuel engine.

General arrangement

The propulsion machinery and living quarters including navigation bridge shall be located aft.

Low flashpoint Fuel supply system (LFSS) room and Methanol tanks shall be located on the upper deck and cargo hold space respectively.

The cargo space shall be divided into six (6) pairs of cargo oil tanks, one (1) pair of slop tank and six (6) pairs of water ballast tanks as shown on the General Arrangement Plan.

Intended Cargoes

The Vessel shall carry following cargoes which are compatible with the coating system in cargo oil tanks, cargo oil handling system and other provisions specified in the Specifications.

- Chemical cargoes compatible with ship type 2 and 3
- Oil products (List of Oils specified in Appendix I of MARPOL 73/78 Annex I)

0.2 Principal Dimensions

Length O. A.	:	abt.	129.9	m
Length B. P.	:		122.0	m
Breadth (mld)	:		21.0	m
Depth (mld)	:		11.8	m
Design/Scantling draft (mld)	:		8.55	m

0.3 Deadweight and Capacities

Deadweight at the design/scantling draft : abt. 13,000 mt

Capacities (100% full)

Cargo tanks (incl. slop tanks)	:	abt.	14,000	m^3
Methanol tank	:	abt.	490	m^3
Water ballast tanks (incl. peak tank)	:	abt.	5,300	m^3
Marine gas oil tanks (incl. serv. tank)	:	abt.	190	m^3
Fresh water tanks	:	abt.	150	m^3

0.4 Main Engine

Number of set	:	One (1) set
Type	:	Wartsila W6L32M
NMCR	:	3,480 kW x 750.0 rpm
SMCR	:	3,000 kW x 125.9 rpm
NCR (90 % of SMCR)	:	2,700 kW x 121.6 rpm

0.5 Speed and Cruising Range

Service speed at the design draft of 8.55 m when running at NCR (90% of SMCR) of main engine including 15% sea margin shall be 13.0 knots.

Cruising range of oil mode	:	about 4,100 nautical miles.
Cruising range of Methanol mode	:	about 5,400 nautical miles.

0.6 Daily Fuel Consumption of Main Engine

Oil Mode

Daily fuel oil consumption at NCR of main engine shall be about 11.8 metric tons/day based on marine diesel oil of 42,700 kJ/kg in lower calorific value at shop test under ISO reference condition.

Methanol Mode

Daily methanol fuel consumption at NCR of main engine shall be abt. 21.9 metric tons/day based on Methanol of 19,900 kJ/kg in lower calorific value at shop test under ISO reference condition.

Daily pilot oil consumption at NCR of main engine shall be about 1.5 metric tons/day based on marine diesel oil of 42,700 kJ/kg in lower calorific value at shop test under ISO reference condition.

0.7 Complement

Twenty one (21) persons

0.8 Classification and Flag

Classification : ABS
✠A1, (E), Oil/Chemical Tanker, IMO Ship type 2, ✠AMS, ✠ACCU, ESP, UWILD, LFFS(DFD-Methanol)

Ship's flag : Liberia

0.9 Rules and Regulations

The Vessel shall be built in compliance with the following Rules and Regulations including Amendments which are enforced on the date of signing the Specifications.

- National Maritime Regulation of Country of Registry.
- International Convention for the Safety of Life at Sea, 1974 with Protocol 1978/1988 and Amendments.
- International Convention for the Prevention of Pollution from Ships, 1973 with Protocol 1978/1997 (Annex I, IV, V & VI) and Amendments.
- Convention on the International Regulations for Preventing Collisions at Sea, 1972 and Amendments.
- International Convention on Load Lines, 1966 with Protocol 1988 and Amendments.
- International Convention on Tonnage Measurement of Ships, 1969 and Amendments.
- International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001.
- International Convention for the Control and Management of Ship's Ballast Water and Sediments, 2004.
- International Code for the Construction and Equipment of Ships Carrying Dangerous Chemical in Bulk, 2004 and Amendments
- IMO Res. MSC.215(82), Performance Standard for Protective Coatings for Dedicated Seawater Ballast Tanks in All types of Ships and Double-Side Skin Spaces of Bulk Carriers.
- International Code on Intact Stability, 2008 and Amendments except Part A Ch. 1.2 'Dynamic stability phenomena in waves'.
- IMO Res. MSC.337(91), Adoption of the Code on Noise Levels On Board Ships (except recommendatory items).
- IMO Res. MEPC.197(62), Guidelines for the Development of the Inventory of Hazardous Materials.
- Maritime Labour Convention 2006 (MLC 2006), Title 3, Regulation Standard A3.1
- International Telecommunication Union (ITU) Radio Regulations.
- Suez Canal Navigation Rules including Tonnage Measurement.
- Panama Canal Rules and Regulations including op-notice to shipping N-1-2023 and Tonnage measurement.

- USCG Rules and Regulations for Foreign Vessels Operating in the Navigable Waters of the United States (CFR 3w3 part 155, 156, 157, 159, 164 and CFR 46 part 39).
- 2013 US EPA Vessel General Permit (VGP)
- Directive 2012/33/EU.
- California Code of Regulations, title 13, section 2299.2 "Fuel Sulfur and other operational requirements for ocean-going vessels within California waters and 24 nautical miles of the California baseline"

0.10 Guidelines and Recommendations

The Vessel shall be built in compliance with the following Guidelines and Recommendations.

- ISO 6954-2000(E), Guidelines for the measurement, reporting and evaluation of vibration with regard to habitability on passenger and merchant ships.
- MSC.1/Circ. 1621 Interim guidelines for the safety of ships using methyl/ethyl alcohol as fuel.

- ISO 15016-2015(E), Ships and marine technology – Guidelines for the assessment of speed and power performance by analysis of speed trial data (for EEDI verification only).
- IEC Publication 60092, Electrical Installation in Ships (where required by the Class).
- OCIMF Recommendations for Oil and Chemical Tanker Manifolds and Associated Equipment (First Edition 2017)
- OCIMF Mooring Equipment Guidelines (MEG4), Fourth Edition 2018 (as far as applicable)
- Marine Environmental, Safety and Quality Assurance Criteria for Seagoing Industry Vessels in Exxon Mobil Affiliate Service, 2017 Edition (permanent provision only for "Must" and "Strongly preferred" items applicable to this size of vessel except item F.6, F.20, K.8, K.16 and P.4).

1. Hull

1.1 Hull General

Hull structure shall be designed in accordance with the requirements of the Classification Society and the Builder's practices.

In general, the hull shall be constructed with longitudinal stiffening and transverse webs except for after body, engine area, fore body, deckhouse, etc. which may be transversely framed.

Scantlings and details of structural members, which are not specified in the rules of the Classification Society, shall be in accordance with the Builder's practices.
Reduction of scantlings on account of corrosion control shall not be considered
Cutouts, air holes, drain holes and scallops shall be provided, where necessary in accordance with the Builder's practices.

Steel for hull construction shall be of normal quality mild / higher strength steel (Min. yield stress = 32 kg/mm^2 and 36 kg/mm^2) approved by the Classification Society.
Longitudinal stiffeners and transverse frames shall be of rolled sections, built-up sections and/or flat bars.
Thermo-mechanically controlled process (TMCP) steel may be used.

1.2 After Body

Chafing bars shall be fitted on the intersection between side shell and transom stern in accordance with the Builder's practices so that mooring ropes can be protected.

Stern boss shall be of steel casting, and the other parts of stern frame shall be of welded steel plates.

Rudder shall be of double plates, stream line, full space type. Rudder stock shall be of forged steel with stainless steel sleeve.

1.3 Engine Area

Main Engine foundation shall be of welded steel construction designed to minimize the transmission of vibration to the hull structure.

Coamings of flat bar shall be arranged around deck opening, foundations for machinery, pumps, pipe penetration openings, etc. on platform decks in accordance with the Builder's practices.

1.4 Cargo Area

Double bottom and double side structure shall be arranged in way of cargo holds. Center line longitudinal bulkhead and transverse bulkheads in cargo tanks shall be of vertically corrugated type without stools.

1.5 Fore Body

Shell plate in the bow flare area and in way of anchor stowage shall be designed in accordance with the requirements of the Classification Society.

Bottom forward structure shall be strengthened against slamming in accordance with the requirements of the Classification Society.

Two(2) self-stowing cylindrical chain lockers with bilge well under false bottom shall be provided.

1.6 Deckhouse

As far as practicable, deckhouse walls shall be aligned with the primary structures of the engine area to minimize vibration.

External walls of deckhouse shall be of vertically stiffened plane type, and the internal walls shall be of vertically stiffened plane or swaged type.

1.7 Hull Outfitting

Details of funnel mark, Vessel's name, port of registry and IMO numbers shall be supplied by the Owner at least one(1) month prior to the commencement of steel cutting for the Vessel.

Sea chests shall be integrated into the hull structure.

Bilge keels shall be tapered at the ends in accordance with the Builder's practices.

1.8 Painting and Cathodic Protection

Painting scheme

Area				Paint Scheme	No. of Coats	Total D.F.T (mic.)
Bottom/ Side bottom (Up to scantling draft)	Flat Bottom			Epoxy Epoxy tie coat SPC A/F **)	1 1 2	150 100 220
	Remaining part			Epoxy Epoxy tie coat SPC A/F **)	1 1 2	150 100 320
Topside				Epoxy Polyurethane	1 2	125 100
Weather deck				Epoxy	2	225
Cargo tank & Slop tank				Pure epoxy	2	250
Engine room	Wall, ceiling			Alkyd	2	120
	Deck			Epoxy Alkyd	1 1	70 50
	Tank top			Epoxy	2	200
Methanol fuel tanks				Inorganic zinc	3	350
Water ballast tank				Epoxy	2	320
Fresh water tank				Epoxy holding primer Solvent free epoxy	1 1	60 250
Various oil tanks				Anti-rust oil wiping	1	20
Super Structure .	Outside			Epoxy Polyurethane	1 2	125 100
	Inside	Under lining	Inside surface of exposed part	Ceramic paint	1	25
			Remain parts	No paint	-	-
		Bare parts		Alkyd	2	120
Cofferdam & void space				Epoxy	1	125
Stores, steering gear room etc.				Alkyd	2	120

**) The anti-fouling system shall be decided in accordance with the selected paint maker's recommendation based on five (5) years lifetime.

Cathodic Protection

Aluminum anodes of bolting type shall be fitted inside of the sea chests.

Mean current density : 25 mA/m^2
Lifetime : Five (5) years

The following cathodic protection of bolted type zinc anode shall be provided to water

ballast tanks.

Mean current density	:	5 mA/m^2
Lifetime	:	Five (5) years
Ballast ratio	:	50%

Impressed current cathodic protection system shall be provided for the protection of underwater hull surface.

2. OUTFITTING

2.1 Maneuvering Equipment

Bow thruster

Number of set	One (1)
Type & Capacity	Hydraulic motor driven, FPP type, 350 kW Hydraulic power shall be provided by HPP for cargo pumps

Steering gear

Number of set	One (1)
Type	Rotary vane type with two (2) pumps of 100 % capacity each
Max. Working torque	Shall be decided according to final calculation of rudder area in accordance with requirements of the Classification Society.

2.2 Lifting Equipment

No	Item	Description
1-1	Hose handling crane	Electro-hydraulic, cylinder luffing type One (1) set of 5.0 ton SWL Outreach as per OCIMF recommendation.
1-2	Provision/Rescue boat handling crane	Electro-hydraulic, cylinder luffing type One (1) set of 2.0 ton SWL SWL may be changed depending on Rescue boat
1-3	Engine Part / Life raft handling crane	Electro-hydraulic, cylinder luffing type One (1) set of 1.0 ton SWL SWL may be changed depending on Rescue boat
1-4	LFSS room davit	Manual operation One (1) set of 0.9 ton SWL
1-5	Bosun store davit	Manual operation One (1) set of 0.2 ton SWL
1-6	Sludge handling & injured person lifting davit	Portable air driven One (1) set of 0.2 ton SWL

2.3 Deck Machinery

No	Item	Description
1	**Windlass combined with mooring winch**	
1)	Type	Electro-hydraulic (high-pressure) type No auto-tension device
2)	Number of set Duty Capacity	Two (2) sets 14.2/10 Ton x 9/15 m/min
3)	Construction	1 x cable lifter + 2 x mooring drums + 1 x warping head, each
4)	Control	Local control device
2	**Mooring winch**	
1)	Type	Electro-hydraulic (high-pressure) type No auto-tension device
2)	Number of set Duty Capacity	Two (2) sets 10.0 Ton x 15 m/min
3)	Construction	2 x mooring drums + 1 x warping head, each
4)	Control	Local control device
3	**HPU for windlass and mooring winch**	
1)	Type	Electro-hydraulic (high-pressure) type Hydraulic power shall be supplied by HPU for Cargo Pumps
4	**Anchoring and mooring equipment**	
1)	Anchor	Two(2) sets x 3,667.5 kg, HHP type
2)	Anchor chain cable	Grade III, Ø 54 mm x 550 m,
3)	Mooring rope and towing rope	Eight (8) of mooring rope : UHMPWE type, Dia. 40 mm x 190 m (MBL: about 36.9 ton) One (1) of towing rope : IWRC (6x37), MBL: about 96.05 ton)

Note: Above capacities may be adjusted in accordance with "Equipment Number".

2.4 Deck Outfitting

No	Item	Description
1)	Accommodation ladder	Two (2), aluminum alloy, air motor driven type
2)	Pilot ladder	Two (2), pilot ladder, air motor driven type
3)	Wharf ladder	One (1), aluminum alloy, handling with hose handling crane
4)	Safe access to Bow	Walkway from accommodation front to f'cle deck shall be provided as per SOLAS requirements.
5)	Access hatches, ladders etc.	Shall be provided as shown on the general arrangement

2.5 Life Saving Appliances

No	Item	Description
1)	Life boat and davit	One (1) of Free fall type for Twenty one (21) persons
2)	Rescue boat	One (1) of FRP open type
3)	Life raft	One (1), inflatable throw-over type for 21 persons One (1), inflatable davit-launched type for 21 persons One (1), inflatable throw-over type for 6 persons
4)	Personal life saving appliances	As per the rule requirements
5)	Others	As per the rule requirements

3. Accommodation

3.1 Accommodation Arrangement

Complement

Grade	No. of persons	Room
Captain class	2 P	Day room, bedroom and private unit lavatory
Senior officer class	2 P	Day room, bedroom and private unit lavatory
Junior officer class	6 P	Single berth cabin and private unit lavatory
Crew class	11 P	Single berth cabin and private unit lavatory
Suez crew	6 P	2-Tier bed(3 sets) cabin and private unit lavatory
Total	21 P + 6 P (Suez crew)	

Free height
Approx. 2,100 mm in general.

Panel system

Partition bulkhead	50 mm thick mineral wool board with PVC film on both sides
Lining panel	25 mm thick mineral wool board with PVC film on visible sides
Ceiling panel	25 mm thick mineral wool board with baked paint

Notes:
The High Noise Reduction Panel (abt. 42 dB) shall be provided between the cabin and the cabin in order to reduce noise.

Deck covering

Underlay	Latex 8mm thickness
Carpet	Captain class, senior officer class cabin & recreation room
Vinyl sheet	Other class cabins, office spaces, public spaces, corridor space & navigation & control space
Cementing mortar w/tile	Galley, laundry & drying room, public toilet, changing room

Accommodation equipment

Wooden furniture, galley equipment and laundry equipment shall be provided in accordance with Builder's standard.

3.2 Air Conditioning System

System

General	High pressure, single duct air conditioning system with a central air-handling unit.
Fresh air ratio	About 50 % of total air volume
Refrigerant	R – 407C
Heating medium	Steam
Air change rate	According to Builder's practice.
Air handling unit	One (1), 100 % capacity, single speed.
Condensing unit	Two (2), each 50 % capacity.

One (1) package type unit cooler with electric heating to be provided for galley

Design condition

	Outside Air		Inside Air	
	Temp.	R.Humid	Temp.	R.Humid.
Cooling	+35° C	70%	+27 ° C	50%
Heating	-15° C		+22 ° C	50%

Mechanical ventilation

Mechanical ventilation system shall be designed and installed in accordance with the requirements of the Rules and Regulations.

3.3 Cold Chamber

Compartment	Room Temperature	Volume	Cooled by
Meat room	- 18℃	About 18 m³	Unit cooler
Fish room	- 18℃	About 13 m³	Unit cooler
Vegetable room	+ 4℃	About 20 m³	Unit cooler
Total		About 51 m³	

The cooling plant shall have two (2) sets of refrigerating machines of R-407C direct expansion system.

4. HULL PIPING

4.1 Application of Pipe & Valves

The materials and dimensions of pipes, valves and fittings shall be in accordance with the JIS/KS, the Builder's standards and manufacturer's standard unless otherwise specified.

System	Pipe material (thickness)	Pipe inside	Valve
Deck foam, fire and wash deck	ERW steel (Sch.40)	Galvanized	Gate, globe
Bilge	ERW steel (Sch.40 or 80)		Globe
Compressed air	ERW steel (Sch.40)		
Deck steam for supply	SMLS steel (Sch.40)	No coating (indoor) Aluminized (weather deck)	
Deck steam for condensate	ERW steel (Sch.40)		
Air vent and sounding	ERW steel (as per Rule)	Galvanized	-
Fuel oil filling system	ERW steel (Sch.40)	No coating	Butterfly
Hyd. oil for COP & deck machinery	As per Maker's recommendation	-	Maker's standard

4.2 Fuel Oil System

Shore connection ; Marine gas oil	At fore & aft of cargo manifold (P&S)

4.3 Decontamination Shower and Eye Washer

Decontamination shower and eye washer	Four(4), Near cargo manifold area (P&S) and in front of accommodation (P&S)

4.4 Fire Extinguishing System

The fire precaution, fire extinguishing and fire-fighting apparatus shall be provided in compliance with the requirements of SOLAS, Class and National Authorities concerned.

Space	Application
Engine room	High pressure CO2, Sea water hydrants, Portable fire extinguishers
Cargo tank deck	Alcohol-resistant foam, Sea water hydrant,
Living quarters	Sea water hydrant, Portable fire extinguishers
Paint locker	Sea water spray
Emergency generator room	Local fixed CO2 fire extinguishing system, Portable fire extinguisher
The fire hazard portion of M/E, G/E, incinerator, purifier and boiler front	Fixed fresh water based local application fire-fighting system
Emergency fire pump	One (1), 50 m^3/h × 90 mTH, Centrifugal, Vertical, Self-priming, El-motor

5. CARGO SYSTEM AND EQUIPMENT

5.1 Application of Pipe & Valves

System	Pipe material (thickness)	Pipe inside	Valve
Cargo	SUS316L (Sch.10S)	No coating	Butterfly
Water ballast	ERW steel (Sch.80)	Epoxy	
Tank vent/ purging system	SUS316L (Sch.10S)	No coating	-
Tank cleaning system			Butterfly
Heating coil in slop tank			Globe
Hyd. oil pressure main for valve control	SMLS steel (Sch.80)		-
Hyd. oil return main for valve control	ERW steel (Sch.40)		
Hyd. oil individual for valve control	Multi or single-core tube welded stainless steel (SUS 316)		
Control air	Copper tube, Multi or single-core tube (Copper)		

5.2 Cargo Oil System

The vessel shall be arranged for cargo loading and discharging via seven(7) midship manifold.

Cargo pumping system shall allow maximum cargo unloading rate of 1,800 m^3/hr in total based on S.G 0.8, viscosity 1.0 cSt at 110mTH pump head.

Cargo oil pump	Twelve(12), 300 m^3/hr x 110 mTH, Centrifugal, Submerged, Hyd-motor
Slop pump	Two(2), 150 m^3/hr x 110 mTH, Centrifugal, Submerged, Hyd-motor
Portable cargo pump	One(1), 70 m^3/hr x 70 mTH, Transportable, Centrifugal, Hyd-motor

Hydraulic power pack shall be provided for cargo pump and following hydraulically driven machineries.

- Cargo pumps in cargo/slop tank
- Ballast pumps
- Deck machineries
- Tank cleaning pump
- Bow thruster
- Methanol fuel transfer pump

The hydraulic power pack with three(3) electric motor (270 kW, each) shall be designed to operate six(6) cargo pump simultaneously.

5.3 Water Ballast System & BWTS

Ballast pump	2 – 500 m^3/hr x 25 mTH based on S.W. Centrifugal, Submerged, Hyd-motor
Piping	Two(2) main line system in tanks
Valve operation : - Valves in tank and pump suction/discharge - Others	 Remote electro-hydraulic Manual-local
Ballast water treatment system	1,000 m^3/hr in total, UV + Filter type

5.4 Cargo Oil Heating System

The steam heating system shall be provided for cargo oil tank and slop tank.

Cargo oil tanks	Heating from 44°C to 66°C within 96 hours at S.W. temp. 5°C and air temp. 2°C, Deck heater
Slop tanks	Heating from 44°C to 66°C within 24 hours at S.W. temp. 5°C and air temp. 2°C (based on oily water 50/50), Heating coil

5.5 Cargo Tank Cleaning System

The fixed tank cleaning system shall be provided for cargo/slop tanks in accordance with

MARPOL 73/78.

Tank cleaning pump	One(1), Approx. 60 m^3/hr x 110 mTH Centrifugal type, Hyd. motor
Tank cleaning heater	One(1), Approx. 60 m^3/hr, Shell & tube, Steam heated, Heating up sea water from 20°C to 80°C
Tank cleaning machine	Fixed cleaning machine for cargo/slop tank in accordance with IMO regulation
Tank cleaning hole for cargo/slop tank	Bolted type for portable cleaning machine and sludge handling
One(1) oil discharge monitoring system	In accordance with IMO regulation

5.6 Cargo Oil tank Venting and Inert Gas System

Each cargo tank and slop tank shall be provided with a gas freeing / venting line from tank hatch, fitted with pressure/vacuum valve.

One(1) vapor recovery system to be provided independently from each cargo and slop tank and connected to the two(2) common vapor return lines.

Inert gas system	Inert gas generator (MGO burning), 2,250 m^3/hr with two(2) fans (100%, each)

5.7 Gas Detection System

The fixed gas detection system shall be provided to be capable of detecting the flammable vapor (HC) concentrations for double hull water ballast tanks adjacent to cargo tank in accordance with the Rules and Regulations

5.8 Cargo Tank Monitoring Systems

Tank	Type	Monitoring
Cargo and slop tank	Radar beam	Level
	Magnetic float (independent)	Hi-Hi level alarm
M.G.O. storage tank	Electric pressure sensor	Level
	Magnetic float (independent)	Hi level alarm
W.B. tanks and draft(4-points)	Electric pressure sensor	Level & Draft

Temperature indication for cargo/slop tanks	Three(3) points per cargo/slop tanks Remote reading in CCR
Inert gas pressure sensor for cargo/slop tanks	One(1) per tank Remote reading in CCR & W/H
Portable measuring unit for cargo/slop tanks	Two(2) portable UTI measuring unit One(1) portable cargo sampling & hand dipping unit

5.9 Cargo Tank Control and Monitoring System

The following controls and indications shall be provided on the cargo/ballast control console of piano type in cargo control room.

- A mimic diagram of cargo/ballast piping system
- Control and monitoring instruments for hydraulic pump for remote hydraulic valve control in cargo/ballast system
- Control of hydraulically remote operated valve for cargo/ballast piping system
- Valve position indicator for intermediate position controlled valve and valve position indicator lamp for open/shut valve
- Level, temperature and pressure indication for cargo/slop tanks (TFT display)
- Level indication for each ballast tank and draft (TFT display)
- Level indication for M.G.O. storage tanks (TFT-LCD display)
- Independent overfill level alarm for cargo/slop/residual tanks
- Independent high level alarm for M.G.O. storage tanks
- Oil discharge monitoring and control unit
- Pressure monitoring and recording device for cargo manifold
- Temperature indication for sea water outlet of tank cleaning heater
- Bilge high level alarm for emergency fire pump, bosun store and fore peak void space
- BWTS control and monitoring equipment

Separate control and monitoring console for submerged cargo pumping system to be provided in cargo control room.

6. METHANOL FUEL SUPPLY SYSTEM

6.1 Application of Pipes and Valves

System	Pipe material (thickness)	Pipe inside	Valve
Methanol fuel	Welded stainless steel (SUS 316 ERW) Sch.10S	No coating	Butterfly, Globe,
Nitrogen purging line	Welded stainless steel (SUS 304L) Sch.10S		Butterfly, Globe, Needle
P/V vent	Welded stainless steel (SUS 316 ERW) Sch.10S		-
LT cooling water	ERW steel (STPG 370E) Sch.40		Globe, Ball

6.2 Methanol Fuel supply System

The low-flashpoint fuel supply system (LFSS) to be designed to deliver methanol to the fuel injection system of main engine.

The LFSS to be composed of a methanol fuel service tank, a supply unit for M/E, a heat exchanger and other necessary unit in methanol fuel preparation space.

Two(2) methanol fuel storage tank in front of engine room to be provided to be used for the dedicated methanol fuel tank and one(1) cylindrical type methanol fuel service tank to be provided on upper deck.

One(1) set of control panel to be supplied by the LFSS maker and installed in engine control room.

6.3 Methanol Bunker Station

Manifold	One(1) liquid and one(1) vapour line (P&S) Liquid : 1 x ND 100A, ANSI 150 lbs Vapour : 1 x ND 65A, ANSI 150 lbs
	Liquid : 1-manual valve & 1-hydraulic operated ESD valve Vapour : 1-hydraulic operated ESD valve

6.4 Methanol Fuel Service Tank

The capacity of methanol service tank shall be based on the main engine 24 hour running by maximum continuous rating (MCR)

No. of set(s)	One (1)
Type	Cylindrical, single shell
Capacity	Approx. 37 m^3
Material	Steel
Coating inside	Inorganic zinc
Design pressure	Approx. 0.45 barG
Design temperature	65 °C
Methanol density	796 kg/m^3

The following shall be provided for methanol fuel service tank:

- Tank level transmitter
- Level alarm for high, high-high and low level
- Pressure/vacuum valve
- Automatic filling system from methanol fuel storage tank to service tank
- Inert gas filling connection
- One(1) temperature sensor
- One(1) pressure sensor

6.5 Equipment for Methanol Fuel Supply System

Methanol fuel transfer pump	Two(2), Approx. 15 m^3/hr x 26 mTH, Centrifugal, Submerged, Hyd-motor
LP methanol supply pump	One(1), Approx. 1.63 m^3/hr x 20 mTH, Centrifugal, El-Motor(VFD)
HP methanol supply pump	One(1), Approx. 1.63 m^3/hr x 188 mTH, Centrifugal, El-Motor(VFD)
Heat exchanger (Shell & Tube)	One(1), Shell & tube, Cap. : Maker′s recommendation
Filter (Duplex)	10 microns or Maker′s recommendation
Flow meter	One(1), Coriolis type
Glycol water system	Maker′s recommendation

6.6 Auxiliary System

N2 generator	One(1), Approx. 20 N m^3/hr, Membrane
P/V valve	Four(4), ND 50A or Maker′s recommendation, 0.2 kg/cm^2 for pressure
Rupture disc	Four(4), ND 50A or Maker′s recommendation, 0.18 kg/cm^2 for pressure
Tank level gauge for methanol fuel storage, service and drain tank	Four(4), High frequency microwave pulse type

N2 generator system to be used for line purging when fuel supply system is not in use and for topping up for methanol fuel storage tanks and service tank.

One(1) high velocity P/V valve and rupture disc to be fitted on each methanol fuel storage tank, service and drain tank.

6.7 Fire Extinguishing System

Protected space	Application
Methanol fuel service tanks, bunkering station	Alcohol resistant foam, Water spray system, Portable dry powder fire extinguishers
Methanol fuel preparation room	CO2 high pressure system, (Common to E/R CO2 system) Sea water hydrant, Portable fire extinguishers
Exposed part of fuel preparation room, Exposed part of methanol fuel service tank	Water spray system

6.8 Gas Detection System

Fixed gas detection system to be provided in accordance with IMO MSC.1/Circ. 1621.

6.9 Emergency Shut Down System

The emergency shut-down system to be activated by following condition

- Manual trip
- High-high level in methanol storage tank
- Gas detection in cofferdam surrounding methanol fuel storage tank
- Emergency shut-down actuated by onshore facility or bunkering vessel

7. MACHINERY

7.1 General Description

Fuel Oil	MGO (Marine Gas Oil)
Low Flashpoint Fuel	Methanol
Cooling	Centralized F.W cooling system for main engine and auxiliary system

Design Condition	
Sea Water temperature	32°C
Central cooling fresh water	36°C
Engine room temperature	45°C
Atmospheric pressure	1,000mbar

7.2 Main Engine

No.	One (1)	
Type	dual fuel, 4-stroke, single acting, non-reversible, trunk piston type, diesel engine equipped with turbocharger, air cooler, Wartsila 6L32M	
NMCR	3,480 kW x 750.0 rpm	
SMCR	3,000 kW x 125.9 rpm	
NCR	2,700 kW x 121.6 rpm (90.0% of SMCR)	
Fuel oil consumption	Fuel Oil, Tier II Mode	SFOC : 183.7 g/kWh + 5 % at SMCR under ISO ambient conditions
	Low flashpoint fuel, Tier II Mode	SMEC : 6622 kJ/kWh + 5% at SMCR under ISO ambient conditions SPEC : 830 kJ/kWh + 5% at SMCR under ISO ambient conditions
IMO NOx Tier III compliance method	SCR system	

The following grade fuel oil shall be used for main engine, generator engine and boiler.

- MGO : 2 ~ 6 cSt at 40℃ (ISO 8217 DMA/DMZ)

7.3 Shafting and Propeller

Propeller shaft	One (1)
Propeller	One (1), Ni-Al-Bronze, keyless, CPP
Stern tube bearing & seal	Cast iron lined with white metal & air seal rings
Reduction gear	One (1), Vertical offset, Gear ratio of approx. 6:1

7.4 Steam Generating Plant

Auxiliary boiler

Q′ty	One (1)
Type	Vertical, water tube
Capacity	13 ton/h
Steam condition	6.0 kg/cm^2 saturated
Feed water temperature	80°C (design condition)
Design condition	Manufacturer′s standards design based on ISO standard reference conditions
Fuel	MGO

Exhaust gas economizer

Q′ty	One (1)
Type	Vertical, forced circulating
Capacity	0.4 ton/h at NCR of M/E based on Tier II
Steam condition	6.0 kg/cm^2 saturated
Feed water temperature	80°C (design condition)
Design condition	Manufacturer′s standards design based on ISO standard reference conditions

7.5 Electric Generating Plant

Generator engine set

No.	Two (2)
Type	4-stroke, trunk piston, turbocharged, in-line type, silencer with spark arrest type

Output	Abt. 960 kW each
Revolution	Max. 900 rpm
Generator output	Abt. 900 kW x AC 450 V x 3 phase x 60 Hz each
Lubrication method	Self-contained lubrication with oil sump wet type
Mounting	Resilient mounting with common bedplate
IMO NOx Tier III compliance method	-
Fuel	MGO

Emergency generator engine set

No.	One (1)
Type	4-stroke, radiator cooling diesel engine driven
Revolution	1,800 rpm
Generator output	120 kW x AC 450 V x 60 Hz
Starting method	1st : automatic battery starting 2nd : manual hydraulic starting
Lubrication method	Self-contained lubrication

The emergency generator set shall be designed for using light diesel oil (ISO DMX)

7.6 Auxiliary Machinery

Cooling water system

Item	No.	Type	Remark
Main CSW pump	2	Motor driven, centrifugal	Each 100 %
M/E HT CFW pump	1	Motor driven, centrifugal	
M/E Stand-by HT CFW pump	1	Engine driven, centrifugal	
M/E LT CFW pump	1	Motor driven, centrifugal	
M/E Stand-by LT CFW pump	1	Engine driven, centrifugal	
Central CFW pump	2	Motor driven, centrifugal	Each 100 %
Central cooler	2	Plate	Each 50 %

M/E JW pre-heater	1	Electric	
G/E JW pre-heater	1	Electric	
CSW pump for IGG	1	Motor driven, centrifugal	
Deck water seal pump	2	Motor driven, centrifugal	
Spray pump	1	Motor driven, centrifugal	

Steam and feed water system

Item	No.	Type	Remark
Feed water pump for auxiliary boiler	2	Motor driven, centrifugal	Each 100 %
Circulating Pump for auxiliary boiler	2	Motor driven, centrifugal	Each 100 %
Dump / drain cooler	1	Shell & tube, FW cooled	

Fuel oil system for main engine & generator engines

Item	No.	Type	Remark
M/E FO supply pump	2	Motor driven, screw	Each 100 %
M/E FO circulation pump	2	Motor driven, screw	Each 100 %
G/E FO supply pump	2	Motor driven, screw	Each 100 %
FO supply pump for IGG	2	Motor driven, screw	
FO supply pump for Aux. boiler	2	Motor driven, screw	
Emergency MGO pump	1	Air driven, screw	
FO automatic filter	1	Automatic back flushing with a manual by-pass filter	
Viscosity controller	1	Electronic	
MGO cooler	1	Plate, FW cooled	
FO flowmeter	3	Coriolis	

Fuel oil system (Miscellaneous)

Item	No.	Type	Remark
MGO transfer pump	1	Motor driven, screw	
FO purifier feed pump	2	Motor driven, screw	
FO purifier	2	Self-cleaning, automatic discharge	

Lubricating oil system

Item	No.	Type	Remark
M/E LO pump	1	Engine driven, gear	
M/E Stand-by LO pump	1	Motor driven, gear	
LO transfer pump	1	Motor driven, gear	
LO purifier feed pump	2	Motor driven, gear	
LO purifier	2	Self-cleaning, automatic discharge	
LO purifier heater	2	Shell & tube, steam heated	
M/E LO automatic filter	1	Automatic back flushing with a manual by-pass filter	
Stern tube LO pump	2	Motor driven, gear	
Reduction gear LO pump	2	Motor driven, gear	

Compressed air system

Item	No.	Type	Remark
Main air compressor	2	Motor driven, piston, FW or air cooled	
Service air compressor	1	Motor driven, screw, FW or air cooled	
Main air reservoir	2	Cylindrical	
Service air reservoir	1	Cylindrical	
Auxiliary air reservoir	1	Cylindrical	
Control air dryer	1	Refrigerated	

Ship's service system

Item	No.	Type	Remark
Fire, Bilge & G/S pump	2	Motor driven, centrifugal, self-priming	
Bilge transfer pump	1	Motor driven, mono	
Eductor for soot collecting tank discharge	1	-	
Oily water separator with pump	1	15 PPM with alarm	
Sludge pump	1	Motor driven, mono	
FW generator	1	Low pressure evaporating, plate	
FW generator ejector pump	1	Motor driven, centrifugal	
Hot water circulation pump	1	Motor driven, centrifugal	
FW sterilizer	1	Ultra violet ray	
Mineralizer	1	Dolomite	
FW hydrophore tank with 2-pumps	1	-	
Calorifier	1	Steam & electric heating	
Waste oil incinerator	1	Waste oil and solid waste burning	
Sewage treatment plant	1	Biological, vacuum pump	
MGPS	1	Electro-anode	
Urea supply pump	2	Motor driven, centrifugal	

Miscellaneous

Item	No.	Type	Remark
M/E overhead crane	1	Hoisting, traveling, traversing by electric motor	
Lathe	1	-	
Drilling machine	1	-	
Grinder	1	Double heads	
Gas welder	1	-	
Electric arc welder	1	-	
E/R ventilation fan	2	Axial flow	

Purifier room exhaust fan	1	Axial flow	
Welding area exhaust fan	1	Wall mounting	
Package unit cooler for ECR	1	Duct	
CO2 room	1	Axial Flow	

8. AUTOMATIN AND REMOTE CONTROL SYSTEM

8.1 Automation System

The automation in engine room, control devices and instrumentation shall be provided to comply with the requirement of Classification Society.

8.2 Control System for Machinery

Control of Main Engine
Remote control of M/E shall be carried out from engine control room and wheelhouse.

Control of Auxiliary equipment
Electric generating plant : Remote manual / automation control
Steam generating plant : Local manual / automation control

8.3 Alarm Monitoring and Control System

The engine room alarm monitoring and control system shall be of microprocessor design for centralized observation to meet ″unmanned engine room″ operation.
- Alarm monitoring system
- Stand-by start for vital pumps

In Engine Control Room

2 - 22″ TFT-LCD with keyboard
1 - Alarm printer
1 - Data logger
1 - UPS

Extended Station

1 - 22″ TFT-LCD with keyboard in wheelhouse (for monitoring)

Alarm monitoring and control of cargo handling system

9. ELECTRICAL EQUIPMENT AND SYSTEM

9.1 Electric Cable and Cable Installation

Cable characteristic	Flame retardant grade in accordance with IEC 60332-3A
Insulation	Cross-linked polyethylene (XLPE) insulation
Sheath	Halogen-free thermoplastic sheath (SHF1)
Cable support	Hanger, tray or pipe system

9.2 Electric Power Source

AC 440V / 220V, 3 Ph, 60 Hz, 3 wire system, DC 24V

Main and Emergency Generator
The generator shall be served as follows :

	Q'ty	Capacity	Enclosure	Insulation
Generator-D/G	2	900 kW	IP 23	Class F
Emergency Generator-E/G	1	120 kW	IP 23	Class H

Service condition	Generator in use
- Normal sea going - Maneuvering with bow thruster - Cargo service - In harbor	D/G x 1 D/G x 2 D/G x 2 D/G x 1
- At emergency	E/G x 1

Transformer

Transformer	Q'ty	Capacity	Voltage	Phase	Enclosure	Insulation
Main	2	90 kVA	AC 440 V / 230 V	3	IP 23	Class F
Emergency	2	30 kVA	AC 440 V / 230 V	3	IP 23	Class F

9.3 Switch board

Main Switchboard
One (1) set of main switchboard consisting of generator panel, synchronizing panel, bus-tie panel, 440 V feeder panel, 220 V feeder panel and group starter panel shall be installed in engine control room.

Emergency Switchboard

One (1) set of emergency switchboard consisting of emergency generator panel, emergency 440 V feeder panel, emergency 220 V feeder panel, emergency group starter panel and shore power connection box shall be installed in emergency generator room.

9.4 Power Equipment

Motor

Motors shall be of squirrel cage induction type of International Electro-technical Commission (IEC) standard frame designed for AC 440 V, 60 Hz, 3 Ph. Small motors may be of AC 220 V, DC 24 V, 1 Ph or 3 Ph.

Motors in general installed in the engine room	IP 23 (Drip proof)
Motors located under engine room floor	IP 44 (Totally enclosed)
Motors installed on exposed deck	IP 56 (Water proof)

Motors installed in hazardous area shall be of explosion proof type according to the Classification Society.

Starter

In general, starting method of motors shall be direct-on-line starting type.

For large motors, reduced voltage starting method (i.e. Star-Delta or auto transformer) shall be applied to prevent voltage drop on the main generator more than 15 % of rated voltage when motors start.

9.5 Electric Lighting

The lighting shall be fed from the AC 220V / DC24V, 60HZ, 1Ph supply system.

General light

Location	Lamp
Machinery space	Halogen lamp Fluorescent lamp Incandescent lamp
Accommodation	Fluorescent lamp Incandescent lamp
Space exposed to weather	Sodium / Halogen lamp Fluorescent lamp Incandescent lamp

Navigation and Signal light

Type	Light
Navigation light	Mast head light Side light Stern light Maneuvering light Anchor light NUC light RAM light
Signal light	Daylight signal light (Portable) Steering light Dangerous cargo light Singapore Strait signal light
Searchlight	1 kW searchlight on each bridge wing
Lighting control panel	Navigation light control panel Signal light control panel Outdoor light control panel

9.6 Interior Communication Equipment

One (1) : Digital automatic exchange telephone
One (1) : Common battery telephone (6 stations)
One (1) : Public address system (400 W)
One (1) : General and fire alarm system (Addressable type)
One (1) : Signal light column
One (1) : LAN system (6 points - Network wiring only)

9.7 Nautical Equipment

One (1) : S-band radar with ARPA
One (1) : X-band radar with ARPA
One (1) : Magnetic compass
One (1) : Gyro compass
One (1) : Auto pilot
One (1) : Speed log
One (1) : Echo sounder
Two (2) : DGPS navigator
One (1) : Anemometer and anemoscope
One (1) : Weather facsimile
One (1) : AIS (Automatic Identification System)
One (1) : VDR (Voyage Data Recorder)
One (1) : Whistle system (Air horn on radar mast / Electric horn on fore mast)
One (1) : Rudder angle indicator
One (1) : Electric clock

One (1) : ECDIS (Electronic Chart Display & Information System)
One (1) : Conning display
One (1) : BNWAS (Bridge Navigational Watch Alarm System)

9.8 Radio Equipment (GMDSS A3 area)

One (1) : MF/HF Radio equipment (250 W)
Two (2) : VHF Radio telephone
One (1) : Inmarsat FleetBroadband 500
Two (2) : Inmarsat-C, with LRIT and SSAS for ISPS code
Three (3) : VHF two-way transceiver
Six (6) : UHF two-way transceiver (IS type)
One (1) : Satellite EPIRB
Two (2) : Radar transponder
One (1) : Navtex receiver
One (1) : Communal Aerial system (For TV and radio)