

REVISION STATUS					
Rev.	Date	Remark	Originated by:	Checked by:	Project approval
<p><b><u>138.000 M<sup>3</sup> LNG CARRIER</u></b></p> <p><b><u>MEMBRANE TYPE</u></b></p> <p><b>DESIGN NO. 45302/08</b></p>					
			<b>PROJECT DESIGN DPT.</b>		
<b><u>OUTLINE SPECIFICATION</u></b>			<u>Customer:</u>		
No. de Plano – Drawing No.:			Approved:	Date:	
<b>45302/08-000-100</b>					

	<b><i>TECHNICAL DOCUMENTS</i></b>
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## **LIST OF TECHNICAL DOCUMENTS**

### **PART I      138.000 M<sup>3</sup> LNG CARRIER Design 45302/08**

- 1.-    OUTLINE SPECIFICATION
- 2.-    GENERAL ARRANGEMENT DRAWING
- 3.-    MAKER'S LIST
- 4.-    ANNEX I

## **CHAPTER 0 – GENERAL REQUIREMENTS**

This specification shall be applied in connection with the General Arrangement Plan (DIG No. 45302/08 007-100)

## **CHAPTER 1 - DESIGN CHARACTERISTICS**

### **101 – TYPE OF VESSEL**

The vessel shall be designed as a single screw steam turbine driven "Liquefied Natural Gas Carrier" with a dead-weight capacity of abt. 68.200 MT.

The vessel shall be designed and built with a continuous upper deck transom stern and bulbous bow without forecastle

All accommodation including navigation bridge and propulsion machinery shall be located aft and machinery casing shall not be integrated into the accommodation deckhouse to minimise vibration transmission.

The transverse cofferdam bulkheads shall be of flat type.

One (1) set bow thruster shall be provided as shown in the general arrangement.

Separate loading from discharge ports include following:

-Loading: Das Island (UAE), Point Fortin (Trinidad & Tobago), Bethouia (Algeria), Bonny Terminal (Nigeria) and North West Shelf (Australia).

-Discharging: Huelva (Spain) and Boston (U.S.A.) and the requirements of the proposed new jetties at Cartagena (Spain), Barcelona (Spain), Bilbao (Spain) and Peñuelas (Puerto Rico).

Vessel's design shall be compatible with terminals above mentioned.

## 102 – GENERAL ARRANGEMENT

The vessel shall be divided by bulkheads, decks and platforms into the following spaces and compartments

### -After body

The aft body of the ship with transom stern shall be used for the steering gear compartment, fresh water tanks, distilled water tanks, after peak ballast tank and store.

### -Engine room area

The engine room shall be arranged to accommodate the main propulsion machinery, sufficient platform decks for the auxiliary machinery, workshop and stores, etc.

Service, settling, bunker tanks for heavy fuel, diesel, lubricating oil and other small necessary tanks shall be provided at suitable places. Double shell will be provided in the way of HFO bunker tanks.

The double bottom shall contain lubricating oil sump tank, bilge tank, bilge oil tank and other necessary tanks.

### -Cargo area

The cargo area shall be of double decks, double hull, and cofferdams which are located at forward and after part of cargo area and between cargo tanks with double bottom construction, and consist of four (4) centre cargo tanks with GTT Membrane Type No. 96 E2 for the carriage of liquefied natural gas cargoes at cryogenic temperature (-163°C) and atmospheric pressure, and four (4) pairs of water ballast tanks surrounding the sides and bottom. of cargo tanks compartments.

Store shall be arranged around cargo machinery room on trunk deck

Water ballast tanks shall be so arranged to effectively control trimming, heeling and stability.

### -Fore body

Fore peak (void space), fuel oil tanks, bow thruster room, chain locker, rope stowage space and bosun store shall be arranged at fore body. Double shell will be provided in the way of HFO bunker tanks.

## 103 – MAIN DESIGN DIMENSIONS

Length over all	abt. 284.40 m
Length between perpendiculars	abt. 271.00 m
Breadth (moulded)	abt. 42.50 m
Depth to main deck (moulded)	abt. 25.40 m

Depth to trunk deck (moulded)	abt. 32.20 m
Draft design (moulded) (98,5% filling)	abt. 11.40 m
Draft scantling (moulded)	abt. 12.30 m

The design draught is based upon departure condition with maximum allowable cargo tanks filling with a LNG cargo of 0.470 specific gravity, sufficient bunkers & consumables for abt. 7,000 miles plus 3 days' reserve steaming at 19.5 knots at 90 % MCR even keel condition in F.O mode or 12,000 miles in dual mode ( considering 50% of the time loaded / 50% ballasted ).

-The design draught may be adjusted if necessary (in the range 11.40 – 11.45 m. max.) to comply with dead-weight and speed requirements.

Freeboard type Type "A" of international Convention on Load Lines 1966.

Total loaded displacement lower than 98,500 t

Mean normal navigation ballast design draught 9.75 m

#### 104 – DESIGN CAPACITIES

All capacities described below are 100% volume:

-Cargo tank capacity

The cargo tank capacity when geometrically calculated at the operation condition (-163°C, atm pressure).

No.1 Cargo tank	abt. 22.630 m <sup>3</sup>
No.2 Cargo tank	abt. 40.070 m <sup>3</sup>
No.3 Cargo tank	abt. 40.070 m <sup>3</sup>
No.4 Cargo tank	abt. 35.230 m <sup>3</sup>

Total (Excluding dome space and internal structure and fittings) abt. 138.000 m<sup>3</sup>

Total (Excluding dome space and internal structure and fitting at 98,5% abt. 135.930 m<sup>3</sup>

-Ballast tanks including peak tanks	abt. 49.900 m <sup>3</sup>
-Heavy fuel oil tanks including service tanks	abt. 7.900 m <sup>3</sup>
-Light diesel oil tanks including storage and service tanks	abt. 470 m <sup>3</sup>
-Fresh water and Distilled water tanks.	abt. 1.000 m <sup>3</sup>
-Lub. oil tanks including storage and sump tanks	abt. 100 m <sup>3</sup>

The fore peak tank is not included in the ballast capacities (dry compartment).

Total bunker and consumables capacity are sufficient for at least 20,000 nautical miles with the main engine at 90 % MCR, fuel oil tanks 98 % full + 2 % unpumpable in departure condition  
Overflow tanks are not considered.

#### 106 – DEADWEIGHT, LIGHTSHIP WEIGHT AND CENTRE OF GRAVITY

The vessel shall have a dead-weight of abt. 68.200 MT on the draft design moulded 11.40 m. in sea water of specific gravity of 1.025.

#### 107 – GROSS TONNAGE

Gross tonnage of the vessel according to International Tonnage Measurement shall be abt. 90.692 tons.

Gross tonnage (international) (UMS)	abt.	90,692
Net tonnage (international) (UMS)	abt.	27,208

#### 108 – PROPULSION, SPEED AND CONSUMPTION

##### Speed

Service speed at design moulded draft 11.40 m when running at NCR (90% MCR) of main propulsion machinery with 21% sea margin shall be 19.50 knots.

##### Fuel oil consumption

The specific contractual fuel oil consumption (based on higher calorific value of 10.280 Kcal/kg) is abt. 288.3 gr/kW/hr (212 gr/mhp/hr) - (with 3 % tolerance) for main engine running at 90% MCR in sea trials conditions

Endurance

Endurance on 19.5 knots at NCR of main propulsion machinery shall be abt. 20,000 sea miles, considering fuel oil tanks at 98% full and 2% umpumpable in departure condition.

Propulsion System

Main turbine : Reversible geared,  
cross compound steam driven  
28,000 Kw x 83 RPM

109 - ACCOMMODATION

The vessel shall accommodate a complement of forty (40) persons including 4 Suez Canal Workers.

Living rooms shall be built and equipped in accordance with the following ranking.

	<u>Deck</u>	<u>Eng.</u>	<u>Others</u>	<u>Total</u>
Captain class	Captain	C/Eng.		2
Senior off. class	C/Off Cargo/Off	1/Eng. Cargo/Eng	. Owner (A)	5
Junior off. class	2ndOff 3rdOff	2ndEng. 3rdEng.	Pilot (1P) Radio (1) Electrician Cadet (4P) Owner(B). Spare (1)	13
Petty off. class.	1 P	2 P	Cook (1)	4
Crew class	Seaman (5p)	Oiler(4p)	Messman(2p) Galley boy(1p)	12
Workers				4
Total				40

## 13 - CLASSIFICATION, REGULATIONS AND TESTS

### 131 - CLASSIFICATION

The vessel including its equipment, outfit, machinery and all appurtenance shall be constructed under the special supervision of and according to the full requirements and recommendations of the Classification Society

Notation : **LR, + 100 A1, Liquefied Gas Tanker, Shiptype 2G, Methane in Membrane tanks**

**Max. pressure 0.25 bar, Min. Temperature -163°C, + LMC, UMS, SDA, FDA, ES IWS, NAV1.**

### 132 - OTHER REGULATIONS

The requirements of the country of registry and the following rules and regulations will be applied :

- a) International Convention on Loadlines 1966, as amended by IMO Resolutions A513 and A514 (XIII).
- a) International Convention for Safety of Life at Sea Consolidated 1997 and any later amendments, including the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code).
- a) Convention on the International Regulations for Preventing Collisions at Sea 1972 and Amendments 1981, 1987, 1989, 1993. and IMO Resolution A464 (XII)
- d) International Convention for Prevention of Pollution from Ships (MARPOL) 1973/78 Consolidated 1991 and later amendments, including 1997 Annex VI "Prevention of Air Pollution from Ships".
- e) International Telecommunication Convention 1973 with Annex and Revisions 1974, 1982 and 1983/87.
- f) International Convention on Tonnage Measurement of Ships 1969, as amended by IMO Resolutions A493/494(XII).
- g) IMO Resolution A468 (XII), "Code of Noise Levels on Board Ship" and IMO A-343 (IX) recommendation on methods of measuring noise levels at listening port..
- g) U.S. Coast Guard Regulations applying to foreign flag vessel entering navigable waters of the U.S. incl. pollution prevention except Alaskan water, as follows :
  - CFR 33 part 155, 156, 159 and 164
  - CFR 46 part 154
  - Public law 95-474 oct. 17, 1978 (Port and tanker safety act of 1978).
- i) ILO Guide to Safety and Health in Dock Work 1976, as amended in 1979.
- j) ILO Convention concerning crew accommodation (92, 133)
- k) Suez Canal Regulations.



- l) National Maritime regulation of country of registry (Spain)
- m) Maritime Traffic Safety Law of Japan.
- n) Oil Pollution Act OPA-90

The following recommendations and guidelines are applied :

- a) OCIMF Mooring Equipment Guidelines, 1997.
- b) OCIMF Guidelines and Recommendations for the Safe Mooring of Large Ships at Piers and Sea Islands, 1994.
- c) OCIMF Recommendations for Manifolds for Refrigerated Liquefied Natural Gas Carriers (LNG), 1994.
- c) OCIMF Recommendations on Equipment for the Towing of disabled tankers.
- f) SIGTTO Recommendations and Guidelines for Linked Ship/Shore Emergency Shutdown of Liquefied Gas Cargo Transfer, 1987.
- g) SIGTTO Guidelines for the Alleviation of Excessive Surge Pressures on ESD, 1987.
- h) SIGTTO Recommendations for the Installation of Cargo Strainers on LNG Carriers.
- i) International Electro-Technical Commission (IEC) Publication 92 - Electrical Installations in Ships.
- j) ISO Guidelines No 6954 - 1984 (for hull vibration).
- j) VDI 2056 Criteria for Assessment of Mechanical vibrations in Machines.
- j) IMO Resolution A272 (VIII) and A330 (IX) Safe Access to and Working in Large Cargo Tanks and Ballast Spaces.
- m) IMO Resolution A601(15) Provision and Display of Manoeuvring Information Onboard Ships.
- n) IMO Resolution A686(17) Code on Alarms and Indicators.
- o) IMO Resolution A719(17) Prevention of Air Pollution on Ships.
- p) IMO Resolution A751(18) Interim Standards for Ship Manoeuvrability.
- q) IMO Resolution MSC 57(67) for access arrangements to tanker bows.
- q) IMO Resolution (NAV 29/WP3) navigation bridge visibility.

It is generally meant that the regulations or industrial recommendations referred to shall be the latest revision

### Flag of Registry

Spanish Flag

191 - BUYER'S SUPPLY

- 1) Nautical instrument in excess of those specified in the specifications.
- 2) Hobby equipment in excess of those specified in the specifications.
- 3) Medicine, medical outfit and sterilizer.
- 4) Galley utensils.
- 5) Silverware, crockery and glassware.
- 6) Linen, carpets and sheets.
- 7) Bedding except mattresses.
- 8) Mooring ropes other than those required by the Classification Society and building specification.
- 9) Charts, books and flags except necessity for issuing the certificate.
- 10) Paintings and pictures.
- 11) Hand tools and inventory otherwise specified in the specifications.
- 12) Bunker, D.O. and L.O. for actual service after delivery at Builder's Builder.
- 13) Consumable stores including stationeries.
- 14) Spare part and tools other than required by Classification Society.
- 15) Gymnasium equipment in excess of those specified in the specifications.
- 16) Test kits for fuel oil and lube oil.
- 17) Radio receivers and TV sets other than those specified in section 8.
- 18) Fenders
- 19) Shore connection cables
- 20) Hoses

194 – LIST OF MAKERS

See MAKER'S LIST attached in this technical documentation

## **CHAPTER 2 - GENERAL STRUCTURES**

Main hull girder which consist of trunk deck, double shell and double bottom in way of cargo hold space shall be of longitudinal framing system, and E/R double bottom, aft and fore ends of hull and machinery space shall be longitudinally and/or transversely framed with adequate scarfing.

The fatigue life of all critical details in hull structure in cargo area shall be at least forty (40) years service span, based on world-wide wave spectra and shall be confirmed by adecuated analysis.

The plates and stiffeners forming part of the ship's hull construction shall be of steel and comply with the requirements of the Classification Society and applicable USCG regulations for a world wide use except ALASKA. Certificate to be issued

Ambient conditions for determining material grade of the hull structure adjacent to cargo space shall be based on the world wide service except Alaskan waters as following:

- Air temperature (at 5 knots): - 18° C
- Sea water temperature: 0° C

The main hull structure shall be mild steel throughout for longitudinal material and high strength steel (yield stress 315/355 N/mm<sup>2</sup>) can be used for local parts of transverse web frames.

The structure of cargo holds shall be strengthened for partially loaded condition of cargo containment system in compliance with requirements of the Class with the restriction i.e. metacentre height (G.M), the filling height of cargo in accordance with the cargo handling instructions/requirements of GAZ TRANSPORT and TECHNIGAZ (GTT)

The ship structure and the modulus of the midship section shall comply whith the requirements of the Classification Society for navigation in the specific load conditions to be considered for this vessel.

A specific gravity of 0,5 Kg/dm<sup>3</sup> shall be considered for the cargo for longitudinal strength and tank scantling design.

No reduction in scantling shall be applied in connection with “corrosion control” allowance permitted by Class.

**CHAPTER 3 – EQUIPMENT AND SURFACES PROTECTION****312.10 - ANCHORS AND CHAINS****Anchor and Chain Cable**

Anchors, chain cables and mooring ropes shall be equipped in accordance with the requirements of Classification Society.

Particulars shall be as follows :

Item	No.	Type	Size
Bower anchor	3	Cast steel	Abt. 12.675 kg AC 14 Type High holding power stockless anchor
Anchor chain cable	1	Grade 3	Abt.102 mm dia. x 742.5m
Mooring rope	20	Galvanised steel wire rope (6x36 +1 Fc)	275m length of 44 mm dia.(MBL=1130KN) 11 mts Nylon tail 94mm diam.

**Emergency Towing Fittings**

One (1) set of emergency towing fittings on the upper deck forward and one (1) set on the aft mooring deck shall be provided in accordance with the SOLAS and OCIMF recommendation equipment for the towing of disabled tankers.

**313.40 – WINDLASSES AND MOORING WINCHES****General**

The electro-hydraulic driven deck machinery of high pressure (max. Pressure 280 bar) and non-autotension with rendering type shall be provided as shown on the General Arrangement Plan.

Tension of all mooring lines to be continuously monitored and displayed in the cargo control room (CCR).

**Windlasses**

Two (2) sets of separate type windlass, each combined with a mooring winch shall be installed on the upper deck forward, and each windlass shall be equipped with one (1) hydraulic motor, one (1) cable lifter, two (2) declutchable mooring drums and one (1) warping head.

Mooring WinchesForward

Two (2) winches with two (2) drums and one warping end.

One (1) winch with two (2) drums and two (2) warping ends

After

One winch with two (2) drums and two (2) warping ends.

Two(2) winches with two (2) drums and one warping end.

Between Engine Casing and accommodation

Two (2) winches with two (2) drums and one warping end.

32 - MAINTENANCE AND SERVICE EQUIPMENT

Portable davits : Sufficient portable davits are supplied.

Tank davit: to facilitate easy removal of injured personnel

A non permanently installed lifting device for Emergency Cargo Pump shall be provided

Provision cranes: Two (2) sets, electro-hydraulic motor driven of 5 tons SWL.

Each one (1) accommodation ladder shall be provided at each side of the upper deck as shown on the General Arrangement Plan.

One (1) set of pilot rope ladder shall be provided on each side of the upper deck in accordance with the requirements of SOLAS (incl. latest Amendments) and National Authorities.

The vertical ladders shall be arranged for access to store rooms requiring ladders, peak tanks, F.O. tanks, ballast tanks, cofferdams and masts

34 - SURFACE PROTECTION

The Builder shall provide the Buyer with technical information on paint regarding requirements for surface preparation, paint application, compatibility and overcoatibility and regulatory approvals, as well as "Quality standard of Painting" ( QSI-003 REV. 4 DATE 15/11/00).

Outside Shell

- Flat bottom, sea chests and thruster tunnels (coal tar epoxy base paints).

Underwater hull shall be painted according to docking interval.

1 Coat of tar epoxy paint. . . . .	1 x 175
1 Coat of tar vinilic . . . . .	1 x 125
2 Coats of SPC antifouling . . . . .	<u>2 x 125</u>
	550

Topsides and bulwarks: (above waterline).

2 coats of modified epoxy	2 x 150
2 coats of Polyurethane	<u>2 x 50</u>
	400

Exposed decks and fittings:

2 coats of modified epoxy	2 x 150
1 coat of Polyurethane	<u>1 x 50</u>
	350

Superstructure and deckhouse,(incl. weather deck part) funnels:

2 coats of modified epoxy	2 x 150
1 coat of Polyurethane	<u>1 x 50</u>
	350

Engine Room, and Steering Gear Room

- Deckheads, bulkheads, funnels inside, casings, inner shell and pillars above floor plating :

1 coat of alkid primer	1 x 80
1 coat of alkid finish	<u>1 x 40</u>
	120

- Galvanised ventilation ducts :

Exterior: as surrounding  
Interior:

- Below floor plates (including foundations) bilge tank tops.

2 coats of modified epoxy or similar	<u>2 x 150</u>
	300

Bilge tank tops: white colour paint

- Cofferdams and void spaces :

1 coat of modified epoxy	1 x 200
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Accommodation, store rooms, cargo machinery and electric motor room, compartments

## - Passageway between upper and trunk deck :

1 coat of holding primer	1 x 50
1 coat of modified epoxy	<u>1 x 150</u>
	200

## - Unlined steel surfaces:

1 coat of alkydic primer	1 x 80
1 coat of finish alkydic	<u>1 x 40</u>
	120

## - Lined steel surfaces, (behind the lining):

Not painted

## - Lined deckheads and bulkheads in refrigerated spaces, under the lining :

1 coat of bituminous paint	1 x 100
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## - Galvanised ventilation ducts :

Exterior: as surrounding

Interior: Not painted

- Cargo holds :

Without painting.

## - Ballast tanks, bilge and sewage water tank:

2 coats modified epoxy	2 x 150
2 stripe coats of post coating	-----
	300

Holding primer or similar touch-up shall be used on inner hull adjacent to cargo hold to rectify coupler welding defects, if necessary. Under suction bell mouths in ballast tanks one (1) coat of glass flake type paint shall be applied.

## - Transverse Cofferdam &amp; double deck:

2 coats modified epoxy	2 x 125
1 stripe coats	-----
	250

## - Fresh water tanks:

1 coat solvent free epoxy paint	1 x 300
1 stripe coat	-----
	300

- Fuel and D.O. tanks:  
Without treatment. Shop primed without touch up-cleaned.

- Lubricating oil tanks:  
Not painted

- Chain lockers:  
2 coats of modified epoxy or similar.  $\frac{2 \times 125}{\text{-----}}$   
250

### 347.10 – SACRIFICIAL ANODES

Zinc anodes shall be fitted on sea chests sea water piping system, rudder, bow thruster tunnel and sea water ballast tanks for a three (3) years life.

Zinc anodes shall be fitted directly welded to the hull structure without using bolt and nuts.

### 347.40 - IMPRESSED CURRENTS

The impressed-Current Cathodic Protection System shall be applied for the protecting wetted surface of hull including propeller, rudder and rudder stock from corrosion.

## 35 - SAFETY EQUIPMENT AND SALVAGE

Portable fire extinguishers shall be provided in accordance with the requirements of the Rules. Basically powder ones, CO<sub>2</sub> in certain areas (i.e. Main board room)

Fireman's outfits shall be provided in accordance with the requirements of the Rules.

Protective clothing equipment shall be provided according to the rules.

Two (2) sets of cargo safety equipment are delivered according to rules.



352 - LIFEBOATS AND LIFERAFTSLifeboat

One (1) free fall life boat fitted with diesel engine shall be installed as shown on the General Arrangement Plan.

A launching ramp with recovery davit will be installed at the stern for service of boat.

Rescue boat

One rescue boat, rigid hull, semienclosed, for six (6) persons to be provided as shown in General Arrang. to be diesel driven.. The boat and its equipment shall comply with SOLAS requirements and other statutory bodies

Liferaft

Liferaft shall be provided as follows:

Seating capacity	No. of set	Location
20 persons	4 sets	Near lifeboat.
6 persons	1 set	Upper deck forward.

Liferaft shall be of inflatable type of approved construction and completely equipped in accordance with SOLAS Regulation.

Remainder life saving appliances shall be provided in accordance with SOLAS Regulation and flag Authority concerned.

38 - INVENTORIES, SPARE AND TOOLS

Spare parts shall be supplied according to the Classification requirements  
Any additional spares required by Buyer shall be supplied on Buyer's account.

## **CHAPTER 4 - ACCOMMODATION AND SHIP'S OUTFIT**

All accommodation quarters such as cabins, public spaces, passage spaces, sanitary spaces, sundry spaces and other miscellaneous spaces are arranged as shown on the Accommodation Arrangement.

All materials used for the interior fittings are of marine use as far as possible.

### Cabins:

Captain class comprises a day room, office, bed room and private toilet with bath room.

Senior officer class comprises a day room, bed room and private toilet with bath room.

Junior officer class comprises a single berth cabin and private toilet with shower.

Petty Officer & Crew class comprises a single berth cabin and private toilet with shower.

Worker comprises a single berth cabin (two 2 tier berths) and private toilet with shower.

### 423.10 - AIR CONDITIONING

Centralised air conditioning system is provided for all cabins and public spaces except sanitary spaces and stores unless otherwise specified.

Fresh air intake are sized for being capable of taking 100% outside air quantity.

Refrigerating machine : Two (2) sets, each having 60% of total required capacity.

### 44 - CATERING EQUIPMENT

#### Catering space

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

Shelf and rack of stainless steel are provided suitably.

#### Galley

The galley is arranged as shown on the Accommodation Arrangement.

Equipment in galley generally to be of stainless steel.

#### Galley Pantry

Equipment in pantry generally to be of stainless steel.

The pantries are arranged near galley

443.10 - REFRIGERATING EQUIPMENT

Refrigerated provision chambers are provided as shown on the General Arrangement Plan. Approximate capacities, maintaining temperature and cooling system for each compartment are as follows :

<u>Compartment</u>	<u>Volume</u>	<u>Temp.</u>	<u>Cooling system</u>
Meat room:	about 30 m3	-25°C	Unit cooler.
Deep freeze:	about 30 m3	-25°C	Unit cooler.
Vegetable room:	about 36 m3	2°C	Unit cooler.
Dairy:	about 24 m3	3°C	Unit cooler
Lobby:	about 26 m3	3°C	Unit cooler.
Total:	about 140 m3		

443.11 - DRY PROVISION STORE

Fittings : -2 tier shelves of stainless steel frame with wooden batten

444.10 - LIFT

One (1) lift driven by an electric winch is installed from the 2nd platform in engine room to wheel house (serving 9 levels) for 6 persons (abt, 500 Kg).

445.30 - INCINERATOR

An incinerator of continuous feed type is provided. Maximum capacity of incinerator is 300.000 Kcal/h.

**CHAPTER 5 – CARGO AND SHIP'S SERVICE EQUIPMENT****501.00 - GENERAL CONDITIONS**

The vessel shall be designed, constructed and equipped to transport liquefied natural gas (hereinafter called LNG) in four(4) membrane cargo tanks at about – 163°C and at the absolute pressure of 1,060 milibar (1.08 Kg/cm<sup>2</sup>A) and in accordance with IMO requirements.

The cargo containment system shall be of the membrane type in accordance with the patents and latest design of the GTT N° 96 type E2 at the time the contract is signed and the requirements of the Classification Society and the Regulatory Bodies concerned

**Main Design Condition****1) Cargo**

Density of LNG : 470 kg/m<sup>3</sup> for general design of the ship.  
: 500 kg/m<sup>3</sup> for scantling of cargo tanks and cargo pumps.

Density of pure methane :425 kg/m<sup>3</sup>.

Minimum design temperature - 163° C.

**2) Ambient temperature condition**

Sea water temperature : max. +32°C  
: min. 0°C  
Air temperature : max. + 45°C.  
: min. – 18°C.

**3) Ambient pressure condition**

Atmospheric pressure range :950 m bar to 1,050 mbar absolute.

**4) Design pressure of cargo tank**

Pressure range : - 10 m bar g to 250 m bar g.  
Normal operating pressure : 1050-1200 mbar abs.

**5) Electrical supply condition**

Electrical supply for power :3300/440 V, 3 Ph, 60 Hz.  
Electrical supply for control & instrumentation : 220 V, 3 Ph, 60 Hz.

### Boil-off Rate

The maximum daily boil-off rate of the cargo during a loaded voyage (tanks to be full but cargo piping to be empty) shall be  $\leq 0.15\%$  of the gross cargo volume assuming the cargo is pure methane (density 425 kg/m<sup>3</sup>, vaporization heat, 511 KJ/Kg)

### Design and Calculation

#### 1) Cargo tank pressure

The normal pressure above the liquid level shall be 1,060 m bar absolute (1.08kg/cm<sup>2</sup> A).  
Cargo tank operating pressure shall be adjustable between 1,050 m bar and 1,200 m bar absolute.

#### 2) Insulation space

The insulation spaces shall be pressurised with gaseous nitrogen between 2 and 4 mbar above atmospheric pressure.

#### 3) LNG filling limit

Cargo tanks shall be filled up to 98,5% of the total capacity

Voyage at sea with filling ratios between 10% of the tank length and 80% of the tank height shall be prohibited.

#### 4) Cargo loading and discharging

The cargo containment and handling system shall be designed to load or discharge the LNG (excluding slow starting topping off, cooling of lines and arms connection and disconnection) within about twelve (12) hours.

#### 5) Calculation

Calculations of cargo handling system shall be based on the condition of the pure methane.

#### 6) Operation time

The required operation time shall be as follows: (Theoretical values; time for starting up of systems, machinery, ... etc, not included)

### Post docking

- Insulation space nitrogenation: 36 hours (2% By volume)
- Drying of cargo tanks: 20 hours (- 20°C, dew point)
  - Inerting of cargo tanks: 20 hours (2% O<sub>2</sub> by volume and -40°C dew point in tank.)
  - Cargo vapour purging: 20 hours (1% CO<sub>2</sub> by volume)
  - Cooling down: 12 hours (- 130C at tank bottom)

Pre docking

- Warming up: 48 hours (+ 5°C on primary barrier and –5°C on secondary barrier).
- Inerting: 20 hours (1,5 hydrocarbon by volume)
- Aeration: 20 hours (20% O<sub>2</sub> by volume)

506 - CARGO PIPING SYSTEM

Two (2) main liquid and one (1) main vapour crossovers, common to all cargo tanks, shall be provided. Four (4) liquid shore connections and one vapour connection shall be provided at each side of the ship.

One common liquid header, one common vapour header and one stripping/cooling down header shall be provided. The liquid lines shall terminate at the bottom and at the aft end of each cargo tank, and the vapour lines shall be connected at the top of each cargo tank.

The vapour domes shall extend from inside the cargo tank up to a suitable height above the weather deck.

All cargo and associated piping shall be laid on the trunk deck.

Thermal stresses due to expansion and contraction shall be minimised by the use of normal bends. Expansion bellows will be used if necessary.

Pipe velocities

- LNG and LN2 liquid lines : 7,4 m/sec. in general

Except in throttling valves and other local features where higher velocities. shall be used (shore connections, etc.).

- Vapour lines : 40 m/sec. in general (45 m/sec at the discharge side of compressors).

Liquid and vapour pipes shall be insulated outside cargo tanks by means self extinguishing polyurethane foam or similar adequate for temperatures up to +80 °C.

Mobile parts (valves, flanges, accessories, ...etc.) not to be insulated.

Adjacent to the cargo manifold, connections for loading fuel oil and diesel oil shall be provided.

The following reducer pieces shall be provided in accordance with the OCIMF recommendations and stored in cargo machinery room.

- Liquid line : 4 pcs x 16"/12", 4 pcs x 16"/20"
- Vapour line : 1 pc x 12"/8", 1 pc x 12"/16"

512.20 - CARGO EQUIPMENT

All cargo machinery equipment shall be designed, constructed and tested at the manufacturer's shop in accordance with the requirement of the Rule/Regulation, GTT and maker's standards,

Summary of cargo equipment shall be as follows :

- Cargo pump 8 x 1,700 m<sup>3</sup>/h at 150 mLC (S.G. 0.50)
- Stripping/cooling down pump 4 x 50 m<sup>3</sup>/h at 145 mLC (S.G. 0.50)
  
- High duty compressor 2 x 30,000 m<sup>3</sup>/h  
Suction – 140°C, 1,06 bar A  
Discharge – 105°C, 1.96 bar A
- LD Compressor 2x 8000m<sup>3</sup>/h at –40<sup>a</sup> C
- Main heater 2  
(warm-up mode) 23000 kg/h from – 105 to + 5  
(fuel gas mode) 8,000 kg/h from – 105° C to + 25° C
- Main vaporiser 1 x 2950 kg/h from - 196°C to + 20 C  
(Nitrogen vaporisation for insulation space)  
20,000 kg/h from – 163° C to -140°C (LNG discharging)
- Forcing vaporiser 1 x 6,950 kg/h from – 163°C to – 40°C
- Safety relief valve For cargo tank: 8, pilot operated  
For insulation space: 2 each insulation space x pilot operated
- Crossover 4 x 16" ANSI 150 for liquid shore cone.  
1 x 16" ANSI 150 for vapour shore cone.
- Vent mast Four (4) vent masts
- Cargo piping Stainless steel 316L with insulation on deck
- Inert gas generator 1 x 15,000 Nm<sup>3</sup> /h inert gas or dry air Dew point  
- 45°C at 30 kPa.
- Nitrogen generator 2 x 120 Nn<sup>3</sup>/h Discharge pressure 8 bar g  
Dew point – 65°C

Two (2) sets of electric motor driven positive displacement type vacuum pumps shall be installed in cargo machinery room and electric motors for vacuum pumps in electric motor room.

552.10 - CARGO HOSE HANDLING CRANE

Two (2) cargo hose handling cranes shall be arranged on ship's port and starboard in way of cargo manifold as shown on General Arrangement Plan, and the particulars based on even keel condition of the vessel shall be as follows

:No. of set: Two (2) sets type Electro-hydraulic, single jib, cylinder luffing type. Hoisting load: 12 tons SWL.

582 - CUSTODY TRANSFER SYSTEM (CTS)1) General

Micro processor-based Custody Transfer System shall be provided.

2) Cargo level measurement

Two independent level measurement system of different design are installed in each tank.

3) Cargo temperature measurement

The following temperature sensors shall be prepared at bottom (0%), middle low level (25%), middle level (50%), upper middle level (85%), vapour level (100%)

Each cargo tank : 5 sets x working sensor  
: 5 sets x spare sensor

4) Cargo tank pressure measurement

Three (3) pressure transmitter will be fitted on each tank.

(2) CTS measurement data report

The data shall be arrayed in columns corresponding to tank numbers and rows according to the measured function.

The CTS report shall be in English and include the date, time, ship's name, list, trim and data

583.21 - DRAUGHT AND TRIM INDICATORS

A four position remote draught indication system shall be fitted with display in wheelhouse and CCR and interfaced with IAS. The following draughts shall be read :

- Extreme aft
- Midships port
- Midships starboard
- Extreme forward

583.50 - LOADING COMPUTER SYSTEM1) General

The system shall be designed for loading calculation on the basis of both "On-line" and "Off-line" modes.



585 – GAS DETECTION SYSTEM1) General

Two (2) gas detection system shall be arranged to monitor the leakage of methane gas according to ICG code.

The system shall scan automatically all sampling points and the complete analysis cycle shall be complied with the rule requirements.

Infrared type : Sequential measurement

Catalytic combustion type : Continuously measurement

5) Portable instrument and calibration equipment

For measurement to be made in different points of the vessel or in a laboratory to be installed near CCR the following instruments shall be provided

- 2 off 100% LEL 100% volume
- 1 off oxygen meter (with 1%, 5%, 10%, 25% scales)

**CHAPTER 6 - PROPULSION, GENERATING PLANTS AND SERVICES****602 - GENERAL DESCRIPTION**

The vessel shall be designed and constructed as a single screw driven by double reduction geared steam turbines located aft.

Steam is generated by two water tube boilers with dual fuel burning system of equal size and fitted with

Superheaters, air heaters and automatic combustion controls.

The main boilers shall be designed to burn heavy fuel oil up to 700 cst at 50°C, or boil off gas of LNG or dual fuel (gas and fuel oil) under forced draft

**61 - PROPULSION PLANT****617.11 – MAIN TURBINE**

No. of set                                      One (1).

Type    Cross compound marine steam turbine with reversible gear.

Maximum continuous rating:              abt. 28000 Kw abt. 83 rpm.

90 % MCR                                      abt.25200 Kw.

Rated steam conditions                      Pressure before control valve : ABT. 60 kg/cm<sup>2</sup> G.  
Temperature before control valve : ABT. 510 °C.  
Exhaust pressure, condenser inlet : 0.05 kg/cm<sup>2</sup> abs.(722 mmHg).  
at max. power and 24°C sea water temperature.

**617.12 - REDUCTION GEAR**

The main reduction gear is tandem articulated double reduction type.

**62 - SHAFT LINE AND PROPELLER**

Shaft line

Two (2)    - Intermediate shaft.

One (1)    - Propeller shaft.

Two (2)    - Intermediate shaft bearing.

One (1)    - Stern tube with 2 white metal type's bearings.

The propeller shall be right handed, solid type of nickel aluminium bronze.

63 - STEAM GENERATING EQUIPMENT

Main boiler:	Two (2).	
No. of set type:	Two (2) drum, automatic, forced draft, dual fuel of oil and boiler off gas burning, marine water tube boiler with air heater and economizer.	
Steam condition:	61.8 kg/cm <sup>2</sup> , G x 515°C superheated	
Evaporation (kg/h):	At normal evap. abt.56.300	At max. Evap. abt.65.000
Superheated steam (kg/h):	Acc. to maker's standard	
De superheated steam (kg /h ):	“	
Steam at Superheater outlet :	“	
Feed water temperature at economizer inlet:	Abt. 138 <sup>a</sup> C acc. to heat balance.	
Air temperature at air heater outlet	120°C	
Air temperature at air heater inlet (for calculations)	40 °C.	

64 - ELECTRIC GENERATING PLANT

The electric generating plant shall be consisted of two (2) sets of turbine generator set, One (1) set of diesel engine generator set and one (1) set of emergency generator engine.

Diesel Generator

No. of set:	One (1)
Type:	Four (4) cycle, trunk piston, exhaust gas turbocharged marine diesel engine with air cooler.
Output Alternator:	Abt. 3000 kW.

Turbine-generator

No. of set:	Two (2).
Type:	Horizontal steam turbine driven type with reduction gear.
Rated output	Abt. 3000 kW,
Rated revolution:	1,800 rpm
(Alternator)	

Emergency generator engine

No. of set:	One (1).
Type:	Four (4) cycle radiator cooled diesel engine driven.
Output Alternator:	ABT. 350 kW,

65 - STEAM, CONDENSATE, FEED AND DISTILLED WATER SERVICES657.41 - MAIN CONDENSER

No. of set: One (1)

Type: Horizontal, single pass surface cooling, shell and tube type and water cooled type.

Vacuum: 722mmHg

Capacity: To be capable of dealing with main turbine exhaust steam at maximum output and one T/G at normal load. (Based on S.W. temperature at 24°C).

657.43 - ATMOSPHERIC CONDENSER

An Atmospheric condenser to condense the maximum flow from the back pressure line with 15 % fouling margin.

657.50 - FEED WATER HEATERS

Two (2) feed water heaters are fitted, one low pressure, one de deaerator.

658.24 – F.W. GENERATOR

The distillation plant consists of two fresh water generators of equal capacity, each of a minimum of 45 tonnes per day.

663.21 - MAIN CONDENSER S.W. CIRCULATION PUMP

No. of set: Three (3).

Type: M.D Centrifugal.

Capacity: ( abt. 8000 m<sup>3</sup>/h)

Total head: Abt. 5 m

672.31 - L.O. PURIFIERS

No. of set: Two (2).

Type: Auto self- cleaning, partial discharge type

Cleaning capacity: Abt.3,000 L/H

L.O. purifier heater: Capable to maintain 85°C

682.26 – FUEL .TRANSFER PUMPS

F.O. trans. pump	<u>E.R part</u>	<u>Forward</u>
No. of set:	One (1).	Two (2).
Type:	M.D. gear or screw	M.D. gear or screw.
Capacity:	50 m <sup>3</sup> /h	50 m <sup>3</sup> /h
Total head:	4 kg/cm <sup>2</sup>	4 kg/cm <sup>2</sup>
Light D.O. trans. Pump	<u>E.R. part</u>	
No. of set:	One (1).	
Type:	M.D. gear or screw.	
Capacity:	20 m <sup>3</sup> /h	
Total head		
G.O transfer pump.		
No. of set:	One (1).	
Type:	M.D. gear or screw.	
Capacity:	2,5 m <sup>3</sup> /h	

**CHAPTER 7 - INSTALLATION AND GENERAL SERVICES****712 - GENERAL**

The vessel shall be provided with fire extinguishing equipments to comply with the requirements of the Rules and Regulations,

For fire extinguishing in each compartment, the following system shall be provided.

Engine room	Water fog system for: purifiers room, incinerator Diesel generator and boiler burners High pressure CO <sub>2</sub> fire extinguishing system. Sea water fire extinguishing system. Portable fire extinguishers.
Cargo tank deck	Dry powder fire extinguishing system. Water spray system. for cargo manifold and cargo tank domes. Sea water fire extinguishing system and curtain side
Living quarter and other spaces	Sea water fire extinguishing system. Portable fire extinguishers. Water spray system for the accommodation front wall, and lifeboat embarkation area
Cargo compressor room	CO <sub>2</sub> fire extinguishing system, waters spray system. Portable fire extinguishers

Paint locker shall be protected by CO<sub>2</sub> system.

**712.10 - FIRE FIGHTING SYSTEMS****Fire Main and Wash Deck System**

The firemain for the cargo area is a ring main located in the underdeck passages with spurs to the fire hydrants on the open deck and shall be served by the fire & general service pumps and the emergency fire pump.

Sufficient number of flexible hoses shall be provided in accommodation, engine room and other spaces where required by the Rules.

**FIRE DETECTION**

A ship wide fire detection and alarm system is fitted to cover all accommodation and control room, working and machinery spaces, including the forward store areas and the cargo machinery spaces.

713.21 - FIRE AND GEN. SERVICE PUMPS

No. of set : Two (2).  
Capacity : According to the rules

713.22 - EMERGENCY FIRE FIGHTING PUMP

An electric motor driven emergency fire pump of centrifugal type shall be installed in emergency fire pump space complying with the requirements of the Rules.

713.23 - WATER SPRAY SYSTEM

The water spray system shall be provided for the exposed tank (liquid and vapour) domes, the cargo manifolds, the accommodation front wall and the boundaries of cargo compressor room and lifeboat embarkation area according to IGC requirements.

715.20 - CO<sub>2</sub> FIRE EXTINGUISHING SYSTEM

A fixed high pressure CO<sub>2</sub> gas fire extinguishing system shall be applied to the Engine Room, Main Switchboard, Engine Control Room and Purifiers Room and shall consist of CO<sub>2</sub> bottles, discharge lines, discharge nozzles, quick releasing device, etc. in accordance with the maker's standards.

CO<sub>2</sub> system shall also serve the Cargo Compressor Room, Paint Store, Emergency Generator Room and Incinerator Room.

The capacity and number of the CO<sub>2</sub> bottles shall be decided in accordance with the requirements of the Rules.

716.20 - DRY POWDER FIRE EXTINGUISHING SYSTEM

A fixed dry chemical powder system shall be provided for protecting the cargo deck area and cargo manifold areas in accordance with the requirements of the Rules

722 - BILGE SYSTEM

The bilge system shall be provided in accordance with the requirements of the Classification Society.

722.29 - BILGE PUMP (RECIPROCATING)

No. of set : One (1).  
Capacity : 20 m<sup>3</sup>/h

It is provided for normal service discharging to a bilge holding tank and overboard

Centrifugal bilge pump

No. of set : One (1).  
Capacity : abt. 220 m<sup>3</sup>/h

722.31 - BILGE SEPARATOR

Bilge separator shall be provided for handling the oily bilge in engine room in connection with the bilge pump. The performance shall meet the requirements of IMO, "International Marine Organisation" according to MARPOL Regulations.

723 - BALLAST SERVICE

The system shall be of ring main with spurs to each tank, with surge protection devices fitted to prevent rupture.

Ballast pumps shall be used for filling, discharging and transferring the ballast water and three (3) identical electric driven self-priming ballast pumps shall be capable of filling or emptying all ballast tanks within 10 hours. Ballast pumps shall be installed in Engine Room.

No. of set: Three (3).  
Capacity: Abt. 2,500 m<sup>3</sup>/h x abt. 35 mTH.  
Type: Vertical, centrifugal

732 - COMPRESSED AIR SYSTEM

Starting air compressor

No. of set : Two (2).  
Type : M.D air cooled type.  
Capacity : 22 m<sup>3</sup>/h  
Delivery pressure : 30 bar



734.00 - PNEUMATIC QUICK CLOSING SYSTEM

Pneumatically operated quick closing systems which can be operated from the outside of Engine Room shall be provided for the outlet valves of fuel and lub. oil tanks as required by the class society and regulatory bodies concerned.

748.42 - SEWAGE TREATMENT EQUIPMENT

In Engine room, a biological type sewage treatment plan with flushing lines for piping, and internal side of sewage tank will be arranged, suitable to treat all black waters in accordance with the U.S.C.G. requirements, and suitable for 40 persons.

757.29 – HYDRAULIC POWER UNIT

A valve control system is installed to allow all normal cargo handling and ballasting operations to be controlled from the cargo control room. The valves are provided with hydraulic actuators powered from a centralised power pack and controlled by electro-hydraulic control valves.

762 - ENGINE ROOM VENTILATION

Mechanical supply and exhaust ventilation is provided and designed according to the rules

Engine room supply fan:

No. of set: 4  
Capacity: According to capacity calculation of E/R air.

Exhaust fans:

No. of set: 2  
Capacity: According to calculations

772 - STEERING GEAR

Particulars of the steering gear shall be as follows:

No. of set 1 set.  
Type: Rotary vane type

The steering gear shall be designed in order to put the rudder in the range of 45 degrees on port and starboard in the low speed manoeuvring mode.

773 - RUDDER AND RUDDER STOCK

The rudder will be spade type, high efficiency and made of rolled steel plates and stiffeners in a totally welded construction.

The design of the rudder to be such that the propeller could be renewed without dismantling the rudder and without disturbing the propeller shaft.

774.10 - BOW THRUSTER AND ASSOCIATES

One (1) electric motor driven bow thruster with a capacity of abt. 27.5 tons thrust shall be provided in the fore part of the vessel. Motor for bow thruster: 1.800 KW.

781 - PIPING AND FITTINGS

Pipes, valves, cocks, flanges, bolts and nuts shall be in accordance with European Industrial Standards / American National Standard Institute (ANSI) or equivalent. The construction, size and materials shall comply with the Classification Society's requirements.

PIPE MATERIAL

SYSTEM	PIPELINE	VALVES
Cargo lines	Stainless steel 316L or equivalent	Cast stainless steel
Heating coils	AISI 304L	
Inert gas lines	Hot-dip galvanised mild steel	Nodular cast iron with bronze disc and st. steel spindle
Nitrogen	Stainless steel 316	Stainless steel 316
Water ballast lines	Glass reinforced Plastic (GRP in tanks), Galvanised in E.R. and steel coated for bulkhead penetr.)	Nodular cast iron body rubber lined, bronze disc and st. steel spindle
Hydraulic lines	Stainless steel 316 L	Stainless steel
Fire main (sea water)	Hot-dip galvanised steel	Nodular cast iron body rubber lined, bronze disc and st. steel spindle
Spray water system on deck	GRP (if not allowed, then CuNiFe)	Bronze
All sea water systems of continuous or intermittent duty	GRP or CuNiFe	Nodular cast iron with rubber lining with Ni-Al bronze disc (bronze body under 200 mm Dia.) with st.st.spindle
Bilge systems	GRP or hot-dip galvanised steel Stainless steel 316L in deck area, including cofferdams	Cast bronze with Ni-Al bronze disc & stainless steel spindle
Fuel oil system	Steel	Steel or cast iron
Domestic water system	Copper (supply) and PVC (drain)	
Fresh cooling water system	Steel, Galvanised on deck, including indoors Copper or steel(inside)	GS cast iron or steel
Pipes less than 25 mm diameter (fresh water, compressed air, lub oil)	St.Steel AISI 316 (outside) and indoors in deck area	
Scupper pipes	Hot-dip galvanised steel LORO type or BM type Galvanised	Heavy gauge bronze
Sounding pipes Steam pipes Air and compressed pipes	To Class requirements Galvanised Stainless steel 316L GRP	To Class requirements
Dry powder line Scrubber drain line		

**CHAPTER 8 - ELECTRIC INSTALLATION**

In general, voltage, frequency and phase for electrical equipments shall be as follows :

<b>Item</b>	<b>Voltage</b>	<b>Frequency</b>	<b>Phase</b>	<b>Conductor</b>
Generators	3.300V, a.c.	60 Hz	3	3 core
Emerg.generator	450 V, a.c.	60 Hz	3	3 core
Power motors	3.300V, a.c.	60 Hz	3	3 core
Bow thruster	3300V, a.c.	60 Hz	3	3 core
Power motors (Fractional ouput & special service)	220V, a.c.	60 Hz	3 or 1	3 core or 2 core
Galley equipment	440V, a.c. 220V, a.c.	60 Hz 60 Hz	3 3 or 1	3 core 3 core or 2 core
Lighting (Main circuit)	20V, a.c.	60 Hz	3	3 core
Lighting (Branch circuit)	420V, a.c.	60 Hz	1	2 core
Nautical Instruments	440V, a.c. 220V, a.c.  24V, a.c.	60 Hz 60 Hz -	3 3 or 1 -	3 core 3 core or 2 core 2 core
Interior communicat.. and alarm system	220V, a.c. 24V, a.c.	60 Hz -	1 -	2 core 2 core
Radio equipment	440V, a.c. 220V, a.c. 24V, d.c.	60 Hz 60 Hz -	3 1 -	3 core 2 core 2 core

801.1 - GENERATORS

Main Generator

1) Main particulars

The particulars of main generators shall be as follows :

Type	Turbine driven	Diesel driven
Number of set	Two (2)	One (1)
Rated output	3,000 KW	
Rated Voltage/phase/ Frequency	A.C. 3,300V, 3 phase, 60Hz	
Rating	Full load continuous	

Emergency Generator

One (1) set of diesel engine set directly coupled to AC generator shall be installed in emergency generator room.

The particulars of emergency generator shall be as follows:

Number of set	One (1)
Rated output	440 KVA (350 KW)
Rated Voltage/phase/ Frequency	A.C. 450 VV, 3 phase, 60 HZ
Rating	Full load continuous

86 - EXTERIOR AND INTERIOR COMMUNICATIONS

One (1) set of engine order telegraph system

One (1) set of sub-telegraph

One (1) set of engine telegraph logger

One (1) auto. telephone exchanger system of electronic type, capable of four (10) simultaneous.

The system will support up to 80 lines.

One (1) set of sound powered telephone

One mobile telephone GSM system with fax and e-mail

One (1) Ship/Shore communication system for cargo terminals

One (1) complete set of public addressor system

One (1) set of selectable call system for calling up engineers

866.10 - ALARMS OF DANGER FOR CREW

Locked-in Alarm  
Hospital Call  
CO2 Release Alarm  
Elevator Failure Alarm

867 - RADIO AND RADIOTELEPHONES EQUIPMENT

Two (2) independent U.H.F. communication channels. 12 multichannel intrinsically safe handheld.  
One (1) Inmarsat satellite Communications Ship Earth Station (SES) standard B.  
One (1) Inmarsat Satellite Communication SES standard M  
One (1) MF/HF transceiver.  
Two (2) VHF transceivers  
One (1) set of Satellite Emergency Position Indicating Radio Beacon (EPIRB)  
Two (2) sets of 9 GHZ radar transponder shall be provided  
One (1) set of Navtex receiver

88 - NAVIGATION EQUIPMENT

One (1) set of total navigation system  
One (1) complete set of "S" band radar with ARPA (True motion).  
One (1) complete set of "X" band radar (one : ARPA, true motion  
One (1) complete set of gyro compass combined with auto pilot  
One (1) Gyro repeater  
Dual automatic pilot and rudder steering control system  
One (1) course recorder of two-pen type  
One (1) set of transmitting type magnetic compass  
One (1) set of doppler log docking system  
One (1) complete set of echo sounder

Two (2) sets of DGPS with differential satellite Navigator connected to the integrated navigation system

89 - ELECTRICITY AND ELECTRONIC MISCELLANEOUS

Remote controlled cameras with zoom, pan and tilt facilities to monitor:

Mooring decks  
Cargo manifolds  
High fire risk areas  
Funnel

Ship's horns shall be provided as follows

- One (1) set of air horn with a space heater on aft part
- One (1) set of electric horn on fore mast.

One (1) master clock

Four (4) slave clock with three (3) hands

Twenty (20) slave clocks with two (2) hands.

**CHAPTER 9 - AUTOMATION AND CONTROL**

Controls and instrumentation shall be provided for all engine room equipment and system in compliance with the Classification Society Requirements for unattended engine room during normal operations at sea.

The main control for the vessel is accomplished with the use of a integrated control and monitoring system (IAS)

Supervision and operation of major systems are performed by use of graphic mimic displays on the workstation of the IAS, as for reference :

- Ballast system
- F.O. filling and transfer systems
- Cargo system
- Electric power system
- Main piping systems
- Main turbine with gear and shafting.
- Boilers system, incl. soot-blowing

**903 - CONTROL STATIONS**

The cargo control room (CCR)  
Bridge Control Console  
Chart table  
Supervisory desk  
Bow thruster control panel  
Two (2) bridge wing consoles  
One (1) fire control station  
Engine Control Room (ECR)

**912.10 - FIRE DETECTION AND ALARM SYSTEM**

One (1) set of general alarm system  
One (1) set of fire alarm system  
Fire Detection System  
General Emergency alarm system



93 - ELECTRIC GENERATING PLANT CONTROL

Turbo generator  
Diesel generator  
Emergency diesel generator

94 - STEAM GENERATING PLANT CONTROL

The main boilers shall be equipped with fully automatic boiler control system

The following control and safety system shall be provided.

- 8) Automatic and remote manual burner control
- 9) Automatic combustion control (ACC)
- 10) Automatic feed water control (FWC)
- 11) Soot blower sequential control (SBC)
- 12) Superheater outlet steam temperature control (STC)
- 13) Steam dump control
- 14) Safety system

The boil-off gas control system shall be designed in accordance with maker's recommendations and Classification Society's requirements.

955 - AUX. AND MISCELLANEOUS MACHINERY CONTROL

Fuel system  
Cooling water system  
Fresh water generator  
Lub. oil system  
Steam dump system  
Feed condensate and drain system  
Compressed air system  
Control valves in engine room  
Auxiliary system in E/R  
Remote control of aux. machinery  
Stern tube bearing temperature  
Shaft power meter  
Machinery condition monitoring  
Aux equipment for Fuel and Oil

97 – INTEGRATED AUTOMATION AND CONTROL OF CARGO HANDLING SYSTEM (IAS)

The IAS shall be provided for cargo control and monitoring of the following systems:

- 1) Cargo handling system
- 2) LNG vapour system
- 3) Gas compressor system
- 4) Vacuum equipment
- 5) Insulation space nitrogen control
- 6) Cargo containment monitoring
- 7) Ballast control system
- 8) Fire and main system
- 9) Inert gas generator

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