

VESSEL PARTICULARS FORM "C"
 ECO ARCTIC 22,000m³ LPG/NH₃/VCM CARRIER - DATE 01/11/2019

Specifications of the vessel and the gas installation which are representations by the Owners.

(A) VESSEL'S CHARACTERISTICS

PREAMBLE

Name : **ECO ARCTIC**
 Owner : **CALIFORNIA GASES INC.**
 Flag : **REPUBLIC OF MARSHALL ISLANDS**
 Build : **HYUNDAI MIPO DOCKYARD**
 Date on Service : **JAN 10th 2018**
 Class : **LLOYDS REGISTER (LRS)**

GRT International (Issued by Class)	: 19,554 tons	Suez	: 20,465.39 tons
		Panama	: 65,976 m3
		(Issued by Panama Canal Authority)	
NRT International (Issued by Class)	: 5,866 tons	Suez	: 16,547.97 tons
		Panama	: 16,329 tons

(Issued by Panama Canal Authority)

Is vessel build according to

USCG regulations?	: Yes
RINA regulations?	: N/A
Japanese regulation?	: JIS

Has vessel received

USCG approval?	: YES (for foreign vessel in US water)
RINA approval?	: N/A

HULL

LOA : **159.87m** LOA
 LBP : **152.20m** LBP
 Breadth : **25.60m** Breadth
 Depth : **17.30m** Depth
 Summer Draft : **11.914m** Summer Draft
 Multiple Draft : **N/A**

Estimated draft with full cargo and full bunkers are as follows.

Product	Draft Fore(m)	Draft Aft(m)	Draft Mean(m)	Corresponding Deadweight(t) (Only cargo)
Propane (98%)	9.04 m	9.23 m	9.14 m	12,709 tons
NH₃ (98%)	9.50 m	10.24 m	9.87 m	14,900 tons
VCM (98%)	11.86 m	11.89 m	11.88 m	21,254 tons

Propeller immersion :

At draft 9.14 m correspond. (Propane cond.) : 100.6%(50% Full Immersion)
At draft 9.90 m correspond. (NH₃ cond.) : 117.7%(50% Full Immersion)
At draft 11.88 m correspond. (VCM cond.) : 146.6%(50% Full Immersion)

VESSEL PARTICULARS FORM "C"
 ECO ARCTIC 22,000m³ LPG/NH₃/VCM CARRIER - DATE 01/11/2019

COMMUNICATION EQUIPMENT

Call letter	:	V7JA6	
Radio Station normally watched	:	Yes	
Radio MF/HF NBDP	:	JSS-2250 include	
Radio MF/HFTEL/DSC	:	JSS-2250 include	
VHF	:	JHS-770S 2sets	
Satellite Communication	Inmarsat 'C'	: 453834665	
	Inmarsat 'FBB'	: +870 773257635	
	V Sat. no.	: +30 2119902490	
	e-mail	: ecoarctic@stealth.gr	
		:	
Main Engine x 1	.	Type and make	: MAN B&W 6S50ME-C8.5
	.	Service power	: 7,155 Kw x 113.0 rpm (90% of SMCR)
		No of Cylinders	6
		Cyl Bore x Stroke	500 mm x 2,000 mm
	.	Grade of fuel used	: HFO - viscosity of up to 700cst at 50°C
Auxiliaries		Type and make (Electrical)	Yanmar 6EY22LW
		(Mechanical)	rated 900 Kw x 450V x 3 phases x 60 Hz
		Grade of fuel used	4 stroke x 970 Kw x 720 rpm
		No off	HFO - viscosity of up to 700cst at 50°C
			3
Emergency Gen		Type	STX Engine 6CT8.3DMGE – 120Kw, AC 450V,
		No off	3 phase, 60 Hz
			1
Composite Boiler		Type	Alfa Laval OC-TCi 3,800 Kg/Hr KBM 200
		Evaporation	2,500 Kg/hr (Oil fired section)
			1,000 Kg/hr (Exhaust gas M/E),
			2X150 Kg/hr (Exhaust gas A/E),
		Max Design Pressure	0.7 Mpa Saturated
		Feed Water Temp	80°C
		No off	1
Exhaust Economiser		Type	N/A
		Evaporation	-
		No off	-
Air Compressors (Main)		Type / Capacity	Sauer Compressor (WP121L) - Vertical,
		No off	2-stage, Air cooled type / 150m³ / hr
			2
Air Compressor (Emergency)		Type	Sauer Compressor (WP33L)
		No off	1
Fuel Oil Purifiers		Type	GEA OSE20-0136-067/20 – Centrifugal
		No off	2

VESSEL PARTICULARS FORM "C"
 ECO ARCTIC 22,000m³ LPG/NH₃/VCM CARRIER - DATE 01/11/2019

Lub Oil Purifier	Capacity	2,500 Ltrs / Hr, 700mm²/s at 50°C
	Type	GEA OSE5-91-037/5 – Centrifugal
	No off	1
	Capacity	1,400 Ltrs / Hr, 30mm²/s
Evaporator (F.W generator)	Type	Alfa Laval AQUA blue-C80-HW / HWL 7-20
	Capacity	1 X 15 m³/24h
Fresh Water Sterilizer	Type	DAE HEUNG TECH ULTRA VIOLET RAY TYPE
	Capacity	1 X 5000 L/h
Waste Oil Incinerator (IMO MEPC 76 (40))	Type	HMMCO MAXI NG50 SL WS
	Capacity	Oil at 38 kg/h & Solids at 80 Kg/h
Oily Water Separator	Type	SKF TMPB-2,5
	Capacity	1 X 2.5 m³/h
Sewage Treatment plant	Type	IL SEUNG Co, Ltd (ISB-04)- BIOLOGICAL MOVING BED BIFILM REACTOR
	Capacity	1 X 25 persons per day
Hot Water Set (Calorifier unit)	No off	DAE HEUNG TECH Co., Ltd. 300L with 1 x 1.0m² steam heater / 1 set
Steering Gear	Type	Rolls-Royce industries -Electro-hydraulic, Rotary vane type (RV850-3)
Bunker capacity		
HFO	:	1,683.3 m³ (Fuel oil bunker tanks are DH) AT 95%
Diesel	:	498.2 m³ (Diesel oil bunker tanks are DH) AT 95%
Fresh Water	:	267.2 m³

VESSEL PARTICULARS FORM "C"
 ECO ARCTIC 22,000m³ LPG/NH₃/VCM CARRIER - DATE 01/11/2019

SPEED & MAIN ENGINE CONSUMPTIONS

About 15 knots up to Beaufort scale 4 and max significant wave height of 1.25m

Av. Speed	M/E IFO Consumption (MT/day)	
	In Ballast condition	In Laden condition
13.0 knots	abt 12.6	abt 15.5
14.0 knots	abt 15.5	abt 19.5
15.0 knots	abt 18.0	abt 22.5
16.0 knots	abt 23.0	abt 28.0

All figures are about, defined as +/- 5% on consumption and speed respectively.

Notes:

1. Speed and consumption figures at sea, are best estimated basis daily weather conditions are up to Beaufort scale 4 – max. significant wave height 1.25 m, without effect of sea currents or swell, and vessel en route under a steady course, with a net sea passage duration of at least 24 hrs.
2. Consumption figures at port, are subject to port movements, port and/or harbour, terminal requirements, for the safe manoeuvring, approach, inland navigation, and port stay of the vessel throughout her call.

AUXILIARY ENGINES CONSUMPTION

	IFO Consumption (MT/day)	No of units running
At Sea (Ballast)	abt 3.5 MT/Day	1
At Sea (Laden & Cooling max Capacity)	abt 10.5 MT/Day	3
Loading (No cooling)	abt 3.5 MT/Day	1
Loading (Cooling at max capacity)	abt 10.5 MT/Day	3
Discharging (Fully Refrigerated)	abt 10.5 MT/Day	3
Discharging (Heating cargo)	abt 7.0 MT/Day	2
At anchor / Idle	abt 3.5 MT/Day	1
Inerting / Gass Freeing	abt 7.0 MT/Day	2

BOILER CONSUMPTION

	Consumption (MT/day)
At Sea	abt 0.5 MT/Day
At Port	abt 2.0 MT/Day

VESSEL PARTICULARS FORM "C"
ECO ARCTIC 22,000m³ LPG/NH₃/VCM CARRIER - DATE 01/11/2019

--	--

(B) CARGO INSTALLATIONS

1. Transportable products and respective quantities, calculated in accordance with IMO – maximum filling formula. (Tonnes)

	100% (CBM)	98% (CBM)
NO.1 CARGO TANK(P/S)	4,927.5	4,829.0
NO.2 CARGO TANK(P/S)	5,829.4	5,712.8
NO.3 CARGO TANK(P/S)	5,831.6	5,715.0
NO.4 CARGO TANK(P/S)	5,614.5	5,502.2
DECK TANK	155.5	152.4
TOTAL	22,358.5	21,911.4

1.1 Carrying capacity at maximum reference temperature

	SPSV	Ref Temp.	Pressure. at Ref. Temp	Density at Ref Temp.	Corresponding Quantity @98%filling (MT) at ref temperatures (deck tank quantity at 45°C)
	MPaG	°C	MPaG	kg/m ³	MT
C-Propane (2,5 mole % ethane)	0.53	7.1	0.53	517	11,315
C-Propane (8 mole % ethane)	0.53	1.6	0.53	520	11,377
Propylene	0.53	2.9	0.53	542	11,859
B/P Mixture (4)	0.53	26.5	0.53	530	11,609
I-Butane	0.53	45.0	0.50	524	11,483
N-Butane	0.53	45.0	0.33	549	12,019
Butylene	0.53	45.0	0.42	560	12,272
Butadiene	0.53	45.0	0.40	589	12,898
V.C.M.	0.35	29.6	0.35	888	19,443
Isoprene (3)	0.53	45.0	0.05	654	14,330
Pentane (3)	0.53	45.0	0.03	600	13,143
Pentene (3)	0.53	45.0	0.06	616	13,488
Anhydrous ammonia	0.53	-20.0	0.09	657	14,391
C4 fractions (4)	0.53	45.0	0.44	545	11,947
Dimethylamine (3)	0.53	45.0	0.28	624	13,662
Diethyl ether, (1) (3)	0.53	45.0	0.04	678	8,239
Methyl chloride (2)	0.35	16.9	0.35	922	11,193
Ethylamine / Monoethylamine (1) (3)	0.53	45.0	0.17	653	7,931
Acetaldehyde (3)	0.53	45.0	0.14	739	16,190
Isopropylamine, (1) (3)	0.53	45.0	0.06	661	8,030
Vinyl ethyl ether. (1) (3)	0.53	45.0	0.04	756	9,182
Raffinate 1 (4)	0.53	45.0	0.37	572	12,539
Raffinate 2 (4)	0.53	45.0	0.33	572	12,529

VESSEL PARTICULARS FORM "C"

ECO ARCTIC 22,000m³ LPG/NH₃/VCM CARRIER - DATE 01/11/2019

- (1) In accordance with section 17.11 of the IGC Code, the quantity of this cargo should not exceed, 3,000m³ in any one tank.
- (2) Methyl chloride must be loaded at min -10 °C as lower temp. will result in too high density.
- (3) Non-Cooled cargoes are carried at ambient conditions, therefore the max ambient air temp (+45°C) is used as reference temperature
- (4) See next page.

Note: Figures in bolt are limits for cargo tanks (not deck tank)

VESSEL PARTICULARS FORM "C"
ECO ARCTIC 22,000m³ LPG/NH₃/VCM CARRIER - DATE 01/11/2019

1.2 Carrying capacity at fully refrigerated condition (minimum carrying temperature)

	SPSV	Ref Temp.	Press. at Ref. Temp.	Density at Ref Temp.	Corresponding Quantity @98%filling (MT) at ref temperatures (deck tank quantity at 45°C)
	MPaG	°C	MPaG	kg/m ³	MT
C-Propane (2,5 mole % ethane)	0.53	-45.3	0.00	583.4	12,763
C-Propane (8 mole % ethane)	0.53	-51.4	0.00	586.5	12,830
Propylene	0.53	-47.4	0.00	608.7	13,317
B/P Mixture (4)	0.53	-30.2	0.00	599.2	13,115
I-Butane	0.53	-11.7	0.00	593.8	13,000
N-Butane	0.53	-0.4	0.00	601.6	13,174
Butylene	0.53	-6.7	0.00	623.3	13,649
Butadiene	0.53	-4.4	0.00	650.3	14,239
V.C.M.	0.35	-15.6	0.00	965.3	21,134
Isoprene (3)	0.53	32.9	0.00	666.7	14,606
Pentane (3)	0.53	36.2	0.00	609.1	13,344
Pentene (3)	0.53	29.9	0.00	632.3	13,852
Anhydrous ammonia	0.53	-33.0	0.00	673.1	14,732
C4 fractions (4)	0.53	-7.8	0.00	609.5	13,346
Dimethylamine (3)	0.53	7.2	0.00	671.6	14,708
Diethyl ether, (1) (3)	0.53	34.6	0.00	690.7	8,391
Methyl chloride (2)	0.35	-10.0	0.08	970.6	11,779
Ethylamine / Monoethylamine (1) (3)	0.53	16.7	0.00	686.8	8,341
Acetaldehyde (3)	0.53	21.0	0.00	771.0	16,888
Isopropylamine, (1) (3)	0.53	32.5	0.00	675.2	8,203
Vinyl ethyl ether. (1) (3)	0.53	35.6	0.00	767.8	9,329
Raffinate 1 (4)	0.53	-2.9	0.00	630.6	13,809
Raffinate 1 (4)	0.53	-0.2	0.00	626.0	13,709

(1) In accordance with section 17.11 of the IGC Code, the quantity of this cargo should not exceed, 3,000m³ in any one tank.

(2) Methyl chloride must be loaded at min -10 °C as lower temp. will result in too high density.

(3) Non-Cooled cargoes are carried at ambient conditions, therefore the max ambient air temp (+45°C) is used as reference temperature

(4) Densities for mixtures:

B/P Mixture: calculated as 50 mol% Propane, 25 mol% i-Butane, 25 mol % n-Butane

C4 fractions: calculated as 50 mol% i-Butane, 25 mol% n-Butane, 25 mol% Butadiene

Rafinate 1: calculated as 50wt % isobutylene, 25wt % cis-2-butene, 25wt % trans-2-butene

Rafinate 2: calculated as 30wt % cis-2-butene, 30wt % trans-2-butene, 20 wt % 1-Butene, 20wt % n-Butane.

Note: Figures in bolt are limits for cargo tanks (not deck tank)

VESSEL PARTICULARS FORM "C"
 ECO ARCTIC 22,000m³ LPG/NH₃/VCM CARRIER - DATE 01/11/2019

2. Other transportable products N/A

SPSV	Ref. Temp. (°C.)	Density at Ref. Temp.	Corresponding Quantity (MT)
------	---------------------	--------------------------	--------------------------------

3. TANKS

- | | | | |
|-----|-----------------------------------|---|---|
| 3.1 | Design pressure (Vapour) – BV-IGC | : | 5.3 bar g (0.53 MPag) |
| | - USCG | : | 5.3 bar g (0.53 MPag) |
| 3.2 | Valve setting | : | 5.3 bar g (0.53 MPag) / 3.5 bar g (0.35 MPag) for cargoes with SG above 0.69 |
| 3.3 | Maximum vacuum obtainable | : | -0.25 bar g |
| 3.5 | Maximum temperature acceptable | : | 45 °C |
| 3.6 | Minimum temperature acceptable | : | -52 °C |
| 3.7 | Hydrostatic Test Pressure | : | 8 bar g |

4. LOADING RATE (TONS/HOUR) – For Full Cargo Parcels

- | | | | | |
|---------------------------------|---|---------|---|---|
| Ex-atmospheric storage with gas | : | 1 tank | : | about 500 m³ per hour for LPG , cargoes with density above 972 kg/m³ at reduced rate |
| Return | | 2 tanks | : | about 1,000 m³ per hour for LPG, cargoes with density above 972 kg/m³ at reduced rate |
| | | 3 tanks | : | about 1,500 m³ per hour for LPG (Liquid crossover 2),cargoes with density above 972 kg/m³ at reduced rate |
| | | 4 tanks | : | about 2,000 m³ per hour for LPG (using both Liquid crossovers), cargoes with density above 972 kg/m³ at reduced rate |

Remarks:

- * Based on maximum velocity of 6.5 metres/sec except VCM, and 5.0 meters/sec for VCM in the liquid piping.
- * Loading by shore pump only, proper size gas return line to be connected
- * Subject to both ship and shore tanks being under favourable conditions

VESSEL PARTICULARS FORM "C"
 ECO ARCTIC 22,000m³ LPG/NH₃/VCM CARRIER - DATE 01/11/2019

5. CARGO PUMPS

- 5.1 Type : **Deepwell type of vertical centrifugal**
 Make : **WARTSILA SVANEHØJ A/S**
 How many : **1 per each tank half (total 8 Nos)**
 Maximum specific gravity : **0.972**
- 5.2 Capacity (CMB/Hour) : **250 m³/hr at 120 m.l.c**
 Two speed or variable speed : **Single Speed**
 Rated kW (each) : **150 kW**
 Working pressure maximum : **20 bar g**
- 5.3 Location : **At each cargo tank**
 Removable : **Not removable**
- 5.4 Booster pumps : **2**
 Type : **Horizontal**
 Maker : **WARTSILA SVANEHØJ A/S**
- 5.5 Capacity (CMB/Hour) : **250m³/h**
 Working pressure : **25 bar g**
- 5.6 Location : **STB between CT 4 & CT 3**
- 5.7 Time to discharge a full liquid cargo using all pumps against back pressure at pump
 1 bar : **about 12 hours for LPG (both liquid crossovers)**
 5 bars : **about 30 hours for LPG (both liquid crossovers)**
 10 bars : **-----**
- 5.8 Nominal back pressure when working : **about 1 bar**
 In series corresponding head : **240 m.l.c.**
 Maximum back pressure : **about 10 bar**
 Nominal pressure at rail (propane) : **about 18 bar at 20 degree C of cargo temperature**
- 5.9 What amount of cargo remains in tanks after completion pumping before stripping:
 - liquid : **about 115 liters for each sump**
 - vapour : **about 5 k m³ per one tank**

6. STRIPPING

- 6.1 Stripping system, if any : **Yes, 1" (DN25) line, in each tank**
- 6.2 Time required to remove all traces of liquid cargo as stated in 5.9 for:
 - LPG : **Stripping time depends on tank pressure. Evaporation for LPG abt. 4 hrs**

VESSEL PARTICULARS FORM "C"
 ECO ARCTIC 22,000m³ LPG/NH₃/VCM CARRIER - DATE 01/11/2019

10. CHANGING GRADE

- 10.1 From completion discharge of cargo Propane, time required in hours and inert gas in CBM required to reach a tank and gas installation atmosphere of less than 100 ppm of Propane in Vapour phase.
Time required: about 22 hrs (abt. 43700 Nm³ of N₂)
- 10.2 Can this operation be carried out at sea? : **Yes**
- 10.3 Can the ship measure the number of ppm in vapour phase? : **Yes**
- 10.4 Has vessel deck tank for changing grade/cooling operations? : **No**
- 10.5 Deck tanks : **1**
 Capacity : **155 m³**
 Purpose : for changing grade or carry additional cargo (deck tank is not insulated and designed to carry all cargo up to ambient temp of 45degC)

11. COOLING BEFORE LOADING :

12. CARGO HEATER

- 12.1 Type : **Shell and Tube**
- 12.2 Inside Diameter : **780 mm**
- 12.3 Overall length : **7,379 mm**
- 12.4 Cargo flow rate : **500 m³/h (Propane)**
- 12.5 Min Inlet Temp : **-55 °C (design)**
- 12.6 Min Outlet Temp : **-52 °C (design)**
- 12.7 Required Sea water Capacity : **790 m³/h**
- 12.8 Design Pressure : **25 bar g (tube side)**
- 12.9 Hydrostatic Test Pressure : **37,5 bar g (tube side)**
- 12.10 Tightness Test Pressure : **25 bar g**
Shell and Tube
- 12.0 State discharging rate for propane to be brought from atmospheric pressure **N/A**
 Loading rate for Propane – **minus 42.8 °C / 0 °C: about 500 m³/hr** (with SW of 15 °C)

13. CARGO VAPORIZER

In case vapour gas is needed to feed compressors, can vessel produce its own if no shore available:
Yes, capacity 2,000 Nm³/hr

14. REFRIGERATING APPARATUS : **3 Reliquefaction Units**

- 14.1 Is it independent of cargo? : **Yes**
 If so, state cooling agents : **Sea Water**
- 14.2 What minimum temperature can be maintained : **-52 deg C (for C-propane with 8% mole ethane)**
- 14.3 What time required at sea to lower by 1°C the full cargo of Propane (basis air temp +45 °C and sea temp +30 °C and three reliquifaction units in operation) : **From 0 °C to -1 °C: 2.8hrs**
From -10 °C to -11 °C: 4 hrs

VESSEL PARTICULARS FORM "C"
 ECO ARCTIC 22,000m³ LPG/NH₃/VCM CARRIER - DATE 01/11/2019

15. MEASURING APPARATUS

What gauges on board?

Type : **Float type level gauge, Henri System Holland B.V. FTLG 807 SUS/T391**
 Location : **Cargo tank dome, 1 per each Cargo tank half**

16. SAMPLES

16.1 State how tank atmosphere samples can be taken and where from?

Sample points at tank bottom, mid and top

Standard of fitting? : **Female 1/2" parallel coupling to ISO 228-1 2003.**

16.2 Same question for cargo : **Sampling connection at outlet of each cargo Pump (PT1/2)**

16.3 Are sample bottles available on board? : **No**

17. CARGO LINES

17.1 Is ship fitted with a port and starboard cargo manifold? : **Yes**

17.2 Position of cargo manifold

- distance from stern (AP) (S / P) : **76.00 M**
 - distance from stem (FP) (S / P) : **76.20 M**
 - height above deck : **1.43 M for 14" Liquid manifold**
 - distance from ship's rail : **3.50 M**
 - underside keel to manifold : **19.01 M**

17.3 Liquid line

- flange-size : **14" X 1, 10" X 1**
 - type : **14" & 10" ANSI 300LB**

Gas line

- flange-size : **10" X 1, 6" X 1**
 - type : **10" & 6" ANSI 150LB**

17.4 What reducers on board? : **Stainless steel 304L pieces supplied**

For Liquid line (low temperature)

14" ANSI 300LB to 16" ANSI 150LB, 12" ANSI 150LB, 10" ANSI 150LB, 8" ANSI 150LB
10" ANSI 300LB to 12" ANSI 150LB, 10" ANSI 150LB, 8" ANSI 150LB, 6" ANSI 150LB

For Vapor line (normal temp)

10" ANSI 150LB to 12" ANSI 150LB, 10" ANSI 150LB, 8" ANSI 150LB, 6" ANSI 150LB
6" ANSI 150LB to 8" ANSI 150LB, 6" ANSI 150LB, 4" ANSI 150LB, 3" ANSI 150LB

VESSEL PARTICULARS FORM "C"
 ECO ARCTIC 22,000m³ LPG/NH₃/VCM CARRIER - DATE 01/11/2019

17.5 Is ship fitted with stern discharge? **No**
 - Liquid line - diameter : **N/A**
 - flange – size : **N/A**
 - type : **N/A**

18. HOSES

Are serviceable hoses available on board? : **None**

18.1 Two pieces, each : **N/A**
 Length : **N/A**
 Diameter : **N/A**
 Flange-size : **N/A**
 Type : **N/A**
 Bending radius : **N/A**

18.2 Minimum temperature acceptable : **N/A**
 Maximum pressure acceptable : **N/A**

18.3 For what products are hoses suitable? : **None**

19. DERRICKS

- Hose cranes : **1 set**
 - Where situated : **Mid-ship (center)**
 - Lifting capacity : **10.0 tons at 10m/min**
 - Working radius : **MAX. 22.0 m ~MIN. 4.9 m**

20. SPECIAL FACILITIES

20.1 How many grades can be segregated? : **Four (4) Grades**
*Load 4 (four) grades of cargoes
 (2 must not require cooling, refer to
 cargo operation manual.)*

20.2 How many cooled? : **Two (2) Grades**

20.3 Can vessel sail with slack cargo tanks? : **Yes**

(C). BALLAST INSTALLATIONS

1. Is Ship fitted with water ballast treatment system? : **Yes**

Maker : ERMA FIRST
 Model : BWTS 800
 Capacity at ballasting : 800 m3/hr
 Capacity at de-ballasting : 800 m3/hr
 Filtration degree : 40 microns
 Working principle : Filter + Electronic (e.g. UV)
 Model No : ECF 750