Petronet LNG Limited

GIDC Industrial Estate, Plot No. 7/A, Dahej,
Taluka : Vagra, Dist. Bharuch (Gujarat) - 392130 (India)
Tel. : 02641 - 670200 / 257
www.petronetlng.com
CIN: L74899DL 1998PLC093073
GST No. : 24AAACP8148D1ZM

REF: PLL/DHJ/HSE/MoEF/2023/01 Date: 27th January, 2023

To,

The Director (Environment)
Forests & Environment Department,
Government of Gujarat,
Block No. 14, 8th Floor, Sachivalaya,
Gandhinagar – 382 010
(Fax No.: 079-23252156)

Subject: Half-yearly Compliance Report with respect to conditions stipulated by Ministry of Environment & Forests, Govt. of India and Department of Forests, Govt. of Gujarat for Installation of Terminal facilities to handle additional 10 MMTPA of LNG (Phase IIIA & Phase IIIB) at PLL Dahej, Gujarat by Petronet LNG Limited, Gujarat as on 31st December, 2022.

Ref : (a) F. No. 11-63/2011-IA-III Dated 26th February, 2014
(b) ENV-10-2013-71-E Dated 13th January, 2014
(c) F. No. 11-63/2011-IA-III Dated 04th Dec, 2020

Dear Sir,

The half yearly compliance report as on 31st December, 2022 with respect to conditions stipulated by Ministry of Environment & Forests, Govt. of India and Department of Forests, Govt. of Gujarat for Installation of Terminal facilities to handle additional 10 MMTPA of LNG (Phase IIIA & Phase IIIB) at Petronet LNG Limited, Gujarat is enclosed.

Thanking you,
Yours faithfully,
For Petronet LNG Limited

S B Singh
ED(Plant Head)

S B Singh
ED (Plant Head)
Petronet LNG Limited,
Dahej Terminal-392130

Encl.: As above

Copy to:-

Director,
Ministry of Env., Forest and Climate Change
Indira Paryavaran Bhawan,
Jorbagh Road,
New Delhi – 110 003

MoEF & CC
Integrated Regional Office
Room No 407 & 409
Sector 10A
A Wing Aranya Bhawan
Gandhinagar-382010

Unit Head - Bharuch Division
Gujarat Pollution Control Board
Paryavaran Bhavan, Sector-10 A
GANDHINAGAR – 382 010 (Gujarat)

Regional Officer
Gujarat Pollution Control Board
C-1\119\3, GIDC, Phase – 2 , Narmadanagar
Bharuch – 392015 (Gujarat)

HALF YEARLY COMPLIANCE REPORT TO (FOR THE PERIOD JULY 22 TO DECEMBER 22) THE CONDITION MENTIONED IN MOE&F LETTER NO. F.No.11-63/2011-IA-III, DATED: 26th February, 2014

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LETTER NO. F.No.11-63/2011-IA-III DATED 04TH December 2020

(For Phase III Expansion) AS ON 31.12.2022

Point-wise compliance statement for the subject environmental clearance is as below:

	CONDITIONS	STATUS
7.	**Special Conditions:**	
i)	"Consent for Establishment" shall be obtained from State Pollution Control Board under Air and Water Act and a copy shall be submitted to the Ministry before start of any construction work at the site.	Complied. "Consent for Establishment" was obtained from GPCB vide their letter no. GPCB/BRCH/B-CCA611(2)/ ID-15479/222771 Dated 21.08.2014 and provisional order obtained for validity extension.
ii)	All the recommendations and conditions stipulated by the Gujarat Coastal Zone Management Authority vide letter no. ENV-10-2013-71-E dated 13.01.2014, shall be strictly complied with.	Complied and detail of compliance attached as Annexure-I.
iii)	The facility shall be constructed in accordance with the NFPA 59 A- Standard for the Production, storage and handling of liquefied Natural gas, OISD-194- Standard for Storage and handling of LNG, EN 1473 - Installation and equipment for LNG - Design of onshore installations and M.B.Lal Committee report.	Complied. The facilities designed and constructed as per NFPA59A, OISD 194,EN1473 and M B lal committee recommendation are incorporated. Attached Annexure IV Engineering design basis document for your reference The construction and commissioning of the Phase-IIIA facilities at Dahej completed and is operational since October, 2016 and Phase-IIIB1 Regasification facility at Dahej completed and is operational since June, 2019.
iv)	Precautionary measures shall be put in place to prevent leakage of LNG due to any disasters including tidal/ tsunami wave, seismic and other natural calamities. Disaster Management Plan shall put in place to manage emergencies.	Complied. The terminal is designed considering all the specified factors for safe operations. ERDMP plan updated and recertify on 12/10/2022 by PNGRB approved agency M/s Bosai Safety and valid up to 11/10/2025.

		Attached Annexure V for ERDMP certificate for your reference.
v)	Oil Spill Contingency Management Plan shall be put in place.	Noted for compliance. Oil spill contingency plan, is available.
vi)	Online sensor for load monitoring shall be provided, as committed.	Complied. Online stack monitoring instrument are installed for gas turbine stacks.
vii)	Temperature sensors, gas detectors, spill detectors shall be installed to take care of any type of spillage or leakage of the gas from the plant and the trucks.	Complied. These sensors placed as per design and as per F & G Mapping study for instant detection of any leakage in Phase-IIIA & Phase-IIIB1 Regasification Project. Attached Annexure VI F&G Study report Index page for your reference.
viii)	Project proponent shall explore training the local population with the help of training institutes like ITI etc, to make them suitable for employment in the facility.	Noted for compliance. Petronet is working continuously for skill development of local people. PLL has recruited fair number of local people. For ancillary and support functions as security services, fire fighting and green belt maintenance etc. PLL is giving preference to local people.
ix)	All the recommendation of the EMP, Risk Assessment and Disaster Management Plan shall be complied within letter and spirit. All the mitigation measures submitted in the EMP/DMP report shall be prepared in a matrix format and the compliance for each mitigation plan shall be submitted to MOEF along with half yearly compliance report to MoEF-RO.	Complied. ERDMP plan updated and recertify on 12/10/2022 by PNGRB approved agency M/s Bosai Safety and valid up to 11/10/2025. Attached Annexure V for ERDMP certificate for your reference.
x)	A separate Environment Monitoring Cell shall be set up especially for this plant and details shall be submitted to the Ministry prior to the commencement of operation.	Complied. Environment Monitoring Cell is already set up in the existing plant and is being used for Environment Monitoring of expansion project and a brief report is being submitted to MoEF on half yearly basis. Detailed organogram of EMC is attached as Annexure-XII for your reference.

xi)	Construction activity shall be carried out strictly as per the provisions of CRZ Notification, 2011. No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.	Complied. Construction activities was done as per CRZ Notification 2011. The construction and commissioning of the Phase-IIIA facilities at Dahej completed and is operational since October, 2016 and Phase-IIIB1 Regasification facility at Dahej completed and is operational since June, 2019.
xii)	No construction work other than those permitted in Costal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.	Complied. CRZ Notification followed during construction phase however The construction and commissioning of the Phase-IIIA facilities at Dahej completed and is operational since October, 2016 and Phase-IIIB1 Regasification facility at Dahej completed and is operational since June, 2019.
xiii)	The project proponent shall set up separate environmental management cell for effective implementation of the stipulated environmental safeguards under the supervision of a Senior Executive.	Complied. EMC is already setup in the company and it will be used for Environment Monitoring of expansion project. Detailed organogram of EMC is attached as Annexure-XII for your reference.
xiv)	The funds earmarked for environment management plan shall be included in the budget and this shall not be diverted for any other purposes.	Noted for compliance. Funds earmarked for environment management plan is included in budget and being monitored regularly.
8.	**General conditions:**	
i)	Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality.	Complied. No digging activity effected the ground water quality during the construction. Ground water samples are taken and being monitors regularly. Ground water monitor data and reports are attached as Annexure-II.
ii)	Full support shall be extended to the officers of this Ministry/Regional Office at Bhopal by the project proponent during inspection of the project for monitoring purposes by furnishing full details and action plan including action taken reports in respect of mitigation measures and other environmental protection activities.	Complied. Entry of GPCB and all government bodies are taken care for any inspection and all required information submitted as and when visited.

iii)	A Six-Monthly monitoring report shall need to be submitted by the project proponents to the Regional Office of this Ministry at Bhopal regarding the implementation of the stipulated conditions.	Complied. MoEF & CRZ Half yearly compliance report submitted regularly. Last January 22 to July 2022 compliance report submitted on 23.07.2022.
iv)	Ministry of Environment & Forests or any other competent authority may stipulate any additional conditions or modify the existing ones, if necessary in the interest of environment and the same shall be complied with.	Noted for compliance.
v)	The Ministry reserves the right to revoke this clearance if any of the conditions stipulated are not complied with the satisfaction of the Ministry.	Agreed. No Such case till date.
vi)	In the event of a change in project profile or change in the implementation agency, a fresh reference shall be made to the Ministry of Environment and Forests.	Noted for compliance.
vii)	The project proponents shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of start of land development work.	Complied. Regional Office as well as the Ministry has been informed about the start of land development works vide our letter no. PLL/DHJ/MoEF/010 Dtd.12th May, 2014.
viii)	A copy of the clearance letter shall be marked to concerned Panchayat/local NGO, if any, from whom any suggestion/ representation has been made received while processing the proposal.	Complied. The environment clearance was forwarded to concerned offices. A copy of inwards from such offices was submitted vide our letter no. PLL/DHJ/MoEF/011 Dt.13th May, 2014.
ix)	State Pollution Control Board shall display a copy of the clearance letter at the Regional Office, District Industries Center and Collector's Office/Tehsildar's office for 30 days.	Complied. Copy of environment clearance was already forwarded to concerned offices.
9.	These stipulations would be enforced among others under the provisions of Water (Prevention and Control of Pollution) Act 1974, the Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act, 1986, the Public Liability (Insurance) Act, 1991 and EIA Notification 1994, including the amendments and rules made thereafter.	Complied. Mention Environment act and Rules are followed. PLI Policy renewed for one year w.e.f 01.06.23. Attached Annexure VIII for PLI policy

10.	All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation Act, 1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponents from the respective competent authorities.	Complied. Applicable clearances from following authorities obtained, a copy of same was submitted vide our letter no. PLL/DHJ/MoEF/011 Dt.13th May, 2014: 1. PESO in principle approval obtained vide letter dated 10/10/2012 [PV(WC)S-784/GJ-II] and letter Dt 19/03/2014[PV(WC)S-784/GJ-II]. 2. Forest Dept. Approval obtained vide letter dated 30/10/2013, No.FCA-1013/10-13/11/SF-31-F.
11.	The project proponent shall advertise in at least two local Newspapers widely circulated in the region, one of which shall be in the vernacular language informing that the project has been accorded Environmental and CRZ Clearance and copies of clearance letters are available with the State Pollution Control Board and may also be seen on the website of the Ministry of Environment and Forests at http://www.envfor.nic.in. The advertisement should be made within 10 days from the date of receipt of the Clearance letter and a copy of the same should be forwarded to the Regional office of this Ministry at Bhopal.	Complied. A Public Notice was advertized in the local newspapers in English and Gujarati languages. A copy of same was submitted vide our letter no. PLL/DHJ/MoEF/011 Dtd.13th May, 2014. Sandesh Gujarati newspaper dated 07.03.2014 and Times of India English Newspaper dated 07.03.2014 A copy of this notice is already forwarded to RO, Bhopal vide letter PLL/DHJ/MoEF/2014/007 dated 07.03.2014.
12.	This Clearance is subject to final order of the Hon'ble Supreme Court of India in the matter of Goa Foundation Vs. Union of India in Writ Petition (Civil) No.460 of 2004 as may be applicable to this project.	Agreed.
13.	Any appeal against this clearance shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.	Agreed. No Such case till date.
14.	Status of compliance to the various stipulated environmental conditions and environmental safeguards will be uploaded by the project proponent in its website.	Complied. Six monthly compliance are uploaded at company website www.petronetlng.com Attached Annexure IX for screen shot of website
15.	A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zilla Parisad/ Municipal Corporation, Urban Local Body and the Local NGO, if any, from whom suggestions/	Complied. Refer reply to 8 (viii).

	representations, if any, were received while processing the proposal. The clearance letter shall also be put on the website of the company by the proponent.	The Environment and CRZ Clearance is already uploaded at company website www.petronetlng.com.
16.	The proponent shall upload the status of compliance of the stipulated Clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB	Complied. The Environment and CRZ Clearance compliance status is already uploaded at company website www.petronetlng.com. The monitored reports are regularly sent to MoEF RO, Bhopal with copy to GPCB & CPCB.
17.	The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of Clearance conditions and shall also be sent to the respective Regional Offices of MoEF by e-mail.	Complied. The Form-V is being updated on company website and sent to MoEF Regional Office by e-mail. Attached Annexure VII for Environment statement.
	Condition Mention in LETTER NO. F.No.11-63/2011-IA-III dated 04TH December 2020	
6i	Marine ecological monitoring and its mitigation measures for protection of phytoplankton, zooplanktons, macrobenthos, estuaries, sea grass, algae, sea, weeds, crustacean, fishes mangroves and migratory birds etc. shall be undertaken through a reputed university/institute with financial support as desired. Six monthly report of the studies to be provided to the regional office of MoEFCC.	Noted for compliance. Marine ecological monitoring study conducted in December,2022 by GPCB authorized vendor M/s Unistar Environment and Research Labs Pvt. Ltd. Attached Annexure XI for Marine ecological monitoring report.
7	The MoEFCC has considered the proposal based on the recommendation of the Expert Appraisal Committee and hereby decided to accord extension of validty of EC of aforementioned project issued by the Ministry vide letter No -11-63/2011-IA-III dated 26th February 2014 for period of thre years i.e up to 25th February 2024 under the EIA Notification 2006 as amended subject to strict compliance of all conditions specified in the EC letter and in addition to additional condition prescribed by the EAC.	Complied. All previous EC conditions are Complied. Half yearly compliance report submitted regularly.

ANNEXURE-I

Compliance to conditions as conveyed by Department of Forests & Environment, Govt. of Gujarat, Letter No. ENV-10-2013-71-E dated 13th January, 2014 as on 31.12.2022

Point-wise compliance statement for the subject environmental clearance is as below:

SR. NO.	CONDITIONS	STATUS
1	The provisions of the CRZ notification of 2011 shall be strictly adhered to by the PLL	Noted for compliance. CRZ Notification 2011 followed strictly.
2	PLL shall have to comply with all the Standards/norms prescribed by the Central Pollution Control Board for this project	Noted for compliance. CPCB and GPCB norms are followed Monthly Environment monitoring done through GPCB approved agency and all measured parameters are under the limit. **Attached Annexure II for Environment monitoring data**
3	PLL shall have to revise the Emergency Preparedness plan in close coordination with District Authority prior to Commissioning of expansion project.	Complied. ERDMP plan is updated and include Phase III expansion. All the recommendation of DMI, Bhopal are incorporated. ERDMP plan updated and recertify on 12/10/2022 by PNGRB approved agency M/s Bosai Safety and valid up to 11/10/2025. **Attached Annexure V for DMI ERDMP certificate for your reference.**
4	All the recommendations and suggestions given by the VIMTA LABS in their Comprehensive Environment Management Plan shall be implemented strictly by the PLL	Complied. Company has adopted and followed best Environment Management practices to minimizing the impact on environment. Company has

		ISO 14001/9001/45001 certificate.
5	The construction debris and sewage generated during the construction phase shall not be discharged into the creek, sea, estuary or into the CRZ area. The debris shall be removed from the construction site immediately after the construction is over and shall be disposed off as per the guidance of the GPCB.	Complied. No debris discharged into the creek, sea or into CRZ area during construction phase.
6	The construction camps shall be located outside the CRZ area and the construction labours shall be provided with the necessary amenities, including sanitation, water supply and fuel and it shall be ensured that the environmental conditions are not deteriorated by the construction labours	Complied. Construction camp set outside the CRZ area and all required welfare services are provided.
7	The groundwater shall not be tapped to meet with the water requirements during construction or operation phase in any case.	Complied. Ground water was not used during the construction phase as well as operation phase.
8	A Disaster Management Plan to meet with any eventualities that may arise during construction and/or operation phase shall be prepared implemented.	Complied. ERDMP plan updated and recertify on 12/10/2022 by PNGRB approved agency M/s Bosai Safety and valid up to 11/10/2025. **Attached Annexure V for ERDMP certificate for your reference.**
9	Necessary permissions/Clearances from different departments/ agencies under different laws/ acts shall be obtained before commencing any enabling activities.	Complied. Applicable clearances from following authorities obtained, a copy of same was submitted vide our letter no. PLL/DHJ/MoEF/011 Dt.13th May, 2014: 1. PESO in principle approval obtained vide letter dated 10/10/2012 [PV(WC)S-784/GJ-II] and letter Dt 19/03/2014[PV(WC)S-784/GJ-II].

		Forest Dept. Approval obtained vide letter dated 30/10/2013, No.FCA-1013/10-13/11/SF-31-F.
10	A separate Environmental Cell with qualified personnel shall be created to implement the Environmental Management Plan and a separate budget shall be provided for this purpose.	Complied. EMC is already setup in the company and it will be used for Environment Monitoring of expansion project. Detailed organogram of EMC is attached as Annexure-XII for your reference.
11	The cost of the external agency that may be appointed by this department for supervision / monitoring of the project activities during construction/ operational phases shall be borne by the PLL.	Agreed. PLL agree to born cost of external agency appointed by this department
12	Massive greenbelt development program including the mangrove plantation in 100 ha. shall be carried out in consultation with the Gujarat Ecology Commission/ Forest Department by PLL.	Complied. PLL has completed 100 ha. Mangrove Plantation in consultation with Forest Department.
13	A large scale socio-economic upliftment program in consultation with the District Collector/ DDO shall be carried out. A separate budget shall be provided for this purpose and details be furnished to this Department from time to time.	Complied. Please Refer Attached **Annexure III** for detail.
14	Environmental Audit report shall be submitted every year. The report shall also cover the change in the coastal and marine environment enroute the proposed rerouted pipeline and due to commissioning of the proposed activities.	**Complied** PLL is ISO 14001(Environment Management System) certified company. Procedure are adopted and followed strictly to protect the environment. Annual external environmental audit for ISO 14001 certification is carried out . Pls refer **Annexure XIII** for ISO14001 certificate.

		Also, Monthly Environmental monitoring done through GPCB approved agency and all parameters are under prescribed limit. Pls refer **Annexure II** for Environment monitoring data. Six Monthly Marine ecological monitoring is also carried out for monitoring marine ecological condition. Last Marine ecological monitoring was conducted on 17th December ,2022 by authorized vendor M/s Unistar Environment and Research Labs Pvt. Ltd. Latest marine ecological monitoring report is attached as **Annexure – XI.**
15	A six monthly progress reports regarding the compliance of the conditions shall be submitted to this department.	Noted for compliance.
16	Any additional condition that may be imposed by the Ministry of Environment and Forests, Government of India/This department from time to time shall have to be complied with by the PLL.	Noted for compliance. No such case till date.

ANNEXURE - II - ENVIROMENT DATA

AMBIENT AIR QUALITY STATUS REPORT

All units are in µg/m^3.

Sr.no.	Month	PM10		PM2.5		SOx		NOx		HC as Methane CH_4	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
	NAAQ norms	100 µg/m^3		60 µg/m^3		80 µg/m^3		80 µg/m^3		Absent	
1	Jan-22	66.00	88.00	16.00	32.00	10.50	19.60	14.50	22.60	BDL	BDL
2	Feb-22	64.00	88.00	17.00	34.00	11.10	18.90	11.40	22.40	BDL	BDL
3	Mar-22	71.00	88.00	18.00	33.00	10.20	18.70	12.50	22.60	BDL	BDL
4	Apr-22	72.00	88.00	21.00	33.00	11.50	18.90	14.10	22.40	BDL	BDL
5	May-22	74.00	88.00	21.00	34.00	10.30	19.60	14.20	22.40	BDL	BDL
6	Jun-22	71.00	86.00	21.00	33.00	11.60	19.40	13.50	22.40	BDL	BDL
7	Jul-22	64.00	88.00	18.00	32.00	10.80	18.70	12.30	21.30	BDL	BDL
8	Aug-22	61.00	81.00	16.00	28.00	10.30	18.40	13.60	20.10	BDL	BDL
9	Sep-22	62.00	78.00	20.00	28.00	10.30	18.70	14.60	21.10	BDL	BDL
10	Oct-22	64.00	84.00	21.00	28.00	11.20	17.10	13.60	19.40	BDL	BDL
11	Nov-22	71.00	88.00	21.00	33.00	11.60	18.40	13.40	21.30	BDL	BDL
12	Dec-22	71.00	88.00	21.00	28.00	11.40	18.40	12.40	22.40	BDL	BDL
	Range (Jan-22 to Dec 22)	61-88		16-34		10.2-19.6		11.4-22.6		BDL	

STACK EMISSION AIR QUALITY STATUS REPORT

Sr.no.	Month	GTG		
		SPM	SO_X	NO_X
GPCB norms		150 mg/NM^3	100 ppm	50 ppm
1	Jan-22	Not monitored due to non operational GTGs		
2	Feb-22	Not monitored due to non operational GTGs		
3	Mar-22	Not monitored due to non operational GTGs		
4	Apr-22	Not monitored due to non operational GTGs		
5	May-22	Not monitored due to non operational GTGs		
6	Jun-22	BDL	BDL	15.30
7	Jul-22	Not monitored due to non operational GTGs		
8	Aug-22	BDL	BDL	14.20
9	Sep-22	BDL	BDL	17.30
10	Oct-22	BDL	BDL	11.60
11	Nov-22	BDL	BDL	15.30
12	Dec-22	BDL	BDL	14.30
	Range (Jan-22 to Dec-22)	BDL	BDL	17.30

BDL: Below Detection Level.

NOISE LEVEL REPORT

Sr.no.	Location	Unit	Limit	Jan-22		Feb-22		Mar-22		Apr-22		May-22		Jun-22		Jul-22		Aug-22		Sep-22		Oct-22		Nov-22		Dec-22	
				L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}
1	North	decibel	Day-75 db Night-70db	72	51	73	55	72	56	71	54	74	58	72	56	74	54	55	45	55	42	51	42	52	41	52	42
2	East	decibel	Day-75 db Night-70db	66	54	68	54	71	51	67	56	72	55	68	54	66	52	54	42	53	42	51	43	49	45	52	44
3	West	decibel	Day-75 db Night-70db	71	52	74	56	73	54	68	52	69	52	70	55	69	54	52	42	51	43	52	41	50	42	51	42
4	South	decibel	Day-75 db Night-70db	69	56	71	51	74	52	72	55	71	54	73	58	72	52	47	42	49	42	50	42	48	42	52	41

GROUND WATER QUALITY STATUS REPORT

Sr.no.	Parameter	Unit	Mar-22		Jun-22		Sep-22		Dec-22	
			GW1	GW2	GW1	GW2	GW1	GW2	GW1	GW2
1	Temperature	*C	29	29	30	30	29	29	28	28
2	PH	-	8.5	8.52	9.13	9.13	8.09	7.88	8.9	8.45
3	Total Dissloved Solids (TDS)	mg/L	3220	3290	2410	2800	972	448	2076	2388
4	Chlorides as CL	mg/L	749.8	599.8	459.8	719.7	286.5	106.8	631.6	607.5
5	Sulphate as SO4	mg/L	330	337	309.8	182.6	116.3	113	197	420.8
6	BOD (5 days @ 20°C)	mg/L	5	6	BDL	BDL	BDL	BDL	BDL	BDL
7	COD	mg/L	20.2	24.3	BDL	BDL	BDL	BDL	BDL	BDL
8	Oil & Grease	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
9	Phenolic Compound	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
10	Zinc as Zn	mg/L	BDL	BDL	BDL	BDL	BDL	0.056	BDL	BDL
11	Total Chromium as Cr+3	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
12	Lead as Pb	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
13	Cyanide as CN	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
14	Flouride as F	mg/L	1.35	2.3	2.14	2.12	0.8	0.4	2	1.3
15	Copper as Cu	mg/L	BDL	BDL	BDL	BDL	BDL	0.059	BDL	BDL
16	Insecticide	mg/L	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
17	Pesticide	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
18	Mercury as Hg	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	ND*: Not detected									

MARINE WATER QUALITY STATUS REPORT

Sr.no.	Parameter	Unit	Mar-22	Jun-22	Sep-22	Dec-22
			MW	MW	MW	MW
1	Temperature	*C	29	30	30	28
2	PH	-	7.62	8.06	7.98	7.92
3	Color	Co-pt	60	50	30	40
4	Total Suspended Solids	mg/L	842	1380	36	648
5	Total Dissloved Solids (TDS)	mg/L	32160	30164	17300	HVR >10000
6	Chlorides as CL	mg/L	19393.9	18344.3	11233.4	HVR>5000
7	Sulphate as SO4	mg/L	2860	2986	1507	HVR >2000
8	BOD (5 days @ 20°C)	mg/L	40	36	12	190
9	COD	mg/L	131.3	125.4	40.2	581.2
10	Oil & Grease	mg/L	BDL	BDL	BDL	BDL
11	Phenolic Compound	mg/L	BDL	BDL	BDL	BDL
12	Zinc as Zn	mg/L	0.096	0.106	0.133	0.174
13	Total Chromium as Cr+3	mg/L	0.077	0.089	BDL	0.099
14	Lead as Pb	mg/L	BDL	BDL	BDL	BDL
15	Cyanide as CN	mg/L	BDL	BDL	BDL	BDL
16	Flouride as F	mg/L	1.34	2.8	1.4	BDL
17	Copper as Cu	mg/L	BDL	BDL	0.051	0.072
18	Insecticide	mg/L	N.D.	N.D.	N.D.	N.D.
19	Pesticide	mg/L	BDL	BDL	BDL	BDL
20	Mercury as Hg	mg/L	BDL	BDL	BDL	BDL
21	Hexavalent Chromium as Cr+6	mg/L	BDL	BDL	BDL	BDL
22	Nickel as Ni	mg/L	0.084	0.077	BDL	BDL
	ND*: Not detected					

ANNEXURE –III

CSR DETAILS

PLL has constructed a temple at the site for the local people and has contributed towards infrastructure in the area for roads and drinking water.

Community development and welfare measures are taken. Village Luwara has been jointly adopted along with another nearby industry, as directed by PCPIR Welfare Society. Separate fund allocated for CSR.
Some of the schemes completed/under progress are Health Center (construction & operation), drainage and provision of street lights at Village Luwara. Rupees 75 lakh contributed to PCPIR Welfare Society. Two ladies from Luwara village sponsored for nursing course at Vidhyadeep Community college, Bharuch. Sponsored construction of Sanitation scheme at village Muller. Active participation in other Government initiated community development programs.

Installed 10 nos. Emergency solar lighting at prominent places in village Luwara. Donated Rs.1 lac for Bharuch District Civic centre development. Participated in Govt. scheme on KanyaKelvani. Installation of drainage crossings to remove accumulated water at 4 locations within the village Luvara at a cost of Rs. 0.8 lacs.Construction of approach road in village Lakhigaon, Dahej.

PLL has sponsored 'Mataria Talav drinking water project' of the Bharuch Municipality Corporation. This project is for the supply of sweet drinking water from the Narmada River to the residents of Bharuch city. MD&CEO handed over cheque for Rs. 25 Lacs to the Collector, Bharuch on 13/06/2011 and further, PLL added Rs. 20 Lacs for the 'MatariaTalav drinking water project'

PLL installed 50 nos. Emergency solar lighting at prominent places in village Luwara& 10 nos. Emergency solar lighting at prominent places in village Lakhigam of Vagra Taluka in Bharuch District. Provided School Bus to Primary School at Lakhigam Village and also running Primary Health Center at Luvara Village. PLL constructed Bus-stand and extended Gram Panchayat Bhavan building at Luvara Village.

PLL installed 25 Nos. of Solar lights at prominent places in village Lakhigam and Luwara. Contributed Rs. 20 Lakhs in Akshay Patra mid-day meal scheme at villages in and around Dahej location. Also, contributed Rs. 10.00 Lakhs in Gujarat Lion Conservation Society towards procurement of Vehicle.

Primary health services to Luvara village, Gynec health and Pulse Polio campaign (Pakhajan PHC). PLL supported noble cause of Construction of Storm water drainage at Shravan Chokdi to Jambusar by pass (over bridge) in Bharuch. This project is executed under District Collector office.

Request from CDHO (Chief District Health Officer) was received to participate in various health initiatives. PLL agreed during meeting with DM to provide the ambulance for PHC, Pakhajan Village of Vagra Taluka. PLL is supporting Luvara School for reference books, uniform, school picnic and creating awareness on environment, health, safety and security aspects through various programs regularly, rewarding bright students etc. PLL celebrated Shala Pravesh Utsav at Luvara School and distributed tool box to children.

Bharuch has problem of solid waste management and garbage disposal. To improve on cleanliness of the town, PLL is supporting initiative of GREEN BHARUCH CLEAN BHARUCH by donating two dumper placer worth Rs. 23.94 Lakh.

Due to delay in recruitment of teachers, primary schools in and around Dahej has 40% teaching staff. To support education by deploying young educated teachers, PLL sponsored 14 teachers in 4 schools of villages of Dahej, Lakhigam and Luvara.

PLL constructed 11hosues of homeless tribes in Luvara village at a cost of 25 Lakh. PLL initiated drive to make Luvara open defecation free by sponsoring toilets for 172 houses at a cost of Rs. 17.2 Lakh.

As a part of initiate for Swachh Bharat Abhiyan, PLL constructed five toilet blocks for school at Lakhigam, Luvara, Ambetha, Jageshwar & Dahej. Also, PLL has constructed 91 Toilet blocks at an estimated expenditure of Rs. 172 Lakhs for various schools in fifteen district of Assam in co-ordination with Rashtriya Madhiyamik Siksha Abhiyan (RMSA).

Cancer screening done (Pep and Breast) for female above 18 years at Luvara village. Establishment of equipment for Ultra Sonography Ward done at General/Civil Hospital, Bharuch. Motivational Awards (Academics and punctuality), School kit and reference books given for Luvara School students. Nutrition and clothing kit (105 nos.) was given to under nourished baby and mother.

PLL has sponsored Drawing competition, Educational tour and uniform distribution at Primary School Luvara. PLL sponsored Medical Equipment such as Eye sight testing, ECG Machine, Spirometer, Pulse Oxymeter etc. to Luvara Primary Health Centre. PLL also celebrated Swatch Bharat Pakhwada during 16th June, 2016 to 30th June, 2016 in co-ordination and consultation with neighboring villages, communities, schools etc.

The launch of Project Vidhyagam was organized in Luwara Primary School wherein a classroom library for std. 7 & 8 students is setup. About 130 books (syllabus and general reading including comics, biographies, story books, general knowledge, science fiction in Gujarati, Hindi and English language) has been kept in the library. The idea behind this project is that students develop interest in reading and thus studying. The PLL Disha Ladies Club organized for food and distribution of educational kits for 65 girls in the Orphanage in Bharuch on 11th Sept 2016. A focused group discussion on importance of hygiene and cleanliness was organized by Ladies club members as well.

Roofing item worth Rs. 2 Lacs was provided to the Gram Panchayat Office of Luwara Village for construction of house for 10 tribal families living below the poverty line. This material consisted of cement roof, channel, and hooks. It is expected that the construction of houses will be done by mid-January 2017.

Petronet LNG Limited celebrated the World Sight Day on 13th October 2016 by organizing the Eye Screening Camp for contractual labor at the company premises. The camp was organized in association with Wockhardt Foundation and about 200 labor and 60 employees participated in the same. During the camp; 125 specs and 60 unit of drops were distributed to beneficiaries based on assessment by Doctors.

On the occasion of 147th birth anniversary of Father of Nation Shri Mahatma Gandhi Health and Hygiene talk, Swachhta Selfie Campaign, Drawing Competition at Govt. High School, Lakhigam and other activities were organized as part of Swachh Bharat Abhiyaan.

It is observed that there is a shortage of regular teachers in local schools and severely hampering the quality of education of poor children in schools. To mitigate this problem, PLL has started supporting para teachers in local school and ensuring improvement in quality of education in local schools.

PLL CSR team participated in world school day celebration on 23 March, 2017. As a part of celebration PLL has distributed Uniforms to Std. 8th Students. It was decided to provide two pair of uniforms to all students in school. The uniforms were prepared by Sardar Mahila Vikas Mandal a group of tribal women for employment generation and livelihood opportunity. PLL provided work order worth of Rs. 2,23,980/-

As the students studying in primary schools are coming from BPL and poor families, most of the families are not able to afford educational tours for their children. Every year school is organizing such tour sponsored by PLL. Students will get exposures to various places and gain experience. About 150 students get benefit of this tour and

places covered like Dwarka, Somnath, Porbandar, Smruti Mandir, Naheru Planetorium, Sasan Gir etc.

PLL had sponsored community mass marriage of weaker community, participated in Shala Pravesh Utsav 2017, planted 150 of trees in nearby villages, distributed food packages during water logging observed at nearby villages, supported empowerment of Special children, engaged contractor for repair and maintenance of Toilets in nearby School, arranged cessions for awareness on solid waste management at school.

PLL supported 10th Special Olympics, Bharuch in January, 2018, sponsored project "Kaushal Setu" Skill Development Program with CIPET, Ahmedabad and trained 100 underprivileged youth, supported educational tour for Primary School of Luvara Village, provided para-teachers at school of nearby villages, sponsored community mass marriage of weaker community, supported "Startup Village" project towards Rural Youth Entrepreneurship Development Program, Supporting Swachh Bharat Abhiyan by District Administration Bharuch (Heritage Walk).

PLL signed MoA with Samagra Shiksha Abhiyan, Department of Education, Govt. of Gujarat on 23rd Jan. 2019 at Govt. Primary School, Luvara village for the Development of Primary School at Luvara Village. PLL supported District Level Special Olympics Games which was organized on 23rd February 2019. Around 250 special children, 150 volunteers including PLL volunteers and coaches participated during the event.

(July, 2019 to Dec. 2019)

PLL has signed MoU with ALIMCO to provide Aids and Equipment to disables of Bharuch District. PLL has signed MoU with Wockhardt Foundation to run Mobile Medical Unit (MMU) in nearby villages of PLL plant area. PLL has signed MoU with NHFDC to provide skill training to disable youth of Bharuch District. PLL has supported relief camp for affected community near Lakhigam during monsoon season.

(Jan.2020 to June 2020)

PLL has conducted assessment camps at Jambusar and Vagra Taluka of Bharuch Distrcit to Aids and Equipment to disables. Kaushal Setu Skill Training with CIPET Ahmedabad 78 candidates have complated the training and 90% of them got job with the salary range of Rs. 9000 to Rs. 12000. PLL has conducted District Level Special Olympics in parnership with Kalrav Trusy Bharuch and Special Olympics, Gujarat. As a part of COVID-19 pendemic response, PLL has contributed Rs. 34.00 lakhs to

Distrcit Health Office, Bharuch to proqure PPE Kits, Masks and Senitise materils for COVID-19 worriers. PLL has provides 4300 nos. of Ration kits worth of Rs. 25.00 lakhs to Migrant Labours, and Poor Families of nearby villages. Petronet LNG Limited (PLL) under its CSR initiatives aims at distributing 1,00,000 face masks to the migrant labor communities, slum dwellers, nearby hospitals, local police authorities & Government Offices to combat COVID-19 in the Bhaurch District of Gujarat.

(July 2020 to December 2020)

PLL has supported Construction of Priamry School, at Luvara village worth of Rs. 1,71 Crore. Construction is about to complete by March, 2021. PLL has distributed aids and equipment to about 250 disable beneficiaries at Jambusar and Vagra Taluka of Bharuch District. As a part of COVID-19 pandemic response, in addition to supporting District Health Office (CDHO) and Distributing Rations Kits to to Migrant Labours, and Poor Families of nearby villages, PLL has prepared 1,00,000 cotton masks through Women SHGs of Bharuch Distrcit. About 80 women got indirect employment during pandemic through this initiative. These masks were distributed among local communities of nearby villages, health workers, labour community, Nagarpalika Sawachhta Karmchari, Special Children and their families, Vegetable vendors, Local Police authorities, Government Offices, Security Guards, PLL employees also participated in mask distribution initiative. These masks were made of Cotton considering it environment aspect for reusable and bio-degradable properties.

(January, 2021 to June, 2021)

PLL/PLF has signed agreement with Wockhardt Foundation to run Mobile Medical Unit (MMU) in nearby villages of PLL plant area. This MMU is providing its services to nearby villages like Lakhigam, Navi Nagari, Luvara, Jageshwar, Ambetha. More than 5500 patients have been benefited during last six months. PLL/PLF has signed agreement with NHFDC to provide skill training to disable youth of Bharuch District. First batch of 30 candidate started from April, 2021. . PLL/PLF has signed agreement with MOKSHDA to install environment friendly green crematorium system to reduce excessive use of wood. The works are under progress, Construction of Govt. Primary School at Luvara village with 12 classrooms and modern amenities worth of Rs .1.71 Crs. and Construction of 24 Nos. of widow quarters for BSF worth of Rs. 5.87 Crs. are going to completed by end of July, 2021. PLL/PLF skill training partner CIPET, Ahmedabad has completed skill training of 75 candidates and remaining 25 candidates are under progress. Candidate have secured job of Rs. 10,000 per month to Rs. 15,000 per month post completion of training programme. Most of the CSR projects got delayed due COVID-19 restrictions.

(July, 2021 to December, 2021)

PLL/PLF has signed agreement with Wockhardt Foundation to run Mobile Medical Unit (MMU) in nearby villages of PLL plant area. This MMU is providing its services to nearby villages like Lakhigam, Navi Nagari, Luvara, Jageshwar, Ambetha. More than 8500 patients have been benefited during last six months. PLL/PLF has signed agreement with NHFDC to provide skill training to disable youth of Bharuch District. First batch of 30 candidate started from April, 2021 and second batch of 20 candidates started in August, 2021 and both batches have been completed during December, 2021. PLL/PLF has signed agreement with MOKSHDA to install environment friendly green crematorium system to reduce excessive use of wood. The works are under progress, Construction of Govt. Primary School at Luvara village with 12 classrooms and modern amenities worth of Rs .1.71 Crs. and Construction of 24 Nos. of widow quarters for BSF widow's worth of Rs. 5.87 Crs. are completed. PLL/PLF skill training partner CIPET, Ahmedabad has completed skill training of 93/100 candidates. Candidate have secured job of Rs. 10,000 per month to Rs. 15,000 per month post completion of training programme. PLL has signed agreement with Bharuch Nagarpalika to provide support for Disaster Management and Swachh Bharat Abhiyan, Bharuch Nagarpalika would procure one fire tender and Road sweeping machine with the financial support of Rs. 1.93 Cr. under PLL CSR Initiatives. PLL has signed an agreement with Gujarat CSR Authority (GCSRA) for construction of Panchayat Bhavan at Lakhigam village. PLL has supported Development of Green Zone beneath newly constructed flyover bridge at Bharuch City.

(January, 2022- June, 2022)

PLL/PLF has signed agreement with Wockhardt Foundation to run Mobile Medical Unit (MMU) in nearby villages of PLL plant area. This MMU-1 is providing its services to nearby villages like Lakhigam, Navi Nagari, Luvara, Jageshwar, Ambetha. More than 15000 patients have been benefited during last six months. PLL/PLF has signed agreement with NHFDC to provide skill training to disable youth of Bharuch District. First batch of 30 candidate started from April, 2021 and second batch of 20 candidates started in August, 2021 and both batches have been completed during December, 2021.This project benefited 50 disable persons with computer skill, Certificate distribution held during June, 2022. PLL/PLF has signed agreement with MOKSHDA to install environment friendly green crematorium system to reduce excessive use of wood. The works are under progress, Construction of Govt. Primary School at Luvara village with 12 classrooms and modern amenities worth of Rs .1.71 Crs. and Construction of 24 Nos. of widow quarters for BSF widow's worth of Rs. 5.87 Crs. are completed. PLL/PLF skill training partner CIPET, Ahmedabad has completed skill training of 93/100 candidates. Candidate have secured job of Rs. 10,000 per month to Rs. 15,000 per month post completion of training programme.

PLL has singed a new agreement with CIPET, Ahmedabad to train 400 candidates in CNC Machine and Plastic Product Manufacturing. First batch of 50 candidate enrolled and initiated. PLL has signed agreement with Bharuch Nagarpalika to provide support for Disaster Management and Swachh Bharat Abhiyan, Bharuch Nagarpalika would procure one fire tender and Road sweeping machine with the financial support of Rs. 1.93 Cr. under PLL CSR Initiatives. PLL has signed an agreement with Gujarat CSR Authority (GCSRA) for construction of Panchayat Bhavan at Lakhigam village with financial support of Rs. 1.13 Crs.. PLL has supported Development of Green Zone beneath newly constructed flyover bridge at Bharuch City with financial support of Rs. 5.00 lakhs. PLL has supported development of Sports facility by Police Department, Bharuch with financial support of Rs. 5.00 lakh. PLL has supported Medical Equipments to Kasturba Hospital, Seva Rural Jhagadia with financial support of Rs. 5.00 lakh. PLL has provided support to Seva Yagaya Samiti for Strengthening of Facilities for Orphan/destitute Old Age Patients at Civil Hospital, Bharuch for Rs. 5.00 lakh. PLL has partnered with National Youth Foundation to Support for School Health Check-Up Program' at 48 Schools of Vagra Taluka, Dist. Bharuch Gujarat for Rs. 19.92 lakh.

(July, 2022- December, 2022)

PLL/PLF has signed agreement with Wockhardt Foundation to run Two Mobile Medical Unit (MMU) in nearby villages of PLL plant area. This MMU-1 is providing its services to nearby villages like Lakhigam, Navi Nagari, Luvara, Jageshwar, Ambetha. MMU-2 is providing services to Dahej, Suva, Rahiyad, Vav, Vadadla, Kadodar and Sambheti More than 30000 patients have been benefited during last six months. PLL has singed a new agreement with CIPET, Ahmedabad to train 400 candidates in CNC Machine and Plastic Product Manufacturing. First batch of 50 candidates and second batch of 45 candidates enrolled and initiated. PLL skill training partner CIPET, Ahmedabad has completed skill training of 39 candidates. Candidate have secured job of Rs. 10,000 per month to Rs. 15,000 per month post completion of training programme. PLL has signed an agreement with Gujarat CSR Authority (GCSRA) for construction of Panchayat Bhavan at Lakhigam village with financial support of Rs. 1.13 Crs. The Construction works are under progress. PLL has partnered with National Youth Foundation to Support for School Health Check-Up Program' at 48 Schools of Vagra Taluka, Dist. Bharuch Gujarat for Rs. 19.92 lakh. This programme successfully completed about 6500 students benefited from this initiative. PLL had partner with Blind People's Association and Torch It to distribute 1000 assistive devises to Divyang Jans of Gujarat State, The Project successfully completed with distribution in various interior districts of Gujarat State.

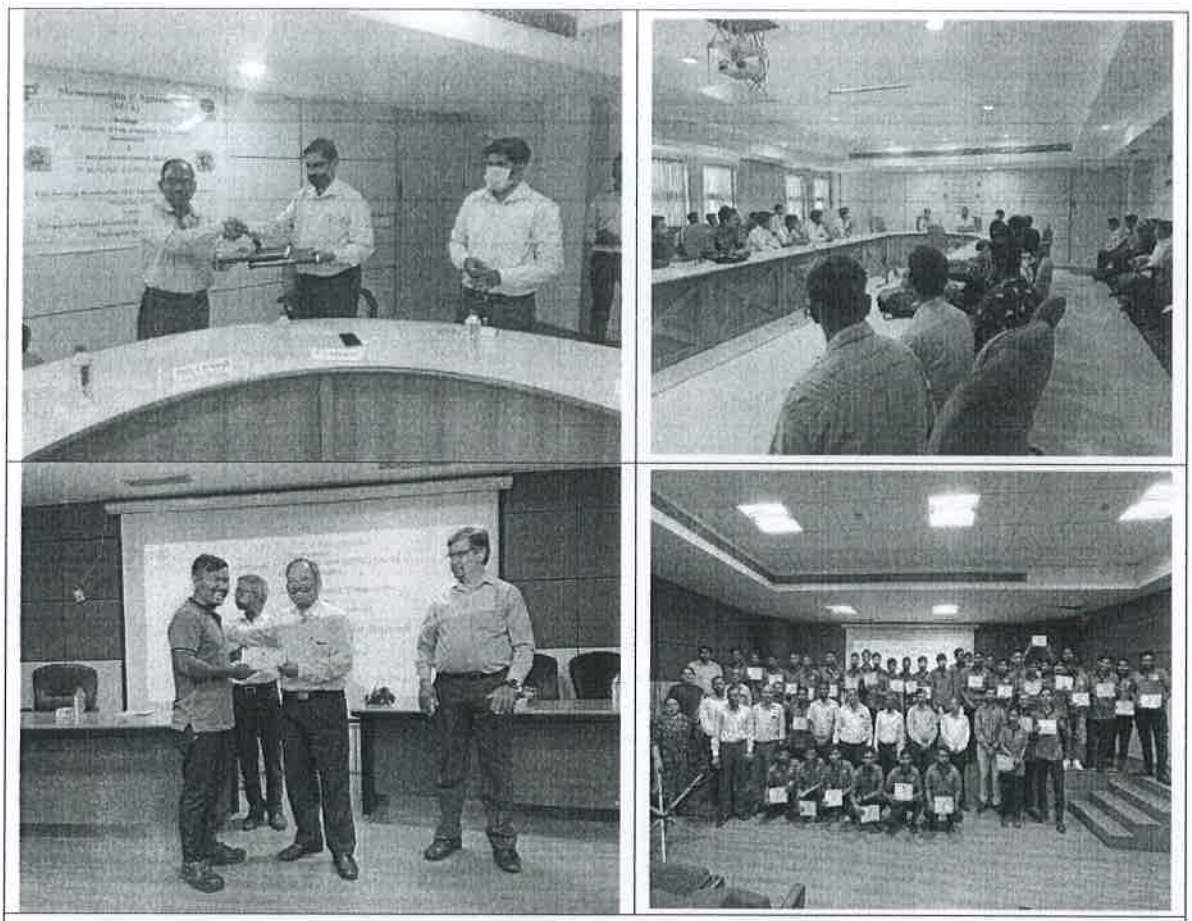
PLL has celebrated Swachhta Pakhwada 2022 with Say no to Plastic theme, distributed about 20,000 cotton bags prepared by SHGs and various awareness initiatives in local villages. PLL has celebrated Har Ghar Tiranga 2022 Abhiyan, and distributed about 10,000

National Flags prepared by SHGs in local villages. PLL has supported Installation of Dishwasher Machine at Asmita Vikas Kendra, Tralsa (Bharuch) worth of Rs. 4.75 Lakhs.

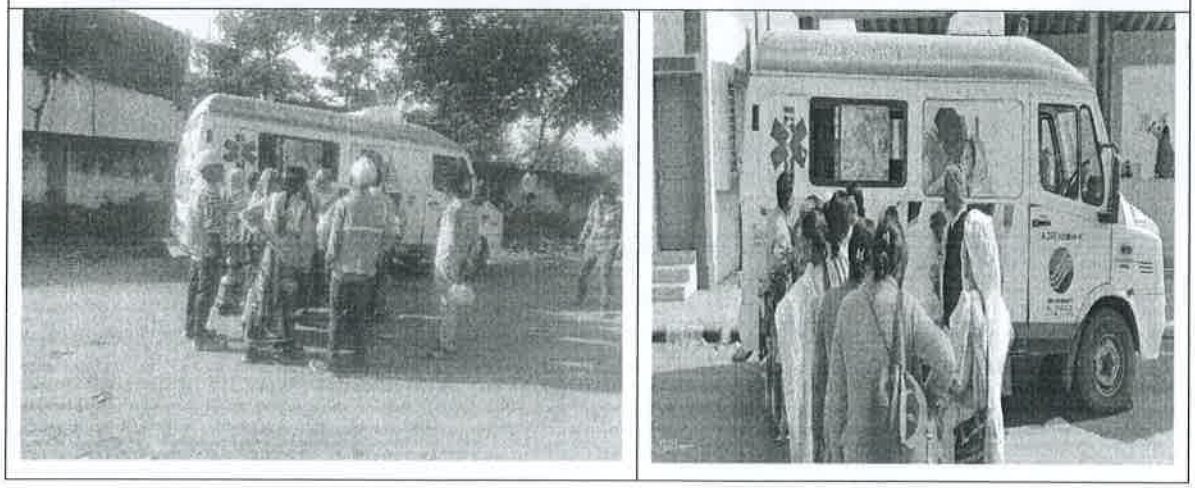
Widow Quarters 24 Nos. at BSF, Gandhinagar

Construction of Primary School Luvara Village

Kaushal Setu Skill Training – CIPET Ahmedabad, MOA Signed (P-III)



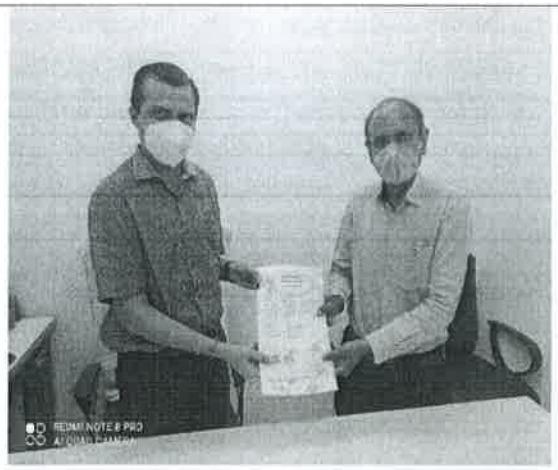
Mobile Health Unit (MHU) (Wockhardt Foundation)



Promote fitness and encouragement of sports activities by Police Department, Bharuch

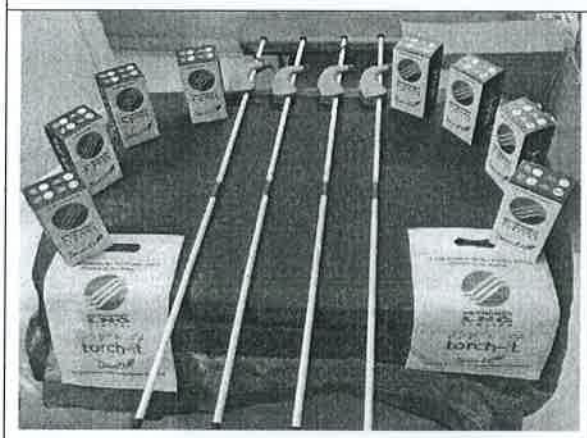
Agreement Signed with GCSRA for Construction of Panchayat Bhavan at Lakhigam village

Swachh Bharat with Bharuch Nagarpalika



Visit of Seva Rural Jhagadiya

Distribution of 1000 Saarthi Assistive Devices to 1000 Blind persons in Gujarat State



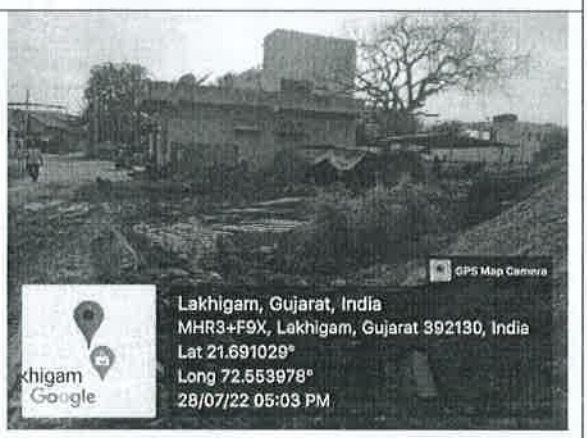

રાષ્ટ્રીય અંધજન મંડળ

Certificate Distribution for NHFDC Skill Training for Disables

Handover Old age care facility to Seva Yagya Samiti

Visit of Ashmita Vikas Kendra, Tralsa

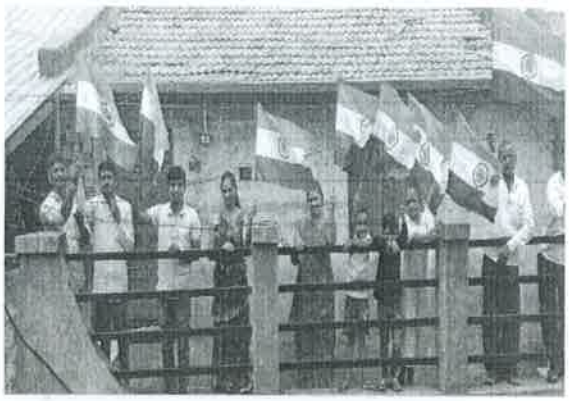
Construction of Panchayat Bhavan, Lakhigam



Visit of IIT-Gandhinagar

Skill Development Workshop on for promotion of Art & Culture

Har Ghar Tiranga Celebrations



Free School Health Care Camps at 48 Govt, Schools of Vagra Taluka


પ્રાથમિક શાળા કેશવાણા

ANNEXURE IV

ENGINEERING DESIGN BASIS (STATIC EQUIPMENT)

PROJECT: LNG TERMINAL AT DAHEJ

CLIENT: M/s PLL

JOB NO.: A324

(EIL) **(PLL)**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	07.09.2012	ISSUED AFTER CLIENT COMMENTS INCORPORATED	RS	TG	RKT
A	25-05-2012	ISSUED FOR CLIENT'S COMMENTS/APPROVAL	RS	TG	RKT

Tomale

CONTENTS

1.0 REFERENCED PUBLICATIONS

a) **Codes and Standards:**

The following codes and standards in their latest edition including latest addenda as on the date of first issue of this design basis shall be followed unless otherwise specified in the requisition for the design, fabrication, inspection and testing of Vessels, Double Wall Storage Tanks, Air coolers & heat exchangers:

ASME SEC. VIII DIV.1	For Pressure Vessels, Heat Exchangers
ASME SEC. II	For material specification
ASTM	For material specification
ASME SEC. V	Non Destructive Examination
ASME SEC. IX	For welding
ASME B31.3	Process piping
BS EN 14620 PART I TO V	Flat bottom, vertical, cylindrical tanks for storage of refrigerated, liquefied gases with operating temperatures between 0° C and (-) 165° C
BS 8110 + Amendements	Structural use of concrete
BS EN 1473	Installation and equipment for LNG-design of onshore installations
API 620	For Low Pressure Storage Tanks
API 2000	Venting atmospheric and low pressure storage tanks, Non refrigerated and refrigerated
API 2003	Protection against ignitions arising out of static, lightning & stray currents
API 678	Accelerometer Based Vibration Monitoring System – Reaffirmed (1987)
API 2550	Standard Methods for Measurements and calibration of upright cylindrical tanks
ACI 373	Design & construction of circular prestressed concrete structures

ACI 305R	Hot weather concrete
ASTM 549	Perlite loose fill insulation
NFPA 59A	Production, storage & handling of LNG
NFPA 70	National Electric Code
NFPA 780	Standard for Installation of Lightning protection system
FIP recommandations	Acceptance and application of post tensioning system
PI-201-77	Compacted density
OISD 194	Standard for the storage and handling of LNG
IS: 875/SITE DATA	For wind load consideration
IS: 1893/SITE DATA	For seismic design consideration
ASME B 16.5	Steel Pipe flanges and pipe fittings
ASME B 16.47	For large diameter flanges
ASME B 16.20/ B 16.21	For gaskets
TEMA Class R	For shell and tube Exchanger
API 661	For Air Cooled Exchanger
IS 800	For Air Cooled Exchanger Structural Design

b) **Statutory Provisions:**

National laws and statutory provisions together with any local by-laws for the state shall be complied with. Static and Mobile Pressure Vessel (SMPV) rules and OISD norms as applicable shall also be complied with.

2.0 DESIGN PHILOSOPHY / GENERAL CRITERIA

Equipment shall be designed in compliance with the latest design code requirements and applicable standards/ specifications. All design calculations shall be performed considering all applicable loads for erection, operating and hydro test conditions.

2.1 Full Containment with Prestressed Concrete Outer Tank Wall

The storage tanks are to be above ground, flat bottom, and vertical full containment Prestressed cylindrical type. The under face of the concrete slab shall be minimum two meter above the ground, contractor for Storage Tank during detail engineering shall work out the actual height of the concrete slab.

A concrete outer tank and a roof constructed of reinforced concrete with carbon steel vapor barriers on the inside of the wall & base slab.

ANNEXURE I

Bosai Safety

Certificate of Conformity

Standard: Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP) Regulations, 2010 and 2020.

Certificate Number: **BOSAI/0157**

Certificate Holder: Petronet LNG Ltd., Dahej LNG Terminal.

Scope: **Review and implementation of ERDMP as per the PNGRB Regulations**

This is to certify that **BOSAI SAFETY PRIVATE LIMITED**, approved TPIA by PNGRB vide Registration No. PNGRB/Tech/11-TPIA/(3)/2021(P-3506) dated 09.11.2021 have reviewed and assessed the **ERDMP document prepared by Petronet LNG Ltd., Plot No 7/A, GIDC Industrial Estate, Dahej - 392130** and found the same in conformity with the **Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP) Regulations, 2010 and 2020.**

The audit team conducted site assessment visit on 29.09.2022 & 30.09.2022 at **Petronet LNG Ltd., Dahej LNG Terminal** to review implementation of ERDMP as per the requirement and found the same to be compliant.

This certificate is being issued to **Petronet LNG Ltd., Dahej LNG Terminal** for their compliance of ERDMP documents as per PNGRB Regulations. 2010 and 2020.

Issued on:12/10/2022, Valid till:11/10/2025

Dinesh Kumar Singh
Digitally signed by Dinesh Kumar Singh
Date: 2022.10.12 16:48:37 +05'30'

(D.K. SINGH)
Chief Executive Officer

BOSAI SAFETY PVT. LTD. NOIDA

(Note: This Certificate is valid for maximum 3 years from the date of issue or till any major Modification/ Revamp in the facility or as per directives of PNGRB whichever is earlier.)

G-405, C58/23, INDIAN OIL APARTMENT, NOIDA-201309, Mob: 9868920846, bosaisafety@gmail.com

ANNEXURE VI

F&G Mapping Study

PROJECT NAME : DAHEJ EXPANSION PHASE – IIIA
LNG REGASIFICATION FACILITIES

OWNER : PETRONET LNG LTD

	AP
	AP

TABLE OF CONTENTS

ANNEXURE VII

O/C

Petronet LNG Limited

GIDC Industrial Estate, Plot No. 7/A, Dahej,
Taluka : Vagra, Dist. Bharuch (Gujarat) - 392130 (India)
Tel. : 02641 - 670200 / 257
www.petronetlng.com
CIN: L74899DL 1998PLC093073
GST No. : 24AAACP8148D1ZM

Ref.: PLL/DHJ/HSE/GPCB/2022/15

Date: May 28, 2022

GPCB XGN ID: 15479

To,

Gujarat Pollution Control Board
Paryavaran Bhavan
Sector-10 A
GANDHINAGAR – 382 010

Sub: Environmental Statement for the financial year April 2021 to March 2022

Dear Sir,

Enclosed Please find Environmental Statement (FORM – V) for the financial year April 2021 to March 2022 for your kind perusal.

Thanking you,

Yours faithfully,
For Petronet LNG Limited

S B Singh
ED (Plant Head)

S B Singh
ED (Plant Head)
Petronet LNG Limited,
Dahej Terminal-392130

Encl: As above

Copy to:
Gujarat Pollution Control Board, Bharuch

30/5/22
Post Received
Gujarat Pollution Control Board
BHARUCH

Regd. Off.:
World Trade Centre, First Floor, Babar Road,
Barakhamba Lane, New Delhi-110 011 (INDIA)
Tel : 011 - 23472525, 23411411 Fax : 23472550

Kochi Site :
Survey No. 347, Puthuvypu
P.O. 682508, Kochi (INDIA)
Tel.: 0484-2502268

FORM-V
ENVIRONMENTAL STATEMENT
(See rule 14)

Environmental Statement for the financial year ending with **31st March 2022**

PART - A

i. Name and address of the owner/occupier of the industry operation or process:

Mr. S B Singh
ED (Plant Head)
M/s Petronet LNG Limited
Plot.7/A, GIDC Industrial Estate
Dahej, Taluka Vagra
Dist. Bharuch – 392130
Ph. 02641-670299/201

ii. Industry category Primary-(STC Code) Secondary-(STC Code)

Not Applicable.

iii. Production capacity – Dahej Unit.

17.5 MMTPA (Million Metric Tons per Annum) Regasification Capacity

Receipt of LNG through Ship, storage, Regasification and Despatch of Natural Gas and LNG through tanker

iv. Year of establishment: **2nd April, 1998**

v. Date of the last environmental statement submitted: **22nd April 2021**

PART - B

Water and Raw Material Consumption:

i. Water consumption in m^3/d:

Process : Nil
Cooling : Nil
Domestic : 21.2 m^3/day

Name of Products	Process water consumption per unit of product output	
	During the previous financial year	During the current financial year
1. Regasified Liquefied Natural gas (RLNG)	Nil	Nil

ii. Raw material consumption:

Name of raw materials*	Name of Products	Consumption of raw material per unit of output	
		During the previous financial year (F.Y. 2020-21)	During the current financial year (F.Y. 2021-22)
1. Liquefied Natural Gas (LNG)	RLNG	15.558 MMTPA 21353.55 MMSCM of send out RLNG	14.4135 MMTPA 19873.68 MMSCM of send out RLNG
MMSCM = Million Metric Standard Cubic Meter MMTPA = Million Metric Ton per Annum			

* Industry may use codes if disclosing details of raw material would violate contractual Obligations, otherwise all industries have to name the raw materials used.

PART – C

Pollution discharged to environment/unit of output:
(Parameter as specified in the consent issued)

Pollutants	Quantity of Pollutants discharged (mass/day)	Concentration of Pollutants discharged (mass/volume)	Percentage of variation from prescribed standards with reasons.
(a) Water (b) Air (Stack emissions from Gas Turbine Generator)	No effluents generated ----	Not Applicable SPM : BDL** SOx : BDL NOx : 21.4 ppm	Not Applicable Concentration of pollutants discharged is well within the GPCB norms.

** BDL= Below detection limit

PART - D
HAZARDOUS WASTES

(as specified under Hazardous and Other Wastes (Management & Trans boundary Rules,2016)

Hazardous Wastes (Disposed)	Total Quantity (Kg)	
	During the previous financial year (F.Y. 2020-21)	During the current financial year (F.Y. 2021-22)
1. From Process	Nil	Nil
2. From Pollution Control Facilities	Nil	Nil
3. Used oil	10,500 Liters	2725 Liters
4. Waste Residue containing Oil	846.3 Kgs	967 Kgs
5. Insulation Waste	Nil	Nil
6. Paint Waste	1160 Kgs	Nil
7. Contaminated Empty barrels and drums	Nil	73 Nos (400 Kgs)

PART- E
SOLID WASTES

Solid Wastes	Total Quantity (Kg)	
	During the previous financial year (F.Y. 2020-21)	During the current financial year (F.Y. 2021-22)
a. From process	Nil	Nil
b. From Pollution Control Facility	Nil	Nil
c. (1) Quantity recycled or re-utilized within the unit.	Nil	Nil
(2) Sold :	Nil	Nil
(3) Disposed: a) E Waste	1090 Kg	2370 Kg

PART – F

Please specify the characteristics (in terms of concentration and quantum) of hazardous as well as solid wastes and indicate disposal practice adopted for both these categories of wastes.

Hazardous waste : 1. Used oil 2725 Liters (Disposal through GPCB approved Recycler/ Preprocessor, M/s R.K. steel, Bharuch)

Solid Waste : 1. Waste residue containg oil(Cotton waste) of 967 Kgs dispossed to approved incineration site of M/s Bharuch Enviro Infrastructure (BEIL) , Dahej for incineration process.

2. 73 Nos (400Kg) Contaminated Empty barrels and drums are send to approved decontamination facility of M/s Vikas Enterprise.

E-Waste : Total 2370 Kg E - waste dispossed to GPCB approved agency , M/s Earth E Waste Managemnet Pvt. Ltd. , Surat

Lead Acid Batteries: Total 162 nos batteries are disposed off through supplier buy back system under Batteries (Management and Handling) Amendment Rules, 2010. Details are as follows.

Sr No	Date	Description	Quantity (Nos)	Agency
1	13.04.2021	Exide Battery	05	SURYA POWER BATTERY
2	13.04.2021	Amaron Battery	03	SURYA POWER BATTERY
3	21.10.2021	Exide Battery	34	UMA Battery
4	21.10.2021	SMF Battery	84	UMA Battery
5	29.11.2021	Lead acid battery	36	Deccan Sales & Service

PART – G

Impact of the pollution control measures taken on conservation of natural resources and consequently on the cost of production.

Regular Environmental monitoring is carried out through GPCB approved agency. (M/s. Unistar Environment & Research Labs Pvt. Ltd, Vapi) and monitored results are well within the consent limit

PART – H

Additional measures/investment proposal for environmental protection including abatement of pollution.

The total Green Belt area approximately 1,66,000 Sq. meters has been allocated in and around periphery wall. Whereas, PH-I & PH-II green belt has been developed and maintained and the PH-III green belt (57,000 Sqm) area development has been initiated. In addition to this, the total lawns/ green cover developed & maintained till date is 30000 Sq.m.

S.No	Financial Year	Amount Spent (Rs. In Lacs)	Purpose of Investment
1	2009-10	33.22	Development & maintenance of Green belt and Mangrove Plantation during the year.
2	2010-11	55.00	Development & maintenance of Green belt and Mangrove Plantation during the year.
3	2011-12	93.31	Development & maintenance of Green belt and Mangrove Plantation during the year.
4	2012-13	109.57	Development & maintenance of Green belt and Mangrove Plantation during the year.
5	2013-14	95.20	Development & maintenance of Green belt and Mangrove Plantation during the year.
6	2014-15	88.83	Development & maintenance of Green belt and Mangrove Plantation during the year.
7	2015-16	42.20	Development & maintenance of Green belt and Mangrove Plantation during the year.
8	2016-17	77.96	Development & maintenance of Green belt and Mangrove Plantation during the year.
9	2017-18	71.08	Development & maintenance of Green belt during the year.
10	2018-19	60.93	Development & maintenance of Green belt during the year.
11	2019-20	51.11	Development & maintenance of Green belt during the year.
12	2020-21	78.96	Development, maintenance of Green belt & related to STP project during the year.
13	2021-22	76.26	Development & maintenance of Green belt during the year.
		155.34	STP Installation
	Total	1088.97 Lakh	

PART- I

Any other particulars for improving the quality of the environment.

Total 1150 ha. Mangrove Plantation undertaken along the Gujarat Coast till date as furnished below:

S.No	Financial Year	Covered Area	Location	Consultation with Forest Department/ GEC
1	2009-10	50 ha.	NadaVillage, Jambusar, Bharuch	Gujarat Ecology Commission (GEC), Govt. of Gujarat
2	2010-11	100 ha.	AnkalvaVillage, Hansot, Bharuch	Gujarat Ecology Commission (GEC) , Govt. of Gujarat
3	2011-12	200 ha.	AnkalvaVillage, Hansot, Bharuch	Gujarat Ecology Commission (GEC) , Govt. of Gujarat
4	2012-13	200 ha. 100 ha.	AnkalvaVillage, Hansot, Bharuch RoniyaBhatha, Nr. Nirma, Bhavanagar	Gujarat Ecology Commission (GEC) , Govt. of Gujarat Bhavnagar Forest Division, Govt. of Gujarat
5	2013-14	200 ha.	RoniyaBhatha, Nr.Lock Gate, Bhavanagar	Bhavnagar Forest Djvision, Govt. of Gujarat
6	2014-15	200 ha.	RoniyaBhatha, Nr.Lock Gate, Bhavanagar	Bhavnagar Forest Division, Govt. of Gujarat
7	2014-15	50 ha.	Kentiyajal, Hansot Bharuch	Bharuch Forest Sub-Division, Govt. of Gujarat
8	2016-17	50 ha.	Gadula Village, Talaja Taluka, Mahuva, Bhavnagar	Bhavnagar Forest Division, Govt. of Gujarat
	Total	**1150 ha.**		

(Signature of person carrying out an industry – operation or process)

Name: Mr. S B Singh
Designation: ED (Plant Head)
Address: M/s Petronet LNG Limited,
Plot.7/A, GIDC Industrial Estate
Dahej, Taluka Vagra
Bharuch – 392130
Ph. 02641-670299/201

S B Singh
ED (Plant Head)
Petronet LNG Limited,
Dahej Terminal-392130

ANNEXURE VIII

SBI general INSURANCE
SURAKSHA AUR BHAROSA DONO

To,
PETRONET LNG LIMITED
First Floor, World Trade Centre, Babar Road Barakhamba Lane,
New Delhi,
Delhi - 110001,
India.
Contact No. : +91-9654182826

Date: 03/06/2022

Subject: Policy Number: : 0000000028749377

Dear Customer,

Welcome to SBI General. Thank you for choosing SBI General's Public Liability Insurance Act Policy. We are delighted to have you as our esteemed Customer.

We enclose the following documents pertaining to your Policy:

- Policy Schedule
- Policy Clauses & Wordings
- Grievance Redressal Letter

We have taken care that the documents reflect details of risk and cover as proposed by you. We request you to verify and confirm that the documents are in order. Please ensure safety of these documents as they form part of our contract with you. For all your future correspondence you may have with us, kindly quote your Customer ID and Policy Number.

Your Customer ID : 00000000047519696

Your Policy Number : : 0000000028749377

The Postal Address of your SBI General Branch that will service you in future is:

SBI General Insurance Company Limited
Punj Essen House,Sixth Floor,Level-6 , 17-18,
Nehru Place,New Delhi - 110019,
Delhi - 110019,
India.

In case of any queries or suggestions, please do not hesitate to get in touch with us. You can contact us at customer.care@sbigeneral.in or call our Customer Care Number **1800-102-1111, 1800-22-1111**

We look forward to a continuing and mutually beneficial relationship.

Yours sincerely,

Authorized Signatory

SBI general INSURANCE
SURAKSHA AUR BHAROSA DONO

PUBLIC LIABILITY INSURANCE ACT POLICY (CLAIMS MADE)

SCHEDULE

Policy No: **: 0000000028749377**	**Servicing Branch Office:** SBI General Insurance Company Ltd. Punj Essen House,Sixth Floor,Level-6, 17-18,Nehru Place,New Delhi - 110019, Delhi-110019,India.	**Issue Date:** **03/06/2022**

Intermediary Details:

Intermediary Name	SBI General Insurance Direct Code	
Intermediary Code	0061174	
Intermediary Contact Details	Mobile No. NA	Landline No. +91-22-18002211

Insured Details:

Insured Name and Address	**PETRONET LNG LIMITED** First Floor, World Trade Centre, Babar Road Barakhamba Lane, New Delhi, Delhi - 110001, India
Additional Insured if any	None
Business of the Insured	Develop, Construct, Own and Operate Liquefied Natural Gas (LNG) Regasification Terminals
Turnover declared by the Insured	Rs. 4,76,09,00,00,000
Paid up Capital of the Insured	Rs. 1,500 CRORE
Coinsurance Details	Our Share : 100%

Cover Details:

Policy Period	**From:** 02/06/2022 (00:00) **To:** 01/06/2023 (Midnight)
Retroactive date	02/06/2004
Territorial Scope	India
Jurisdiction	India
Limit of Indemnity	
Aggregate One Year (AOY)	Rs. 15,00,00,000
Any One Accident (AOA)	Rs. 5,00,00,000
Compulsory Excess	Nil

SBI general INSURANCE
SURAKSHA AUR BHAROSA DONO

PUBLIC LIABILITY INSURANCE ACT POLICY (CLAIMS MADE)

Attached to and forming part of the Schedule to the Policy No. : 0000000028749377

Particulars of Premises Insured	
No. of Premises Insured	1
Address of the Premises Insured	Dahej, State of Gujarat - 392130 and Kochi, State of Kerala – 682508

Additional Conditions: Cover provided herein is subject to the following additional Conditions and attached Clauses / Endorsements / Warranties:

Terms & Conditions as per Public Liability Insurance Act, 1991

The Primary Exclusions under the Policy are:
1. arising out of wilful or intentional non-compliance of any Statutory Provisions
2. in respect of fines, penalties, punitive and/or exemplary damages
3. arising under any other legislation except in so far as is provided for in section 8 sub-section (1) and (2) of the Act.
4. arising out of damage to property owned, leased or hired or under hire purchase or on loan to the Insured or otherwise in the Insured Owner's control, care or custody.
5. directly or indirectly occasioned by, happening through or in consequence of war, invasion, act of foreign enemy, hostilities (whether war be declared or not), civil war, rebellion, revolution, insurrection or military or usurped power.
6. directly or indirectly caused by or contributed to by
(a) ionising radiation or contamination by radioactivity from any nuclear fuel or from any nuclear waste from the combustion of nuclear fuel.
(b) the radioactive, toxic, explosive or other hazardous properties of any explosive nuclear assembly or nuclear component thereof.

SBI general INSURANCE
SURAKSHA AUR BHAROSA DONO

PUBLIC LIABILITY INSURANCE ACT POLICY (CLAIMS MADE)

Attached to and forming part of the Schedule to the Policy No. : 0000000028749377

Premium Computation:

Particulars	Amount (Rs)
Gross Premium	**18,349.00**
Taxes as applicable	3,302.82
Contribution to Environment Relief Fund	18,349.00
Final Premium	**40,001.00**

Collection Details: Receipt No. 25710898 **Receipt Date 01/06/2022**

P.S. If premium paid through cheque, the policy is void ab initio in case of dishonour of cheque.

Consolidated Stamp Duty paid Rs. 0.50/- towards Insurance Policy Stamps vide Order No. LOA/CSD/323/2022/(Validity Period Dt.18/04/2022 to Dt. 14/04/2023)/1652 Date:- 13/04/2022 Dated 2022-05-05 11:20:06.0 of General Stamps Office Mumbai.

Signed at : Mumbai		**For SBI General Insurance Company Limited**
Date : 03/06/2022		**Signatory**

GSTIN : 07AAMCS8857L1ZE

Important Note:

Please examine this Policy including its attached Schedules/ Annexure if any. In the event of any discrepancy please contact the office of the Company immediately, it being noted that this Policy shall be otherwise considered as being entirely in order.

Please refer the Claims Settlement & Grievance Redressal procedure document attached herein for ready reference

Annexure IX Upload of Half Yearly Returns on Company Website

Screen Reader Access | Follow @PetronetLNGLtd | Follow @PetronetLNGLtd

Company | Natural Gas | Terminals | CSR | Media Centre | Investor Centre | Careers | Tender | Customers

DAHEJ LNG TERMINAL

The Company had set up South East Asia's first LNG Receiving and Regasification Terminal with an original nameplate capacity of 5 MMTPA at Dahej, Gujarat. The infrastructure was developed in the shortest possible time and at a benchmark cost. The capacity of the terminal has been expanded in phases which is currently 17.5 MMTPA and the same is under expansion to 22.5 MMTPA in two phases. The terminal has 6 LNG storage tanks and other vaporization facilities. The terminal is meeting around 40% of the total gas demand of the country.

The terminal has two LNG Jetties at Dahej. While the first jetty can handle berthing of up to Q-Flex vessels, the second jetty can handle berthing of up to Q-Max vessels.

Dahej terminal is the largest single location LNG storage and regasification terminal in the country and has recently achieved the milestone of handling 3000th LNG cargo on 7th July 2022. The terminal is also offering tolling services to Offtakers & Bulk customers. To cater the small customers who are not having gas pipeline connectivity, Dahej is supplying LNG to such customers which is transported through cryogenic trucks.

PLL Dahej is first terminal to start loading of LNG in trucks for supply of LNG to the areas where pipelines have not reached and today has 04 truck loading bays and hub for development of Small Scale LNG business. It has handeled 4040 LNG cryogenic trucks fillings in FY 2021-22

- Environment statement (Form-V) for the FY 2021-22

- Annual Report (Form - IV) as per Bio Medical Waste Management Rules 2016 for CY 2021

- Annual Report (Form - IV) as per Bio Medical Waste Management Rules 2016
- Environmental Statement (Form - V) for the FY 2020-21

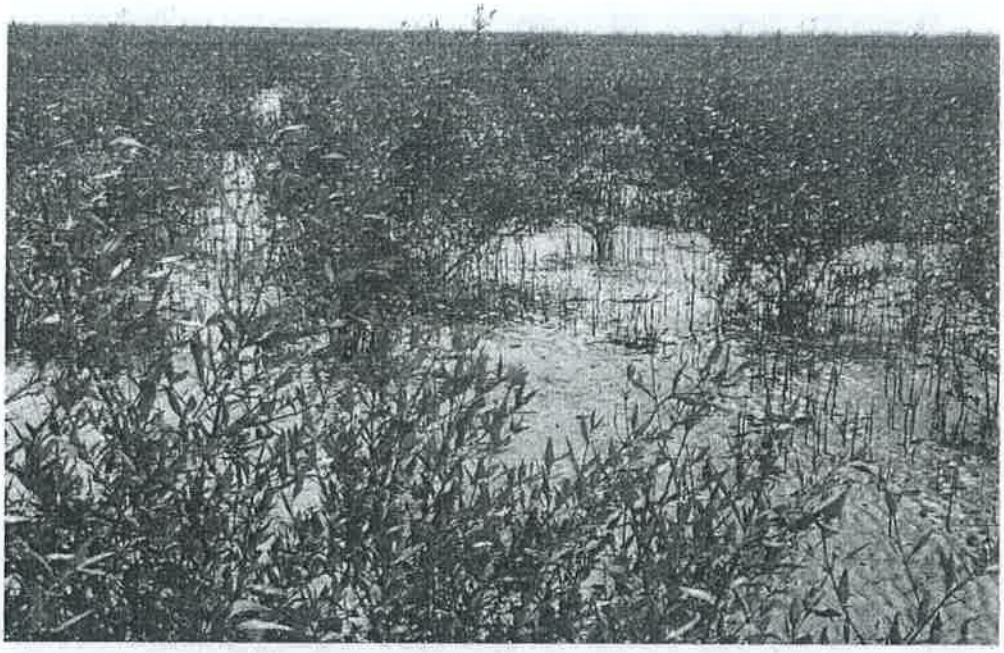
- Environmental and CRZ clearance for Installation of Terminal facilities to handle 10 MMTPA of additional LNG at PLL, Dahej
- Environmental Statement (Form - V) for the FY 2018-19

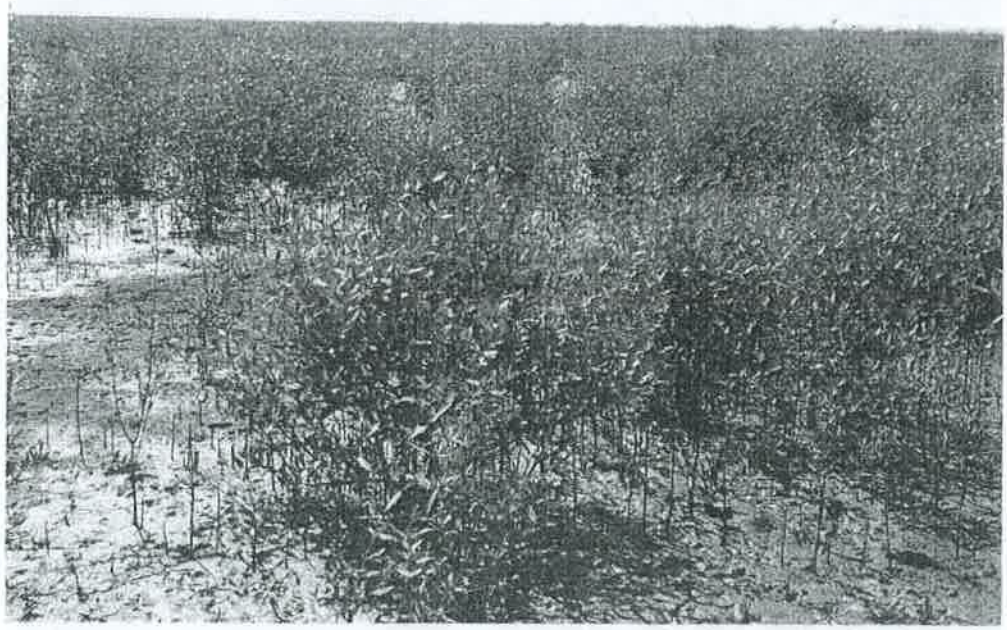
MoEF & CRZ Compliance Report

Description	Status Report
Half yearly MoEF & CRZ compliance report for Standby Jetty	30.06.2022
Half yearly MoEF & CRZ compliance report for Phase III	30.06.2022
Half yearly MoEF & CRZ compliance report for Phase II	30.06.2022
Half yearly MoEF & CRZ compliance report for Phase I	30.06.2022
Half yearly MoEF & CRZ compliance report for Standby Jetty	31.12.2021

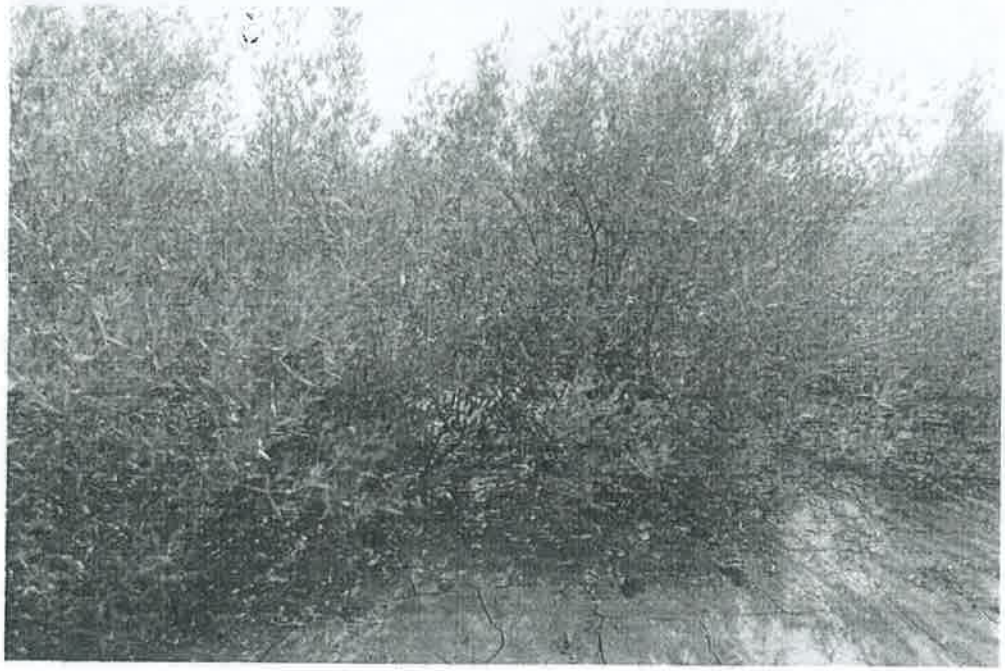
ANNEXURE X

Mangroves planted in 50 ha. area at NADA Coast during 2009-10

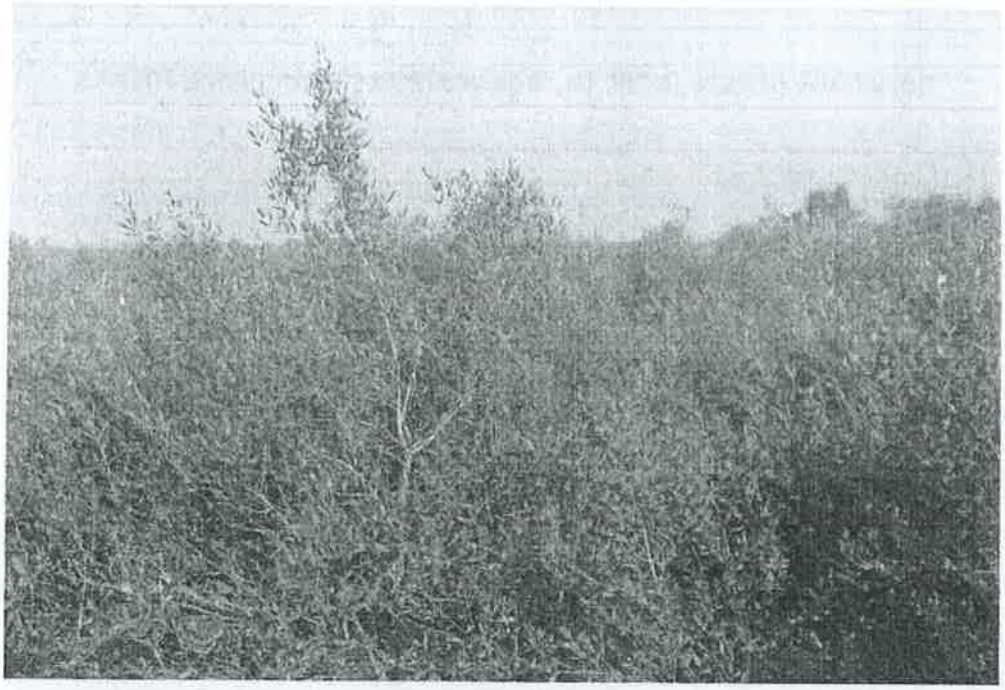




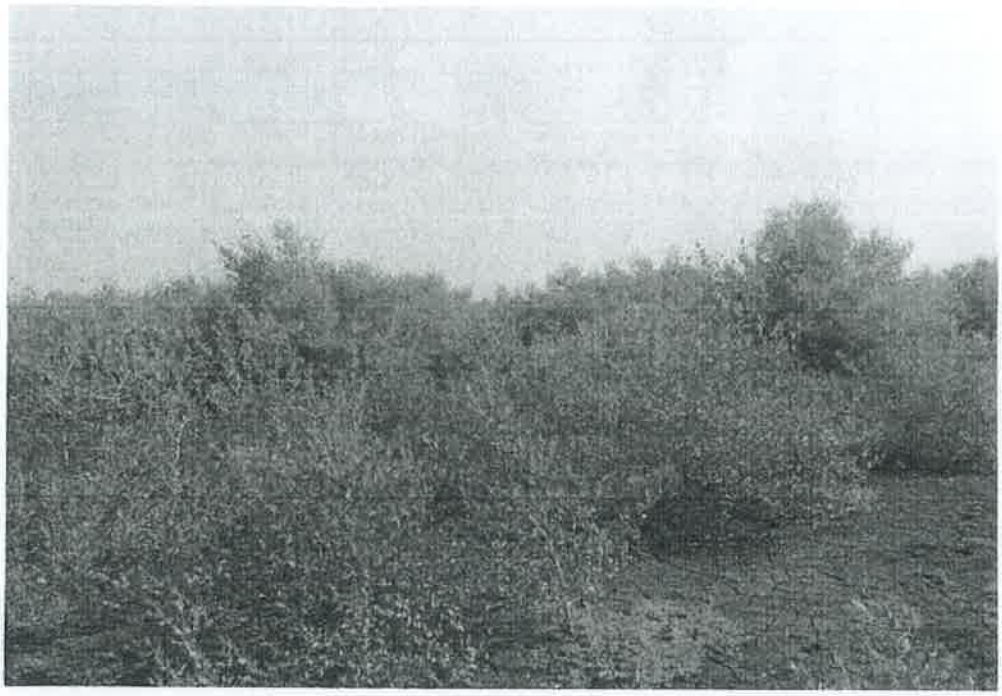
Mangroves planted in 100 ha. area at Ankalva Coast during 2010-11

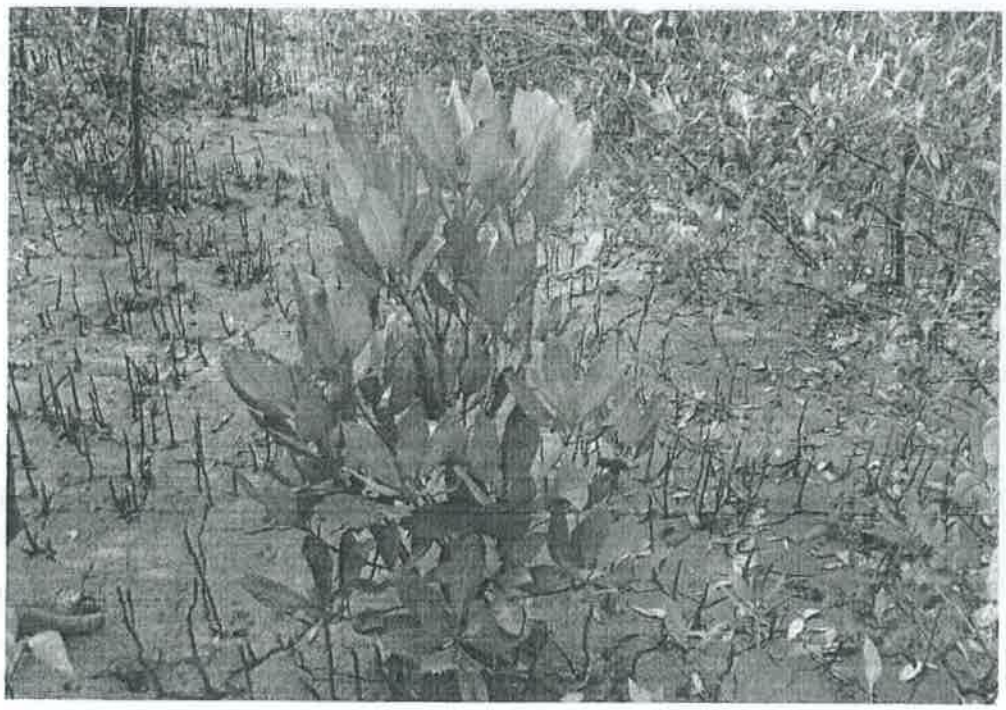


Mangroves planted in 200 ha. area at Ankalva Coast during 2011-12



Mangroves planted in 200 ha. area at Ankalva Coast during 2012-13

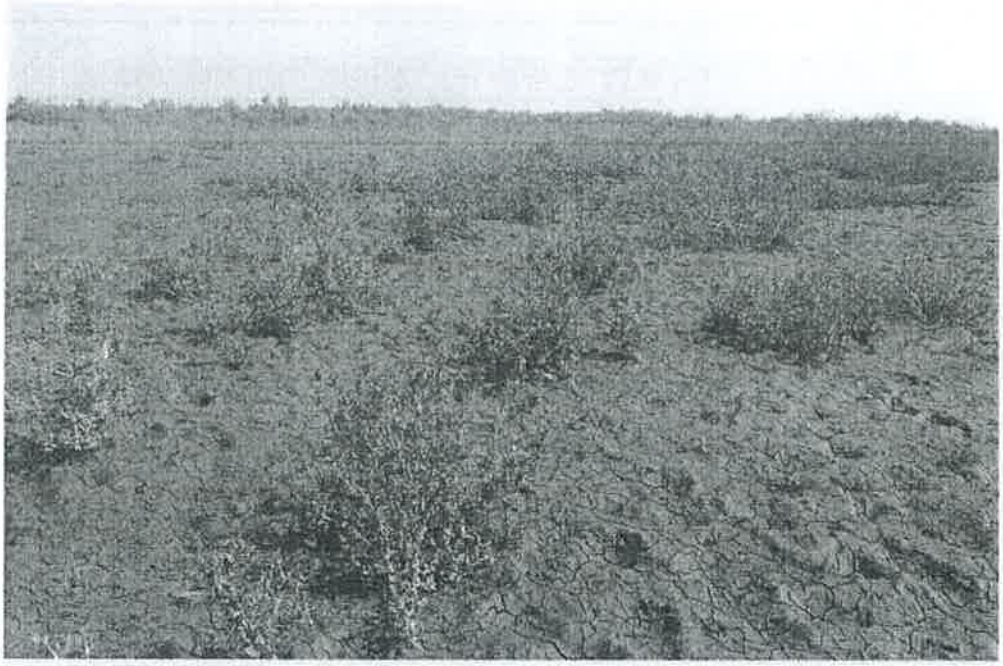


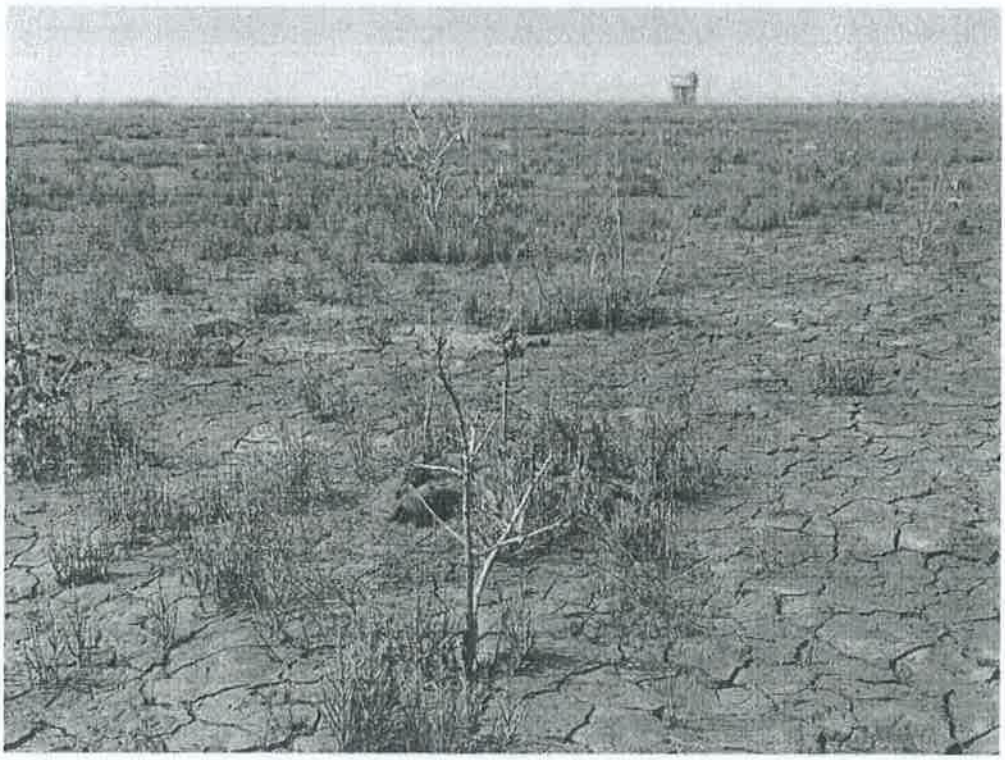


Mangroves planted in 100 ha. area at Bhavnagar Coast during 2012-13

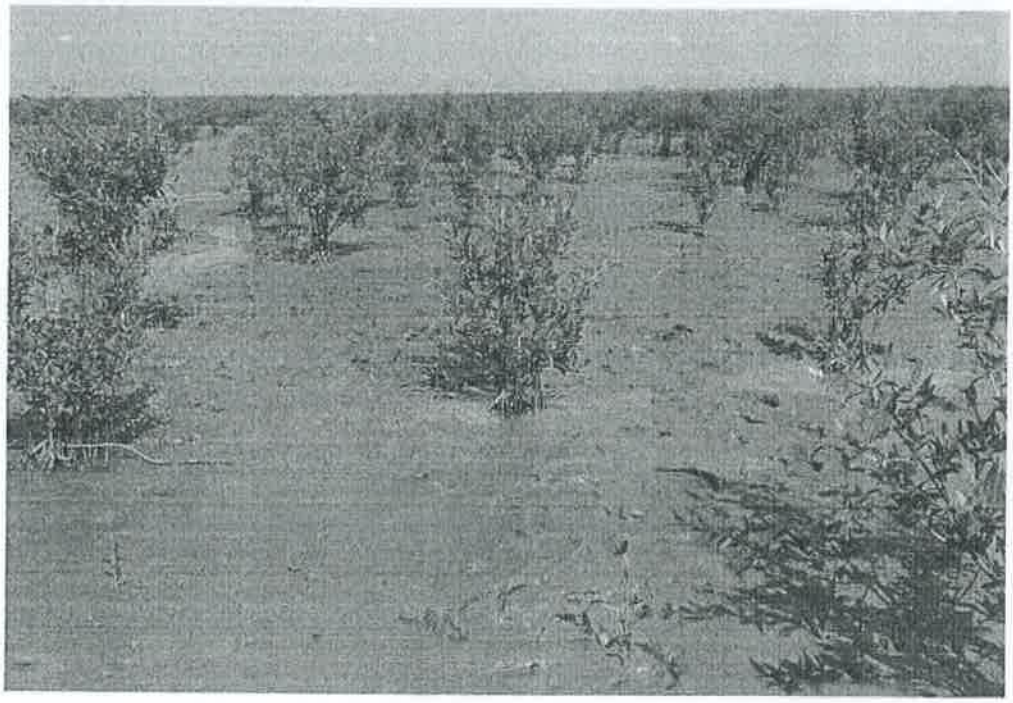
Mangroves planted in 200 ha. area at Bhavnagar Coast during 2013-14

Mangroves planted in 200 ha. area at Bhavnagar Coast during 2014-15

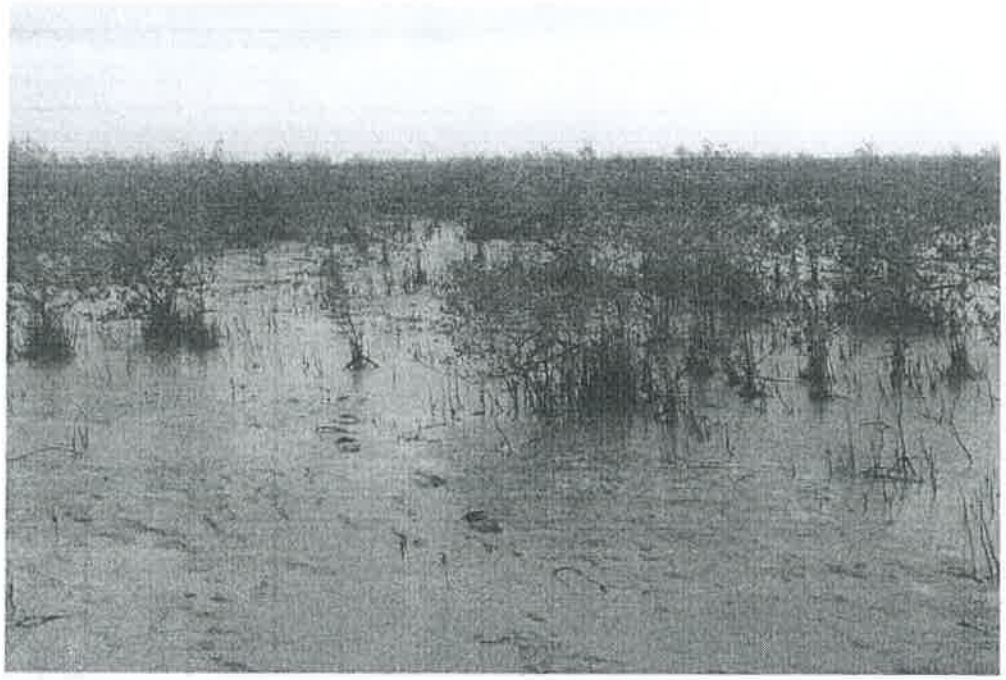


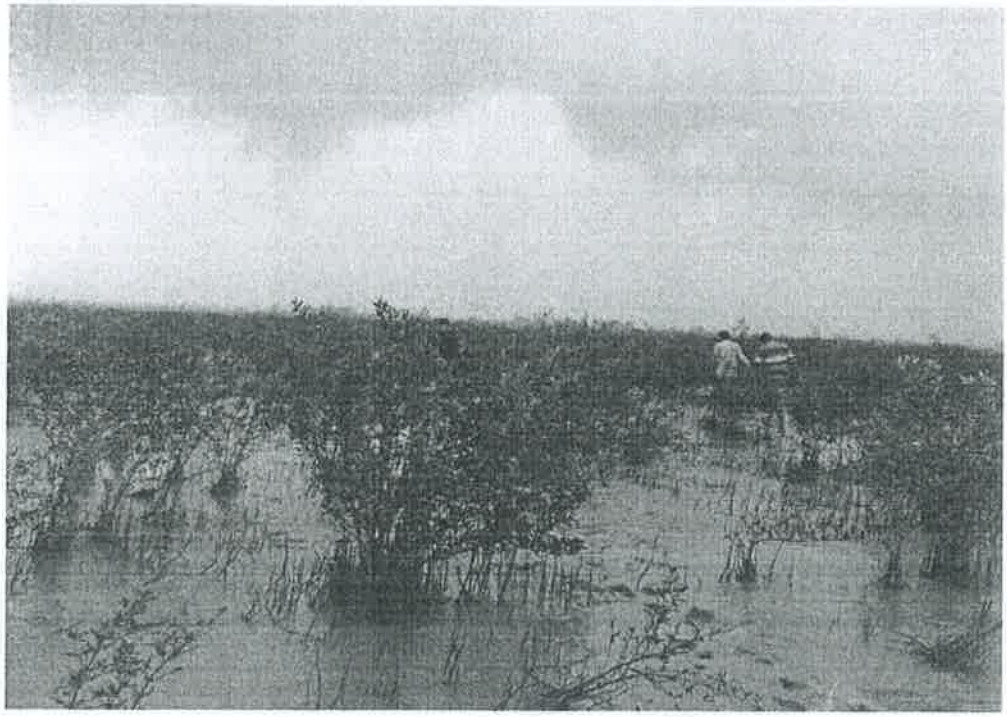


Mangroves planted in 50 ha. area at at Kentlyajal Coast during 2014-15



Mangroves planted in 50 ha. area at Gadhula, Talaja Coast during 2016-17





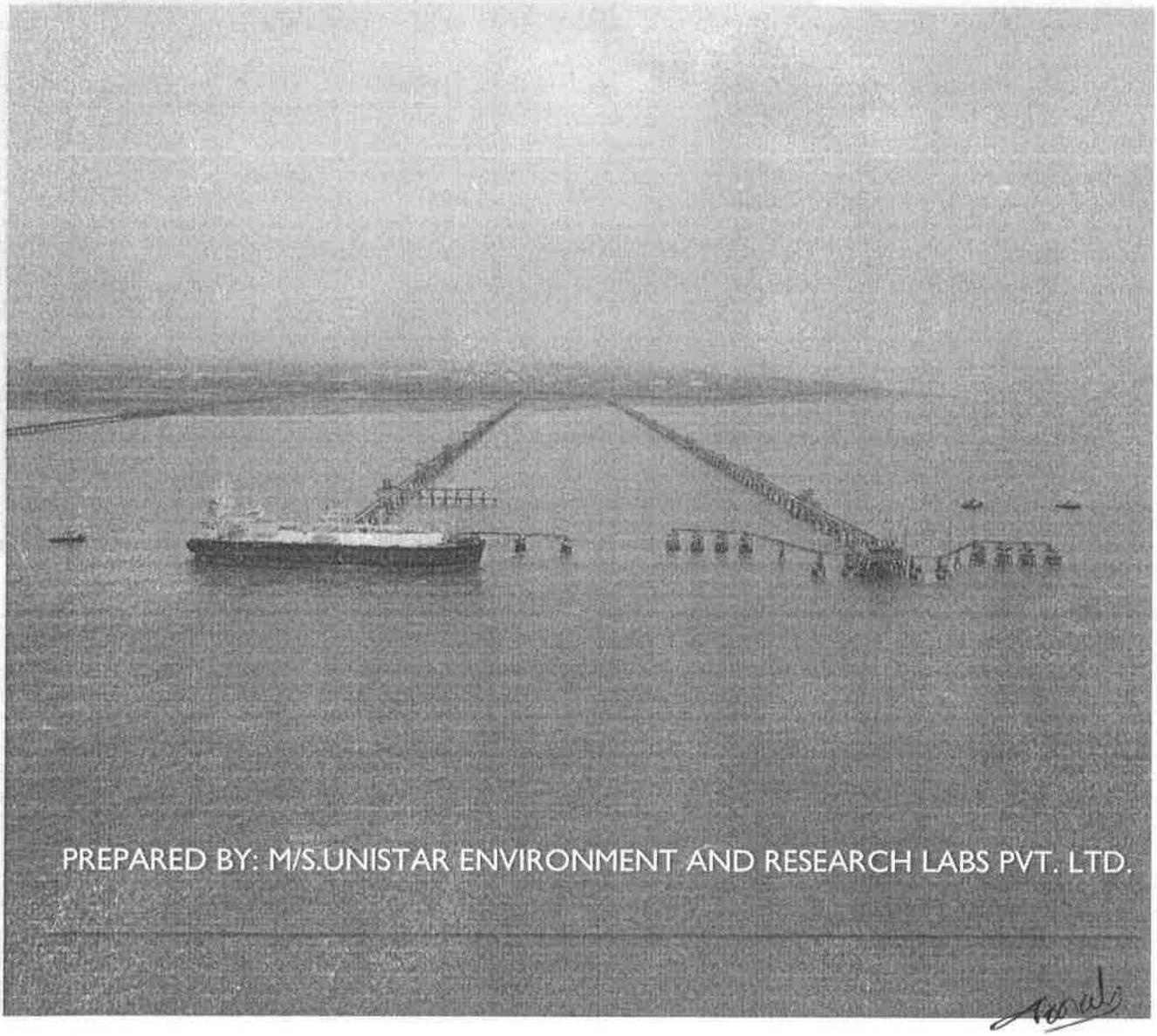
ANNEXURE XI

MARINE ECOLOGICAL MONITORING REPORT

FOR

M/s.PETRONET LNG LIMITED., DAHEJ

DECEMBER 2022



PREPARED BY: M/S.UNISTAR ENVIRONMENT AND RESEARCH LABS PVT. LTD.

PREFACE

The Company had set up South East Asia's first LNG Receiving and Regasification Terminal with an original nameplate capacity of 5 MMTPA at Dahej, Gujarat. The infrastructure was developed in the shortest possible time and at a benchmark cost. The capacity of the terminal has been expanded in phases which is currently 17.5 MMTPA and the same is under expansion to 22.5 MMTPA in two phases. The terminal has 6 LNG storage tanks and other vaporization facilities. The terminal is meeting around 40% of the total gas demand of the country.

The terminal has two LNG Jetties at Dahej. While the first jetty can handle berthing of up to Q-Flex vessels, the second jetty can handle berthing of up to Q-Max vessels.

Dahej terminal is the largest single location LNG storage and regasification terminal in the country and has recently achieved the milestone of handling 3000th LNG cargo on 7th July 2022. The terminal is also offering tolling services to Off takers & Bulk customers. To cater the small customers who are not having gas pipeline connectivity, Dahej is supplying LNG to such customers which is transported through cryogenic trucks.

PLL Dahej is first terminal to start loading of LNG in trucks for supply of LNG to the areas where pipelines have not reached and today has 04 truck loading bays and hub for development of Small-Scale LNG business. PPL has entrusted the work of carrying out Marine Ecological Monitoring to **M/s.UniStar Environment and Research Labs Pvt. Ltd.**

These Marine Ecological Monitoring reports provide a data obtained from monitoring and analysis activities undertaken on dated.17.12.2022. (December-2022)

Date: 28/12/2022

M/s.UniStar Environment and Research Labs Pvt. Ltd.
White house, Char Rasta, Vapi-396 191

Approved by

Manager - Operations
(Jaivik Tandel)

TABLE OF CONTENTS

❖ INTRODUCTION

1.1 Background:

The Marine Ecological Monitoring involves Physico-chemical and biological analysis of Marine water. Marine water quality of Sub-tidal and Intertidal regions, Flora and Fauna analysis in marine water area and Benthos in inter-tidal and sub-tidal analysis for the Petronet LNG Ltd. (Dahej LNG Terminal). Water sample are collected from different location (station) and Benthos sample are collected from High water and low water transect area. Samples are brought to the laboratory by field sampling team and the analysis was carried out in our laboratory and the results are presented in this report.

1.2 Objectives:

The primary objectives of this study are,

a) To evaluate the physico-chemical parameters of seawater for better understanding of water quality in study region.
b) To assess the marine biological status of the study region with quantitative and qualitative data of marine organisms (phytoplankton, zooplankton, and macrobenthos).
c) To recommend adequate marine environmental management measures.

1.3 Scope of work

Sample collection on spatial basis for the M/s.Petronet LNG Ltd. (Dahej LNG Terminal) to evaluate the following parameters:

a) Mrine Biological Water quality sample analysis from subtidal region

Water quality will be assessed for Temperature, pH, Turbidity, Total suspended solids, salinity, Oil & grease, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Calcium Carbonate, Alkanity, Petroleum Hydrocarbons (PHc), Total Phosphate, Nitrate, Ammonical nitrogen, Total nitrogen and Total coliform.

b) Biological Analysis of collected sample with respect to phytoplankton, zooplankton, Chlorophyll from subtidal region

c)Sampling of benthic communities from subtidal region between Low tide and high tide

d)Intertidal flora/fauna Qualitative and quantitative estimations: phytoplankton, pollutation and generic diversity,primaery productivity, zooplankton standing stock, miceobenthic standing stock subtidal region,sea grass,algae,sea weeds,crustaceans,fishes mangroves and migratory birds etc.

1.4 Sampling strategy

To evaluate the influence of activity at the Petronet LNG Ltd. (Dahej LNG Terminal), sedimentary parameters and marine biota present sampling was carried out on dated.17.12.2022.

Table 1: Co-ordinates of subtidal and intertidal sampling stations

Stations			Co-ordinates	
Sub-tidal (ST)	ST-1	HTL	21°40.880'N	72°29.807'E
		LTL	21°40.887'N	72°29.948'E
	ST-2	HTL	21°39.867'N	72°29.799'E
		LTL	21°39.880'N	72°29.790'E
	ST-3	HTL	21°39.100'N	72°29.800'E
		LTL	21°39.055'N	72°29.801'E
	ST-4	HTL	21°38.130'N	72°30.432'E
		LTL	21°38.020'N	72°30.587'E
Intertidal (IT)	IT-01		21°40.572'N	72°30.921'E
	IT-02		21°40.559'N	72°30.586'E
	IT-03		21°40.128'N	72°30.950'E
	IT-04		21°39.896'N	72°30.629'E

a) Sampling frequency:

All Sampling subtidal stations were monitored during flood to ebb. Water samples were collected in Triplicate (surface, Middle and bottom) for assessing water quality and marine biological characteristics. Intertidal sampling was completed during low tide, for assessed Macro benthic fauna samples were collect in duplicate from each transects.

b) Sampling methodology:

➢ **Water quality**: Surface water samples were collected using the clean polyethylene bucket. Niskin water sampler (5-liter capacity) with a mechanism for closing at a desired depth using messenger was used for collecting sub-surface (bottom) water samples (~1m above the sea floor).

➢ Sediment sampling: For estimation of sedimentary parameters samples were collected from subtidal stations using Van-veen type grab (area of 0.1m^2), while intertidal samples were collected using metal quadrant (0.25 m^2 area).

➢ Biological characteristics: Samples for chlorophyll and phytoplanktons were collected using clean plastic bucket and Niskin water samples. The samples for chlorophyll were immediately preserved with ice and kept in ice box till further analysis whereas the phytoplankton samples were fixed with Lugol's iodine and few drops of 3% buffered formaldehyde solutions, while for zooplankton oblique hauls were made at water surface using Heron Tranter net (mesh size 0.33m, mouth area 0.25m^2) attached with calibrated flow meter (General Oceanic). The samples were preserved in 5% buffered formaldehyde solutions. Samples for macrobenthos were collected using van veen type of grab covering an area of 0.04 m^2 and sieving through 500 um mesh size. The samples were preserved with 5% formaldehyde Rose Bengal solutions.

1.5 Team Members

This Marine Ecological Monitoring work presented in this report is done by M/s. UniStar Environment and Research Labs Pvt. Ltd. With active co-operation from M/s. Petronet LNG Ltd. for this Marine Ecological Sampling and Analysis UERL team members as follows.

➢ Sampling team members:

1. Dr. Sushant Vilas Sanaye (Marine Scientist)
2. Mr. Jaivik S. Tandel (Manager-Operations)
3. Mr. Bhavin Patel (Environmental Engineer)
4. Mr. Pravin Singh (Environmental Engineer)

➢ Laboratory members

1. Dr. Ashwini Pawar-Sanaye, (Marine Scientist)
2. Dr. Sushant Vilas Sanaye (Marine Scientist)
3. Ms. Shweta A. Rana (Sr. Microbiologist)
4. Mr. Nilesh Patel (Sr. Chemist)

- WATER QUALITY

2.1 Marine Water quality:

Seawater samples have been collected during December 2022.

2.2 Physico chemical Water analysis result:

All the water sampled, which is collected by sampling team is brought to the lab for Physico chemical analysis. The marine water quality at different collected stations are measured during this investigation is presented in Table No.2.1 and its method of analysis is present in Table No.2.0

Table: 2.0 Methodology of Physico chemical Water Analysis

Sr.No.	Parameters	Test Method
1	pH @ 25 °C	IS 3025 (Part 11)1983
2	Temperature (^{0}C)	IS 3025 (Part 9)1984
3	Turbidity	IS 3025 (Part 10)1984
4	Total Suspended Solids	APHA 23rd Ed.,2017,2540- D
	CHEMICAL QUALITY	
1	Biochemical Oxygen Demand (BOD)	IS 3025 (Part 44)1993
2	Oil & Grease	IS 3025 (Part 39) 2021
3	Ammonical Nitrogen	APHA 23rd Ed.,2017,4500- NH3 B
4	Salinity	By Calculation
5	Dissolved Oxygen	APHA 23rd Ed.,2017,4500-O, B
6	Total Alkalinity as $CaCO_3$	IS 3025 (Part 23)1986
7	Phosphate	APHA 23rd Ed.,2017,4500-P, D
8	Nitrate	APHA 23rd Ed.,2017,4500 NO3-B
9	Calcium Carbonate	APHA 23rd Ed.,2017,3500 Ca. B
10	Petroleum Hydrocarbon (PHc)	GC Method
	MICROBIOLOGY QUALITY	
1	Total Coliform	APHA 23rd Ed.2017,9222-B

Table: 2.1 Physico chemical Water Analysis Result

Sr.No.	Parameters	Unit	Station 1			Station 2		
			Surface	Middle	Bottom	Surface	Middle	Bottom
PHYSICAL QUALITY								
1.	pH @ 25 °C	--	8.12	8.1	8.03	8.15	8.07	8.05
2.	Temperature	(^{0}C)	28	28	28	28	28	28
3.	Turbidity	NTU	1	1	1	5	5	5
4.	Total Suspended Solids	(mg/l)	218	210	198	236	226	206
CHEMICAL QUALITY								
1.	Biochemical Oxygen Demand	mg/L	3.5	3.3	3.1	3.4	3	2.9
2.	Oil & Grease	mg/L	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)
3.	Ammonical Nitrogen	mg/L	BDL (MDL:2.0)	BDL (MDL:2.0)	BDL (MDL:2.0)	BDL (MDL:2.0)	BDL (MDL:2.0)	BDL (MDL:2.0)
4.	Salinity	ppt	27	27.87	28.74	27.87	28.74	28.82
5.	Dissolved Oxygen	mg/L	6.6	6.5	6.3	6.4	6.3	6.2
6.	Total Alkalinity as $CaCO_3$	mg/L	131	135.8	131	126.1	135.8	131
7.	Phosphate	mg/L	0.18	0.28	0.4	0.33	0.35	0.5
8	Nitrate	mg/L	1	0.9	0.8	1	1	0.8
9	Calcium Carbonate	mg/L	768	748.8	806.4	758.4	739.2	729.6
10	Petroleum Hydrocarbon (PHc)	ppb	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
MICROBIOLOGY QUALITY								
1.	Total Coliform	CFU/ 100ml	68	22	Absent	50	23	Absent

Note: MDL = Minimum Detection Limit (MDL: 0.01) and N.D. = Not detectable

Table: 2.2 Physico chemical Water Analysis Result

Sr.No.	Parameters	Unit	Station 3			Station 4		
			Surface	Middle	Bottom	Surface	Middle	Bottom
PHYSICAL QUALITY								
1.	pH @ 25 °C	--	8.19	8.05	8.04	8.17	8.1	8.05
2.	Temperature	(°C)	28	28	28	28	28	28
3.	Turbidity	NTU	1	1	5	1	1	1
4.	Total Suspended Solids	(mg/l)	250	224	212	234	224	212
CHEMICAL QUALITY								
1.	Biochemical Oxygen Demand	mg/L	3.8	3.6	3.5	4.2	3.9	3.7
2.	Oil & Grease	mg/L	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)
3.	Ammonical Nitrogen	mg/L	BDL (MDL:2.0)	BDL (MDL:2.0)	BDL (MDL:2.0)	BDL (MDL:2.0)	BDL (MDL:2.0)	BDL (MDL:2.0)
4.	Salinity	ppt	27.87	29.61	30.48	28.74	28.74	31.36
5.	Dissolved Oxygen	mg/L	6.5	6.4	6.2	6.4	6.3	6.1
6.	Total Alkalinity as $CaCO_3$	mg/L	126.1	126.1	131	131	126.1	131
7.	Phosphate	mg/L	0.29	0.14	0.19	0.18	0.15	0.17
8	Nitrate	mg/L	0.9	0.9	0.8	1	1	0.9
9	Calcium Carbonate	mg/L	729.6	720	739.2	739.2	739.2	739.2
10	Petroleum Hydrocarbon (PHc)	ppb	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
MICROBIOLOGY QUALITY								
1.	Total Coliform	CFU/ 100ml	70	30	02	44	15	Absent

Note: MDL = Minimum Detection Limit (MDL: 0.01) and N.D. = Not detectable

❖ BIOLOGICAL CHARACTERISTICS (BIODIVERSITY STUDIES):

Marine ecosystems are subject to a multitude of direct human pressures, such as overexploitation, eutrophication, pollution, and species introductions. These stressors can have synergistic effects on marine ecosystems, altering its functioning. Anthropogenic involvements constantly compromise the health of the marine ecosystem by disturbing the ecological balance. Hence the assessment of the biotic components along with abiotic factors is an integral part of environmental assessment and monitoring study. During the present investigation at Petronet LNG, Dahej, the abundance and distribution of marine organisms (Plankton and benthos) were studied as part of routine environmental monitoring.

3.1 Planktonic Forms:

The name plankton is derived from the Greek word "planktons", meaning "wanderer" or "drifter". While some forms of plankton are capable of independent movement and can swim up to several hundred meters in a single day, their position is primarily determined by currents in the body of water they inhabit. As per definition, organisms classified as "plankton" are unable to resist ocean currents. Plankton is primarily divided into two broad functional groups i.e., Phytoplankton and Zooplankton.

3.1.1 Phytoplankton

Phytoplankton are microscopic, single-celled photosynthetic organisms that live suspended in all water niches, including oceans, freshwater, and marine niche. Like the terrestrial ecosystem where plants are an integral part of the ecosystem, phytoplankton play key role in the biogeochemistry of the oceans. As they are dependent on sunlight for energy, they mostly inhabit the euphotic zone. Therefore, they are responsible for production of half of the atmosphere's oxygen and more than half of the primary production in the oceans. There are many species of phytoplankton, each of which has a characteristic shape, size, and function. Marine species of phytoplankton grow abundantly in oceans around the world and are the foundation of the marine food chain. Marine phytoplankton are the producing (autotrophic) component in the ocean. There are fourteen classes of phytoplankton. Each class of phytoplankton contains unique attributes in size, cell structure, nutrients, and function.

3.1.2 Zooplankton:

Zooplankton occupies second position in the food web of the marine niche. They are the primary consumer's organisms and generally feed on phytoplankton or small, microscopic group of organisms for they are nutritional needs. They are incapable of making their own food from sun-light or inorganic compounds, and feed on organisms or the remains of other organisms to get the energy necessary for survival.

- SIGNIFICANCE OF PHYTO- AND ZOOPLANKTONS

Phytoplankton are vital to marine ecosystems. They are producers, or autotrophs, that form the foundation of most marine food webs. As photosynthetic organisms, they can convert solar energy into chemical energy and store it in form of sugars. They are responsible for half of the photosynthetic activity on the planet. The significance of zooplanktons is found in their role of transferring biological production from phytoplankton to large organisms in the marine food web and the seafloor. The microscopic protozoan, tunicates, copepods, and other crustaceans graze upon many phytoplankton species. These in turn become food for other animals further linking the food web. Therefore, variability in reproduction of copepods would affect the survival of young fish that feeds on them.

Table 3: Test methods for phytoplankton, Zooplankton, Chlorophyll a and Pheophytin, Macro benthos analysis

Sr. no.	Test performed	Method
1	Phytoplankton	APHA, Edition 23, Part 10000, 10200 F
2	Chlorophyll *a* and Pheophytin	APHA, Edition 23, Part 10000, 10200 H (with some modification)
3	Zooplankton	APHA, Edition 23, Part 10000, 10200 G
4	Macro benthos	APHA, Edition 23, Part 10000,10500 A-10500 D

3.2 ZOOPLANKTON DIVERSITY

Zooplankton includes arrays of organisms, varying in size from the microscopic protozoans of a few microns to some jellyfish-like organisms with tentacles several meters long. By virtue of sheer abundance and intermediate role between phytoplankton and fish, zooplankton is considered as the chief index of the utilization of aquatic biotopes at the second trophic level.

Zooplankton standing stock in terms of population and biomass revealed substantial variation within all Subtidal (4 stations) and inter-tidal (4 stations) stations (Table 4 and Table 5) in the study area of Petronet LNG jetty, Dahej during December 2022. In the sub-tidal area, the maximum zooplankton population density (21.5 nos. x 10^3/100 m^3) and biomass (3.80 ml/ 100 m^3) was recorded at Station 1 during high tide level and minimum zooplankton population density (10 nos. x 10^3/100 m^3) and biomass (1.21 ml/100 m^3) were recorded at Station 3 during low tide level (Figure 1). In the inter-tidal area, the maximum zooplankton population density (13.8 nos. x 10^3/100 m^3) and biomass (1.82 ml/100 m^3) were recorded at Station IT-4 and the minimum zooplankton population (10.5 nos. x 10^3/100 m^3) and biomass (1.2 ml/100 m^3) were recorded at Station IT-2 (Figure 2). A total of 12 groups of zooplankton including Copepods, Copepod nauplii, crab larvae, Chaetognaths, Decapod larvae, fish and shellfish eggs, fish larvae, gastropod larvae, Polychaetae larvae, Siphonophora, Ostracods and Oikopleura were identified during this study (Table 4 and 5). Among these identified groups Copepods (78.32%) and Copepod nauplii (11.72%) were most dominant (Figure 3). Crab larvae (3.48%) and Chaetognaths (3.20%) were also the dominant groups in the zooplankton population (Figure 3). As well as fish and shell eggs, polychaetae larvae also were another observed group during the present study.

Table 4: Population (nos. x 10^3/100 m^3) and biomass (ml/100 m^3) of various zooplankton groups in the sub-tidal area at the Petronet LNG, Dahej during December 2022.

Zooplankton Groups	High Tide level				Low Tide level			
	St-1	St-2	St-3	St-4	St-1	St-2	St-3	St-4
Copepods	15.10	14.62	14.77	14.57	9.53	8.41	8.28	10.86
Copepod nauplii	3.38	3.40	2.74	2.93	1.59	1.08	0.92	0.69
Crab larvae	1.16	0.91	0.77	0.66	0.25	0.41	0.24	0.34
Chaetognaths	1.06	0.66	0.49	0.46	0.39	0.37	0.32	0.41
Decapod (shrimps)	0.054	0.039	0.075	0.034	0.000	0.019	0.000	0.000
Fish and shell fish eggs	0.322	0.348	0.302	0.271	0.125	0.174	0.129	0.142
Fish larvae	0.018	0.000	0.019	0.000	0.018	0.000	0.000	0.000
Gastropod larvae	0.054	0.000	0.038	0.034	0.018	0.019	0.021	0.000
Polychaete larvae	0.268	0.406	0.434	0.321	0.143	0.116	0.086	0.124
Siphonophora	0.036	0.019	0.019	0.000	0.018	0.000	0.021	0.000
Ostracods	0.036	0.000	0.000	0.034	0.000	0.000	0.000	0.000
Oikopleura	0.018	0.019	0.057	0.034	0.018	0.000	0.000	0.000
Population (nos. x 10^3/100 m^3)	**21.50**	**20.43**	**19.71**	**19.34**	**12.09**	**10.60**	**10.02**	**12.56**
Biomass (ml./100 m^3)	**3.80**	**2.54**	**2.00**	**2.96**	**2.01**	**1.21**	**1.21**	**1.66**

Table 5: Population (nos. x 10^3/100 m^3) and biomass (ml/100 m^3) of various zooplankton groups in the inter-tidal area at the Petronet LNG, Dahej during December 2022.

Zooplankton Groups	Inter tidal stations			
	IT-1	IT-2	IT-3	IT-4
Copepods	9.46	8.66	9.42	11.97
Copepod nauplii	1.12	0.89	0.89	0.75
Crab larvae	0.23	0.37	0.37	0.38
Chaetognaths	0.32	0.32	0.37	0.42
Decapod (shrimps)	0.014	0.016	0.000	0.000
Fish and shell fish eggs	0.086	0.143	0.116	0.164
Fish larvae	0.000	0.000	0.019	0.000
Gastropod larvae	0.000	0.000	0.000	0.018
Polychaete larvae	0.173	0.143	0.135	0.164
Siphonophora	0.000	0.000	0.019	0.000
Ostracods	0.000	0.000	0.000	0.000
Oikopleura	0.000	0.000	0.000	0.000
Population (nos. x 10^3/100 m^3)	**11.41**	**10.54**	**11.33**	**13.86**
Biomass (ml./100 m^3)	**1.44**	**1.20**	**1.81**	**1.82**

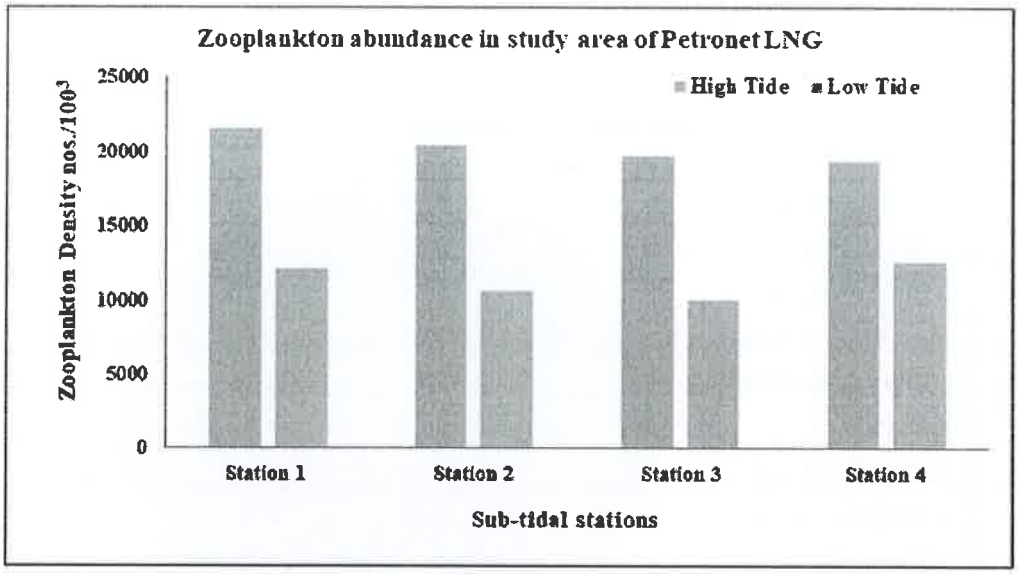


Figure 1: Zooplankton population (nos./100 m^3) recorded in the sub-tidal waters along the Petronet LNG, Dahej during December 2022.

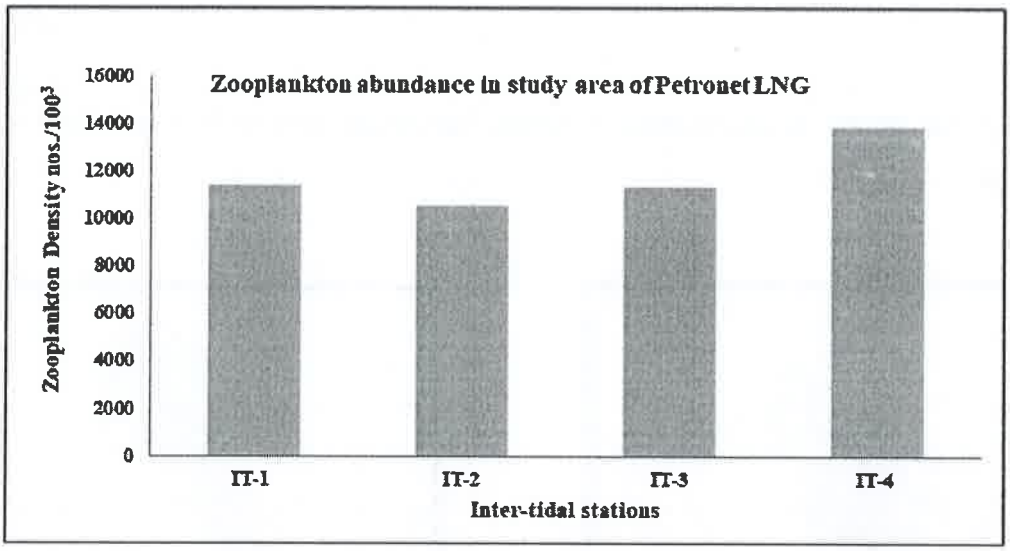


Figure 2: Zooplankton population (nos./100 m^3) recorded in the inter-tidal waters along the Petronet LNG, Dahej during December 2022.

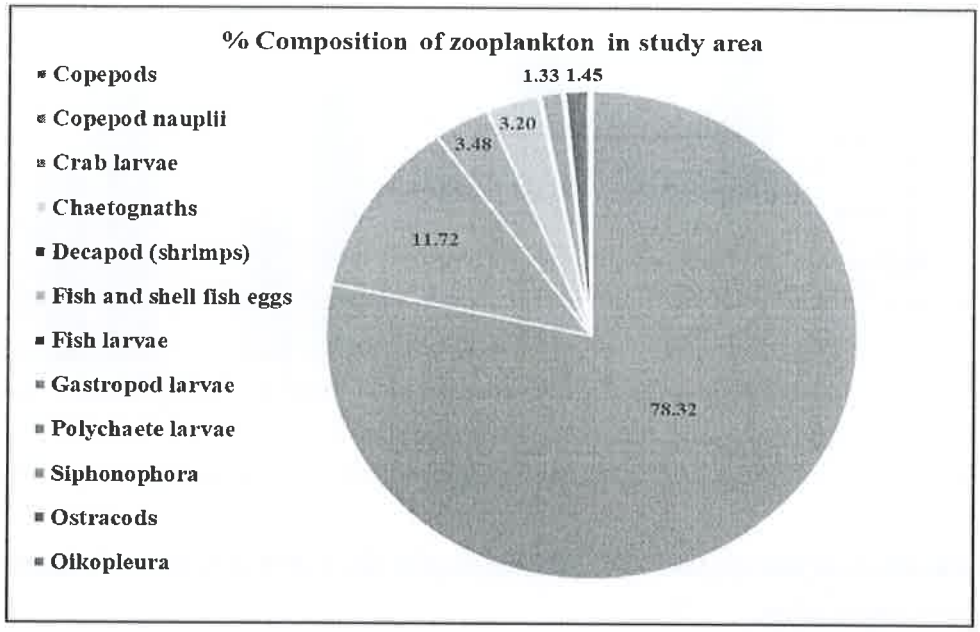
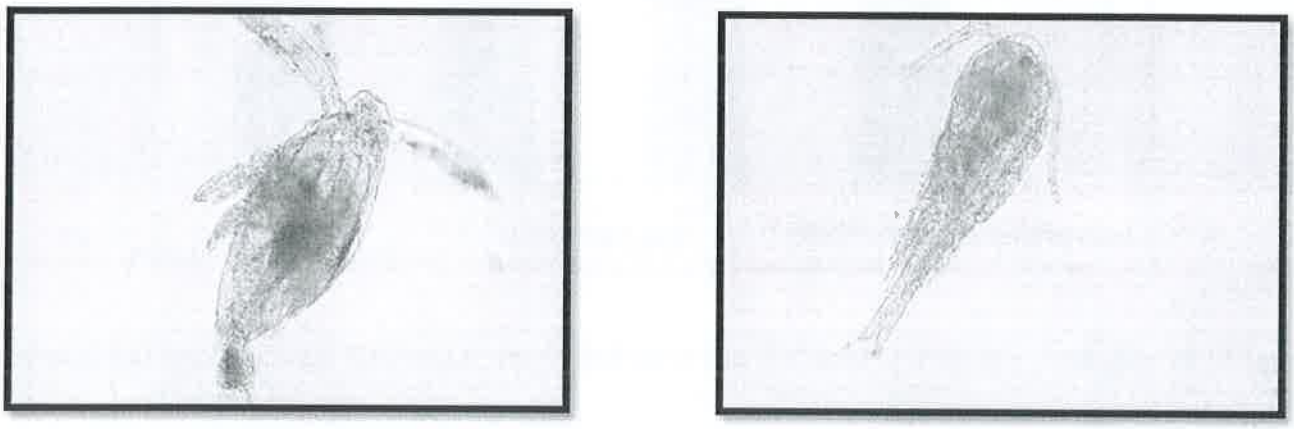


Figure 3: Dominant groups of Zooplankton reported from study area of Petronet LNG, Dahej during December 2022.



Copepod

Copepod Nauplius

Figure 4: Microphotographs of zooplanktons reported in the coastal waters of Petronet LNG, Dahej during December 2022

3.3 MACRO-BENTHIC FAUNA

The benthic zone is the lowest ecological zone of a water body which usually involves the sediments on the seafloor. The number of phyla and species of benthic animals exceeds those of pelagic species, at least partly because of the greater physical variety of benthic habitats. Benthic animals are separated into in faunal and epifaunal species, depending upon whether they live within sediments or on the surface of the seafloor, respectively. Size categories of the zoobenthos consist of the larger macrofauna (>1.0 mm), the small meiofauna which is characteristically found in sand and mud, and the microfauna which is made up mostly of protozoans.

Benthic organisms are morphologically different from those planktonic organisms. Many are adapted to live on the substrate (bottom). In benthic habitats, they can be considered dominant creatures. These organisms adapted to deep-water pressure so cannot survive in the upper parts of the water column. Since light does not penetrate very deep ocean water, the benthic organisms often depend on the organic matter falling from the upper water column as their main energy source. This dead and decaying matter sustains the benthic food chain. The most benthic organisms are scavengers or detritivores. These organisms under being relatively stationary, are constantly exposed to changes undergoing in overlying water, and hence, respond very well to aquatic pollution. The macro benthos population is very sensitive to environmental perturbation and is highly influenced by the physicochemical characteristics of water, the nature of the substratum, food, predation, and other factors. The density of benthic invertebrates also fluctuates widely with the changes in the season.

- **Significance of macrobenthic organisms**

The biomass of microbenthic organisms in estuaries and coastal embayment is often high. Burrowing and tube-building by deposit-feeding benthic organisms (bioturbations) help to mix the sediment and enhance the decomposition of organic matter. Nitrification and denitrification are also enhanced because a range of oxygenated and anoxic micro-habitats are created. Macro fauna is also important constituents of fish diets and thus are an important link for transferring energy and nutrients between trophic levels, also driving pelagic fish and crustacean production. For these reasons, the benthic organisms are extremely important indicators of environmental change.

3.4 BENTHIC DIVERSITY

3.4.1 Subtidal region:

During the present study, macrobenthos abundance and biomass were recorded at sub-tidal stations during high and low tide levels at Petronet LNG, Dahej (Table 6). The macrobenthos density ranged from 240 nos./m^2 to 430 nos./m^2 at sampling stations (Table 6; Figure 5) and comprising of 4 different groups (mollusks, Sipuncula, annelids and foraminifera). The biomass of the macrobenthic community in the study region ranged from 1 g/m^2 to 1.9 g/m^2. The maximum abundance of benthic microorganisms was reported at Station 3 (430 nos./m^2) during high tide levels and mainly contributed by the dominance of polychaete worms. The highest biomass of macrobenthic species was observed at Station 3 (1.9 g/ m^2) during high tide levels with the dominance of Polychaetas. The least density (240 no/m^2) and biomass (1 g/m^2) was observed at Station 4 during low tide level. In species composition, Foraminifera is the first largest group observed at all the stations during the present study. Secondly, Polychaete species (Phylum Annelida) belonging to the family Paraonidae, Pilargidae, Capitillidae, Cossuridae, Spionidae, Nereidae, Eunicidae, were abundant.

Table 6: Faunal composition, density (nos./m^2) and biomass (g/m^2) of the macrobenthos community in the sub-tidal region at Petronet LNG, Dahej during December 2022.

Benthos Faunal Groups	High tide Level				Low tide Level			
	St-1	St- 2	St- 3	St- 4	St- 1	St- 2	St- 3	St- 4
Phylum Mollusca								
Bivalves and gastropods	30	20	20	10	20	20	30	10
Phylum Sipuncula								
Sipunculids	20	0	10	0	10	10	20	0
Nemertine	30	10	10	10	0	20	10	0
Phylum Annelida								
Polychaetes	190	180	210	120	120	130	160	120
Phylum Retaria								
Foraminifera	140	160	180	160	170	190	140	110
Density (nos./ m^2)	**410**	**370**	**430**	**300**	**320**	**370**	**360**	**240**
Biomass (gm/m^2)	**1.8**	**1.6**	**1.9**	**1.4**	**1.4**	**1.7**	**1.6**	**1**

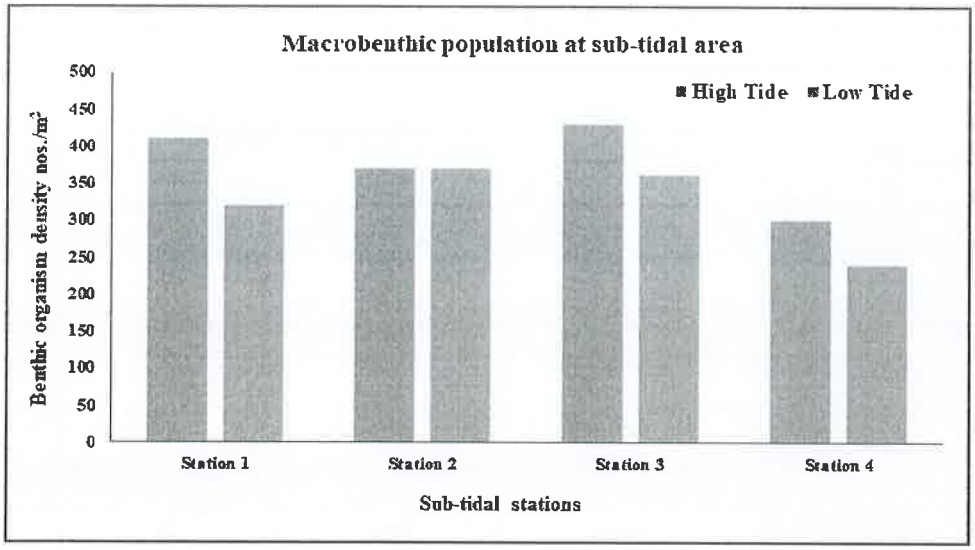


Figure 5: Subtidal macrobenthos abundance (nos./m²) during high tide and low tide at different sampling stations at Petronet LNG, Dahej during December 2022.

3.4.2 Intertidal region:

The muddy and sandy substratum with moderate organic matter supports the occurrence of the microbenthic community in the intertidal region. No considerable difference in macrobenthos biomass was measured (1.5 g/m² to 2.1 g/m²) in the intertidal region at the Petronet LNG, Dahej (Table 7). The lowest density and biomass of macrobenthic organisms were reported at station IT-1 (344 nos./m² and 1.5 g/m², respectively), whereas the highest density was reported at Station IT-3 (450 nos./m² and 2.1 g/m², respectively) (Table 7 and Figure 6). In the inter-tidal area, Foraminifera (46%) and Polychaete (45%) species were contributed to the total macrobenthic abundance at these stations followed by bivalves and gastropods (5%). Some photographs of benthic fauna are shown in Figure 8.

Table 7: Faunal composition, density (nos./m²) and biomass (g/m²) of the macrobenthos community in the inter-tidal region at Petronet LNG, Dahej during December 2022.

Benthos Faunal Groups	Inter-tidal stations			
	IT-1	IT- 2	IT- 3	IT- 4
Phylum Mollusca				
Bivalves and gastropods	10	10	20	10
Phylum Sipuncula				
Sipunculids	0	0	10	10
Nemertine	10	10	0	10
Phylum Annelida				
Polychaetes	150	190	210	160
Phylum Arthropoda				
Decapod larvae (crab)	4	4	0	0
Phylum Retaria				
Foraminifera	170	190	210	160
Density (nos./ m²)	**344**	**404**	**450**	**350**
Biomass (gm/m²)	**1.5**	**1.8**	**2.1**	**1.6**

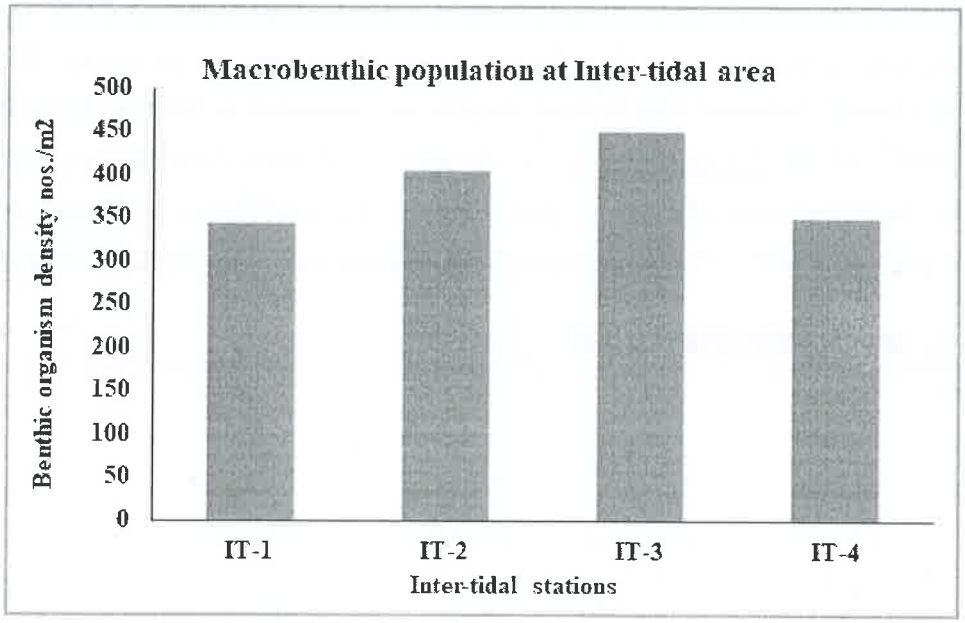


Figure 6: Inter-tidal macro benthos abundance (nos./m²) at different sampling stations at Petronet LNG, Dahej during December 2022.

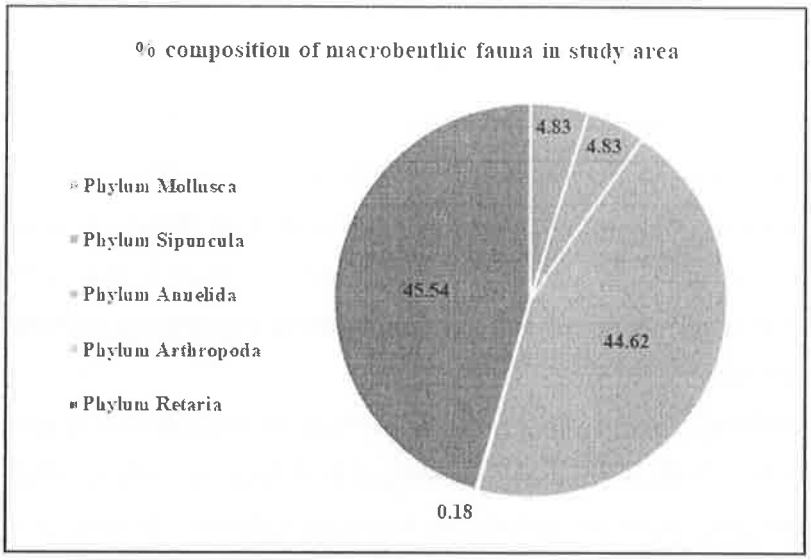
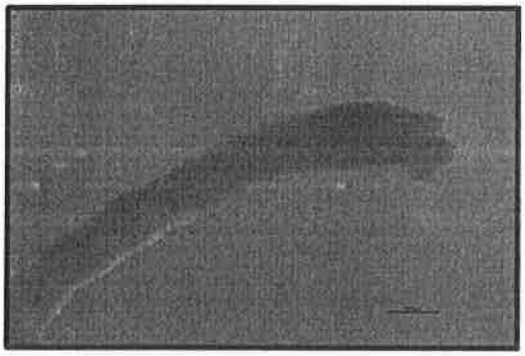
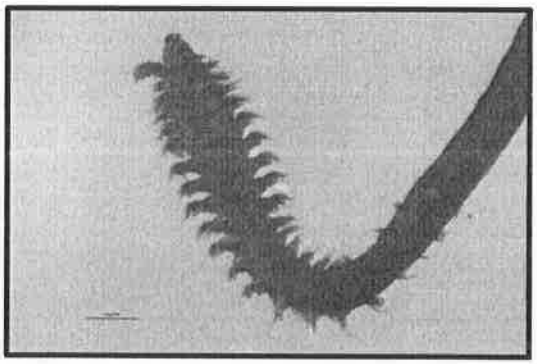


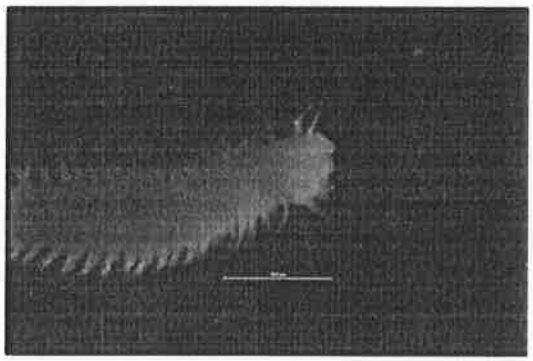
Figure 7: Percent composition of Subtidal benthic taxa from the marine waters of Petronet LNG, Dahej during December 2022



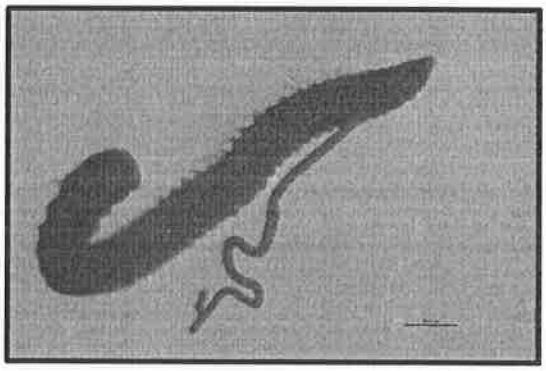
Capitallidae



Spoinidae



Pilargidae



Cossuridae

Figure 8: Microphotographs of microbenthic organisms observed in the sediment samples collected in the vicinity of Petronet LNG, Dahej during December 2022

3.5 AVIFAUNAL DIVERSITY

Due to their importance in the ecosystem for various roles such as scavengers, pollinators for crops, seeds dispersal agents and also predators of insect pests, the avifaunal diversity study of a given region is a major indicator to evaluate habitats both qualitatively and quantitatively. Due to anthropogenic activities along with climate changes, the global diversity of birds is rapidly decreasing. IUCN Red List of endangered birds has already recognized 1226 bird species as threatened globally and whereas, 88 bird species are found in India.

Coastal and estuarine waters are always been important habitats for many bird species, including many migratory birds. Mudflats and sandy beaches are important feeding grounds for coastal birds and nearby mangrove forests and land trees provide shelter and breeding habitats. During the present study, an overview of the avifaunal diversity present in the study area has been taken. Due to the restricted approach to mudflats and shores directly for security reasons, only available bird species are listed in Table 8.

Table 8: List of bird species observed in the study area.

Sr. No.	Scientific name	Common name	IUCN category
1.	*Actitis hypoleucos*	Common sandpiper	Least concern (LC)
2.	*Ardeola grayii*	Indian pond Heron	Least concern (LC)
3.	*Bubulcus ibis*	Cattle egret	Least concern (LC)
4.	*Casmerodius albus*	Great egret	Least concern (LC)
5.	*Columba livia*	Rock dove	Least concern (LC)
6.	*Charadrius leschenaultii*	Sand plover	Least concern (LC)
7.	*Egretta gularis*	Western reef egret	Least concern (LC)
8.	*Larus heuglini*	Heuglin's gull	Least concern (LC)
9.	*Milvus migrans*	Black kite	Least concern (LC)
10.	*Vanellus indicus*	Red-wattled Lapwing	Least concern (LC)

Most of the bird species were observed foraging in the inter-tidal mud flats during low tide. Rock doves were observed to make nests in jetties and building structures. All the avifaunal species found in the study area are common in appearance and in the least concern (LC) category in the IUCN red list of threatened species. Except Heuglin's gull which is winter migrator to the area all other species are resident species.

3.6 MANGROVES

Mangroves are a very specialised group of plants found only in the transitional zone between land and the sea. The mangrove species are adapted to the salty water, less oxygen in sediments as well as daily tidal variation. The mangrove species developed a special kind of roots called 'Pneumatophores' which enables them for intake of air for plants in the water filled muddy soil. These breathing roots help mangrove trees to absorb oxygen from air and therefore thrive them into oxygen less muddy soil.

Mangrove plants generate a variety of natural resources and ecosystem services that are vital to subsistence economies and sustain local and national economies. During many natural calamities like cyclones, storm surges, heavy flooding and tsunamis they act as barriers and protect the land from erosion and reduce the effect on living resources. The value of mangroves as a carbon sink and the efficiency with which they can remove carbon from the atmosphere put them center stage in the context of increasing global concerns about climate change and sea level rise. They also maintain the stability of the shoreline and prevent the release of toxic wastes into the coastal waters. The mangrove ecosystem is also a rich of nutrients in the coastal waters. The falling leaves from the mangrove area become the primary source of a food chain, which goes on to feed microorganisms, larvae and the adults of many invertebrates and fishes. These roots also harbor the number of fish species which use this area as their breeding grounds. It is estimated that over 70% of commercially important fishes depend on mangroves for their nutrient cycle and nursery breeding. This fish reach habitat attracts the number of birds and animals in the area thus making the mangroves a biodiversity reach habitat.

During the present study, scattered patches of mangroves mainly Avicennia species were found towards the northwest side of Petronet LNG jetties. All observed patches are shrub type and may be because of the high tidal amplitude in the Gulf of Khambhat.

3.7 PHYTOPLANKTON DIVERSITY:

The phytoplankton are vast array of minute and microscopic plants passively drifting in natural waters and mostly confined to the illuminated zone. In an ecosystem these organisms constitute primary producers forming the first link in the food chain. The phytoplankton have long been used as indicators of water quality. Some species flourish in highly eutrophic waters, while others are very sensitive to organic and/or chemical wastes. Because of their short life cycles, plankton responds quickly to environmental changes. Hence, their standing crop in terms of biomass, cell counts and species composition are more likely to indicate the quality of the water mass in which they are found. Phytoplankton composition also varies considerably. Thus, a very few species may be overwhelmingly common during blooms, while a large number of species may occur without clear dominance under normal conditions.

Phytoplankton sampling was carried out at 4 stations from three levels i.e., Surface, Middle and Bottom at HTL (High Tide Level), LTL (Low Tide Level) and IT (Intertidal zone). During the sampling period (December 2022) the phytoplankton population in the coastal waters of Petronet LNG, Dahej was diverse and represented with a total of 33 phytoplankton genera (Table 9) belonging to diatoms (29 genera) and dinoflagellates (4 genera). Diatoms Species belonged to *Chaetoceros* sp. *Corethron* sp., *Coscinodiscus* sp., *Cyclotella* sp., *Cymbella* sp., *Ditylum* sp., *Guinardia* sp., *Odontella* sp., *Paralia* sp., *Rhizosolenia* sp., *Thalassiosira* sp., *Amphora* sp., *Asterionella* sp., *Bacillaria* sp., *Cylindrotheca* sp., *Diploneis* sp., *Gyrosigma* sp., *Lauderia* sp., *Leptocylindrus* sp., *Licmophora* sp., *Meunieri* sp., *Navicula* sp., *Nitzschia* sp., *Pinnularia* sp., *Pleurosigma* sp., *Pseudo-nitzschia* sp., *Surirella* sp., *Synedra* sp. and *Thalassionema* sp.

The phytoplankton abundance in the study region was ranged from 101 to 231 cells$\times 10^2$/L (Table 9, Figure 9) at HTL. The highest phytoplankton abundance was observed at Station 4 in the surface (231 nos.$\times 10^2$/L) and lowest at Station 2 in bottom water (101 nos.$\times 10^2$/L). The phytoplankton abundance was ranged from 84 to 198 nos.$\times 10^2$/L (Table 9, Figure 9) at LTL. The highest phytoplankton abundance at LTL was (198 nos.$\times 10^2$/L) was observed at Station 4 in surface water and lowest was at station 3 bottom water (84 nos.$\times 10^2$ / L). The phytoplankton abundance was ranged from 108 to 123 nos.$\times 10^2$/L (Table 9, Figure 9) at Intertidal zone study. The phytoplankton abundance was ranged from 108 to 123 nos.$\times 10^2$/L (Table 9, Figure 9) at IT stations. The highest phytoplankton abundance at IT was (123 nos.$\times 10^2$/L) was observed at Station 1 and lowest was at station 2 (108 nos.$\times 10^2$ / L). The study shows that the marine water around was enriched with the diverse phytoplankton population.

Table 9: Phytoplankton abundance (cells×10²/L) at different sampling stations during High Tide Level (HTL) in the coastal waters of Petronet LNG, Dahej during December 2022.

Note: S=surface; M= Middle; B=bottom; HTL= High Tide Level; LTL= Low Tide Level; St=station

Phytoplankton Genera	Sampling Stations (HTL)											
	St-1			St-2			St-3			St-4		
	S	M	B	B	M	B	S	M	B	S	M	B
Diatoms												
Chaetoceros sp.	1	2	0	1	1	0	1	0	1	2	1	2
Corethron sp.	0	0	0	0	2	0	0	0	0	1	0	1
Coscinodiscus sp.	30	26	42	18	18	8	22	10	1	4	1	4
Cyclotella sp.	0	2	2	0	0	4	0	0	0	1	0	1
Cymbella sp.	0	1	0	1	0	0	0	0	0	0	0	0
Ditylum sp.	5	6	3	1	0	1	11	8	1	1	1	1
Guinardia sp.	18	12	14	20	0	3	3	10	16	0	16	0
Odontella sp.	16	18	1	1	9	4	15	12	19	26	19	26
Paralia sp.	9	0	0	12	16	36	11	6	2	2	2	2
Rhizosolenia sp.	1	1	19	11	3	3	1	8	3	5	3	5
Thalassiosira sp.	1	1	20	10	2	0	3	0	0	1	0	1
Amphora sp.	1	0	0	3	7	1	1	0	7	4	7	4
Amphorprora sp.	1	0	0	0	1	2	23	1	0	1	0	1
sterionella sp.	30	26	62	20	20	3	19	3	50	46	50	46
Bacillaria sp.	2	1	0	4	10	2	2	0	4	4	4	4
Cylindrotheca sp.	1	0	0	0	3	1	0	4	0	2	0	2
Diploneis sp.	0	1	0	0	1	0	0	0	0	1	0	1
Gyrosigma sp.	2	1	0	0	2	0	0	0	0	0	0	0
Lauderia sp.	0	2	0	0	0	0	0	0	0	0	0	0
Leptocylindrus sp.	4	0	21	3	0	2	0	1	0	3	0	3
Licmophora sp.	0	3	2	0	0	1	0	2	3	0	3	0
Lithodesmium sp.	5	0	0	1	2	0	3	8	4	1	4	1
Navicula spp.	17	2	1	1	5	4	5	15	11	7	11	7
Nitzschia spp.	4	20	41	18	4	1	9	10	19	35	19	35
Pinnularia sp.	8	0	0	2	0	0	10	0	2	2	2	2
Pleurosigma spp	2	10	0	2	8	2	14	12	12	2	12	2
Pseudo-nitzschia sp.	0	0	2	1	0	1	4	4	2	0	2	0
Synedra sp.	1	1	0	0	0	1	2	0	2	1	2	1
Thalassionema sp.	15	20	0	1	18	16	10	14	8	16	8	16
Dinoflagellates												
Alexandrium sp.	0	0	1	0	0	0	1	0	0	2	0	2
Gymnodinium sp.	1	2	0	1	8	4	0	4	4	2	4	2
Protoperidinium sp.	3	2	0	0	2	1	0	0	1	0	1	0
Prorocentrum sp.	0	0	0	0	2	2	0	0	0	0	0	0
Total Phytoplankton (nos. x 10²/L)	**160**	**131**	**103**	**132**	**126**	**101**	**170**	**122**	**108**	**231**	**167**	**115**

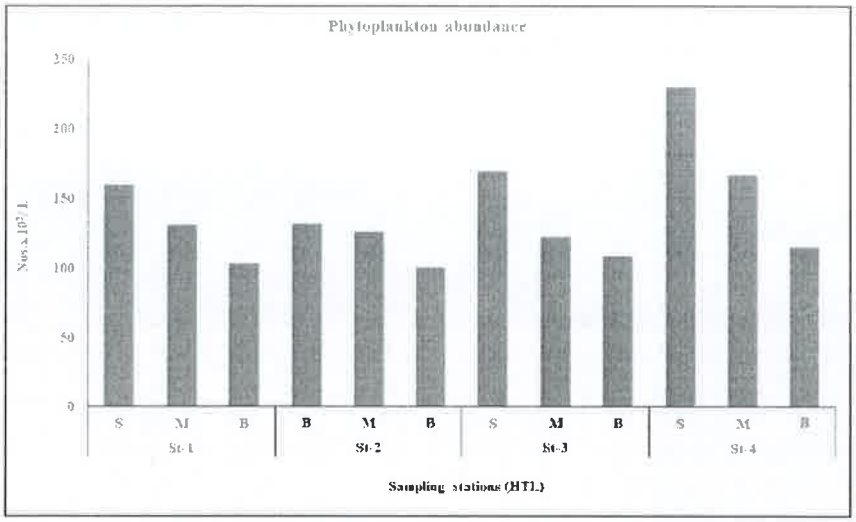


Figure 9: High Tidal Level (HTL) phytoplankton abundance (no. x10²/ L) at different sampling stations at Petronet LNG, Dahej during December 2022

Table 10: Phytoplankton abundance (cells×10²/L) at different sampling stations during Low Tide Level (LTL) in the coastal waters of Petronet LNG, Dahej during December 2022.

Note: S=surface; M= Middle; B=bottom; HTL= High Tide Level; LTL= Low Tide Level; St=station

Phytoplankton Genera	Sampling Stations (LTL)											
	St-1			St-2			St-3			St-4		
	S	M	B	B	M	B	S	M	B	S	M	B
Diatoms												
Chaetoceros sp.	2	2	0	1	1	0	1	0	1	4	1	0
Corethron sp.	0	0	0	0	2	0	0	0	0	1	0	1
Coscinodiscus sp.	21	25	20	18	15	8	12	7	0	4	1	1
Cyclotella sp.	1	2	2	0	0	4	0	0	1	5	0	1
Cymbella sp.	1	1	0	1	0	0	0	0	0	0	0	0
Ditylum sp.	5	5	1	1	0	1	11	6	1	1	1	1
Guinardia sp.	8	5	11	20	0	3	3	10	8	0	10	0
Odontella sp.	10	8	1	1	5	4	15	8	10	31	19	13
Paralia sp.	9	0	0	10	11	22	11	6	2	2	2	2
Rhizosolenia sp.	1	1	11	11	3	3	1	8	3	10	3	0
Thalassiosira sp.	1	1	15	10	2	0	3	0	8	1	0	1
Amphora sp.	1	0	0	3	7	1	1	0	7	4	7	1
Amphorprora sp.	1	0	0	0	1	2	4	1	0	1	0	1
sterionella sp.	21	15	21	14	14	3	19	3	1	50	35	12
Bacillaria sp.	2	1	0	4	10	2	2	0	4	9	4	4
Cylindrotheca sp.	1	0	0	0	3	1	0	4	0	2	0	2
Diploneis sp.	0	1	0	0	1	0	0	0	0	4	0	1
Gyrosigma sp.	2	1	0	0	2	0	0	0	0	0	0	0
Lauderia sp.	0	2	0	0	0	0	0	0	0	2	0	0
Leptocylindrus sp.	4	0	0	3	0	2	0	1	0	5	0	3
Licmophora sp.	0	3	2	0	0	1	0	2	3	1	3	0
Lithodesmium sp.	5	0	0	1	2	0	3	6	4	1	4	1
Navicula spp.	12	1	0	1	5	4	5	10	8	10	11	5
Nitzschia spp.	4	15	8	15	4	1	9	10	5	21	19	21
Pinnularia sp.	8	0	0	2	0	0	10	0	2	3	2	2
Pleurosigma spp	2	10	0	2	7	2	9	9	4	6	12	2
Pseudo-nitzschia sp.	1	0	1	1	0	1	4	4	1	0	0	0
Synedra sp.	1	0	0	0	0	1	2	0	1	3	2	1
Thalassionema sp.	15	10	0	1	7	14	6	9	5	12	5	6
Dinoflagellates												
Alexandrium sp.	1	0	1	0	0	0	1	0	1	2	0	1
Gymnodinium sp.	1	2	0	1	8	4	0	4	2	2	4	2
Protoperidinium sp.	4	1	0	0	2	1	0	0	1	1	1	0
Prorocentrum sp.	0	0	0	0	2	2	0	0	1	0	0	0
Total Phytoplankton (nos. x 10²/L)	**145**	**112**	**94**	**121**	**114**	**87**	**132**	**108**	**84**	**198**	**146**	**85**

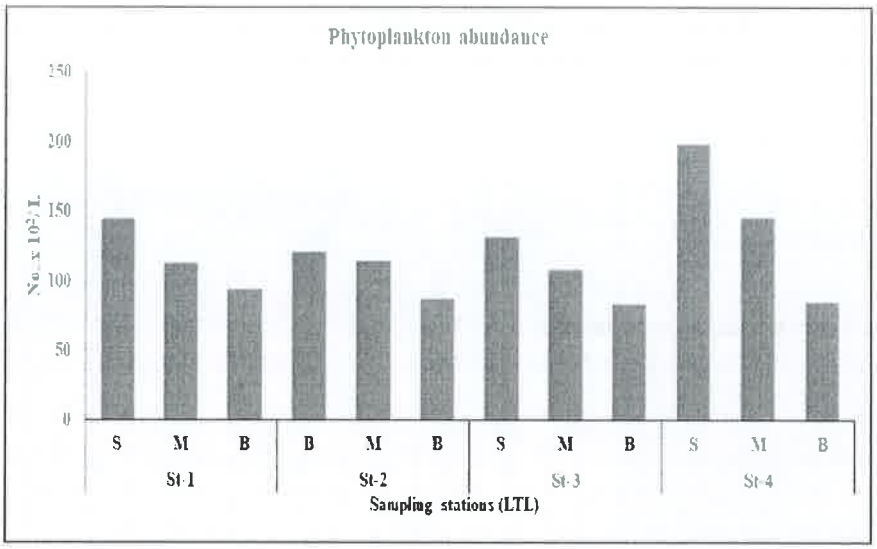


Figure 10: Low Tidal Level (LTL) phytoplankton abundance (no. x10²/ L) at different sampling stations at Petronet LNG, Dahej during December 2022

Table 11: Phytoplankton abundance (cells×10²/L) at different sampling stations during Intertidal zone of Petronet LNG, Dahej during December 2022.

Phytoplankton Genera	Sampling stations			
	IT1	IT2	IT3	IT4
Diatoms				
Chaetoceros sp.	2	2	2	1
Corethron sp.	0	0	0	0
Coscinodiscus sp.	14	25	22	18
Cyclotella sp.	1	2	2	0
Cymbella sp.	1	1	1	1
Ditylum sp.	5	5	1	1
Guinardia sp.	5	5	11	20
Odontella sp.	10	8	1	1
Paralia sp.	1	0	4	10
Rhizosolenia sp.	1	1	11	11
Thalassiosira sp.	1	1	15	10
Amphora sp.	1	0	1	3
Amphorprora sp.	1	0	0	0
sterionella sp.	12	15	21	14
Bacillaria sp.	2	1	0	4
Cylindrotheca sp.	1	0	0	0
Diploneis sp.	0	1	0	0
Gyrosigma sp.	2	1	3	0
Lauderia sp.	0	2	1	0
Leptocylindrus sp.	4	0	0	3
Licmophora sp.	0	3	2	0
Lithodesmium sp.	0	0	2	1
Navicula spp.	12	1	0	1
Nitzschia spp.	4	11	8	12
Pinnularia sp.	8	0	0	2
Pleurosigma spp	2	10	0	2
Pseudo-nitzschia sp.	5	0	1	1
Synedra sp.	1	0	0	0
Thalassionema sp.	21	10	2	1
Dinoflagellates				
Alexandrium sp.	1	0	1	0
Gymnodinium sp.	1	2	0	1
Protoperidinium sp.	4	1	0	0
Prorocentrum sp.	0	0	0	0
Total Phytoplankton (nos. x 10²/L)	**123**	**108**	**112**	**118**

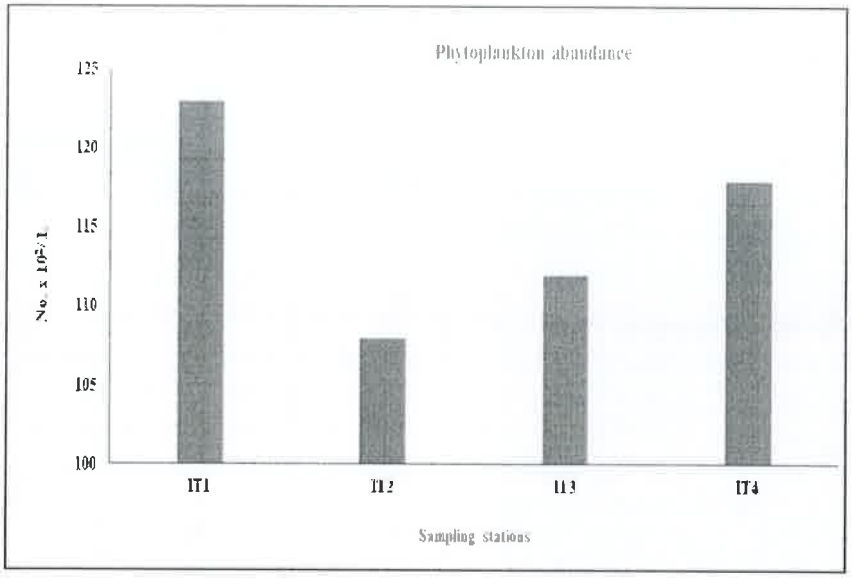
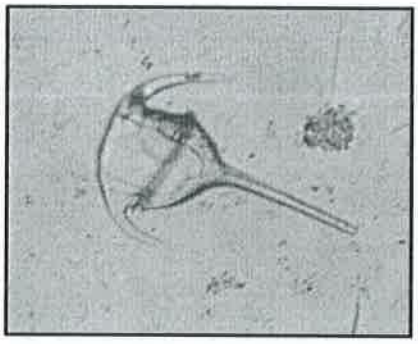


Figure 11: Inter-tidal phytoplankton abundance (no. x10²/ L) at different sampling stations at Petronet LNG, Dahej during December 2022.

Navicula sp.



Ceratium sp.

Fig. 12- Microphotographs of phytoplankton reported in the coastal waters of Petronet LNG, Dahej during December 2022.

3.8 PHYTOPLANKTON PIGMENTS (CHLOROPHYLL AND PHEOPHYTIN):

Marine phytoplankton contains essential as well as accessory pigments like that of terrestrial plants. Phytoplankton pigments capture sunlight. The resulting photosynthesis and its products, especially the oxygen and organic compounds, all rely on the light energy captured by the different phytoplankton pigments. Chlorophyll *a* is the major pigment for light harvesting, and plays a significant role in photosynthesis and photoprotection, by extending the light collection window and protecting the cell from the damage of high irradiance levels or high ultraviolet light exposure.

Algal chlorophyll forms a series of degradation products upon degradation. In addition to Chlorophyll the naturally occurring pigments in algal cells. The nature of these degradation products depends on which part of the chlorophyll molecule is affected. As chlorophyll degrades, the initial step is either the loss of the magnesium from the center of the molecule or the loss of the phytol tail. This results in the formation of the molecule, phaeophytin. Depending on the parent molecule several distinct molecules like phaeophytins, chlorophyllides, and pheophorbides can be produced. Thus, in addition to Chlorophyll *a* filtered seawater contains color degradation products of phytoplankton pigments.

3.9 CHLOROPHYLL *a* AND PHAEOPHYTIN CONCENTRATIONS

The phytoplankton biomass distribution expressed in terms of Chlorophyll *a* (Chl-*a*) and Pheophytin at selected stations in the coastal region of Petronet LNG, Dahej.The samples for chlorophyll a and pheophytin is analysed for High Tide Level (HTL), Low tide level (LTL) and Inter-tidal zone (IT). For HTL and LTL samples collected from surface, middle and bottom and for IT samples collected only form surface water. The Chl-*a* concentrations in the HTL surface water were ranged from 1.16 µg/L to 1.57 µg/L. The Pheophytin content was ranged from 0.32 µg/L to 0.43 µg/L. The Chl-*a* concentrations in the HTL middle water were ranged from 1.06 µg/L to 1.21 µg/L. The Pheophytin content was ranged from 0.12 µg/L to 0.32 µg/L. The Chl-*a* concentrations in the HTL bottom water were ranged from 1.01 µg/L to 1.11 µg/L. The Pheophytin content was ranged from 0.10 µg/L to 0.34 µg/L. The Chl-*a* concentrations in the IT water were ranged from 0.87 µg/L to 1.11 µg/L. The Pheophytin content was ranged from 0.29 µg/L to 0.42 µg/L.

Table 12: Chlorophyll *a*, Pheophytin concentrations in the surface marine water of Petronet LNG, Dahej at High Tide level (HTL) and Inert-tidal zone (IT) during December 2022.

Sr. No.	Parameters	Unit	High Tide Level (HTL)							
			Surface Water							
			St.1	St.2	St.3	St.4	IT1	IT2	IT3	IT4
1.	Chlorophyll a	mg/m^3	1.43	1.57	1.16	1.32	1.11	1.03	0.87	0.94
2	Pheophytin	mg/m^3	0.32	0.43	0.40	0.39	0.41	0.42	0.32	0.29

Table 13: Chlorophyll *a*, Pheophytin concentrations in the middle marine water of Petronet LNG, Dahej at High Tide level (HTL) during December 2022.

Sr. No.	Parameters	Unit	High Tide Level (HTL)							
			Middle Water							
			St.1	St.2	St.3	St.4	IT1	IT2	IT3	IT4
1.	Chlorophyll a	mg/m^3	1.11	1.21	1.06	1.12	-	-	-	-
2	Pheophytin	mg/m^3	0.12	0.32	0.32	0.29	-	-	-	-

Table 14: Chlorophyll *a*, Pheophytin concentrations in the bottom marine water of Petronet LNG, Dahej at High Tide level (HTL) during December 2022.

Sr. No.	Parameters	Unit	High Tide Level (HTL)							
			Bottom Water							
			St.1	St.2	St.3	St.4	IT1	IT2	IT3	IT4
1.	Chlorophyll a	mg/m^3	1.01	1.11	1.01	1.10	-	-	-	-
2	Phaeophytin	mg/m^3	0.10	0.33	0.34	0.32	-	-	-	-

Table 15: Chlorophyll *a*, Pheophytin concentrations in the surface marine water of Petronet LNG, Dahej at Low Tide level (LTL) and Inert-tidal zone (IT) during December 2022.

Sr. No.	Parameters	Unit	Low Tide Level (LTL)							
			Surface Water							
			St.1	St.2	St.3	St.4	IT1	IT2	IT3	IT4
1.	Chlorophyll a	mg/m^3	1.33	1.46	1.17	1.33	-	-	-	-
2	Pheophytin	mg/m^3	0.22	0.32	0.39	0.41	-	-	-	-

Table 16: Chlorophyll *a*, Pheophytin concentrations in the middle marine water of Petronet LNG, Dahej at Low Tide level (LTL) during December 2022.

Sr. No.	Parameters	Unit	Low Tide Level (LTL)							
			Middle Water							
			St.1	St.2	St.3	St.4	IT1	IT2	IT3	IT4
1.	Chlorophyll a	mg/m^3	1.10	1.18	1.03	1.10	-	-	-	-
2	Pheophytin	mg/m^3	0.11	0.31	0.30	0.28	-	-	-	-

Table 17: Chlorophyll *a*, Pheophytin concentrations in the bottom marine water of Petronet LNG, Dahej at Low Tide level (LTL) during December 2022.

Sr. No.	Parameters	Unit	Low Tide Level (LTL)							
			Bottom Water							
			St.1	St.2	St.3	St.4	IT1	IT2	IT3	IT4
1.	Chlorophyll a	mg/m^3	1.00	1.10	1.00	1.08	-	-	-	-
2	Pheophytin	mg/m^3	0.09	0.31	0.32	0.31	-	-	-	-

3.9 SEA GRASS AND MACRO ALAGE (SEA WEEDS)

During the present study, no occurrence of sea grasses and sea weeds in the inter-tidal area was observed.

4.0 CONCLUSION

4.1 Chemical Analysis of Water Sample

- pH at all Subtidal region Sampling Station was observe between rang in 8.03 to 8.19.
- Temperature at all Subtidal region Sampling Station was observed around 28°C
- Turbidity at all Subtidal region Sampling Station was observed between 1 to 5 NTU
- Total Suspended Solids at all Subtidal region Sampling Station was observed between 198 to 250 mg/L
- Biochemical Oxygen Demand (BOD) Solids at all Subtidal region Sampling Station was observed between 2.9 to 4.2 mg/L
- Oil & Grease and Ammonical Nitrogen at all Subtidal region Sampling Station was observed under below detection limit.
- Salinity at all Subtidal region Sampling Station was observed between 27 to 31.36 ppt
- Dissolved Oxygen at all Subtidal region Sampling Station was observed between 6.1 to 6.6 mg/L
- Total Alkalinity as $CaCO_3$ at all Subtidal region Sampling Station was observed between 126.1 to 135.8 mg/L
- Phosphate at all Subtidal region Sampling Station was observed between 0.14 to 0.50 mg/L
- Nitrate at all Subtidal region Sampling Station was observed between 0.8 to 1.0 mg/L
- Calcium Carbonate at all Subtidal region Sampling Station was observed between 720 to 806.4 mg/L
- Petroleum Hydrocarbon (PHc) at all Subtidal region Sampling Station was Not detected.
- In microbiological parameter Total Coliform at all Subtidal region Sampling Station was observed between Absent to 70 CFU/100ml

4.2 Biological parameters of water samples

- The Chl-a and Pheophytin concentrations were more in the surface water as compared to the bottom water. The variations observed between the surface and bottom waters could be due to several natural biological variability.
- During the sampling period (December 2022) the phytoplankton population in the coastal waters of Petronet LNG, Dahej was diverse and represented with a total of 33 phytoplankton genera (Table 9) belonging to diatoms (29 genera) and dinoflagellates (4 genera).
- In the sub-tidal area, more density and species were reported in the surface water than middle and bottom waters. This difference could be attributed to the depth of water as surface water are more productive due to more penetration of light which deceases as increase in depth of water.

- The occurrence of copepods and their nauplii together with decapods and fish larvae/eggs in zooplankton samples highlights the fair production potential of live food resources (organisms) to support the fish and crustacean population in the study region.
- Difference in zooplankton abundance during high tide level and low tide level in the sub-tidal area was observed during the present study. Increased levels of suspended solids and the apparent increase in turbidity of water as well as high current during low tide will be considered as a possible reason for low zooplankton abundance during low tide levels.
- Compared to sub-tidal stations, in inter-tidal region zooplankton abundance was observed to be less and higher turbidity and current caused by the lower depth of water in inter-tidal areas also possible reasons for the same.
- During present study, two groups of organisms i.e., Foraminifera contributed to the 45.54% and Polychaete worms contributed to the 44.62% of total benthic organisms. Overall, the presence of Polychaete and Sipuncula worms suggests the availability of food organisms for benthic predators in the area. Due to presence of sand in the study area, foraminiferans are more abundant.
- Mangrove species Avicennia sp. is very sparse.
- Avifauna present in the study area is most common type and only single species of migratory bird (Heugin's gull) was reported.
- Overall, considering biological parameters of the study area, the study area is showed healthy environment contributing good production of phytoplankton, zooplankton and benthic organisms.

- Different Types of Sampling Photographs

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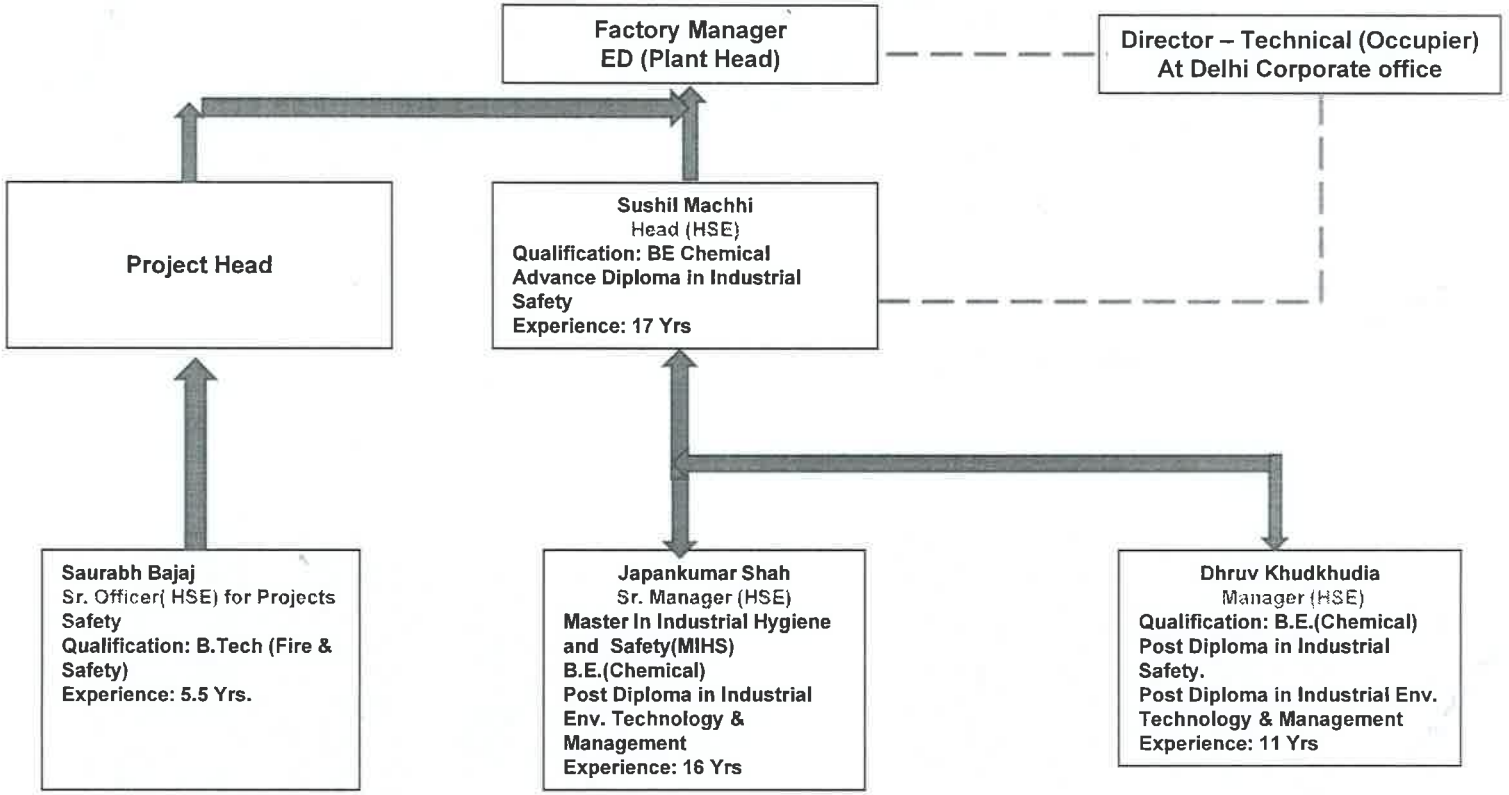
Annexure-XII

EMC Organogram – PLL, Dahej



ANNEXURE XIII

Bureau Veritas Certification

PETRONET LNG LTD.

PETRONET LNG LIMITED

PLOT NO. 7/A, GIDC INDUSTRIAL ESTATE, DAHEJ, TALUKA : VAGRA,
DISTRICT: BHARUCH – 392 130, GUJARAT, INDIA.

Bureau Veritas Certification Holding SAS – UK Branch certifies that the Management System of the above organization has been audited and found to be in accordance with the requirements of the Management System Standards detailed below.

Standards

ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018

Scope of certification

PORT OPERATION, RECEIPT, STORAGE, RE-GASIFICATION OF LNG, DISPATCH OF RLNG & LNG

Original cycle start date for ISO 9001 & ISO 14001: **21 January 2005**

Original cycle start date for ISO 45001: **11 March 2021**

Recertification cycle start date: **31 July 2022**

Subject to the continued satisfactory operation of the organization's Management System, this certificate expires on: **30 July 2025**

Certificate No. **IND.22.6844/IM/U** Version: **1** Revision date: **31 July 2022**

Signed on behalf of BVCH SAS UK Branch
Jagdheesh N. MANIAN
Director – CERTIFICATION, South Asia
Commodities, Industry & Facilities Division

UKAS MANAGEMENT SYSTEMS
0008

Certification body address: *5th Floor, 66 Prescot Street, London, E1 8HG, United Kingdom.*

Local office: *Bureau Veritas (India) Private Limited (Certification Business)*
72 Business Park, Marol Industrial Area, MIDC Cross Road "C",
Andheri (East), Mumbai – 400 093, India

Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organization.
To check this certificate validity please call + 91 22 6274 2000.