

नुमालीगढ़ रिफाइनरी लिमिटेड

भारत सरकार का उपक्रम

নুমালীগড় রিফাইনেৰী লিমিটেড

ভাৰত চৰকাৰৰ এক প্ৰতিস্থান

NUMALIGARH
REFINERY
LIMITED

A GOVERNMENT OF INDIA ENTERPRISE



Ref:

Date:

NRL/ENV/PCBA/22-23/05

Dated: 26th September, 2022

To,

The Member Secretary,
Pollution Control Board, Assam
Bamunimaidam,
Guwahati-781021

Sub : Submission of Environmental statement in Form- V for the year 2021-22

Dear Sir,

We are submitting herewith the duly filled in "Environmental Statement" in Form-V for the year 2021-22 for your kind perusal.

Hope, the same shall meet the requirement.

Thanking you.

Yours' faithfully,

(Alok Nayan Nath)
CM (TS-ENV)

Cc: RO, PCBA, Golaghat

पोस्ट: एन. आर. प्रोजेक्ट, जिला: गोलाघाट, असम, पिन-785699
P.O. : N.R. Project, District : Golaghat, Assam, PIN - 785699

Registered Office:

122 ए, जी एस रोड, क्रिश्चनबस्ती, गुवाहाटी - 781005 (असम), दूरभाष: 0361-2203140/2203147, फेक्स: 0361-2203146, वेबसाइट: www.nrl.co.in
122A, G.S. Road, Christianbasti, Guwahati - 781005 (Assam), Phone: 0361-2203140/2203147, Fax: 0361-2203146, Website: www.nrl.co.in

[FORM – V]

(See rule 14)

**Environmental Statement of NUMALIGARH REFINERY LIMITED
for the financial year – 2021-2022**

PART – A

- (i) **Name and address of the owner/occupier:
of the industry operation or process.** **Numaligarh Refinery Limited
P.O. Numaligarh Refinery Project
Golaghat -785699, Assam**
- Co-ordination Office:** **Tolstoy House, 6th Floor
15-17 Tolstoy Marg
New Delhi-110001**
- Registered Office :** **122A , G.S.Road
Christianbasti
Guwahati-781005**
- (ii) **Industry category Primary ----(STC code) : Primary
Secondary-----(SIC Code)**
- (iii) **Production capacity (Crude T'put) : 3.0 MMTPA**
- (iv) **Year of establishment : 22nd April ,1993**
- (v) **Date of the last environmental statement submitted: 27th Sept,2021**

PART – B

Water and River Material Consumption

- (1) **Water consumption m3/d:**
- | | | |
|-----------------|----------|-------------|
| Process | : | 3169 |
| Cooling | : | 4514 |
| Domestic | : | 3463 |

Name of Rawmaterial: Crude Oil

Process water consumption in m3 per MT of raw material *:**

	2020-2021	2021-2022
	0.450	0.440

*****As all the products are obtained from the same raw material i.e Crude Oil, Process Water Consumption shown above has been indicated as M3 per MT of crude processed.**

- ii) **Raw Material Consumption:**
- | Raw material: Crude Oil | 2020-2021 | 2021-2022 |
|-----------------------------------------------------------------------|------------------|------------------|
| T'put during the year (in MT)
(Design Capacity: 3.0 MMTPA) | 2707353 | 2624409 |
-

PART - C

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

a) Treated Effluent Water: 2021-2022

Pollutants	CPCB Standard (mg/l)	Concen. of pollutants in discharges(av.) (mg/l)	Quantity of pollutants discharged (kg/yr, exc. pH)	Qty of pollutants in kg/1000 MT of Crude		Percentage of variation from STD. with reasons
				Actual(mg/l)	STD(mg/l)	
pH	6-8.5	7.3	-	-		All parameters are within prescribed limit/stds.
OIL & GREASE	5.0	3.15	3361.10	1.28	2.00	
BOD3	15.0	9.2	9795.22	3.73	6.00	
COD	125.0	62.83	67035.34	25.54	50.00	
TSS	20.0	15.048	16055.94	6.12	8.00	
Phenol	0.35	0.16	165.39	0.06	0.14	
Sulphides	0.5	<0.1	106.70	0.04	0.20	
CN	0.2	0.00	21.34	0.01	0.08	
Ammonia as N	15.0	9.7500	10403.42	3.9641	6.0	
Cr (Hexavalent)	0.1	0.0000	0.00	0.0000	0.04	
Cr (Total)	2.0	0.0048	5.07	0.0019	0.8	
Pb	0.1	0.0033	3.5478	0.0014	0.04	
Zn	5.0	0.0295	31.48	0.0120	2.0	
Ni	1.0	0.0080	8.54	0.0033	0.4	
Cu	1.0	0.0110	11.74	0.0045	0.4	
Benzene	0.1	0.0465	49.62	0.0189	0.04	
Benzo (a)-Pyrene	0.2	0.0538	57.35	0.0219	0.08	
Hg	0.01	0.0039	4.16	0.0016	0.004	
V	0.2	0.0625	66.69	0.0254	0.8	
TKN	40.0	19.4500	20753.48	7.9079	16.0	
P	3.0	1.2050	1285.76	0.4899	1.2	

(b) AIR

Average Sulphur Dioxide emission from the refinery during – 2021-22:

SO2 Emission, Kg/hr	During April , 2021 to Mar,2022
As per NOC of PCB, Assam max. allowable limit is 256 kg/hr as SO2	90.8 kg/hr

2021-22						
AMBIENT AIR QUALITY MONITORING						
STATION	PARAMETER	STD NAAQS-2009	Unit	OBSERVATIONS		
				MAX	MIN	AVG.
REFINERY (WATCH TOWER NO. 6)	SO2	80 (24 hr avg.)	µg/m3	14.90	7.40	11.25
	NO2	80 (24 hr avg.)	µg/m3	20.00	9.30	14.85
	O3	100(8 hr avg.)	µg/m3	43.10	13.70	24.45
	CO	2000(8 hr.avg.)	mg/m3	1.100	0.520	0.85
	NH3	400(24 hr.avg.)	µg/m3	37.3	12.9	22.67
	PM 10	100(24 hr.avg.)	µg/m3	72.7	38.1	50.73
	PM 2.5	60(24 hr.avg.)	µg/m3	39.9	17.2	23.15
	Benzene	5.0(Annual)	µg/m3	3.50	1.00	2.17
	BaP	1.0(Annual)	ng/m3	<0.5	<0.5	<0.5
	Pb	1.0(24 hr.avg.)	µg/m3	0.49	0.14	0.28
	As	6.0(Annual)	ng/m3	1.00	1.00	1.000
	Ni	20(Annual)	ng/m3	4.30	1.10	2.31
ECO-PARK IN NRL TOWNSHIP	SO2	80 (24 hr avg.)	µg/m3	14.60	7.20	10.88
	NO2	80 (24 hr avg.)	µg/m3	19.90	9.30	14.38
	O3	100(8 hr avg.)	µg/m3	41.4	12.5	23.6
	CO	2000(8 hr.avg.)	mg/m3	1.070	0.540	0.772
	NH3	400(24 hr.avg.)	µg/m3	33.6	12.50	21.800
	PM 10	100(24 hr.avg.)	µg/m3	69.5	36.0	51.65
	PM 2.5	60(24 hr.avg.)	µg/m3	36.9	14.8	23.15
	Benzene	5.0(Annual)	µg/m3	3.60	0.90	2.075

	BaP	1.0(Annual)	ng/m3	<0.5	<0.5	<0.5
	Pb	1.0(24 hr.avg.)	µg/m3	0.44	0.15	0.27
	As	6.0(.0Annual)	ng/m3	1.00	1.00	1.00
	Ni	20(Annual)	ng/m3	4.20	1.20	2.493
RAW WATER INTAKE	SO2	80 (24 hr avg.)	µg/m3	13.30	6.90	9.93
	NO2	80 (24 hr avg.)	µg/m3	18.10	9.00	13.08
	O3	100(8 hr avg.)	µg/m3	35.1	12.2	23.03
	CO	2000(8 hr.avg.)	mg/m3	0.960	0.510	0.728
	NH3	400(24 hr.avg.)	µg/m3	32.2	12.20	21.43
	PM 10	100(24 hr.avg.)	µg/m3	88.2	34.5	48.20
	PM 2.5	60(24 hr.avg.)	µg/m3	33.4	13.5	21.43
	Benzene	5.0(Annual)	µg/m3	3.30	0.90	2.05
	BaP	1.0(Annual)	ng/m3	<0.5	<0.5	<0.5
	Pb	1.0(24 hr.avg.)	µg/m3	0.41	0.12	0.26
	As	6.0(Annual)	ng/m3	1.00	1.00	1.00
	Ni	20(Annual)	ng/m3	3.70	1.00	2.18
	NH-39 BYPASS	SO2	80 (24 hr avg.)	µg/m3	16.9	8.6
NO2		80 (24 hr avg.)	µg/m3	22.0	10.9	16.68
O3		100(8 hr avg.)	µg/m3	45.1	15.3	29.38
CO		2000(8 hr.avg.)	mg/m3	1.18	0.53	0.93
NH3		400(24 hr.avg.)	µg/m3	40.1	15.9	28.13

KAZIRANGA WILDLIFE SANCTUARY AT AGARTOLI	PM 10	100(24 hr.avg.)	$\mu\text{g}/\text{m}^3$	78.6	43.3	61.53
	PM 2.5	60(24 hr.avg.)	$\mu\text{g}/\text{m}^3$	39.9	17.4	27.8
	Benzene	5.0(Annual)	$\mu\text{g}/\text{m}^3$	4.30	1.10	2.61
	BaP	1.0(Annual)	ng/m^3	<0.5	<0.5	<0.5
	Pb	1.0(24 hr.avg.)	$\mu\text{g}/\text{m}^3$	0.51	0.16	0.33
	As	6.0(Annual)	ng/m^3	1.00	1.00	1.00
	Ni	20(Annual)	ng/m^3	4.60	1.30	2.93
	SO2	80 (24 hr avg.)	$\mu\text{g}/\text{m}^3$	12.7	6.70	9.6
	NO2	80 (24 hr avg.)	$\mu\text{g}/\text{m}^3$	16.5	8.1	12.60
	O3	100(8 hr avg.)	$\mu\text{g}/\text{m}^3$	34.30	11.00	21.7
	CO	2000(8 hr.avg.)	mg/m^3	0.880	0.480	0.68
	NH3	400(24 hr.avg.)	$\mu\text{g}/\text{m}^3$	30.70	10.90	20.20
	PM 10	100(24 hr.avg.)	$\mu\text{g}/\text{m}^3$	56.8	32.6	45.28
	PM 2.5	60(24 hr.avg.)	$\mu\text{g}/\text{m}^3$	29.9	11.7	20.4
	Benzene	5.0(Annual)	$\mu\text{g}/\text{m}^3$	3.00	0.10	2.0
	BaP	1.0(Annual)	ng/m^3	<0.5	<0.5	<0.5
	Pb	1.0(24 hr.avg.)	$\mu\text{g}/\text{m}^3$	0.37	0.12	0.2
	As	6.0(Annual)	ng/m^3	1.00	1.00	1.00
	Ni	20(Annual)	ng/m^3	3.50	1.10	2.17

All the parameters are found to be within limit

**PART – D
Hazardous Wastes**

(As specified under Hazardous Waste Management and Handling Rules, 1989 as amended up to date)

Hazardous Wastes(Generated/disposed)	Total Quantity (In MT)	
	During the previous Financial Year (2020-21)	During the current Financial year (2021-2022)
a) From Process		
i) Spent Catalyst (Schedule-1, Category-4.3)	Generation: NIL Stock as on 31.03.21: 370 MT	Generation: Nil Stock as on 31.03.22: 370 MT**
ii) Spent Adsorbents	Generation: Nil	Generation: Nil
iii) Tank Bottom (oily Sludge/waste) (Schedule -1, Category -4.1)	Generation: 45 MT Closing stock as on 31.03.21: 504 MT	Generation: 620 MT Disposed: NIL Stock as on 31.03.22: 1124 MT, kept in sealed drum for disposal.
iv) Slop Oil (Schedule-1, Category-4.3)	Generated:32574 MT Disposed: 25756 MT, Processed in CDU/VDU. Closing stock as on 31.03.21: 65322 MT	Generated: 55528 MT Disposed: 9994 MT (sold to recycler) Processed in CDU/VDU:31090 MT Stock as on 31.03.22: 79766 MT
v) Spent lube oil (Schedule-1, Category-5.1)		Generation: 1.026 MT Stock as on 31.03.22: 10.143 MT
b) From Pollution Control Facilities		
Chemical & Oily Sludge (Schedule -1, Category -4.1)	Generated: 70 MT (disposed off in the SLF)	Generated:28 MT (disposed off in the SLF)

**** 350 MT nonprecious catalyst sold to recycler through E-auction conducted on 24.03.2022 and under process of lifting by the party as per HWM Rule 2016. Rest 20 MT (appx) precious catalyst is in advance stage of auction.**

Part – E
Solid Wastes

Solid Wastes generated /disposed	Total Quantity (in M3)	
	During the previous financial Year (2020-21)	During the current financial year 2021-22
(a) From Process		
Generation of Incinerable substances -	3500m3	3500 m3
(b) From pollution control facilities		
Generation at ETP Bio sludge -	450 MT	385 MT
(C)		
(1) Quantity recycled or reutilized within the unit	Nil	Nil
(2) Sold	Nil	Nil
(3) Disposal -		
Incinerable substances -	Entire quantity disposed through incineration	Entire quantity disposed through incineration
Bio sludge -	Entire Quantity disposed off into SLF	Entire Quantity disposed off into SLF

Part – F

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

A typical laboratory analysis report of the Chemical & Oily Sludge is given hereunder:



Analysis of Chemical and Oily sludge sample

Date	SAMPLE SOURCE	PARAMETERS	RESULTS %,wt
29-09-21 11:30 hrs	ETP (Chemical & Oily sludge)	Moisture Content	84.62
		Oil Content	3.7
		Organic & Volatile Matter	9.2
		Iron	0.48
		Sodium	0.12
		Sulphide	0.12
		Phenol	0.003
		SiO ₂	0.045
		Chloride	0.96
		Calcium	0.22
		Magnesium	0.10
		Manganese	0.008
		Nickel	0.0002
		Sulphate	0.42
		Zinc	0.0009
		Lead	0.0001
		Copper	0.0009
Cobalt	0.0005		

Analysed By: Mr Prabhash Kumar Thakur

Barhai
Certified by: Dr. Bedobrat Barhai
Officer (Quality Control)
Numaligarh Refinery Limited
Golaghat, Assam
Pin: 785699

बेदब्रत बडई / BEDOBRAT BARHAI
अधिकारी (गुणवत्ता नियंत्रण) / Officer (Quality Control)
नुमालीगर्ह रिफाइनरी लिमिटेड / Numaligarh Refinery Limited
गोलाघाट, असम - 785 699 / Golaghat, Assam - 785 699

Disposal practice adopted for both categories of wastes

Numaligarh Refinery, popularly known as the “Accord Refinery” has been set up in the district of Golaghat, Assam as the part of fulfillment of the commitment made by the Govt. of India in the historic Assam Accord for providing the thrust towards industrial and economic development of North-East. Environment management initiatives of Numaligarh Refinery is guided by the principle of sustainable development and its corporate vision statement of committing itself to attain the excellence in environment management with a prime focus on management of environment. In its quest for environmental excellence and continual improvement, NRL has been pursuing a focused programme towards environment protection through well-defined objectives and has taken up several initiatives that has been implemented in well- defined and systematic manner. NRL being an energy efficient & environment friendly refinery, committed to control of all kinds of pollution & protection of natural environment.

Numaligarh Refinery was conceptualized as one of the most Environment friendly Refinery in the country. Right from its inception, conscious efforts have been taken at every stage to preserve the environment and to attain the excellency in Environment Management. A fully functional "Environment Cell" is continuously working for improvement, monitoring, safe-guarding and reporting of environmental activities.

A proper solid waste management procedure is in place at Numaligarh Refinery to deal with storage / disposal of the solid wastes (hazardous /non-hazardous) generated due to operation of refinery. As a part of the operation of the refinery, some amount of solid wastes are generated - to manage and to deal with the same, an environment friendly & proper solid waste management system has been prepared and as per the laid down procedure hazardous /non-hazardous solid waste are handled. Considering the activities related to waste management, NRL Management has delineated a solid waste management plan with the following objectives:

1. To protect human health and natural environment from the hazards posed by waste disposal.
2. To conserve energy and natural resources through waste recycling and recovery.
3. To reduce /eliminate, as far as possible, the generation of solid wastes including hazardous wastes.
4. To ensure proper management of solid wastes which protect the human health and the environment.

In-built measures had been adopted to minimize, control pollution and generation of waste in all the units with proper collection and disposal system. Adequate segregation, collection and treatment facilities for wastewater for centralized treatment has been provided to meet the stringent standards laid down in the latest MoEF Notification. An environmentally compatible management system for disposal of the ETP hazardous wastes i.e. Chemical & Oily sludge through Secure Land Fill has been developed inside the refinery premises. Types of Hazardous solid waste like – Chemical & Oily sludge which is generated at different sections of Effluent Treatment Plant (ETP) are collected in a sludge thickener through sludge collection system. Floating oil with water from the thickener, is recycled back to the Inlet Receiving Sump (IRS) of ETP for further processing and oil recovery. The thickened sludge from the bottom of the thickener is taken to the centrifuge feed sump for feeding to the specifically designed Chemical & Oily centrifuge for recovering the absorbed oil from it. By using the highly efficient centrifuge, almost total oil is recovered from the sludge and is recycled back to the slop oil system for reprocessing. The oil free cake from the centrifuge was disposed off in the Secured Land Fill (SLF). To cater the needs of future requirement, a Secured Land Fill with a capacity of 6000m³ has been constructed inside the Refinery Premises and has been used. Tank bottom sludge generally sold to CPCB/PCBA recognized Vendor, if not possible to sell, the same is disposed off through Bio-remediation in a more scientific and efficient manner in the Refinery premises itself. To cater the requirement, two number Bioremediation facility available for bioremediation of Crude Tank cleaning sludge.

Spent catalysts are generally generated after a gap of 3/4 years when the catalyst required to replace in the various units of Refinery. After generation, the spent catalyst is kept in sealed drums at demarcated place for onward selling to CPCB/SPCB approved vendors with due intimation to PCBA and following the stipulated guidelines/procedures. Spent catalyst are sold to CPCB/SPCB recognized Vendors by following proper guidelines with intimation to SPCB.

Non –hazardous solid waste generated in the Refinery are mainly - incinerable waste, non-incinerable but reusable waste and bio -degradable waste etc. After collecting the wastes from the various sources viz. - process area, various units, admin office and other locations, wastes are segregated and kept in demarcated locations in the Solid waste disposal yard. Non-hazardous solid Waste like- paper, hard boards, packing materials/papers and cartons are incinerated through incineration process and non-hazardous bio- degradable wastes are disposed off by burying at isolated low laying areas within the refinery premises itself.

Part –G

Impact of the pollution abatement measures taken on conservation of natural resources and on the cost of production:-

Numaligarh Refinery Limited, as a good Corporate Citizen, from the very onset itself has been pursuing a focused program towards environment management by formulating a comprehensive policy towards its commitment for the protection, preservation and development of the environment. Numaligarh Refinery was conceptualized as one of the most Environment friendly and Energy efficient Refinery in the country. Right from its inception, conscious efforts have been taken at every stage to preserve the environment and to attain the Excellency in Environment Management.

NRL has determined the sources of pollution in various activities focusing on pollution load,

Company's management is very careful and proactive regarding the environmental impacts of the new initiatives and products. NRL is conducting the Environmental Impact Assessment

study of every project to understand the implications of setting up any new project or unit. Significant contribution made by NRL on the specific contribution on innovative clean technology, sustainability, broader user or target groups on the following fields:

- a) Environment friendly technology adopted for highly polluting industries.
- b) Innovativeness/creativity of clean technology.
- c) Any significant contribution towards the manufacture of environmentally friendly products.
- d) Abatement including reduction reuse, recycling or any beneficial use of waste generated.
- e) Substantial and steady reduction in the effluents and emission in the year.
- f) Success in defining environmental pollution needs meeting pollution prevention goals and overall improvements to the quality of air, water and land.
- g) Reduction of risk to the community living in the vicinity of units handling hazardous chemicals.

- h) Sustainability of the developed environment friendly technology from financial, social and ecological aspects.

As the higher fuel consumption directly contributes to the higher emission of the greenhouse gases affecting natural ecological processes, so energy conservation efforts have received continuous focus at NRL since conceptualization of the refinery by applying optimum consumption of fuel in furnaces thereby reducing the rate of emission of Green House Gas. It has adopted state of the art energy efficient technology, high efficiency furnaces with glass air pre-heaters, plate type exchangers, installation of captive co-generation power plant using heat recovery system, maximization of waste heat recovery, installation and operation of power recovery turbine in the hydrocracker and other units etc.

NRL has adopted very advance and comprehensive steps towards controlling pollution. Its corporate vision statement commits itself to attain the excellent in environment management. From the very onset, selection of process of technologies and equipment was done with special care for environmental protection.

Additionally, all the furnaces are provided with ultra-low NOx burners. Low noise rotary equipment were considered during the time of equipment selection.

Minimum Generation of waste:

In-built measures had been adopted to minimize and control of pollution and generation of waste in all the units with proper collection and disposal system.

Adequate segregation and centralized treatment facilities:

Adequate segregation, collection and treatment facilities for wastewater for centralized treatment has been provided to meet the stringent standards laid down in MoEF notification, 2008.

Details regarding the some of the pollution abatement measures of NRL are as follows:

1. Effluent Treatment Plant with latest technology

A centralized modern Effluent Treatment Plant having tertiary treatment facilities has been installed. Also, the ETP includes a three-stage oil recovery system from the wastewater and high efficiency centrifuge for recovering oil from the oily sludge. To avoid hazardous solid waste generation, more environmentally friendly hydrogen peroxide treatment process

has been introduced. As a measure of conservation of water, 100 % recycle of the treated effluents in our Effluent Treatment plant inside refinery has been achieved since October 2006. Further, 100% recycle of the effluents from Sewage Treatment Plant has been achieved since April 2007. The treated effluent from Township is diverted to our ETP inside the Refinery by implementing suitable modifications in the disposal line in ETP, where the treated water from township STP is received at aeration tank. The outlet at Numaligarh Jetty in river Dhansiri has been blinded and the discharge from township STP also has been routed to ETP through the same line. So, no treated effluent is discharged to outside environment from the refinery. As a part of ETP modernization VOC recovery system has been implemented.

2. Green Belt Development

An ambitious plan of green belt development has been adopted around the refinery to serve as a barrier for air pollutants and noise. A 100m wide green belt around the refinery and 25 m wide around the marketing terminal covering 56 Ha of land has been developed and thereby rendering a perfectly natural barrier to the industrial noise, minor air pollutants from reaching the immediate surroundings, both human population, rich flora & fauna and also help in mitigating the effects of fugitive emission in all around Refinery. There are green covers of tea gardens (tea bushes and shed trees) in northern and southern boundary of refinery with approx. 260 hectares, contiguous to refinery Green Belt. Township situated at a distance of about 5 KM from the refinery is spread in 250 acres area. Although the township is full of natural green vegetation, large nos. of trees has been planted on both sides of roads and other parts in the township. Initially plantation of around 1,25,000 nos of saplings of various species were carried in the Green Belt around Refinery and 20,000 nos in the Green Belt around NRMT. Massive plantation are being carried out every year in the Green Belt to increase the density of trees. Around 55900 saplings have been planted in the Green Belt area during 2000-2018. Plantation activities inside the Refinery as well as outside the refinery have been carried out in a phased manner considering weather conditions. The meticulously planned and developed green belt all around the refinery has now grown into a rich foliage, rendering a perfectly natural barrier to the industrial noise and minor air pollutants from reaching the immediate surroundings, both human population and the rich flora and fauna. NRL is aggressively pursuing tree plantation in the refinery area with plantation of around 7000 saplings during 2018-19. Plantation drive in nearby area of the refinery taken time to time under various scheme & programmes.

NRL has taken up two major flagship initiatives for plantation under Afforestation drive in degraded areas. An MoU was signed on 14.09.2020 between NRL and Golaghat Social Forestry Division, Government of Assam, for plantation of 1 lakh tree saplings (equivalent to 600 Ton of Carbon absorption), towards compensatory afforestation of 40 Hectares of degraded land in Nak-Kati Chapori under Khumtai Revenue Circle of Golaghat.

In a significant development for plantation of approx. 68000 tree saplings (equivalent to 400 Ton of Carbon absorption), an MoU was signed on 23rd August 2021 between NRL and Nagaon Forest Division, Govt. of Assam for compensatory afforestation of 35 Hectare land in Kondoli PRF under Nagaon Forest Division with a total budget of ₹1.97 Crore.

Keeping environment as a prime concern, NRL has envisaged an ambitious experimental project for the first time in the country. This unique project called “Butterfly Eco System” located in the Refinery Township is an effort to give a natural habitat for butterflies to come, stay and breed in their natural way. Also a unique herbal garden of rare medicinal plants called “Smritibon” has been developed in the township.

In addition, plantation of various saplings have also been carried out on a wide scale all along the road sides in the Township & in the butterfly valley. More than 84% green cover maintained in Township.

3. Unique Ground Flare System

To avoid any adverse impact of the flare on wild animals in the Kaziranga National Park, non-illuminating ground flare has been incorporated which is first of its kind in the country.

4. Sulfur Recovery Plant

Assam crude is sweet crude (only 0.26 % Sulfur content), in spite of processing low sulfur Assam crude, a Sulfur Recovery Unit (SRU) has been installed to remove sulphur from sour water and sour gas generated during the refining process. Subsequently its capacity has been enhanced from 14.6 Tonnes Per Day to 19.3 Tonnes Per Day in the year 2010 commensurate with the Diesel Quality Upgradation Project.

A new SRU has been commissioned and is under operation. Implementation of a new train of Sulphur Recovery Unit (SRU) has been taken up for parallel execution to meet future environmental requirement and along with the implementation of Tail Gas Treating Unit (TGTU) with an objective to improve the sulphur recovery efficiency from the existing 96% to 99.9%. This will further reduce SO₂ emission from the incinerator of SRU.

5. High Stack Height & Strict Emissions Monitoring

To reduce the ground level concentration of pollutants, height of stacks at different plants in the refinery is kept at 60 meters. Further, the height of stack at Coke Calcination Unit is kept at 77 meters. Facilities for continuous monitoring of SO_x, NO_x, PM, CO have been provided for all the furnace stacks and low NO_x burners have been used in all the furnaces. Real time online emission data have been transmitting to CPCB sever continuously with remote alert facility. Connectivity of real time data to SPCB server has also been completed this year.

6. Use of low sulfur fuel for the Refinery furnace

Only the sweet fuel gas, after removing sulfur in the Amine Treatment Unit, is used in the refinery furnaces.

7. Solid Waste Management

Chemical and Oily sludge generated at different sections of Effluent Treatment plant are centrifuged in the highly efficient Centrifuge in order to further removal of the oil content. After centrifuge, the oil free cake is kept in sealed drums which are then disposed off in the Secured Land Fill. The Secured Land Fill has been divided into various cells separated by soil mounts for easy handling and operation. The waste is disposed off at these cells and compacted. The compacted waste is then covered by 15 cm soil layer after every day's operation which minimizes the chance of fire hazard, water percolation and odour problem.

NRL has taken up a lot of advance & innovative initiatives in the management of Hazardous Waste Treatment and Disposal Facilities. Cleaning of Tank bottom oily sludge has been done by adopting BLABO/ Mechanized process which is a close loop process and by which nearly 100% recovery of hydrocarbon could be achieved.

8. Spent Catalyst & Tank Boom Sludge

Spent catalysts are generally generated after a gap of 3/4 years when the catalyst is replaced in the various units of Refinery. After generation, the spent catalyst is kept in demarcated place in sealed drums and then the same is sold to CPCB approved vendors with due intimation to PCBA and following the stipulated guide lines. Tank bottom sludge

are generally generated after a gap of 10/15 years when the Tanks, particularly Crude Tanks are cleaned. Whatever sludge is generated due to cleaning of the tanks, the accumulated sludge is either sold to CPCB/SPCB recognized recycler or bio-remediated inside Refinery premises itself. Bio remediation of 500 MT tank bottom is under progress. Approx. 350 MT spent catalyst generated during Refinery Turn Around (RTA) was sold to CPCB approved recyclers and action has been initiated for sale of approx. 30 MT spent catalyst containing precious metals.

9. Implementation of Hydrogen Peroxide Treatment

In pursuance of latest development, H₂O₂ treatment process has been introduced for the chemical treatment of wastewater in the ETP by replacing the conventional FeCl₃ process. Introduction of this technique has reduced the solid waste generation drastically.

10. Installation of oil traps in the Storm Water drains

Several numbers of oil traps have been installed and hay filters are placed in the refinery storm water system as a preventive measure to eliminate any possibility of oil carry over to outside environment. A scheme for reusing entire storm water in fire water network and in Cooling Tower as makeup is under operation.

11. Estimation of Carbon Foot Print and Green House Gas Emission

As a step towards NRL's commitment for protection of environment and to assess its contribution towards GHG emission leading to global warming, NRL has developed a Carbon Management Strategy for mapping of Green House Gas (GHG) emission /carbon foot print accounting for its activities. NRL commenced the activity for estimation of Green House Gas (GHG) Emission and carbon foot print of the refinery taking 2009-10 as base year, the study was carried out by engaging a reputed consultant. NRL is focusing on energy efficiency, building carbon sink to minimize GHG emission. NRL continues to monitor its GHG inventory and get it validated through accredited agency. Company engaged TUV India Private Limited to conduct the independent assurance of Refinery's GHG emission, which includes "limited level of assurance" of NRL direct and other indirect (Scope 1 and 3, there are no Scope 2 emissions presently) GHG emission. This assurance engagement has been conducted against the methodology & standards of API compendium 2021, ISO 14064, GHG protocol ISAE 3000 (revised), and ISAE 3410 (GHGs)

for verification process under the operational control approach. GHG emission stands at 0.817 and 0.740 Million ton CO₂ equivalent during FY 2020-21 & 2021-22 respectively. The carbon footprint has been reduced by 10.4% as compared to previous year.

12. CDM Projects

NRL installed a 12.0 MW Steam Turbine Generator (STG) to utilize and recover waste (thermal/pressure) energy of HP steam. This project has been registered as a CDM Project and NRL has earned Carbon Emission Reductions (CERs) from UNFCCC.

13. Fuel switch over

NRL has entered into a JV with Oil India Ltd (OIL) and Assam Gas Company Ltd (AGCL) to form Duliajan Numaligarh Pipe Line (DNPL) who laid 192 KM pipeline from Duliajan to Numaligarh to supply Natural Gas (NG) which is currently used at Captive Power Plant (CPP) and Hydrogen Unit of NRL in lieu of Naphtha. This has resulted in reduction of carbon emission.

PART – H

Additional measures/investment proposal for environmental protection including abatement of pollution, prevention of pollution:

1. Secured Land Fill

As per CPCB recommendations with latest technic / scientific design, a Secured Land Fill of capacity of around 6000 m³ has been constructed and is in operation in the Refinery premises to cater the needs for disposal of Chemical & Oil Sludge.

2. Bioremediation facility

Construction of an additional new bioremediation facility has been completed to facilitate bioremediation of tank bottom oily sludge (calorific value >2500kcal/kg) in future.

3. Decanter System

A three phase decanter system has been commissioned for efficient slop management of the Refinery. About 50-70 KL of slop can be processed per day and the resultant processed slop can be directly transferred to CDU unit for re-processing along with crude.

- 4.** Installation of double mechanical seals in IFRT (Internal Floating Roof Tanks) and EFRT (External Floating Roof Tanks) In line with MoEF notification, 2008, relating to Oil Refinery Industry, setting of double mechanical seals in all the IFRT and EFRT tanks have been completed.

5. Transmission of online real time data

Transmission of online real time data with remote alert facility for SO_x, NO_x, CO, PM and Ambient Air quality to CPCB and SPCB Server has been implemented. As per direction of CPCB, online transmission of Treated effluent data for four parameters of i.e. pH, TSS, BOD, COD and flow have been implemented.

6. Installation of additional CAAQMS

As per recommendation of MoEF and CPCB – installation of another Continuous Ambient Air Quality Monitoring Station (CAAQMS) at downwind direction has been completed and commissioned.

7. Flare Gas Recovery System

Numaligarh Refinery was originally designed with a twin flare system i.e. the ground flare and the elevated flare to avoid any adverse impact of the illumination of flare on animals and migratory birds in the surrounding wildlife sanctuaries and protected forest including Kaziranga National park. In normal operation, the ground flare is in line and only pilot burner is lit up in the elevated flare. The elevated flare caters to the load during plant emergencies when flare load is very high or during maintenance of the ground flare system.

As a measure for the further protection of environment & conservation of energy, Flare Gas Recovery System has been implemented to recover and reuse the excess gas going to the flare.

Flare Gas Recovery System (FGRS) supplied by M/s Garo SPA, Italy was successfully commissioned in the year 2018-19. Implementation of the Flare Gas Recovery System has not only reduce specific energy consumption of the refinery but has also reduced Greenhouse gas emission.

8. Despatch of Ethanol Blended Motor Spirit

NRL has commenced despatch of Ethanol blended Motor Spirit (EBMS) from its Marketing Terminal in Numaligarh for supply to Retail Outlets located in North East India. The first tank truck loaded with EBMS was despatched on 03-03-2022 from Numaligarh Refinery Marketing Terminal to be sold through BPCL Retail Outlet. This augurs well with the Govt of India's target to achieve 20% blending of Ethanol with MS (Petrol) by 2025.

India imports 85% of its crude oil requirement. Ethanol, produced domestically, blending in Motor Spirit (Petrol) assumes significance at a time when the Govt. of India is focussed on reducing import dependence, thereby saving on foreign exchange while promoting green energy. Also, ethanol is a less polluting fuel, and offers equivalent efficiency at a lower cost as compared to MS (Petrol).

NRL has recently commissioned 2 above ground tanks of capacity 860 KL each, through its subsidiary ABRPL, along with modification of existing truck loading gantry facilities to enable online blending of Ethanol in required proportion before it is dispatched to its customers. NRL's joint venture company, M/s Assam Bio Refinery Pvt. Ltd. which is executing the first 2G bio refinery with bamboo mass as feedstock and bioethanol as one of the products is all set to be commissioned in the latter part of this year, which will substantially cater to the ethanol requirement in the North East region and beyond.

9. Maximum product evacuation through pipeline

About 80% of the product evacuation takes place via NSPL (Numaligarh Siliguri Pipeline) thereby contributing as an initiative towards reducing vehicular traffic for product despatch.

PART – I

Any other particulars for improving the quality of the environment:-

As a part of continuous efforts towards reduction of emissions, Numaligarh Refinery produces ultra –low sulphur High Speed Diesel and motor spirit having less than 0.001%(10ppm) sulphur conforming to the Euro-VI Specifications. This contributes in reducing pollution from diesel and petrol vehicle due to the reduction in emission of Sulphur di-oxide in the atmosphere.

Numaligarh Refinery Limited (NRL) has recently upgraded its refinery for production of BS-VI HSD to meet product quality requirement as per Auto Fuel Policy of the Government of India by implementation of the Diesel Hydro Treater Project (DHDT), which was commissioned during January, 2018. NRL has also increased the capacity of its MS plant by 50% in 2019 and entire quantity of MS produced meet BS VI standards.

As an advance step towards environment protection, NRL has installed four mounded Bullets which are more environment friendly and safe for the storage of LPG replacing the existing LPG spheres.

Energy conservation measures:

Numaligarh Refinery emphasizes utmost importance to maintain energy efficiency and energy conservation. Refinery closely monitor the key Energy performance measurement indicators viz Specific Energy Consumption (SEC) and Energy Intensity Index (EII) out of several operations parameters. Unit performance is gauged on a continual basis and efforts are on incorporating best in class technology and global best practices.

To reduce fuel consumption, NRL has started installing solar panel to generate electricity and inject the same in the refinery grid. Numaligarh Refinery has a portfolio of 1.05 MW of Solar photovoltaic capacity, which is 0.4% of the total captive power generation. The 1.025 MW solar plant installed in 2018 reduces power requirement to the extent of heat generation during the day time. The total generation from the project is 1083 MWh in 2021-22 which translates to reduction of global warming potential at 10 lac lbs CO₂.

NRL continues to pursue the opportunity for further electricity production through solar resources in extended area.

The energy savings out of the Encon schemes commissioned in 2021-22 are outcome of internal initiative as well as quick win recommendation from external audit. The total direct energy savings is 7400 SRFT and monetary savings of 25 Crore. Further, around 0.27 Lac ton CO2 reduction by means of energy conservation projects and 20 ton of CO2 emission reduction achieved through pipeline transportation.

The details relating to energy conservation measures is as below:

S.I.	Encon schemes in 2021-22	SRFT
1	Boiler blowdown recovery system commissioning in Hydrocracker Unit	65
2	Reduction in external fuel NG in Hydrogen generation unit and increasing internal off-gas in reformer by optimising steam carbon ratio at 2.45 instead of earlier 2.5 since later Oct'21	450
3	CDU Preheat temperature in heater increased at 288° C consistently after opportunity shutdown in Dec'21	1920
4	Plate type Diesel Product cooler installed in Hydrocracker Unit	2500
5	Waste Heat Recovery Boiler in Sulphur Recovery Unit for steam generation(@1.5Tph) after installation of NOx reduction furnace	900
6	Steam trap performance rate at 98% in working condition	950
7	Reduction in flue gas loss from Utility Boiler	274
8	Improving performance of condenser of steam turbine	110
9	Optimize Boiler Feed Water System of CCU WHRB Boiler	96
10	Bag filter and duct leakage in WHRB of CCU attended	135
	Total	7400

S.I.	Details of energy efficiency best practice measures in 2021-22
1	Reuse of phenolic stripped water ex SRB as Desalter wash water make up replacing DMW make up.
2	Utilise Enriched Oxygen in Utility Boiler and improved fuel efficiency and capacity utilization
3	Decanter system skid for efficient slop processing at 10-20KL per day
4	Closed sampling process for LPG and Fuel gas to enhance safety and reduce flushing loss
5	APC up gradated version implementation in process unit (uptime >98%) viz CDUVDU, HCU, HGU, DCU, MSP, Wax unit.
6	Dedicated Stack for individual HRSG 1 and 2 along with GTG1 and GTG2 during parallel GTG operation to recover waste heat steam generation fully.
7	New elevated flare (77m height) commissioned replacing the old one(60m height) with FT to measure loss during ground flare isolation

Energy conservation measures planned for commissioning in FY 2022-23 and beyond:

1. Online predictive analysis tools with AI & ML to detect loss from steam traps, ultrasonic PSV, IP21, wireless sensors
2. Condensate recovery scheme in balance units
3. Replacement with energy efficient motor and pump in process units
4. VAM for low heat recovery /reduce waste steam energy
5. Pressure energy recovery from PRDS with turbo generator
6. PRT arrangement to run motor in sync and reduce waste energy

Other schemes adding to continual benefit:

1. Steam traps dynamic analysis and monitoring.
2. Regular monitoring of Hydrocarbon passing of all valves connected with flare system by Acoustic Leak Detector and Fugitive emissions from tanks, line flanges etc, throughout the year under LDAR program.
3. Continuous operation of APC in CDU, DCU, HCU and H2U.
4. Conventional light replacement with Energy efficient light
5. Steady operation of 12 MW STG for Captive Power generation by utilizing and recovering waste energy (thermal and pressure) of HP steam, Maximization of NG use for continual improvement in the energy consumption, Increased Reliability with installation of Prognostic Online monitoring system for Off-Gas and Make-up Gas Compressor of HCU. There has been increase in productivity, safety and reduction of unplanned outages & maintenance cost, Replacement of higher heat duty exchanger EE-01 in HCU, etc.

ENCON schemes implemented during 2015-16:

1. CDU/VDU column internal modification for yield/energy optimization.
2. Installation of plate type heat exchanger (air pre-heater) in HGU flue gas duct.
3. Replacement of catalyst in RB-02 of Isomerization Unit.
4. Replacement of old trays with High Capacity Tray in HCU fractionators' kero zone.
5. Emissivity coating for controlled thermal radiative and convective heat transfer from the Furnace surface and tubes of Process units.
6. Up-rating of GTG-1 for augmentation of capacity (4-5MW).
7. Replacement of metallic blades with E-FRP blades in all the air fin fan coolers of the Process Units
8. Installation of Ultrasonic Activator in CDU/VDU in upstream of crude booster pump
9. Use of FO additive program post successful trial run with resulted fuel savings.
10. Modification in DCU by diversion of Slop as Quench instead of SRGO as quench. This has enabled reduction in slop generation.
11. HP steam header pressure reduction from 41kg/cm² to 39.0 kg/cm² resulting in savings of fuel.
12. Energy management system implementation in Electrical metering system. Online energy consumption is now available in desktop in micro level for any critical equipment.
13. Diversion of the Stabilizer off gas ex -CDU to DCU off -gas compressor to recover the LPG component from fuel gas.

ENCON schemes implemented during 2016-17:

1. Maximizing reformatte production with reduced energy by internal modification and increase in Isom plant load by conversion of available redundant equipment as DIH bottom pump. This has resulted in saving of around 1.5TPH LP steam and realization of 38KW of power.
2. Hook up of Hot VGO line with cold VGO line to maximize hot feed in HCU.
3. Incorporating heater bank coil for NG heater 34-HE-121 -01/02 up to 43 degC thereby stopping MP steam in NG heater.
4. Upgrading of Gas Turbine by 4-5 MW has helped in single GT operation even with increase load of new units.
5. CDU VDU column internal replacement with structured packing has resulted in improved vacuum, less COT by 5 degC with same distillation yield profile. This has reduced energy consumption significantly
6. Chemical cleaning/foam cleaning of exchangers/columns/CR loops done which resulted in increase in preheat temp
7. Burner alignment checking done for all major furnaces for efficiency improvement
8. Significant saving potential in electrical energy has been identified through system drive audit carried out for all motors and pumps through PCRA (Petroleum Conservation Research Association)

ENCON schemes implemented during 2017-18:

1. Stoppage of Turbine driven Fuel oil pump and switched to motor. Saving of 3.5TPH MP steam in lieu of 45KW motor. Net saving is 1200 MTOE.
2. Reduction of reboiler steam in MSP-DIH with operational change. Net steam saving leading to saving of 300MTOE.
3. 10 KW rooftop Solar PV panel installed at the NRMT admin Bldg and Control room.
4. Achieved zero steam leak by attending leaky steam traps and i/l valve.
5. Stoppage of steam tracing in SDU feed line and the tank heating steam coils of Solvent de-oiling unit. Stoppage.
6. Trial installation of E-glass fiber insulation in DCU transfers line. Shell outside temp dropped by 15- 20degC.
7. Air Compressor 3rd stopped (400KW) with close monitoring, Isolating the plant air at battery limit.
8. Reuse of Storm water as CT make up at 300m³/h
9. PATII mandatory Energy audit by PCRA and Energy efficiency Improvement study by EIL done during the year. Recommendations taken up for implementation at various phase.

10. Overhauling of STG turbine and improvement in condenser vacuum done during the year lead to a saving of 1500 MTOE
11. GTG exhaust to HRSG SH inlet heat loss plugging done .This lead to saving of 3000 MTOE.

ENCON schemes implemented during 2018-19:

1. CDU Pre-heat improvement by 15 degC with introduction of new HGO CR loop.Net saving is 2500 MTOE (Metric Tonne Oil Equivalent).
2. FGRS commissioned in Flare area to recover refinery flared gas. Net saving is 1800 MTOE.
3. 1 MW rooftop Solar panel installed within the Refinery premise .Net saving is 220 MTOE.
4. Electric heat tracing in WHFU. Net saving is 500 MTOE.
5. Auto water decantation valve installed in all Crude and slop tanks to reduce oil carryover in ETP.
6. Sun-domes installed in Warehouse and Electrical Lab to reduce artificial lighting.
7. Trial online Antifouling chemical injection programme in preheat train of CDU/VDU has been found to be successful leading to energy conservation.
8. Application of new e-glass fibre insulation in DCU transfers line has resulted in reduction of heat loss.
9. Implementation of APC (Advanced Process Control) in MSP and Wax Unit and continued operation in CDU, DCU, H2U and HCU has helped in reduction in energy consumption.

ENCON schemes implemented during 2019-20:

1. Burners (216 Nos.) in the reformer of Hydrogen Unit were replaced by FPMR-5 burners to increase reformer outlet temperature and reduce methane slippage. Steam generation has increased by two fold and equivalent annualized saving is 4000 SRFT (Standard Refinery Fuel Tonne).
2. A new plate and glass enamelled carbon steel tube Air-Preheater (APH) installed in CDU/VDU replacing the old cast / glass APH. Equivalent annualized saving is 1060 SRFT.
3. Booster pumps (2 Nos.) in CDU/VDU have been replaced from API 6th edition to API 10th edition. Equivalent annualized saving is 350 SRFT.
4. Capacity of MS Plant has been augmented by 50% with modifications in NHT Pre Heat Train, new convection coil in CRU inter heater and waste heat utilization for generation of superheated steam in CRU. Equivalent annualized saving is 1300 SRFT.

ENCON schemes implemented during 2020-21:

1. Feed effluent exchangers (Shell & Tube type) have been replaced by Plate Type Heat Exchangers in Sulphur Recovery Block. Equivalent annualized saving is 1600 SRFT.
2. Installation of electrical tracing in Solvent De-oiling Unit and offsite of Wax Plant replacing the steam tracing. Equivalent annualized saving is 615 SRFT.
3. Optimization of excess air in furnaces of Crude Distillation Unit, Vacuum Distillation Unit and Hydrocracker Unit. Equivalent annualized saving is 500 SRFT.
4. Condensate recovery scheme in Delayed Coker Unit and Captive Power Plant. Equivalent annualized saving is 450 SRFT.
5. Replacement of electrical motors and pumps with energy efficient motors and pumps. 590
6. Improvement in stream trap performance rate to 99% in working condition. Equivalent annualized saving is 150 SRFT.

Technology Absorption, Adaptation and Innovation measures:

1. Numaligarh Refinery Expansion Project (NREP)

NRL is in the process of augmenting its refining capacity from 3.0 MMTPA to 9.0 MMTPA, by setting up a new refinery train of 6.0 MMTPA in the existing premises.

The project is being executed using a mix implementation model engaging a combination of PMC, EPC, EPCM and other supporting consultants. The Hydrogen Generation Unit will be set up in BOO mode. Basic Engineering & Design Package for all the major units are complete and overall progress made as on 31st March 2022 is 19.4%. Noteworthy technologies adopted are PFCC giving high yield of Propylene & Ebullated Bed Resid Hydrocracker of RPTU.

Capacity expansion of NRL from 3.0 MMTPA to 9.0 MMTPA will ensure additional availability of petroleum products primarily LPG, MS and HSD in the NE and Eastern region of India and meet the growing energy demand in the region.

2. Bio Refinery Project

NRL is setting up a 49 TMTA Bio Refinery project as a joint venture company promoted by NRL with 50% equity and balance 50% by Fortum 3.B.V Netherland and Chempolis Oy, Finland for producing ethanol from cellulosic feedstock 'Bamboo'. The process for production of bio-ethanol from bamboo biomass is based on the Formicobio™ Technology from M/s Chempolis. Major equipment like Digester & Washpress are erected at site. Physical progress of the project is 70.2%.

Bio Ethanol production from the Bio-Refinery shall be used in blending with Motor spirit by North-East refineries. Bio Refinery project will help in meeting the (Ethanol Blended Petrol at 20%) EBP20 programme of GOI's National Bio-fuel policy by 2023-24 which will in turn help to strengthen country's energy security, enable local enterprises and farmers to participate in the energy economy and reduce vehicular emissions.

3. Wax Pastillation Unit

For 50 TMTPA Wax plant, NRL wax is marketed only as slabs of 5kg produced in an Automatic Slabbing and Packaging Unit (ASPU). However, to cater customers requirement and augment wax sale with flexibility in marketing, NRL is going for a new Wax Pastillation Unit (WPU) having production capacity 144 TPD. M/s IPCO, Germany is the technology provider and process licensor of the WPU. This involves an efficient and cost effective process, in which molten liquid wax is converted to pastille form (5 to 6 mm size) with the help of Rotoformer and Steel belt cooler. The wax pastille is then shifted to bagging/storage facility with the help of conveyor belt and bucket elevator. Mechanical progress of WPU is near completion and target commission of the unit is FY 2022-23.

With commissioning of WPU, NRL will be able to cater additional customers requirement and augment wax sale with the flexibility in marketing. This plant will also improve capacity utilization of Wax block as existing ASPU is sensitive to maintenance.

4. Aq. Ammonia Project

Aq. Ammonia 25% (NH₃) project will be set up to meet 10 TPD aq. ammonia requirement in Bio refinery to maintain pH for proper performance of enzymes. It is noteworthy that NRL is going to produce aq. NH₃ (25%) from a waste NH₃ rich stream of sour water stripper utilizing technology that is developed & licensed indigenously by EIL and it is 1st of its kind that NRL is going to implement in refinery. It will be a skid mounted solution with target completion period of 28 months from date of order.

This project will reduce NOX generation it releases to atmosphere. Moreover, this project will convert waste to value added by product.

5. Green Hydrogen

NRL has been playing a pivotal role amongst the Indian PSU to meet the Green Hydrogen Consumption Obligation (GHCO) as per Govt. of India mandate. Green Hydrogen offers a

renewable energy-based alternative for meeting Hydrogen requirements in fertilizer Unit and petroleum refining. This has the potential to reduce the country's dependence on fossil fuels, energy security and decrease the carbon footprint of these industrial processes.

The MNRE on 31st May 2021 came up with a mandate for production of green hydrogen upto 10% of total hydrogen consumption by 2030 in PSUs of Fertilisers and Refining sector. The draft mandate was further revised on 20th January 2022 to change the GHCO targets to 50% by 2029-30 and 70% by 2034-35. To meet the target of this mandate, NRL floated an EOI on October 2021 for detail Engg., Supply, Installation and Commissioning of Electrolyser module/s along with all auxiliaries for production of 3 KTPA (375 Kg/h) Green Hydrogen. Multiple responses received against EOI having different electrolyser technology namely AEL (alkaline water electrolysis), PEM (proton exchange membrane) and SOEC (solid oxide electrolyser cell).

Based on the information received against the responses of EOI, a tender was floated on 3rd April 2022 for "Design, Engg, Supply, Installation & Commissioning of Water Electrolyser system for 300 KG/HR (2.4 KTPA) of Green Hydrogen production at Numaligarh". By implementing 3 KTPA green hydrogen production, NRL shall meet 5% of GHCO by 2024-25.

6. Initiative for solar power

In its pursuit of tapping new and renewable energy sources, a slew of initiatives have been taken up to utilize solar energy in the refinery and in the township premises. 1000KWp Solar PV panel installed in all non-critical building rooftops inside the refinery in 2017-18. Also installed 20KW solar rooftop PV panels in adjacent to NRL marketing terminal. NRL has replaced conventional streetlights with solar powered lights in several places in its township. NRL extending its solar power initiative for the benefit of the nearby community, solar panel has been installed in nos. of nearby schools. In its foray to renewable energy, NRL has taken initiative to install 50 KW Solar power plant on the roof top of Corporate Office Building in Guwahati.

Research and Development (R&D) Activities

NRL took a few initiatives to strengthen research and development capability of the organization through partnership with academia and research organizations. R&D activities presently pursued by NRL are as follows:

1. R&D Collaboration with CSIR: NEIST

NRL entered into a framework collaboration with CSIR: NEIST for Identification of critical research areas pertinent to microbial remediation, soil chemistry, functionalization of low grade/ weight hydrocarbons and subsequent upgradation, training of scientists, technologists and officials in specialized areas. As part of this collaboration, a project “Removal of Phenol from sour & strip water, it’s re-use and value addition” has been taken up at an estimated cost of ₹1.27 Crore for a total project duration of 2 years with the aim to reduce water foot print and to produce value added chemicals. Under this project, lab scale demonstration for phenol removal is successfully completed and design and fabrication of pilot plant is ready for demonstration at NRL site.

2. NRL Centre of Excellence for Sustainable Material at IIT Guwahati:

As a positive development, NRL has joined hands with Indian Institute of Guwahati (IITG) to develop Bio-degradable plastics from oil and bio refinery streams. An R&D project with a financial involvement of Rs. 4 Crore has been identified as the first project to be taken up. Earlier, an Memorandum of Understanding (MoU) was signed between NRL and IITG on 13th September 2019 for establishing ‘NRL Centre of Excellence on Sustainable Materials (NCESM)’ in Guwahati.

Presently the centre is carrying out research activities on “Development of Biodegradable Plastics from Oil and Bio-Refinery Streams”. Development of indigenous technology for production of biodegradable plastic will help in replacing non-biodegradable polyethylene based packaging and contribute towards reduction of pollution from solid waste. Bio-degradable plastic will be a value added stream for the Bio Refinery. The aim of the project is to convert “Furfural”, one of the by-products of the ABRPL, to biodegradable polymer “Polycaprolactone (PCL)”. Under this project, a pilot plant for research study on polymer material has been installed at NRL-CoE, IITG.

3. Research Project at St. Edmund’s College, Shillong

NRL has engaged St. Edmund’s College, Shillong for research study on Utilization of cyanobacteria in the bioremediation of crude oil, hydrocarbon storage tank bottom sludge, and ETP hydrocarbon sludge and its environmental biotechnology implications at an estimated cost of ₹83 Lakh.

The aim of this project is Utilization of cyanobacteria in the bioremediation of crude oil, hydrocarbon storage tank bottom sludge, and ETP hydrocarbon sludge. Under this project, significant development on culture of cyanobacteria samples collected from NRL have been achieved and bio-accumulation study with the cultured bacteria on hydrocarbon sludge is being investigated.

4. R&D Collaboration with CSIR IIP Dehradun

A project titled “Studies for Efficient Utilisation of UCO stream generated from upcoming Ebullated Bed (EB) Resid Hydrocracker under Numaligarh Refinery Expansion Project” has been taken up to carry out studies to convert un-converted oil (UCO) into value added products or speciality products like Bitumen.

5. Projects taken up in collaboration with BPCL Corporate R&D Centre (CRDC), Noida

NRL is currently collaborating with BPCL CRDC, Noida in two R&D projects:

- Production of Furfural Alcohol (FA) and Tetra Hydro Furan (THF) from Furfural: Furfural will be one of the by-products from bio-refinery. CRDC is currently developing technology for production of Furfural Alcohol and Tetra Hydro Furan from Furfural.
- Measuring efficacy of Enzymes of various suppliers for conversion of bamboo pulp into glucose by hydrolysis process.

6. Scientific and Technical Collaboration with Engineers India Limited

As per Govt. of India guidelines on collaborative research and development (R&D) among PSUs, NRL and EIL have entered into a Memorandum of Understanding (“MOU”) dated 31.03.2022 to exchange scientific knowledge, encourage joint research in the field of hydrocarbon, petrochemicals, energy technology, and commercialize such jointly developed technologies. Both the parties have already identified a list of projects for joint development of its technology with separate Memorandum of Agreement having defined objectives, scope of work, roles of parties, deliverables, cost and royalty sharing etc.

NRL and EIL are entering into a Memorandum of Agreement (MoA) for joint development and commercialization of Above Ground Sulphur Seal technology.

7. Indigenous Isomerisation Catalyst:

The indigenous isomerization catalyst once developed would be manufactured from third party manufacturers in India. Successful implementation of this R&D scheme will lead to

increase indigenous capabilities for manufacturing such items which are presently procured from foreign manufacturers. Besides reducing dependency on foreign vendors, this initiative will give fillip to the Make-In-India mission of the Government.

Projects of NRL:

On-going Projects

1. Numaligarh Refinery Expansion Project (NREP)

Numaligarh Refinery Expansion Project (NREP) is for the capacity expansion of the existing Refinery from the present 3 MMTPA to 9 MMTPA. The NREP consists of 02 major components, the Refinery Expansion with new train of process units (6 MMTPA) and Paradeep-Numaligarh Pipeline along with Crude Oil Import Terminal (COIT) at Paradeep (1630 km, 9 MMTPA).

The Cabinet Committee on Economic Affairs (CCEA) of the Government of India has accorded investment approval for the project on 16.01.2019. Environmental Clearance (EC) for setting up the new train of refinery of 6 million capacity was accorded by the MoEFCC on 27.07.2020. EC-CRZ clearance for COIT was received on 19th May 2021. Financial closure for the expansion project has been achieved on 30-12-2021.

The NREP project is being executed using a mix implementation model comprising EPC, EPCM, PMC and BOO contracts. Process units like CDUVDU, DHDT, MS Block, SRU etc. are planned to be set up through EPC contracts. Few critical and complex units like RPTU and PFCC are planned to be set up in EPCM mode. The Hydrogen Generation Unit (HGU) will be set up in BOO mode. NRL will consider the green hydrogen option while sizing its hydrogen unit.

In terms of project progress and achievement of major milestones, process licensors for all the major process units of the new 6 million refinery have been finalized. Engineering activities are in progressive stage and 60% model review for process units have commenced. All three EPC packages for process units have been awarded and jobs commenced at site. All major utility and off-site packages have been ordered. Procurement activities for long lead items are nearing completion. Manufacturing activities are in progress at vendor shop and first lot of equipment is expected by 3rd quarter for FY 22-23. Piling jobs are in progress in all construction areas. Civil and structural contracts are being lined up for all areas under EPCM scope. Process Design Basis (PDB), Engineering Design Basis (EDB) and HAZOP have been completed for COIT and PNCPL. Tendering activities for COIT are in progressive stage. Enabling contracts for boundary wall construction and construction power lined up. Enabling works II and BOOT contract is under award. Dredging jobs are in progress. Line Pipe manufacturing for PNCPL, receipt at site is

nearing completion and Pipeline laying jobs have commenced. Contracts for HDD works at various river locations are being progressively awarded.

Overall progress of NREP as on 31st March 2022 is 16.2%. Progress for refinery scope of job is 11.1% while progress for pipeline scope of jobs is 24.5%.

2. Indo-Bangladesh Friendship pipeline (IBFPL)

NRL is constructing a 129.50 km long India Bangla Friendship Product Pipeline (IBFPL) from NRL's Siliguri Marketing Terminal in India to Parbatipur in Bangladesh. The 10 inch diameter pipeline will facilitate export of 1 MMT HSD annually. Procurement of all materials was completed and Pipeline laying & Terminal construction works are in progress. As on 31.03.2022, overall progress of the project was 90.3%.

Future Projects:

1. Petrochemical Project for NRL

NRL is setting up a Petrochemical Complex to produce 360 KTPA of homopolymer grade polypropylene by leveraging on the capability to produce high value petrochemical feedstock from NRL's 6 MMTPA new refinery (NREP) presently under implementation. The project will consist of polypropylene production unit & dispatch facilities, along with associated utility systems. The investment approval for the project was obtained in March 2022. The project is anticipated to be completed in FY 2025-26.

The polypropylene plant will utilize propylene as feedstock, which will be made available from high severity Petro-FCC of NREP. Once implemented, the integration of petrochemical with refinery will provide significant value addition from the complex. The process licensor for the technology has been already engaged and process package is under preparation.

Joint Ventures and Associate Companies of NRL

NRL has three joint venture companies and one associate company:

1. Indradhanush Gas Grid Limited (IGGL)

IGGL is a joint venture company among Numaligarh Refinery Limited (NRL), M/s Oil India Limited (OIL), M/s Oil and Natural Gas Corporation Limited (ONGC), M/s Indian Oil Corporation Limited (IOCL) and M/s GAIL(India) Limited (GAIL) and was incorporated on

10th August 2018 to implement the North East Gas Grid project envisaged in the Hydrocarbon Vision 2030 for North East of Govt. of India. NRL is a partner with 20% stake in Indradhanush Gas Grid Limited (IGGL) which is executing Natural Gas Pipeline of 4.75 mmscmd capacity. **The project will** establish gas grid connectivity in the eight North-Eastern States, viz. Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, Tripura and Sikkim with the National Gas Grid through the Barauni-Guwahati Gas Pipeline. Overall physical progress of the project as on 31st March, 2022 was 43.1%.

2. Duliajan Numaligarh Pipeline Limited (DNPL)

DNP Limited is a Joint Venture Company between Assam Gas Company Limited (AGCL), Oil India Limited (OIL) and Numaligarh Refinery Limited (NRL) and was incorporated on 15th June 2007 with an authorized share capital of ₹170.00 Crore. The present shareholding of the Company as on 31st March 2022 stands at AGCL (51%), NRL (26%) and OIL (23%). The registered office of the Company is at Guwahati, Assam with its operational headquarters at AGCL, Duliajan. The company started transportation of natural gas from Oil India Limited's installation in Duliajan to Numaligarh Refinery from March, 2011 onwards.

The main object of DNP Limited is transportation of natural gas through pipeline having a design capacity of 1.2 MMSCUM of natural gas per day from Madhuban at Duliajan to NRL Refinery. During the year 2021-22, the Company transported 2,86,038 TSCM of natural gas as against 3,00,136 TSCM of natural gas in 2020-21.

3. Assam Bio Refinery Private Limited (ABRPL)

Country's first 2G bamboo based bio refinery being executed through a JV with Finnish collaborators "**Assam Bio Refinery Private Limited**" has recorded adequate progress on ground.

Assam Bio Refinery Private Limited was incorporated on 4th June, 2018 as a joint venture company promoted by NRL with 50% equity and balance 50% by Fortum 3.B.V Netherland and Chempolis Oy, Finland for producing ethanol from cellulosic feedstock 'Bamboo' which is available in abundance in North-Eastern (NE) states of India. The Project envisages using 300 Kilo-Tones Per Annum (KTPA) of dry bamboo (500 KTPA of green bamboo) as raw material and shall produce Cellulosic Ethanol, Acetic Acid, Furfuryl/Furfuryl Alcohol, along with combustible residue in the form of Bio coal and Stillages. The technology being used is based on selective fractionation of biomass and coproduction of multiple products. It shall produce approx. 49,000 Tones Per Annum (TPA) of bio-ethanol, 11,000 TPA of acetic acid and 18,000 TPA of furfural alcohol. Bamboo residue shall be used as fuel to produce steam and electricity. The Project Construction activity at the site was started in late 2018 and is continuing with major civil and

structural works going on. Engineers India Limited (EIL) has been appointed as the Engineering, Procurement and Construction Management (EPCM) consultant on August 24, 2018. Civil & Structural works at the site is continuing in full swing and manufacturing works at vendors' locations are also progressing well. Overall physical progress of the project as on 31st March, 2022 was 66.6%. Due to travel restrictions as well as uncertainties for COVID-19 pandemic situation, scheduled engineering activities were delayed and accordingly, the Project schedule has been revised with commissioning by December, 2022.

Awards and Recognitions :

NRL was honoured with FAME International Award (Platinum Category) -2020-21 for excellence in Environment Management.
