EXECUTIVE SUMMARY

1.0 Executive Summary

The Executive Summary covers the following topics in brief:

1. Project Description
2. Description of Environment
3. Baseline data collection
4. Anticipated Environmental Impacts and Mitigation measures
5. Environmental Monitoring Programme
6. Environment Management Plan
7. Additional studies
8. Project Benefits

1.1 Project Description

HPCL's Mumbai refinery was established in 1954. Through progressive revamps/ capacity expansions, current crude oil processing capacity of HPCL MR is 7.5 MMTPA. It currently has two trains of primary distillation units (CDU I & II), secondary processing facilities viz. FCCU's, DHDS, MS Block (NHT/ISOM, NHT/CCR and Prime-G), LOBS production facilities and other associated treating and utility facilities.

The refinery has recently implemented a DHT project which includes processing facilities such as new diesel hydrotreating unit, SRU, ARU, SWS and necessary utilities and offsites.

With the installed facilities, the refinery shall be able to produce gasoline and diesel meeting Euro IV quality specifications, besides other petroleum products like LPG, Naphtha, Kerosene, ATF, fuel oil and sulphur.

HPCL intends to increase the refining capacity of its Mumbai refinery upto 9.5 MMTPA. HPCL entrusted the task of carrying out Environmental Impact Assessment (EIA) and Risk Analysis/Assessment (RA) studies to M/s Engineers India Limited (EIL) for obtaining Environmental Clearance. The details of such assessment studies are given in the proceeding chapters. EIL is an accredited consultant for carrying out EIA studies by Quality Council of India in refineries.

Project proposal for issue of Terms of Reference (TOR) for EIA was considered in the 36th meeting held during 16-17th March, 2015. The Committee discussed the project details, utility requirements and the presentation by the project proponent/EIL. After detailed deliberations, the Expert Appraisal Committee prescribed Terms of Reference (TOR) for preparation of EIA/EMP. EIA report is prepared in accordance with the approved TOR.

Nature and size of the project

The expansion envisaged for various process units is proposed to be done within the battery limit or immediate vicinity of the existing units. Thus the administration building and other associated facilities shall be kept same as that of existing one.

The new units are proposed to be located within refinery. The locations for the project are:

- Within existing Refinery premises

The proposed project is located in Aanik Village, Chembur tehsil and district Chembur located in Mumbai in Maharashtra. The site is located approximately at Latitude 19.01974 and longitude of 72.90321.

The estimated capital cost for the proposed project is Rs 3223.43 Crores.

The details of the existing unit capacities of Mumbai refinery are given below in Table 1.

Table 1: Existing Unit Capacities of Mumbai refinery

Sl. No.	Unit Name	Unit Capacity (MMTPA)
1	FRAPS	4.26: Bas/Ku 4.40 AL/AM
2	FRVPS	1.086 max
3	LRVPS	1.086 max
4	FRE APS	3.57/3.71 (BH/AXL)
5	FRE VPS	P.G:1.39, BH 1.21
Residue processing units		
6	Propane deasphalting unit	0.755
Lube refinery units		
7	Industrial oil hydro finers	12.2 m3/hr
8	Propane de-waxing unit	65/70/76(150N, Spindle, IO 100)/ 70 m^3/hr (500N)/ 48m^3/hr(BS)
9	Solvent extraction unit-1	SPO/150N/500N/DAO: 37/37/45/30m^3/hr
10	Solvent extraction unit-2	SPO/150N/500N/DAO: 37/37/45/30m^3/hr
11	Solvent extraction unit-3	SPO/150N/500N/DAO: 37/37/45/30m^3/hr
12	Raffinate hydrotreater	49 m^3/hr
Secondary processing units		
13	Old FCC	1.0
14	New FCC	1.277 (Design case) / 1.457(Check case)
Middle distillates treating unit		
15	DHDS	2.27
16	DHDT	2.2
17	ATF treating unit	93 m^3/hr
18	MTO dehazing unit	35 m^3/hr
Light end processing units		
19	NSU	1.222
20	NHT-CCR/PSA	0.545/0.046 (100% AM Case)
21	Prime-G	0.475 (Design) // 0.584 (Actual with max. feed sulfur of 680 ppm)
22	NHT-ISOM	0.250
23	FCC Naphtha Splitter	100 m^3/hr
24	LPG Treating unit	Old cracked : 38 m^3/hr (used for virgin LPG)

		New cracked:439 KTPA (Presently Used)
25	Hexane Unit	0.3836
26	Propane Unit	12.35 m3/hr of treated Vr. LPG

The expansion capacity of various units is given in Table 2.

Table 2: Expansion Capacity of various Units – Mumbai refinery

Units	Design Capacity	Base Case	Expansion Case
FRAPS/VPS	4260 (Bas/Kuw) 4400(AL/AM)	4000	6000
FREPS/VPS	3570 (BH) 3710 (AXL)	3500	3500
Naphtha Splitter Unit	1222	903	939
NHT/ISOM	250	175	300
NHT/CCR	545	445	654
Prime G+	475	531	425
New FCCU	1456	870	1019
Old FCCU	950	560	813
DHDS Unit	2270	940	2034
DHDT Unit	2200	1140	1100
PDA	755	755	755
HGU	-	19.2	14.5
New HGU	-	-	36
VBU	-	-	56.5

1.2 Description of Environment

In order to minimize the impact of the project on the environment, due attention is given for implementing effective pollution control measures.

Air Environment

Total SOx emission from the refinery post expansion is expected to be 8.62 TPD which will be well within the existing permissible limit of 12.6 TPD as stipulated by MOEF/SPCB. All efforts will be taken to minimize SO_2 and other emissions from the refinery during design stage itself. The stack wise emission from new facilities is given in Table 3.

Table-3: Stack details and fuel consumption

Unit	Stack height (m)	Exit velocity (m/s)	Stack Diameter (m)	Flue gas flow rate (Nm3/hr)	Pollutant Concentration	
					SO2 (kg/hr)	NOx (kg/hr)
New FRVPS	60	20	1.36	53021	20.08	15.89
Visbreaker	60	20	0.76	16634	6.30	6.65
New HGU	60	20	1.34	51064	0.24	9.32

SO_2 (maximum 24 hr Ground Level Concentration) GLC due to refinery expansion is predicted as 20.04 $\mu g/m^3$.

Maximum 98th Percentile Baseline Value (within 10 km radius) is 25.2 µg/m^3. By superimposing the same with background SO_2 level, the maximum resultant GLC value (c) is observed as 42.24 µg/m^3 (24 hourly averages) which is well within the standard limits for 24 hourly averages for industrial area i.e. 80 µg/m^3.

Table 4: Predicted values of GLC for SO_2

	SO_2 (24 hourly maximum)				
	Maximum GLC (due to proposed facilities) (a) µg/m^3	**Maximum GLC From Centre of complex (0,0) Co-ordinates (m)**	**Location from the complex Centre (m)**	**Maximum 98th Percentile Baseline Value (within 10 km radius) (b) µg/m^3**	**Maximum Resultant GLC Value c = (a + b) µg/m^3**
Release of emission from refinery expansion	20.04	-820,-200	Inside project boundary	25.2	45.24

NO_X (maximum 24 hr GLC) GLC due to operation of proposed petrochemical complex is predicted as 21.43 µg/m^3.

Maximum 98th Percentile Baseline Value (within 10 km radius) is 33.5 µg/m^3. By superimposing the same with background NO_X level, the maximum resultant GLC (c) is observed as 54.8 µg/m^3 (24 hourly averages), which is well within the standard limits for 24 hourly averages for industrial area i.e. 80 µg/m^3.

Table 5: Predicted values of GLC for NO_X

	NO_X (24 hourly maximum)				
	Maximum GLC (due to proposed facilities) (a) µg/m^3	**Maximum GLC From Centre of complex (0,0) Co-ordinates (m)**	**Location from the complex Centre (m)**	**Maximum 98th Percentile Baseline Value (within 10 km radius) (b) µg/m^3**	**Maximum Resultant GLC Value c = (a + b) µg/m^3**
Release of emission sources from refinery expansion	21.43	-840,-200	Inside project boundary	33.5	54.8

Water Environment

Integrated Effluent Treatment Plant (IETP) in existing refinery was commissioned in 2010 with state of art technology. About 70 m^3/hr of ETP treated water from Reverse Osmosis system is routed to DM Plant for reuse. The design capacity of IETP is 300 m^3/hr. presently, the actual operating flow to IETP is 125-130 m^3/hr with all the units in operation. The additional flow proposed to be generated after refinery capacity expansion shall be 48 m^3/hr. Therefore, post refinery capacity expansion, total flow to IETP shall be 178 m^3/hr. As the existing IETP can handle the above flow of 178 m^3/hr, no new ETP is proposed for treatment.

Solid waste management

The following wastes shall be generated from the Complex:

1) General Solid waste
2) Hazardous waste

Catalyst used in various process units are listed in Table 6.

Table 6: Catalyst Quantity and Catalyst Life

Units	Catalyst	Quantity (kg's)	Life (Years)
HGU	Hydrogenation catalyst	7074	3
	Sulphur Chlorine Absorber catalyst	9508	1
	Pre Reformer Catalyst	7450	3
	Reformer catalyst	5825	10
	MT Shift catalyst	9288	5
NHDT-ISOM	Main Hydrotreating Catalyst	3960	3
	Sulphur Guard Bed	4225	1
	Benzene Saturation Catalyst	3045	3
	Isomerization Catalyst	55000	3
	Feed Dryer Adsorbent	19200	3
	Hydrogen Dryer Adsorbent	4700	3
	Chloride Guard Bed	12082	3
Prime G	Hydro Desulfurization catalyst	14161	3
	Selective Hydrogenation Catalyst	13500	3
NHT-CCR	Main Hydrotreating Catalyst	5717	3
	Selective Hydrogenation catalyst	33750	4
	Net Gas Chloride Treater Adsorbent	10147	2
	LPG Chloride Treater Adsorbent	650	2
DHT	DHT Hydrotreating Catalyst Ni-Mo/Co-Mo	318750	3
	DHT Guard Bed Catalyst	7340	3
	TGCU Hydrotreating Catalyst Co-Mo	8000	5
	SRU Claus Catalyst	39880	5
	ARU Activated Carbon	12240	1
	TGCU Activated Carbon	5712	1
DHDS Unit	Isotherming Catalyst	318325	2
	Claus reactor Alumina Catalyst	26570	3
	CBA Reactor Alumina Catalyst	26128	3
	Catalyst Support	6080	3
FCCU-I	Alumina Silica Zeolite Catalyst	85000	Shelf life: 2 yrs
FCCU-II	Alumina Silica Zeolite Catalyst	175000	Shelf life: 2 yrs
IOH	Nickel-Molybdenum	2960	3
	Catalyst Guard Bed	83	3
SEU-I	Nickel Molybednum Guard Bed	897000	1
	Nickel-Molybednum	11100	3
SEU-II	Nickel Molybednum Guard Bed	1032	3
	Nickel-Molybednum	10836	3
SEU-III	Nickel Molybednum Guard Bed	2064	3
	Nickel-Molybednum	21762.3	3
LOUP	Co-Mo/Ni-Mo	55878	4

	Isomerisation Catalyst	30203	4
	Hydro Finishing Catalyst	13115	4
	Catalyst Support	42532	4
Utilities	Activated Charcoal	46107	3
	Cationic/Anionic Resin	176866	5/10
LEU	Activated Charcoal	99000	3

1.3 Baseline data collection

The baseline data forms the basis for predicting/assessing the environmental impacts of the proposed project. The data has been collected around refinery site during the period of March, 2015 – May, 2015 by M/s Pragathi Labs Pvt. Ltd, Hyderabad which is MoEF approved environmental laboratory. The baseline data for various environmental components related Ambient Air Quality, Water Quality, Noise Level, Traffic, Soil, Meteorology and Socio-Economic Data were monitored and collected in an area of 10 km radius from the plant site.

Air Environment

A network of six ambient air-sampling locations has been selected for assessment of the existing status of air environment within the study zone. Measurement of the actual PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, NH_3, VOC, HC and non methane, Benzene, VOC, Nickel, vanadium, Benzo Pyrene levels were measured and analyzed. It has been observed that the 98th percentile concentrations of PM_{10} ranging from 70 to 126 µg/m^3. Minimum concentration is recorded at Mahul village (40 µg/m^3) where man made activities are comparatively less than other stations. Maximum concentration is found at Gawanpada (128 µg/m^3) followed by HPCL Colony west (112 µg/m^3) and HPCL Terminal Wadala (112 µg/m^3). The 98th percentile concentration of $PM_{2.5}$ ranges from 24 to 65 µg/m^3. Minimum concentration is recorded at Mahul village (14µg/m^3). Maximum concentration is found at Gawanpada (65 µg/m^3). The concentration of $PM_{2.5}$ is found to be well within the NAAQS limit of $PM_{2.5}$ (60 µg/m^3) at all locations except Gawanpada (65 µg/m^3).

The 98th percentile concentration of SO_2 ranges from 10.9 to 25.2 µg/m^3. Minimum concentration was recorded at HPCL Terminal Wadala (6.0 µg/m^3). Maximum concentration of 26.5µg/m^{3}is found at Gawanpada which could be attributed to Heavy movements of Oil tanker vehicles and nearby thermal power plant activities. All the maximum results monitored at 6 sampling stations were found to be below NAAQS. (80 µg/m^3)

The 98thpercentile concentration of NO_2 ranges from 19.5 to 33.5 µg/m^3. Minimum concentration is recorded at Mahul village (11.5 µg/m^3) where vehicular moment comparatively very less. Maximum concentration is found at Gawanpada (34.2 µg/m^3) which may be attributed due to release of emissions from the diesel vehicles moving from the Oil refineries. The concentration of $NO_{2v}$is found to be well within the NAAQS limits (80 µg/m^3) at all monitoring locations.

The 98th percentile concentration of CO ranges from 0.96 to 1.27 mg/m^3. Minimum concentration is recorded at HPCL Terminal Wadala (0.17 mg/m^3) where man made activities are comparatively less. Maximum concentration is found at Gawanpada (1.18 mg/m^3).The major cause of CO emissions is regular vehicular moments at HPCL, BPCL and IOCL refineries for filling tankers. The concentration of CO is found to be well within the NAAQS limits (2 µg/m^3).

The 98th percentile concentration of Hydrocarbons (Methane) ranges from 1.18 to 3.39ppm. Minimum concentration is recorded at HPCL Colony East with the concentration of 0.66

ppm, where as maximum concentration is recorded at HPCL Terminal Wadala with the concentration of 3.42 ppm.

The 98th percentile concentration of Hydrocarbons (Non-Methane) ranges from 0.94 to 12.76 ppm. Minimum concentration was recorded at HPCL Colony West with the concentration of 0.72 ppm, where as maximum concentration was recorded at Mahul village with the concentration of 13.62 ppm respectively.

The 98th percentile concentration of Benzene ranges from 0.94 to 2.85 µg/m^3. Minimum concentration was recorded at HPCL Colony East with the concentration of 0.60 µg/m^3, where as maximum concentration was recorded at HPCL colony west and Gwanpada with the concentrations of 2.98 µg/m^{3}followed by HPCL Terminal Wadala (2.36 µg/m^3) respectively. The maximum concentration is attributed due to vehicular emissions and oil storage terminals occurred at the HPCL Terminal Wadala.

The 98th percentile concentration of Benzo (a) pyrene ranges from 0.32 to 1.41 ng/m^3. Minimum concentration was recorded at HPCL Colony East with the concentration of 0.10 ng/m^3, whereas maximum concentration was recorded at HPCL Terminal Wadala with the concentrations of 0.98 µg/m^3 followed by Prayagnagar (1.46 ng/m^3) respectively. The maximum concentration is attributed due to vehicular emissions and Oil storage terminals occurred at the HPCL Terminal Wadala.

The 98th percentile concentration of VOC ranges from 22.1 to 72.54 µg/m^3. Minimum concentration was recorded same (15.0 µg/m^3) both at Mahul village, whereas maximum concentrations were recorded at Gawanpada with the concentration of 73.0 µg/m^3. VOC emissions could be attributed due to vehicular moments and evaporative loss of liquids generated from fuel storage tanks surrounding to the refinery.

Nickel was detected only 4 locations. The 98th percentile concentration of Nickel ranges from 2.76 to 9.40 ng/m3. Minimum concentration was recorded at HPCL Colony East (1.20 ng/m^3), where as maximum concentration was recorded at Prayagnagar with the concentration of 9.40 ng/m^3.

Vanadium is detected only at two locations: Gawanpada and Prayagnagar**.** At remaining other locations, it has been found to be Below Detectable Limit (BDL).

Water environment

Water samples were collected at 3 locations for ground water and 3 locations for surface water sources. The pH of the ground water samples varies from 7.23 to 7.69. Total dissolved solids observed between 184 and 1405 mg/l. Maximum TDS was observed at Gawanpada village, which is exceeding desirable limit (1405 mg/l).TDS values for all the ground water samples were within the permissible limits (2000 mg/l).

Hardness values are ranging from 108 to 834 mg/l. Results are slightly exceeding the permissible limits.

Chlorides concentrations are ranging from 35 to 530 mg/l. It was observed that maximum all the locations of ground water is slightly saline in nature.

Sulphates concentration was observed in the range of 8 to 38 mg/l. Maximum sulphate concentration was observed at Gawanpada village, which is well within the desirable limits (200 mg/l).

Noise environment

Noise levels have been monitored at four different points within the study zone. The hourly noise levels were within the stipulated level of 55 dB. The noise levels were within the stipulated level of 45 dB in night time.

Noise levels during night time ($L_{night.}$) ranges from 41.5 to 43.2 dB(A).Noise levels during day time ($L_{day.}$) ranges from 51.7 to 54.3dB(A). The minimum noise levels 41.5 dB(A) is recorded at Prayagnagar which may be due to minimal domestic activities. It is also observed that higher noise levels are recorded during day time at Gawanpada (54.3 dB(A)). This may be due to industrial activities and regular vehicular movements occurred in the respective area.

Land environment

Four sampling sites were selected to understand physico-chemical and biological status of the soil.

- The texture of the soil is mostly Sandy clay loam. Soil particle size directly involves in deciding soil texture, porosity and infiltration capacity.
- The bulk density of the soil is varied from 1.6 to 2.6 g/cc. Its shows the infiltration rate is medium.
- The pH of the soils is varied from 6.1 to 6.22 shows basic in nature.
- The EC levels are average and not harmful to germination.
- The nitrogen levels found to be satisfactory as it ranges 0.08 to 0.18 kg/ha.
- Phosphorus level found to be medium where as Potassium is found to be deficient in soils and demands fertilization.

Biological environment

The study was aimed at enumeration of the available flora and fauna resources and obtaining a broad representation of the existing floristic variations in and around the proposed project site. A total of 134 species of plants (including wild, ornamental and cultivated plants) belonging to 108 genera and spreading over 53 plant families were documented and identified in the 10 km radial distance from the proposed project site of the study area. Altogether 19 species of mangroves and their associates were enumerated and identified on field. A total of 30 bird species belonging to 18 families are recorded in the study area. There are 14 butterfly species belonging to 5 families which were identified in a random survey around the study area. Several species of fishes are available in the mangrove water and collected by local fisherman. 5 species of snakes, one species of lizards and 2 types of skinks.

No National Park and Wildlife Sanctuary is coming within 10 km surrounding of the study area. Mahul creek is a shallow wetland area where lots of birds were seen in winter season.

Socio-economic environment

Socio economic survey is necessary in any EIA/EMP report to predict the changes on social and economic status in its study area. Hence baseline data for demographic characteristics, education, health, amenities and sensitive locations have been studied existing in and around the study area.

The study area of Mumbai city is an industrial base for sectors having many industries such as Chemicals, Paints, Petrochemicals, Fertilizer industries, Thermal power plant and food processing industries. The most important sectors are the Petrochemicals industries. The

major languages prevalent are Marathi, Hindi and English with a conglomeration of different cultures like Hindus, Muslims and Christians.

1.4 Anticipated Environmental Impacts and Mitigation measures

1.4.1 Air Environment

Potential emissions sources during construction phase include the following:

- Site preparation and civil works
- Storage and handling of construction material (e,g. sand, cement) at proposed project site.
- Operation of temporary Diesel Generator (DG) sets
- Movement of vehicles carrying equipment, construction material and project-related personnel

Mitigation Measures

- Ensuring preventive maintenance of vehicles and equipment.
- Ensuring vehicles with valid Pollution under Control certificates are used.
- Avoiding unnecessary engine operations.
- Implementing dust control activities such as water sprinkling on unpaved sites.
- Controlled vehicle speed on site
- Ensuring vehicle are covered during transportation of material

1.4.2 Noise Environment

The main sources of noise during construction will be:

- Site preparation.
- Civil works
- Heavy equipment operations
- Transportation of construction material

Mitigation Measures

- Ensuring preventive maintenance of equipments and vehicles.
- Avoiding unnecessary engine operations (e.g. equipments with intermitted use switched off when not working).
- Ensuring DG sets are provided with acoustic enclosures and exhaust mufflers.

During operational phase of the proposed project, the noise shall be caused due to various rotating equipment viz. Pumps, Compressors & Mixers, Cooling Tower etc.

Mitigation Measures

- Avoiding continuous (more than 8 hrs) exposure of workers to high noise areas.
- Provision of ear muffs at the high noise areas
- Ensuring preventive maintenance of equipment.

1.4.3 Water Environment

During construction phase, raw water will be required for the following purposes:

- Civil works (such as concrete mix preparation, curing etc)
- Hydro testing (of tanks and associated piping)

- Domestic use (such as drinking water for workers, washing etc.)
- Water sprinkling on site for dust abatement

The effluent streams that will be generated regularly during construction stage include the following:

- Sewage and grey water from work sites
- Cleaning and washing water for vehicle and equipment maintenance area.

During construction, waste materials would contribute to certain amount of water pollution. But these would be for a short duration. All liquid waste will be collected and disposed to identify water impoundment within the construction site.

Mitigation Measures

- Monitoring water usage at work sites to prevent wastage.

During Operation phase, for existing refinery facilities, total raw water from BMC shall be 426 m^3/hr. Raw water required post expansion is 112 m^3/hr which will be met from the allocated quantity of refinery.

Mitigation Measures

- Installation of rainwater harvesting structures to collect and use rainwater, thereby reducing abstraction.
- Developing the possibility for increasing the amount of treated effluent from IETP.

1.4.4 Land Environment

The impact on land environment during construction phase shall be due to generation of debris/construction material, which shall be properly collected and disposed off. However, being the modifications limited to few units and two new units, the generation of such waste shall be minimal.

Mitigation Measures

- Restricting all construction activities inside the project boundary.
- Ensuring the top soil is not contaminated with any type of spills.
- Ensuring any material resulting from clearing and grading should not be deposited on approach roads, streams or ditches, which may hinder the passage and/or natural water drainage.
- Developing project specific waste management plan and hazardous material handling plan for the construction phase.

The impact on land environment during operational phase shall be due to disposal of solid and hazardous waste generated during operation of the plant.

Mitigation Measures

- Disposing of hazardous wastes to vendors authorized by the concerned statutory authorities.

1.4.5 Biological Environment

The proposed facilities are to be developed within the available area of the existing refinery.

This area is a graded land without any vegetation. The project site does not harbor any fauna of importance. Therefore, the impact of construction activities on fauna will be insignificant.

Mitigation Measures:

- Closing of trenches as soon as possible of construction.
- Prevent littering of work sites with wastes, especially plastic and hazardous waste.
- Training of drivers to maintain speed limits.

The impacts due to proposed project activities during operation phase shall be limited to long run impact of emissions and traffic movement.

Mitigation measures

- Maintain the greenbelt already developed will be continued.
- Plant additional trees during operation phase.

1.4.6 Socio-economic Environment

The construction phase is expected to span for three years. During this phase, the major socio-economic impact will be in the sphere of generation of temporary employment of very substantial number of personnel. Transport requirements will arise during the construction phase due to the movement of both the personnel and materials. Transport of the managerial personnel is likely to increase the vehicular traffic on the roads connecting the proposed site to the city. The incremental traffic for the additional people would be about 50 cars.

The transport of construction materials to the project site will result in increased traffic in the impact area. The incremental daily traffic during construction phase works out to be about 20 cars and 6 buses per day. The majority of skilled and unskilled labourers are available in the impact area itself, the incremental effect on housing during the construction phase will be minimal. But, during the working hours of the day, the demand for food, water, sanitation and health facilities at the construction site will go up.

Mitigation Measures

- Conducting awareness programmes for workers.
- Monitoring speed and route of project-related vehicles
- Determining safe, legal load limits of all bridges and roads that will be used by heavy vehicles and machinery.
- Determining allowable traffic patterns in the affected area throughout the work week will be made based on community use, include a consideration of the large turning requirements of certain vehicles/machineries that might increase congestion and traffic hazards
- Consolidating deliveries of materials and personnel to project sites, whenever feasible, to minimize flow of traffic
- Minimizing interruption of access to community for use of public infrastructure
- Providing prior notice to affected parties when their access will be blocked, even temporarily.
- Preventing use of drugs and alcohol in project-sites
- Preventing possession of firearms by project-personnel, except those responsible for security.

Operational phase of the plant covers the entire life span of the plant. Hence the impacts of the operational phase extend over a long period of time. Transport requirements will arise due to the movement of both the personnel and materials. There shall be increase in additional load on traffic due to transport of personnel. The incremental traffic during the operational phase works out to be about 3 buses per day.

Mitigation Measures

- Extending reach of CSR Program
- Monitoring speed and route of project-related vehicles

1.5 Environmental Monitoring Programme

The proposed environmental monitoring program during both construction and operation phases of the project are given in Table 7 and Table 8 below:

Table 7: Environmental monitoring program (construction phase)

Sl. No.	Component	Location	Parameters	Frequency
Air Environment				
1.	Ambient air quality	Monitoring at existing continuous ambient air quality monitoring stations.	Ambient air quality parameters as per NAAQS viz. PM_{10}, $PM_{2.5}$,SO_x, NO_x, CO, VOCs, Benzene, Benzo pyrene, Nickel, Vanadium	As per existing practice.
Water Environment				
1.	Drinking Water quality	One of the drinking water taps	According to IS:10500	Once in a Month
Land Environment				
1.	Waste (including hazardous)	Construction sites	Quantity/ volume generated and disposed	As per requirement.
Noise Environment				
1.	Ambient noise levels	Near construction sites	Ambient noise levels (L_{eqday} & $L_{eqnight}$)	Once in a month

Table 8: Environmental monitoring program (operation phase)

Sl. No.	Component	Details	Frequency
Air Environment			
1	Stack emission characteristics	Monitoring at all stacks for PM, SOx, NOx and HC	Online analyzers shall be installed as per the existing practices
2.	Ambient air quality	Monitoring at existing continuous ambient air quality monitoring stations for PM_{10}, $PM_{2.5}$,SOx, NOx, VOC and HC	Existing practice will be continued.
Water Environment			
1.	Effluent quality	From treated effluent	Once in a month

Sl. No.	Component	Details	Frequency
		discharge	
Land Environment			
1.	Waste (including hazardous)	Quantity/ volume generated and disposed at units	As per requirement
Noise Environment			
1.	Source noise emissions	Noise level monitoring in dB(A) near pumps, compressors, GTGs and DGs installed as part of the proposed project	Once in a month
2.	Ambient noise levels	Ambient noise levels (Leq day &Leq night) at units	Once in a month

1.6 Environmental Management Plan

Air Environment

Construction phase (Impact significance: Medium)

- Ensuring preventive maintenance of vehicles and equipment.
- Ensuring vehicles with valid Pollution under Control certificates are used.
- Avoiding unnecessary engine operations.
- Implementing dust control activities such as water sprinkling on unpaved sites.
- Controlled vehicle speed on site
- Ensuring vehicle are covered during transportation of material

Operation phase (Impact significance: Medium)

- Developing green belt in the proposed new premises.
- Ensuring preventive maintenance of equipment.
- Regular monitoring of air polluting concentrations.
- Provision of Low NOx burners is envisaged in all furnaces.

Water Environment

Construction phase (Impact significance: Consumption of water-Low, Generation of effluent - Low)

- Monitoring water usage at work sites to prevent wastage.

Operation phase (Impact significance: Consumption of water - Medium, Generation of effluent - Medium)

- Installation of rainwater harvesting structures to collect and use rainwater, thereby reducing abstraction.
- Developing the possibility for increasing the amount of treated effluent from IETP.

Land environment

Construction phase (Impact significance: Land use & topography - Low, Soil quality - Low)

- Restricting all construction activities inside the project boundary.
- Ensuring the top soil is not contaminated with any type of spills.
- Ensuring any material resulting from clearing and grading should not be deposited on approach roads, streams or ditches, which may hinder the passage and/or natural water drainage.
- Developing project specific waste management plan and hazardous material handling plan for the construction phase.

Operation phase (Impact significance: Soil quality - Low)

- Disposing of hazardous wastes to vendors authorized by the concerned statutory authorities.

Noise environment

Construction phase (Impact significance: Low)

- Ensuring preventive maintenance of equipments and vehicles.
- Avoiding unnecessary engine operations (e.g. equipments with intermitted use switched off when not working).
- Ensuring DG sets are provided with acoustic enclosures and exhaust mufflers.

Operation phase (Impact significance: Medium)

- Avoiding continuous (more than 8 hrs) exposure of workers to high noise areas.
- Provision of ear muffs at the high noise areas
- Ensuring preventive maintenance of equipment.

Socio-Economic environment

Construction phase (Impact significance: Low)

- Conducting awareness programmes for workers.
- Monitoring speed and route of project-related vehicles
- Determining safe, legal load limits of all bridges and roads that will be used by heavy vehicles and machinery.
- Determining allowable traffic patterns in the affected area throughout the work week will be made based on community use, include a consideration of the large turning requirements of certain vehicles/machineries that might increase congestion and traffic hazards
- Consolidating deliveries of materials and personnel to project sites, whenever feasible, to minimize flow of traffic
- Minimizing interruption of access to community for use of public infrastructure
- Providing prior notice to affected parties when their access will be blocked, even temporarily.
- Preventing use of drugs and alcohol in project-sites

- Preventing possession of firearms by project-personnel, except those responsible for security.

Operation phase (Impact significance: Low)

- Extending reach of CSR Program
- Monitoring speed and route of project-related vehicles

1.7 Risk Assessment

Rapid Risk Assessment involves identification of various potential hazards & credible failure scenarios for various units and other facilities including off-site storages & pumping, etc., based on their frequency of occurrence & resulting consequence. Basically two types of scenarios are identified spanning across various process facilities; Cases with high chance of occurrence but having low consequence, e.g., Instrument Tapping Failure and cases with low chance of occurrence but having high consequence, e.g., Catastrophic Rupture of Pressure Vessels / Large Hole on the outlet of Pressure Vessels. Effect zones for various outcomes of failure scenarios (Flash Fire, Jet Fire, Pool Fire, Blast overpressure, toxic release, etc.) are studied and identified in terms of distances on plot plan. Based on effect zones, measures for mitigation of the hazard/risk are suggested.

The major credible failure scenarios are modeled in terms of hydrocarbon release rate, dispersion, flammability & toxic characteristics and detailed consequence analysis of the outcome is presented in the Rapid Risk Analysis (RRA) report. The summary of major observations & recommendations of RRA study for new proposed process units & existing process units undergoing revamp (modifications) under Refinery Expansion Project are summarized below.

APS operator cabin is under affect zone of 5 & 3 psi blast overpressure waves of high frequency credible failure scenarios in APS unit. The operator cabin personnel need to be shifted to safe location or to be accommodated within blast resistant DIDC control room.

Depending upon the prevalent weather conditions at the time of release, Administrative building & its Annex buildings and Workshop may get affected by explosion & toxic outcomes in the event of realization of high frequency credible failure scenarios in NHT/CCR. It is recommended to ensure hydrocarbon & toxic gas detectors at appropriate locations within the unit and detailed mitigating procedures are available as a part of the Disaster Management Plan (DMP) & Emergency response procedures (ERP).

Fire tender bays and store of Fire & Safety Building are under direct affect zone of the high frequency credible failure scenarios of NHDT/ISOM unit. It is recommended to relocate the fire tender bays to a safe place. Also, it is recommended to add an auxiliary fire station at safe location, to cater post expansion fire & safety requirements.

In the event of high frequency failure scenario in DHT unit (instrument tapping failure at Charge Pumps) storage tank TK-111 located on east side of the unit may get affected by the 5 psi blast overpressure wave, depending upon the prevalent weather condition and presence of ignition source at the time of release. It is recommended to minimize the traffic on road between DHT and dyke containing Tanks (TK-110/111/112/113) and ensure adequate number of hydrocarbon detectors is placed at suitable locations within the unit for early leak detection and inventory isolation.

New Proposed HGU is surrounded by Class-A storage tanks from three sides. In the event of realization of credible high frequency failure scenario in Naphtha/LPG handling section, storage tanks in adjacent dykes may get affected and lead to possible domino effects. It is recommended to locate Naphtha & LPG handling section of the HGU towards northern side

(DHT side) in the proposed plot. However, affected tankage/s if any, needs to be either relocated or the service of the tanks needs to be changed to Class-C/B service, to downscale the hazard.

Explosion & radiation effects for credible high frequency failure scenarios for the Fractionator overhead & stabilizer section of VBU are modelled & it is observed that affect zone shall extend beyond the unit's B/L and may affect the storage tanks in nearby dykes. It is recommended to locate Fractionator overhead & stabilizer section of the VBU towards eastern side in the proposed plot.

The scenario of Diesel Tank on Fire in the Offsite area is modeled and it is observed that 8 Kw/m^2 radiation intensity in the event of Pool Fire may affect the nearby Diesel tank/s, leading to possible failure of tank. Hence, it is recommended to provide necessary active fire protection for the Diesel tanks and adjacent VGO Feed tanks.

Explosion & radiation effects for credible high frequency failure scenarios for Diesel Feed Pump are modeled and it is observed that the 8 Kw/m^2 Pool Fire radiation intensity and 8 & 32 Kw/m^2 Jet Fire radiation intensity may affect the project ware house. It is recommended to shift the project ware house from its present location.

Outcomes of the low frequency credible failure scenarios for various units (APS, NHT/CCR, NHT/ISOM, Prime-G, DHT, HGU, VBU and VPS) are recommended to be included for updation of the existing Disaster Management Plan (DMP) & Emergency Response Plan (ERP). Adequate number of hydrocarbon/ toxic detectors to be ensured at suitable locations within these units for early leak detection and inventory isolation.

1.8 Project Benefits

Contribution to National Energy Security

India has been witnessing rapid urban and industrial growth in the past two decades, and with the country's current liberalization policy, this growth is expected to accelerate further. As a consequence of the rapid rate of industrialization in India, petroleum products needs are increasing at an equally rapid rate and the supply-demand gap is widening and steps must be taken to address this issue. The proposed project will result in the supply of increased volumes of petroleum products to meet the energy security of the country.

Socio-Economic Development

- The proposed project would generate some direct and indirect employment opportunities during construction and operation phases, which will benefit the local economy. Improvement in the overall socio-economic status of the vicinity of project area, in the thematic areas of health, education, livelihood and infrastructure is expected.
- Social Development is an important component of any project taken by HPCL. An understanding of society is essential in helping people meet their social needs - food, water, shelter, health, knowledge, skills and physical and emotional security. How people define such needs and the priority and value they give to them varies tremendously, not only from one country to another, but between different groups of people. A starting point for establishing appropriate and sustainable social services should be an analysis of how individuals, families and communities organise themselves in society to meet their needs as they define them. These facts have been already been noticed by HPCL and same are being focused while carrying out the development programmes in nearby areas. Post

expansion, Euro-IV & V grade MS and HSD products shall be produced. This will result in overall environmental quality improvement.

- Increased local community activity, especially during the construction phase, when new families become established in the area requiring education, health and commercial services.
- Contribution to local training and employment programmes for employees, including dedicated local indigenous training programmes.
- Added stimulus to the state's business sector, including manufacturing, construction, transport, engineering and related consultancies as a result of the project.
- Savings in foreign exchange and subsidy for the Government of India.
- With no current capacity in the region, the plant will meet the needs of a core market – customers, in doing so; it will reduce region's reliance on imports.