INTRODUCTION

1.0 INTROUCTION

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 hydro-treating 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 install a Propylene Recovery Unit (PRU) and implement Captive Power Plant (CPP) revamp project inside Mumbai Refinery. HPCL entrusted the task of carrying out Environmental Impact Assessment (EIA) and Risk Assessment (RA) studies to M/s Engineers India Limited (EIL) for obtaining Environmental Clearance. EIL is an accredited consultant in Category 'A' projects for carrying out EIA studies by Quality Council of India in Refinery Sector.

Overall plot plan of Mumbai refinery including Propylene Recovery Unit and Captive Power Plant Revamp units is provided in Annexure I.

1.1 IDENTIFICATION OF PROJECT AND PROJECT PROPONENT

Mumbai Refinery of Hindustan Petroleum Corporation Limited is located at Mahul, Survey No 234/482, Chembur, Mumbai Suburban district, Maharashtra. The refinery was commissioned in 1955 and has been revamped up to 7.5 MMTPA with the addition of new units over the last four decades. The refinery is going to expand its capacity to 9.5 MMTPA under Mumbai refinery expansion project.

1.2 COST OF PROJECT AND TIME OF COMPLETION

Total cost of the PRU and CPP revamp projects are estimated at Rs.242.45 crores and Rs.380 crores respectively. The anticipated time for completion of both the projects is 24 months from the date of the Environmental Clearance (EC).

1.3 JUSTIFICATION OF THE PROJECT AND BENEFIT

A market assessment study has been carried out and the same establishes that the quantity of chemical grade propylene produced in India is not enough to meet the domestic requirement. As a result India has to rely on import. In coming years many consumers of chemical grade propylene are looking to expand their production capacity. Therefore, it is expected that the demand for chemical grade propylene is expected to rise over the next decade.

The CPP revamp project is envisaged as a combined cycle gas turbine plant with natural gas (RLNG) & Naphtha as fuel. The gas turbines proposed for the power station will have the benefits of clean fuel, marginally higher output, higher availability, efficiency and environmental friendly exhaust gases.

1.4 PROJECT PROPONENT

1.4.1 Address of the Project Proponent

The correspondence address of the project proponent is:

Mr. A.B. Chattopadhyay (DGM-Projects),
Hindustan Petroleum Corporation Limited,
Mumbai Refinery,
P. O. Box. No. 18820,
B D Patil Marg,
Mahul, Mumbai – 400 074,
Maharashtra, India
Tel: +91-22-25077024, 25534707
Website: www.hindustanpetroleum.com
Email: abchattopadhyay@hpcl.in

1.4.2 Particulars of EIA Consultant

The EIA consultant is Engineers India Limited accredited in Refinery sector (Category A) by NABET/QCI. The complete address for correspondence is given below:

Mr R.B. Bhutda
Head-Environment, Water & Safety Division
Engineers India Limited
Research & Development Complex, Sector-16, On NH-8
Gurgaon – 122001, Haryana
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1.5 SCOPE OF EIA STUDY

The objectives of prescribed TOR for preparation of EIA study are as follows:

- To establish environmental setting of the project in terms of site details, project description, products/chemicals its storage, safety measures and precautions taken during storage and transportation, pollution control devices/measures, emission summary, hazardous waste/chemicals management etc.
- Establish existing environmental status for the period of 3 months (except monsoon season) for meteorology, air quality, water quality, noise, soil, ecology and Socio-economic aspects.
- Prediction and evaluation of the environmental impacts that may result from project development.
- Outline the Environmental Management Plan (EMP) to mitigate the negative impacts, if any.
- Risk assessment study.

1.6 MoEFCC APPROVED TERMS OF REFERENCE FOR EIA

Project proposal for issue of Terms of Reference (TOR) for EIA report was considered in the 4th meeting held during 11-12th February, 2016. The Expert Appraisal Committee (EAC) of MOEFCC discussed the project details, utility requirements and about the

presentation given by the project proponent. After detailed deliberations, the EAC suggested merging of 'PRU and CPP revamp' project with Mumbai Refinery Expansion Project (MREP) and the Terms of Reference of MREP will be amended accordingly. The Committee indicated that the Public Hearing of both these projects to be combined. The Project Proponent informed the EAC that the public hearing application of MREP has already been submitted to Maharashtra Pollution Control Board (MPCB). The EAC agreed that basis on the short synopsis of EIA & RRA report for 'PRU & CPP revamp' project; Project Proponent can go ahead for a combined public hearing.

2.0 PROJECT DESCRIPTION – FACILITIES

2.1 PROPYLENE RECOVERY UNIT

The process facilities for the PRU consist of (i) Unit facilities & Offsite facilities and (ii) Dispatch facilities.

2.1.1 Unit Facilities

In order to meet tight product specifications with respect to C2s, a three columns configuration has been selected for the process facilities which consist mainly of Debutaniser, De-ethaniser, Propane – Propylene Splitter columns with associated equipments & S-Guard bed. Flare KOD is also considered in ISBL.

As it was confirmed that the existing sea cooling water system is not having extra capacity to meet the cooling water demand of PRU hence a new cooling tower of 2500 m^3/hr capacity is proposed and to be installed near DHT Cooling Tower (Approx distance 2 km from PRU) along with 2 Cooling water circulation pumps (Rated capacity: 2500 m^3/hr, 1 Working + 1 Standby).

2.1.2 Offsite Facilities

Two existing mounded bullets (Storage Capacity: 1768 m^3 each), designed for LPG/propylene are to be used to store propylene product from PRU unit. Three (2 operating + 1 standby) new loading pumps are considered to load the propylene in tankers.

2.1.3 Dispatch Facilities

Existing marketing terminal facility which is located just outside the Refinery shall be used to load the propylene in tanker trailers. There shall be dedicated header with 2 modified/new loading arms for 2 shift operation (16 hours) for Propylene loading. The Propylene tanker storage capacity of 18 ton is envisaged for dispatch of propylene. A vapour balance line of 4" from tanker loading to propylene bullets is considered.

2.1.4 Utilities and Chemicals

The major utilities needed for the PRU are:

(i) Cooling Water for distillation columns condensers, C4 LPG coolers and Propylene product coolers.

(ii) LP steam for the columns' re-boilers and power for the pumps. Normal Consumption of these utilities is:

- LP Steam : 41.2 T/hr

- Cooling Water : 2125 m^3/hr
- Power : 600 KW (415 V LT) + 622 KW (6.6 KV HT)
- S-Adsorbents : 1 Working + 1 hot-standby arrangement*

*Hot standby means that the two beds shall be in lead - lag operation. One bed life is expected around 6 months.

LP steam for the PRU shall be met from the existing boilers located close to the PRU. Cooling water requirement shall be met from new sea cooling water system proposed near DHT Cooling tower (approx. distance 2 km). Other utilities such as plant air, Instrument air, service water etc. shall be tapped from the nearby headers (250 m distance from PRU).

2.1.5 Blow Down and Flare

The governing case for the blow down into flare header from the PRU unit is cooling water failure case. The total flare load for this case is 322 tons/hr. A unit flare knockout drum is provided for this purpose and flare from the knock out drum joins the existing refinery flare header nearby PRU unit.

2.1.6 Propylene Storage

The cracked LPG shall directly come from LPG Treating Unit and shall be fed into the PRU through a feed surge drum without considering any intermediate storage. A line shall be laid down from PRU to existing bullets for storage of products.

2.1.7 By-Products-LPG Return to existing Bullets

De-butanizer bottom and Propane/Propylene splitter bottom are rich in Propane & C4+ which is considered as the by-product of PRU. These bottom streams (Propane and C4+) shall be routed to LTU unit where these shall be mixed with existing LPG stream to LPG Bullets.

2.2 PRU PRODUCT AND SPECIFICATIONS

- Product Name : Propylene
- Design Flow rate : 100 KTPA (approx.), based on 95% recovery
- Yield of Propylene : Min. 95 % wt of Propylene in LPG feed (for Design case, recovery for other cases shall be checked)

Product Propylene will be stored in existing Mounded Bullets. The product specifications of propylene are given below.

Sr. No	Parameter	Specification
1	Total C1 + C2	0.1 wt% max
2	Propylene	95 % wt min
3	C4	1000 ppmw max
4	Carbon Dioxide	0.1 wt% max
5	Total Sulphur	5 ppmw max
6	Free Water	1000 ppmw max
7	Methyl-acetylene, Propadiene, Allene, Butylene, Butadiene	5 ppmw max

The total 8000 on-stream hours/annum are considered for this study.

2.3 PROCESS DESCRIPTION - PRU

The feed to the PRU shall be cracked LPG from the two FCCUs (old and new) after treatment in LPG treatment unit. The PRU shall be designed to produce approximately 100000 TPA of 95 wt. % pure chemical grade propylene from cracked LPG streams (95% recovery of propylene from the Feed).

Cracked LPG stream is a mixture of propane, propylene, butane and butylene with some amount of C2 and C5 hydrocarbons. Cracked LPG is treated in the LPG Treating Unit (LTU) for removal of sulphur impurities and shall then be routed to PRU for recovery of propylene. The above LPG from LTU is received in Feed surge drum.

The pressure of the feed surge drum is set at 10.7 kg/cm^2 (g), which is higher than the vapour pressure of the feed stream. The pressure of the feed surge drum is maintained by split range control, opening either to fuel gas/FCCU or allowing vapours of Debutanizer reflux drum to sustain the set pressure.

Cracked LPG from the feed surge drum is pumped by feed pumps to Debutanizer column through the feed / bottom exchanger under flow control with low level override by feed surge drum level control. The column shall have 55 trays and the feed shall be introduced on 20th tray. The column design has been optimized so as to have reasonable size of column and exchangers (condenser & re-boiler duties). Feed forward control scheme is selected whereby the feed is analyzed for ethane, propylene & propane contents and the input along with the feed flow rate is manipulated in a controller block which provides input to Debutanizer re-boiler steam inlet flow controller. Higher amount of C4' s have been allowed to creep into the column overhead product resulting into lower condenser / re-boiler duties and lower vapour flow in the column. The overhead product is cooled in the overhead condenser and routed to the reflux drum. Column pressure is controlled by pressure control valve located between the column and the condenser. The reflux and the overhead product are pumped by overhead pump to column and De-ethaniser column respectively. The reflux flow is maintained by flow controller cascaded with temperature controller located on the 49th tray. The reflux drum pressure is controlled by hot vapour by-pass under PDIC control (in case of low pressure) or by releasing the vapours to fuel gas system (in case of high pressure).

The re-boiler for the column is a vertical thermo-syphon type with LP steam as the heating medium. The re-boiler duty is controlled by the flow controller located in the LP steam line which gets advance input from controller block based on ethane, propylene & propane contents in the feed and feed flow rate. The condensate is routed to the condensate recovery system. The bottom product from column which is the lean LPG, exchanges heat with the feed in exchanger and is then cooled to 40°C in the product cooler and routed to the LPG pool under flow control cascaded with column bottom level control. Vapour product from reflux drum shall be routed to FCCUs during normal operation & fuel gas header when FCCUs are under shutdown.

The overhead product from column reflux drum is pumped to De-ethaniser column under flow control cascaded with De-butanizer reflux drum level controller. The column shall have 58 trays and the feed shall be introduced on 10th tray for Case 1 & Case 3. For Case 2, feed shall be fed onto 20th tray. The column is essentially required to ensure propylene product specifications with respect to C2 contents and shall have only vapour product from the reflux drum. Vapour product from reflux drum contains substantial amount of C3s (124 kg/hr out of 291 kg/hr for design case & 636 kg/hr out of 1104 kg/hr & 98 kg/hr out of 233 kg/hr for check cases) and therefore shall be routed to FCC Unit during normal operation for further recovery of same. During shutdown of FCCUs, vapour product shall be routed to Fuel Gas header. The overhead pressure of the column shall be controlled by pressure

control valve located in the overhead vapour product. The reflux to the column is generated in the heat exchanger and is routed to the reflux drum. The reflux to the column is pumped by pump and the flow is maintained by flow controller cascaded with reflux drum level controller.

The re-boiler for the column is a vertical thermo-syphon type with LP steam as the heating medium. The re-boiler duty is controlled by the flow controller located in the LP steam line which gets advance input from controller block based on ethane, propylene & propane contents in the feed and feed flow rate. Additionally a selector switch is provided to select between the calculation block and temperature signal from tray 1. This control scheme is provided since the column is operating at high pressure which is close to critical pressure. The condensate is routed to the condensate recovery system. The bottom product from column which is mainly the stream containing propane and propylene is routed to Propane-Propylene splitter column under flow control cascaded with column bottom level controller.

During actual operation, if it is felt that product specifications with respect to C1+C2s can be adjusted to accept higher quantities of these components, then there is a potential to by-pass this column and save on energy consumption.

The Propane-Propylene splitter column has 116 trays with the feed being introduced at 50th tray. The overhead product is cooled in the overhead condenser and routed to the reflux drum. Column pressure is controlled by pressure control valve located between the column and the condenser. The reflux and the overhead product are pumped by overhead pump to column and existing LPG bullets respectively for storage. The reflux flow is maintained by flow controller and the propylene product withdrawal is under flow control with reflux drum low level override. The reflux drum pressure is controlled by hot vapour by-pass under PDIC control (in case of low pressure) or by releasing the vapours to the FCCUs during normal operation & fuel gas header when FCCUs are under shutdown (in case of high pressure).

The re-boilers for column are horizontal thermo-syphon type with LP steam as the heating medium. The re-boiler duty is controlled by the flow controller located in the LP steam line cascaded with temperature controller at 1st tray of Propane-Propylene splitter column. The condensate withdrawal from the condensate pot is on level control cascaded with condensing pressure in the re-boiler. The condensate is routed to the condensate recovery system. The bottom product from column is cooled to 40℃ in the propane cooler and routed to the LPG pool under flow control cascaded with column bottom level control.

The propylene product is pumped by product pumps through propylene treatment package to existing mounded bullets for storage.

2.4 UTILITIES – PRU

2.4.1 Water Requirement for PRU Project

Additional 0.9 m^3/hr fresh water is required for PRU project and the same will be sourced from Brihanmumbai Municipal Corporation (BMC). Fire fighting water requirement shall be met from the existing facilities of HPCL.

2.4.2 Power Requirement for PRU Project

Total of 1.22 MW power is required and the same will be sourced from refinery/outside grid.

2.4.3 Fuel Requirement for PRU Project

Post installation of PRU, there shall be a marginal increase of fuel consumption in refinery due to extra steam generation in boilers to meet steam requirement for the PRU re-boilers. The increase in fuel oil is about 2.86 tons/ hr. In the refinery Low sulphur Fuel oil (0.5 wt% max) has been considered for firing in the furnaces.

2.5 EMISSION AND EFFLUENT – PRU

2.5.1 Effluent Generation

There are no regular liquid effluents from the PRU. The only liquid effluents from the unit are run down water during rains or washing or the OWS (intermittent) from the vessels during maintenance. All such effluents shall be collected and routed to existing effluent treatment system of refinery.

2.5.2 Emission

It is estimated that approx. 0.69 tons/day of SO_2 shall be emitted due to PRU.

Under normal circumstances, there will be no continuous/intermittent point releases of volatile hydrocarbon streams. However, if during start up/shut down or an emergency situation any hydrocarbon stream is released, they will be directed to an elevated flare for complete combustion. This will eliminate the possibility of forming an explosive mixture due to sudden release of unburned hydrocarbons to the atmosphere. All vents from the PRU shall be routed to existing flare or the fuel gas system. As such there shall be no gaseous effluents from the unit to atmosphere.

2.5.3 Solid waste generation

A total of 36 TPA of spent adsorbent will be generated from PRU project. The same will be disposed off as per Hazardous waste (Management and Handling) Rules 2008, amended up to 2009.

2.6 REVAMP OF CAPTIVE POWER PLANT

CPP Revamp project at HPCL Mumbai refinery is brown field project coming up within the existing refinery complex. Existing CPP configuration consists of 5 Gas Turbines (GT) out of which GTs 1, 2, 3 & 4 will be demolished to accommodate new GT of 81 MW. In addition to a new GT, one Steam Turbine (ST) and one Heat Recovery Steam Generator (HRSG) will also be installed to recover steam. The breakup for power from CPP revamp is as follows.

- Gas Turbine : 81 MW
- Steam Turbine : 15.1 MW
- Gross Power : 81 MW
- Net Power : 77.8 MW

2.6.1 Gas Turbine (GT)

A gas turbine will be rated for 77 MW at ISO conditions to give output of about 65.6 MW at site rating at an average ambient temperature of about 32 ^{0}C using natural gas as fuel. The corresponding gross output in combined cycle operation with one (1) gas turbine, one (1) HRSG and one (1) steam turbine will be about 81 MW at site ambient conditions. Net available power after auxiliary consumption will be about 77.8 MW.

The gas turbine set will be complete with the following system.

a) Combustion System

Combustors will be external annular type consisting of multiple combustors or as per manufacturer's design suitable for firing NG. The combustor chamber will be provided with liners, and cooling arrangement. Combustion system will be provided with flame detection system for monitoring & protection.

Compressed air cooling system will be provided to control the temperature of nozzles and turbine blades during operation. Cooling air and sealing air will be taken from the turbine compressor.

b) NOx Control

NOx can be controlled by steam / water injection or by providing dry low NOx (DLN) combustors. Water injection is envisaged to limit NOx to permissible limit.

c) Lubricating System

A complete self-contained lubricating system to supply oil at required temperature and pressure to the bearing of Gas turbine, generator and accessory gear will be provided. This will include main oil pump (shaft driven from accessory gear), 1x100% AC motor driven centrifugal type auxiliary lubricating oil pump, 1x100% centrifugal type DC emergency lubricating oil pump 1x100 % AC & DC Jacking oil pumps, AC motor driven auxiliary hydraulic oil pump, oil tank to give at least 5 oil changes per hour, oil filters for lubricating oil system & hydraulic oil system, Dual oil to water heat exchangers, vapour extractor, oil purification unit etc.

d) Governing System

Gas turbine governing will be by Electronic Governing System with triple modular redundancy designed for high accuracy, speed and sensitivity response.

e) Turning Gear System

Turning gear device will be capable of continuously rotating the shaft at a preset speed during start-up and shut-down to prevent distortion due to non-uniform cooling. It will be driven by a motor, however, manual turning device will also be provided.

f) Starting and cool down System

The starting system will be provided to bring GT to self sustaining speed with Static Frequency Converter system or by Electric Starting motor method. In case of Electric starting motor system, engagement will be by clutch. Cooling down will be by torque converter system. Oil for the torque converter will be supplied from AC lubricating oil system.

g) Fuel/Gas System

An adequately sized 2x100% fuel gas conditioning system capable of providing clean dry gas as acceptable to gas turbine fuel quality and quantity will be provided. Each system will consist of emergency stop valve, gas pressure regulating system, knock out drum, filter unit, filter separator, fuel gas heater etc. as per requirement. The remote

control panels, steam turbine generator panels and heat recovery steam generator control panels will be provided in the Central Control Room.

h) Liquid Fuel System

Necessary provision will be made for using liquid fuel in the GT as a back- up fuel. GT will be capable of on-load fuel change over from NG to liquid fuel and vice-versa automatically or with manual initiation. The system will include low pressure atomising air system, selector valve assembly, accessory gear driven fuel pump, filters, valves instrumentation etc.

i) Air Inlet System

Gas turbine consumes enormous quantity of air and is sensitive to air quality. Contaminated air causes erosion, corrosion, fouling/plugging of cooling air passages and degrades gas turbine performance and reduces its life. Gas turbine will have self-contained air intake system. The intake filtration system will consist of self-cleaning inlet air filters assembly, silencer, weather-hood, ducting, expansion joints, trash screen of suitable mesh size, supporting structures, walk ways etc.

The gas turbine output is dependent on various reference conditions and as has been discussed. The air intake temperature is one of those conditions. The site ambient intake air temperature can be brought down to some lower level or can be matched with ISO conditions by providing air chilling or fogging arrangement in the air intake path. Evaporative cooling system of inlet air for increasing the output of combustion turbine will be considered.

j) Exhaust Gas System

The exhaust gas from the GT will be led to HRSG through exhaust duct. A bypass stack will be provided for open cycle operation when HRSG is not in operation and to discharge exhaust gas to atmosphere. The system will be complete with expansion joint, diverter damper and guillotine damper with electric motor operated system so that the boiler internal maintenance can be safely carried out and the gas turbine can be operated in simple cycle mode of operation. The Single Flap Diverter Damper will be with fail-safe shut down arrangement so that gas turbine and other equipment in the hot gas path, in general, are not damaged under any circumstances. Sealing air fans will be provided for supply of sealing air to diverter dampers.

k) Compressor Washing System

Compressor water wash system will include header and nozzle for injection of water in compressor. Water supply pumps, metering pump set for injection of detergent, tanks, piping works etc. will be provided.

2.6.2 Heat Recovery Steam Generator (HRSG)

Gas turbine will be provided with dual pressure natural circulation type Heat Recovery Steam Generator (HRSG) suitable for outdoor installation. HRSG will be of rugged - all welded design requiring minimum maintenance. The design will be based on spiral finned tube heat transfer banks of super- heaters, evaporators & economizers for HP and super heater and evaporator for LP circuit.

HRSG will be provided with a dedicated self-supporting carbon steel stack to enable to use naphtha as alternate fuel. The stack will be thermally insulated over the complete length of

the stack. Stack closure damper with self opening features will be provided at the inlet of stack which may be closed during shutdown to retain heat in HRSG.

2.6.3 Steam Turbine (ST)

Steam turbine will be single casing back pressure type with extractions, horizontally split multi-stage, single cylinder type having a speed of higher than 3000 RPM coupled to generator through gear box. The steam turbine will receive the steam supply through combined stop and control valves. Exhaust pressure will be 16.85 ata.

Turbine casings will be designed to withstand maximum pressure and temperature to which these will be subjected during base load and part load operation. Rotor will be machined from solid alloy steel forgings. Material for blades will be corrosion and erosion resistant alloy steel.

2.6.4 De-aerator

Spray-cum-tray type design De-aerator will be provided for the HRSG. The storage capacity will be of 10 minutes at normal operating level with filling factor of 0.66 corresponding to 100% base load. The O2 contents of water in the de-aerator will not exceed 0.005 cc/litre at all loads.

2.6.5 Boiler Feed Pump

2x100% capacity feed pump for HP drum of HRSG will be provided, HP Boiler Feed Pumps will be horizontal, multistage, barrel type centrifugal pump with balancing drum leak off and individual minimum re-circulating system to de-aerator. These pumps will supply feed water to HP economisers, of the Heat Recovery Steam Generator. HP Boiler feed pump will be coupled with the booster pump and drive motor by hydraulic coupling.

2.6.6 Compressed Air System

The compressed air requirement both for instrument & service air is proposed to be met by compressed air system comprising two (2) nos. (1 working+1 standby) of adequately sized, Teflon ring, oil free, air compressors complete with, air receivers, air drying unit, associated piping and instrumentation.

2.6.7 Fire Protection System

The existing fire protection system of the plant will be used for the proposed CPP revamp project.

2.7 UTILITIES – CPP REVAMP PROJECT

2.7.1 Water Requirement

No additional water is required, as DM water (153 m^3/hr – required for new GTG) will be diverted from existing boilers to CPP for steam generation. Plant services & fire fighting water requirements shall be met from the existing facilities of HPCL.

2.8 EMISSION AND EFFLUENT - CPP REVAMP PROJECT

2.8.1 Effluent Generation

The only liquid effluent generation is from the blow down of the boiler. 42 m^3/hr of effluent will be generated which consists of 3 m^3/hr of blow down and 39 m^3/hr of sea cooling water for cooling of blow down water. The same will be routed to sea cooling water API separator and finally discharged to sea.

2.8.2 Emission

Total Emissions from all GTs (GT 1, GT 2, GT 3, GT 4 & GT 5) and boilers is 1.77 TPD considering Naphtha (80 PPM wt%) firing in GTs and Low Sulphur Heavy Stock (0.5 wt%) firing in boilers. After demolition of GTs 1, 2, 3 & 4 and running boilers at turn down conditions, emission from GT 5 and new GT along with boilers will be 1.03 TPD. Therefore, a net reduction in SOx emission will be 0.738 TPD.

2.8.3 Solid waste generation

There will be no solid waste generation from CPP revamp project.

3.0 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.

3.1 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 PM10, PM2.5, 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 PM10 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 PM2.5 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 PM2.5 is found to be well within the NAAQS limit of PM2.5 (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 98th percentile 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 NO2vis 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/m3. Minimum concentration is recorded at HPCL Terminal Wadala (0.17 mg/m3) where man made activities are comparatively less. Maximum concentration is found at Gawanpada (1.18 mg/m3).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/m3).

The 98th percentile concentration of Hydrocarbons (Methane) ranges from 1.18 to 3.39 ppm. 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 Gawanpada 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/m^3. 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).

3.2 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).

3.3 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 54.3 dB(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.

3.4 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.

3.5 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.

3.6 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.

4.0 IMPACT ASSESSMENT

4.1 AIR ENVIRONMENT

Total SOx emission from the refinery post PRU & CPP Revamp project is expected to come down by 0.13 TPD. Hence, SOx emission will be well within the existing permissible limit of 12.6 TPD as stipulated by MOEF/SPCB.

4.2 WATER ENVIRONMENT

42 m^3/hr of Liquid effluent from CPP revamp project will be routed to sea cooling water API Separator. No liquid effluent is envisaged in PRU project. Hence, impact on water environment post PRU and CPP revamp project is marginal.

4.3 LAND ENVIRONMENT

No solid waste generation is envisaged from CPP revamp project. The spent catalyst (36 TPA) generated from PRU unit will be disposed off as per Hazardous waste (Management and Handling) Rules 2008, amended up to 2009. Hence, impact on land environment is insignificant.

4.4 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.

4.5 SOCIO-ECONOMIC ENVIRONMENT

The construction phase is expected to span for two years. During this phase, the major socio-economic impact will be in the sphere of generation of temporary employment for very substantial number of personnel. 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.

5.0 ENVIRONMENTAL MONITORING PROGRAMME

The environmental monitoring program as mentioned in MREP EIA report will be followed for PRU and CPP revamp project also.

6.0 ENVIRONMENTAL MANAGEMENT PLAN

The environmental management plan as mentioned in MREP EIA report will be followed for PRU and CPP revamp project also. However, some specific mitigation measures pertaining to these projects are given below.

Adequate care will be taken in process design to minimize the quantity of waste produced. In addition, solid, liquid and gaseous wastes generated from various processes in the refinery will be handled in a manner that minimizes their impact on environment. Some of the measures to be taken are as follows:

- Solid Waste - It is recommended to dispose off solid waste such as spent catalyst, etc, outside the refinery complex.
- Liquid waste – An Existing Effluent Treatment Plant in the refinery will be used to treat various liquid effluents generated in the Propylene Recovery Unit.
- Gaseous Effluents – Gaseous Effluent from Propylene Recovery Unit shall be flared through existing flare of the refinery.

In addition, a Plant Safety and Environment Cell consisting of qualified and experienced technical personnel from the relevant fields will be in place to ensure effective operation of all pollution control measures and suggest further improvements where necessary.

6.1 MITIGATION MEASURES FOR VOC CONTROL

The fugitive emission will originate from joints and seals used in flanges, pumps, valve packings and connection joints to the atmosphere like sampling, etc. In order to minimize the fugitive emissions, the following measures will be taken during engineering:

- Minimum number of flanges, valves, etc.
- High grade gasket material for packing
- Usage of state-of-the-art low leakage valves preferably with bellow seals
- Usage of pumps with Double Mechanical seals for light hydrocarbon services

The standards for VOC monitoring in the form of LDAR program as per guidelines given in environmental standard for refineries will be followed.

6.2 NOISE CONTROL

Comprehensive measures for noise control will be followed at the design stage in terms of:

- Noise level specification of various rotating equipment as per Occupational Safety and Health Association (OSHA) standards.
- Equipment layout considering segregation of high noise generating sources.
- Erecting suitable enclosures, if required, to minimize the impact of high noise generating sources.
- Sizing the flare lines with low Mach number to have lower noise levels.

6.3 SOLID WASTE

General Solid Wastes generated from PRU & CPP revamp unit shall be minimized by implementing solid waste management plan.

7.0 PROJECT BENEFITS

The project benefits due to PRU and CPP revamp project are as follows.

- Production of chemical grade propylene
- Self sustainable in Power
- Employment generation
- Overall Development of the Area/Region
- Substantial increase in revenue generation for the state

8.0 RISK ASSESSMENT STUDY

Synopsis of RRA for PRU, GT & Propylene loading gantry for Public hearing

➢ Consequence modelling is carried out for credible high & low frequency failure scenarios in PRU. It is observed that affect zone may extend beyond the unit's B/L & affect the storage tanks in nearby dyke, depending upon the location of the release, ignition source encountered and prevalent weather conditions at the time of release.

It is recommended to locate ethanizer section of PRU preferably towards northern side of the proposed plot.
 Failure scenario (Instrument Tapping Failure) for the Propylene Product Loading Pump in the Offsite is modeled and it is observed that the 32 & 8 Kw/m2 Jet fire radiation intensity may affect nearby Tank-6 (Diesel back blending stream tank).

Since Tank-6 (Diesel back blending stream tanks, 2 nos.) are in close proximity of Propylene loading pumps, It is recommended to relocate these tanks to safe location.
 Propylene Loading arm rupture and 20 mm leak credible failure scenarios are also modeled in the Propylene Loading Gantry. It is observed that existing truck parking & LPG Bottling plant may get affected because of radiation & explosion effect zones of these scenarios. HT line near Truck parking area may be a potential source of ignition in event of any leakage in the gantry.

Existing LPG bottling plant & truck parking area in the close proximity of loading gantry are not advisable from safety perspective. Large number of people are expected in the Truck parking area which may result in fatalities in the event of this failure scenario. So, it is recommended to restrict the truck parking beneath HT wire and also in LFL zone (~ 85 m from the edge of the Propylene Loading Gantry).
Further, in order to reduce possible risk to people in existing LPG bottling facility & Truck parking area, it is recommended to provide excess flow check valves & shut-down valves in the gantry to restrict the quantity of release in the event of above mentioned failure scenario. Also, it is recommended to provide hydrocarbon detectors near loading arms with hooters & automatic water sprinkler system. Safe evacuation plan in the event of any leakage in the Propylene Gantry & LPG bottling plant needs to be developed & shall be included in the emergency response plan.
It is suggested to evaluate the risk to the personnel through quantified risk analysis at the time of detailed engineering.
 Credible failure scenarios of 20 mm hole is modeled at Naphtha Feed to GTG Pump and Naphtha/ RLNG supply line to GTG. It is observed that Radiation & Explosion affect zone may

cover nearby Naphtha Tanks & existing CPP control room respectively based on the location of release and weather conditions encountered at the time of release.

It is recommended to install hydrocarbon detectors at the Naphtha Pump house, with adequate active/ passive fire protection measures and it is recommended to ensure immediate inventory isolation in the event of any leakage scenario and prepare disaster management plan & emergency response plan for the same.