Pre-Feasibility Report

Proposed Expansion & Debottlenecking

of

Petrochemical Manufacturing Facility

Reliance
Industries Limited

Vadodara Manufacturing Division (VMD)

April 2017

Table of Contents

INTRODUCTION

Reliance Industries Limited (RIL) is India's largest private sector company with businesses across the energy and materials value chain. It also has a strong presence in the rapidly expanding retail and telecommunication sector. RIL is one of the world leaders in the energy sector and has diversified in areas such as Exploration & Production (E&P) of Oil & Gas (O&G), Refining and manufacturing and marketing of petroleum and petrochemical products. RIL has major facilities located in Jamnagar, Dahej, Hazira, Baroda, and Naroda in Gujarat, Nagothane, and Patalganga in Maharashtra, Silvassa in Union Territory (UT) of Dadra & Nagar Haveli and Kakinada in Andhra Pradesh.

Indian Petrochemical Corporation Limited (IPCL), Vadodara was setup in the year 1973 to utilize the Naphtha readily available from the neighboring Gujarat Refinery of Indian Oil Corporation Limited (IOCL). This petrochemical manufacturing facility comprising of a state-of-the-art Naphtha cracker unit as its mother plant and other downstream units. In the year 2002 RIL took over IPCL and renamed it as Vadodara Manufacturing Division (VMD). The VMD consists of the following existing plants & their product:

GAP	Orthoxylene
	Paraxylene
	Dimethyl Terephthalate
GOP (Naphtha Cracker)	Ethylene
	Propylene
	Carbon Black Feed Stock
	Butadiene
	Benzene
	Toluene
	C4 Raffinate
	PGH
	NRS
	Mix C4
LAB	Linear Alkyl Benzene
EO/EG	Ethylene Glycol
	Ethylene Oxide
AF	Monocomponent Acrylic Fiber
DSAF	Monocomponent Acrylic Fiber
PBR-I	PBR-I
PR	Petroleum Resin
PP-I	Polypropylene Copolymer & Homopolymer
PPCP (PP-II)	Polypropylene Copolymer & Homopolymer

LDPE	Low Density Poly Ethylene
ACN	Acrylonitrile
ACR	Methyl Acrylates
	Ethyl Acrylates
	Butyl Acrylates
VC/PVC	Ethylene Dichloride
	Vinyl Chloride Monomer
	Poly Vinyl Chloride
IOP	HP Steam
	Electricity
CPP	HP Steam
	Electricity
CF	Carbon Fiber
PP-IV	Polypropylene
PBR-II	Poly Butadiene Rubber
Railway Gantry	Material Transfer
Dahej-baroda Pipeline	Material Transfer

RIL-VMD is currently planning expansions of its production capacities by way of de - bottlenecking (DBN) of various plants. This debottlenecking of RIL-VMD units include **NCP, EG, EO, VCM, PVC, PP-II & IV, Butadiene, PBR-I & II**, **Benzene, LAB, CPP**. This proposal also includes modification in existing plant for separation of new products & by-products such as **Toluene, Normal Paraffin, Carbon, Black, Feed Stock (CBFC), Di Ethylene Glycol (DEG), Tri Ethylene Glycol (TEG), PEG, HNP, LNP, Heavy Alkylates, Heavy Aromatics**. This proposal also includes setting up of new units **Chlorinated Poly Vinyl Chloride (CPVC**) and a 500 TPH petcoke based boiler to be used as a stand-by to existing steam & power generation by creating flexibility in the existing fuel mix. The detailed product list post the proposed project are listed in below Table;

Plant	**Name of Products**	**Production Capacities (MTM)**		
		Existing Capacity	**Proposed Addition**	**Total**
GOP	Ethylene	17000	**8000**	25000
	Propylene	8000	**7000**	15000
GAP	Ortho xylene	3784	0	3784
	Para xylene	4050	0	4050
	Dimethyl Terephthalate	3333	0	3333
C2 Derivatives including Vinyl	Ethylene Glycol (EG)	1670	**470**	2140
	Ethylene Oxide (EO)	836	**1004**	1840
	Low Density Poly Ethylene (LDPE)	13335	0	13335
	Ethylene Dichloride (EDC)	8335	0	8335
	Vinyl Chloride Monomer (VCM)	4750	**3020**	7770

Plant	Name of Products	Production Capacities (MTM)		
		Existing Capacity	Proposed Addition	Total
	Poly Vinyl Chloride (PVC)	4585	**3315**	7900
	Chlorinated Poly Vinyl Chloride (C-PVC) (**New Product**)	0	**6000**	6000
C3 Derivatives	Poly Propylene (PPCP (PP-II))	2085	**3255**	5340
	Poly Propylene (PP-IV)	6250	**7120**	13370
	Polypropylene (PP-I)	3000	0	3000
	Acrylonitrile	2500	0	2500
	Methyl Acrylates	170	0	170
	Ethyl Acrylates	250	0	250
	Butyl Acrylates	334	0	334
C4 Derivatives	Butadiene (GOP Plant)	4500	**2000**	6500
	Poly-Butadiene Rubber (PBR-I)	1670	**2260**	3930
	Poly-Butadiene Rubber (PBR-II)	4166	**1134**	5300
C6+ Derivatives	Benzene	4585	**2655**	7240
	Toluene (**New Product**)	0	**2250**	2250
	Normal Paraffin (**New Product**)	0	**5000**	5000
	Linear Alkyl Benzene	3625	**3295**	6920
Mono-component Acrylic fibre	Acrylic Fiber (AF)	1000	0	1000
	Dry Spun Acrylic Fiber (DSAF)	1000	0	1000
Carbon fibre	Carbon Fibre (CF)	1	0	1
PR	Petroleum Resin	417	0	417
Utilities	Steam	620 TPH	**96 TPH**	716 TPH
	Steam*	0	**500 TPH**	500 TPH
	Power	81 MW	14	95 MW
By-Products				
GOP	Carbon Black Feed Stock (CBFS)	1585	**1415**	3000
	Mix C4	10585	0	10585
	Pyrolysis Gasoline (PGH)	18335	0	18335
C2 Derivatives including Vinyls	Di Ethylene Glycol (DEG) **(New by-Product)**	0	**135**	135
	Tri Ethylene Glycol (TEG) **(New by-Product)**	0	**15**	15
	Poly Ethylene Glycol (PEG) **(New by-Product)**	0	**150**	150
	HCL	0	**1417**	1417
C4 Derivatives	C4 Raffinate	6085	0	6085
C6+ Derivatives	Heavy Normal Paraffin (HNP) **(New by-Product)**	0	**700**	700
	Light Normal Paraffin (LNP) **(New by-Product)**	0	**200**	200

Plant	Name of Products	Production Capacities (MTM)		
		Existing Capacity	**Proposed Addition**	**Total**
	Heavy alkylates **(New by-Product)**	0	**400**	400
	Naphtha Return Stream (NRS)	13750	0	13750
	Heavy Aromatics **(New by-Product)**	0	**4500**	4500

Note: **Petcoke fuel based boilers to be used as Stand-by for existing steam & power generation by creating flexibility in the existing fuel mix*

Apart from this the existing railway gantry will be modernized for much more convenient handling of raw material and products.

Need for Environmental Clearance & Categorization of the Project

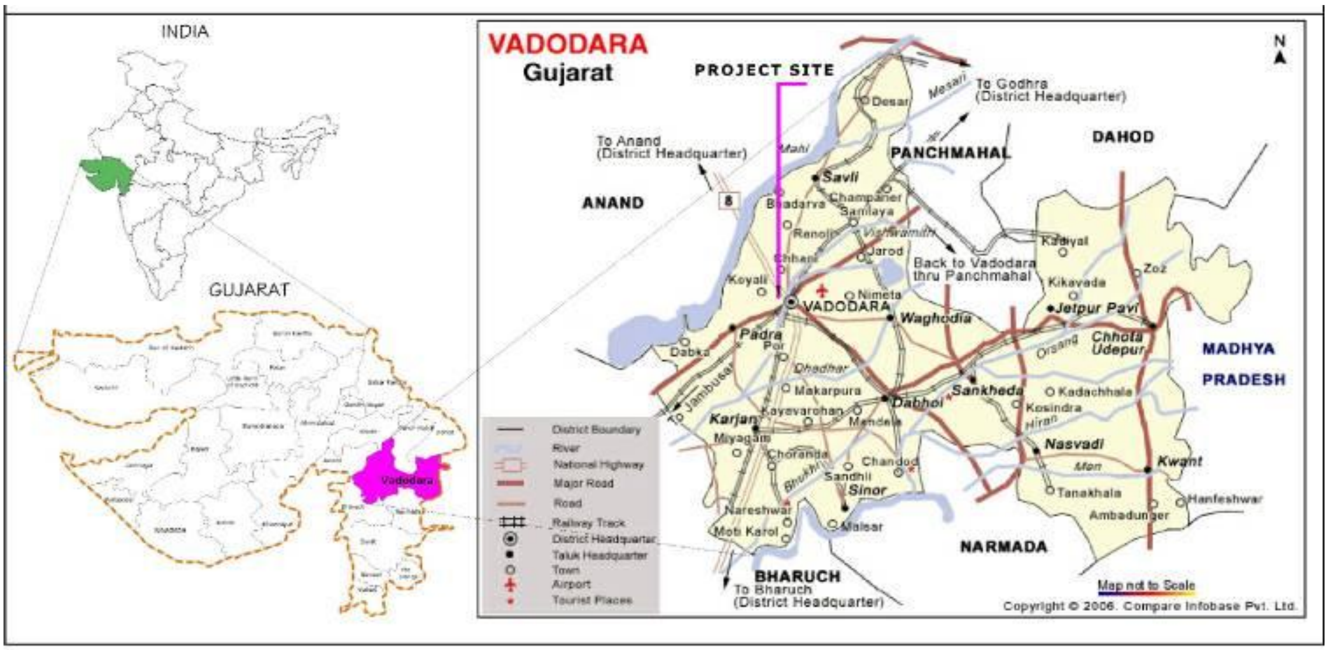
As per the Environmental Impact Assessment (EIA) notification of 14th September, 2006 and its amendments, prior Environmental Clearance (EC) is required to be obtained prior to construction of the proposed projects. The proposed project involves processing of petroleum fractions & natural gas in the Gas Cracker. Hence, as per the EIA Notification 14th September, 2006, the proposed project comes under Schedule '5(c)' and categorized as 'Category A' projects.

SITE ANALYSIS

Location / Project Siting

The proposed project is planned within the VMD site for better integration with the existing infrastructure facilities available there. This will enhance the operational flexibility and manufacturing synergy. This will enable optimized usage of resources thereby reducing the pollution load on the environment with reduction in transportation facilities as well as for the infrastructure required for manufacturing facilities.

The VMD site is flanked by the villages Koyli, Dhanora, Ranoli, Bajawa, in Vadodara Taluka of Vadodara District, Gujarat between latitudes of 22°23'7.78"N latitude and 73° 6'44.57"E longitudes. The location map of VMD is given below. VMD manufacturing facility sprawls over 350 hectares of land, out of which ~ 105 hectares is earmarked for greenbelt which will be strengthened further and maintained.



Location map of VMD

RIL VMD facility is located within the Declared Industrial area of Gujarat Industrial Development Corporation (GIDC). The gazette notification of the declared industrial area is enclosed as ***Annexure II***.

Connectivity

The proposed project is planned within the existing VMD facility for better integration with the existing infrastructure facilities available at VMD, required for the project. The VMD site is located in Vadodara District, Gujarat. The NH-48 (Old NH-8) connecting Ahmedabad & Mumbai is ~4 Km away. The nearest rail station is at Ranoli situated ~1 km away & the nearest airport is Vadodara Airport which is at a distance of ~11.6 km.

Climate

Vadodara features a tropical savanna climate. There are three main seasons: Summer, Monsoon and Winter. Apart from the monsoon season, the climate is dry. The weather is hot through the months of March to July — the average summer maximum is 36 °C, and the average minimum is 23 °C. From November to February, the average maximum temperature is 30 °C, the average minimum is 15 °C, and the climate is extremely dry. Cold northerly winds are responsible for a mild chill in January. The southwest monsoon brings a humid climate from mid-June to mid-September. The average rainfall is ~93 cm.

PROJECT DESCRIPTION

Project Information

RIL-VMD is currently planning expansions of its production capacities by way of de - bottlenecking (DBN) of various plants. This debottlenecking of RIL-VMD units include **EG, EO, VCM, PVC, PP-II & IV, Butadiene, PBR-I & II**, **Benzene, LAB, CPP**. This proposal also includes modification in existing plant for separation of new products & by-products such as **Toluene, Normal Paraffin, Carbon, Black, Feed Stock (CBFC), Di Ethylene Glycol (DEG), Tri Ethylene Glycol (TEG), PEG, HNP, LNP, Heavy Alkylates, Heavy Aromatics**. This proposal also includes setting up of new units **Chlorinated Poly Vinyl Chloride (CPVC**) and a **2x 250 TPH petcoke based boiler** to used as standby for the existing steam & power generation by creating flexibility in the existing fuel mix. These modifications will be located within the existing respective plants at RIL VMD.

Project Justification

RIL VMD facility is an aging plant and certain modifications are planned within the existing facility, by implementing certain efficiency improvement modification, in the process, the production capacity shall be increased. The principal drivers for the proposed project are:

- Increase production capacity by implementing few modifications
- Maximize value addition of by product materials (component extraction), sourced from the existing Plant
- VMD as the best alternative as regards to project site, infrastructure, connectivity, facilities for export/import and market potential.
- VMD is located within the GIDC declared Industrial area
- The product manufactured meets market expectations
- Adequate safety systems are built in the design to handle operational upsets
- Availability of required land for the proposed expansion within VMD
- Location connectivity by rail /road within the country for export/import
- Availability of infrastructure facilities
- Availability of infrastructure for raw water pumping from Mahi river
- Availability of electric power through captive power plant
- Availability of onsite and offsite facilities
- Market potential for the finished products
- Environmental management: Existing plants already have robust management systems for quality, environment and occupational health and safety which are certified against the standards ISO 9001, ISO 14001 and OHSAS 18001 respectively.
- Established EMP and DMP (Disaster management plan).
- The wastewater from proposed project will be treated in the existing ETP.
- The surplus effluents after recycle/reuse from the present plants in operation and proposed project will be discharged through a multi-port diffuser of Vadodara Enviro Channel Limited (VECL) in the Gulf of Cambay.

- VMD operates a TSDF located at Nandesari Industrial area, which is located ~ 4 km from VMD facility which can accommodate additional quantity of hazardous waste, although negligible, that will be generated due to proposed project.
- Greenbelt development: There exists at VMD a well-established greenbelt of ~ 30% of total land area, which is adequate for attenuation of air emissions and noise levels.

Project Area

VMD is declared as industrial area as per notification from Govt. of Gujarat. The industrial area notification is shown at Annexure-II. The site layout map showing the existing plant installation and the location of the proposed installation in the project site is given below. The area breakup of VMD is given in below table.

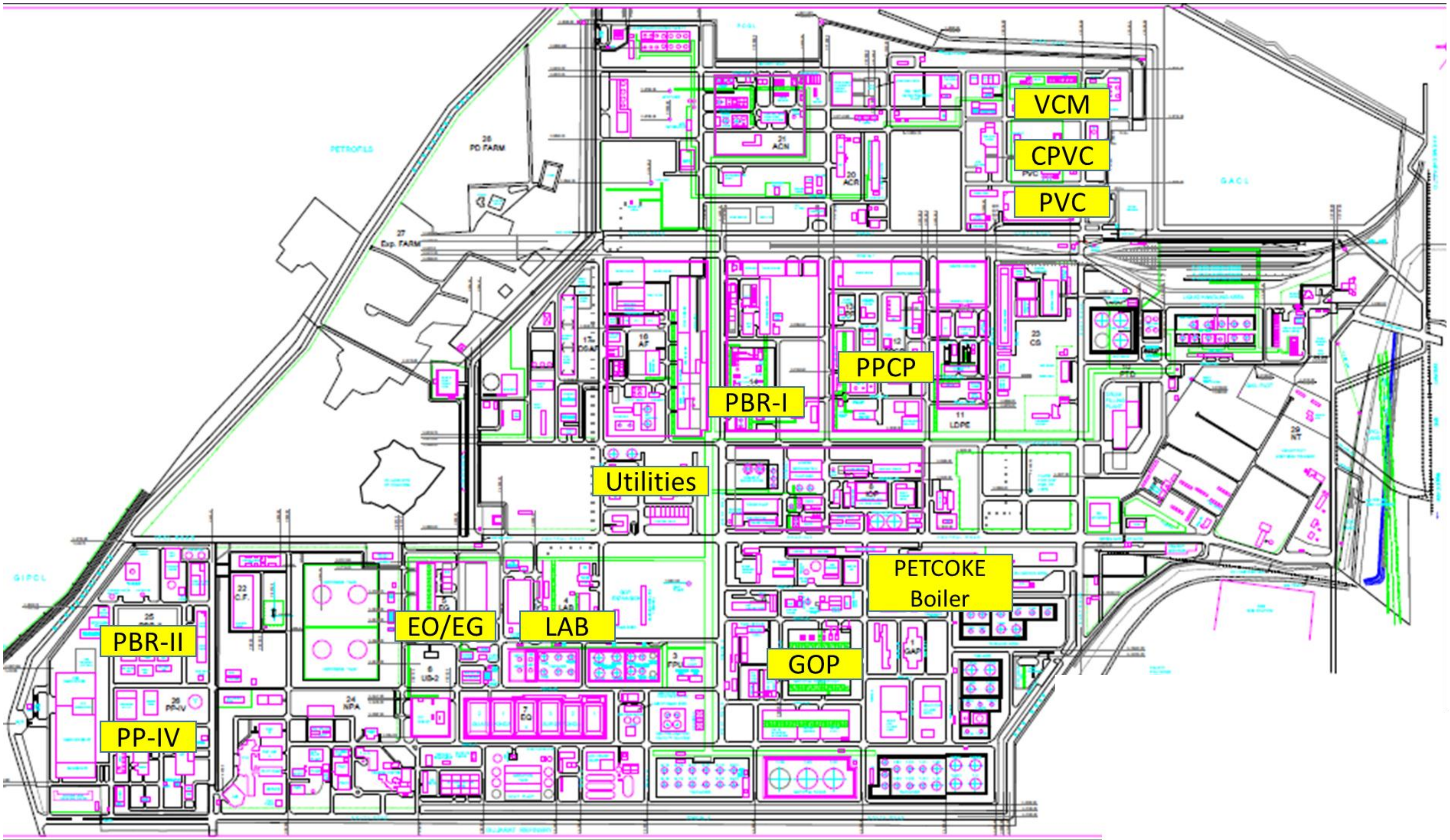
Land	Area (Ha)
Manufacturing area including all units, admin building, utilities, space for future expansion etc	245
Green belt	105
Total land	**350**

Employment Generation due to the project

The existing manpower at VMD is about 3000 (supervisory: 1000 and non-supervisory: 2000). Existing manpower would be used, as most of the projects are DBN/expansion of existing plants. Thus, there is no additional employment generation due to this project.

Project Cost

The proposed activities will be carried out within the existing VMD plant. Hence, no additional land is required for the proposed project. However the CAPEX would involve the construction activities such as foundations & procurement along with machinery installations. Environment Protection and safety systems have also been considered in planning the cost projection. Capex for the proposed project is ~ Rs. 2270.00 crores.



RIL-VMD Site Layout

PROCESS DESCRIPTION

GOP Plant

Naphtha Cracker Plant (NCP): Naphtha Cracker Pyrolysis section deals in cracking of naphtha in the short residence time (SRT) heaters and splitting it into fraction of pure olefin molecules, aromatics and polymerized heavier. The primary fractionation of pyrolysis gasoline and the heavy fuel oil fraction is done in the hot oil recovery section downstream of SRT Heaters.

This naphtha is pumped to naphtha surge drum. The feed to the SRT heaters is pumped from the offsite under the surge drum level control. This naphtha is preheated to 116° C before it is enters the top convection section of the SRT Heater. The out let of this convection goes to the mixed preheat section of the convection zone wherein, a diluent in the name of dilution steam is added at a specified ratio of 0.5 for naphtha and 0.33 for ethane to reduce the partial pressure of naphtha before vaporizing. The mixed preheat outlet @ 500°C enters the radiant zone where the temperature is instantly raised to the cracking temp of 820 °C. The temp of the radiant outlet is controlled by TIC (Temperature Indicator and Controller) and PIC (Pressure Indicator and Controller) by controlling fuel gas pressure to the SRT burners. There are six SRT heaters of which five are used for cracking naphtha, one for processing recycle ethane.

The crack gas are cooled to 375 °C in the Transfer Line Exchanger (TLE), by producing super high-pressure (SHP) steam at 100 Kg/Cm2g. The cracked gases are on the tube side in the TLE. After getting cooled in the TLE the gas enters quench fitting where it is quenched to 175 °C by circulating quench oil. The quench oil and heater effluent enter the Gasoline Fractionator. The heavy oil gets stripped in this column. The quench oil is separated at the bottom and cracked gases along with pyrolysis gasoline fraction leaves at the top. A certain level of quench oil is maintained in the Gasoline Fractionator bottom and excess of the oil is taken out. Some of it is recirculated and the rest is sent to storage as CBFS (Carbon Black Feed Stock).

The cracked gases are then further quenched in the quench tower where three streams of water at different temperature are sprayed. At the bottom of the quench tower mostly C4s and heavier are condensed along with water, which has come from condensation of dilution steam and circulating quench water. Oil and water are separated in a settler called quench water settler. This vessel has got three chambers. The first chamber has the circulating quench water also called quench water. The second chamber has the process water and the third chamber separates the liquid hydrocarbon – pyrolysis gasoline from water. The process water is nothing but the condensed dilution steam, which is stripped off of any hydrocarbon by LP Steam (3.5 Kg/Cm2g) in a column called Process Water Stripper. From the bottom of this column water goes to the dilution steam generator, where dilution steam (8 Kg/Cm2g) is generated and fed back to the SRT Heaters.

Compression and refrigeration section: The gases from the quench tower are known as charge gases which are at 28 °C and 0.33 Kg/Cm2g. This charge gas now contains C1 to C6 gases, H_2, CO and H_2S. The charge gas now enters the compressor. The gases from the quench tower at 28 °C and 0.35 Kg/Cm2g goes to the charged gas compressor which is centrifugal type having three modules for four stages of operation and driven by steam turbine. The inter cooling of each stage is done by cooling water and propylene refrigerant to 24 °C. The purpose of this inter cooling is to minimize the suction and discharge temp so as to avoid any possible polymer formation. In addition, there is a provision to inject an aromatic oil in the suction of each of the stages. The aromatic oil helps in washing the polymer layer and in keeping the compressor impellers clean. Whatever liquid is available up to third stage suction is sent to the gasoline stripper. After the third stage discharge gases goes to caustic scrubber for removal of hydrogen sulfide and CO_2, which were formed during the reaction in SRT heater. The caustic tower overhead gases go to the suction of the fourth stage charge gas compressor via intercoolers. Menthol is injected in the first three stages of compressors to remove any malfunctioning due to hydrate formation. It is not introduced after this stage because the operating temp is lower than the freezing point of methanol.

Propelyene Refrigeration System: Basically, four levels of refrigeration are available in this system. These are 20 °C, 2 °C, -20 °C & -40 °C. Pure propylene is used as refrigerant. Refrigeration compressor is centrifugal compressor driven by a steam turbine. The refrigerant is used mostly in the charge gas inter-coolers, overhead condensers and reboilers of the cold fractionator and other coolers of depropanier, deethanizer, ethylene fractionator charge gas chillers etc. and reboiler of demethanizer, ethylene fractionator and ethylene vaporizer etc.

Etylene Refrigeration System: There are three levels of refrigeration available in this system. These are –56°C, -75 °C & -110 °C. Pure ethylene is used as refrigerant in this system. The compressor used here also is a centrifugal compressor driven by steam turbine. The refrigerant is used in demethanizer overhead condenser, three charge gas chillers and ethylene fractionator vent condenser.

Chilling train and product separation: Charge gas then passed through the side reboiler of Ethylene fractionator and gets cooled to –10 °C. It gets further cooled in the side reboiler of Demethanizer to –17 °C. In the Ethane vaporizer it gets cooled to –23 °C. It is further cooled to –37 °C by propylene chiller. It then passes through the first separator from where liquid is taken as one of the feed to the Demethanizer. The gases overhead of this separator go to one section of the cold box where temp comes down to –45 °C, it is further cooled in two ethylene chillers to –70 °C. Liquid thus formed is separated in the second separator from where liquid is taken as second feed to Demethanizer. The gases from the second separator go to the cold box and it chilled to –84 °C. It is further chilled in Ethylene refrigeration chiller to –98 °C and sent to the third separator from which liquid is drawn at –98°C. This liquid gives refrigeration to the cold box and itself gets heated to –75 °C and goes to the Demethanizer as third feed.

The gases of this drum are chilled in cold box to –129 °C and sent to the forth separator. The liquid from this separator gives refrigeration to the cold box and itself gets heated to –103 °C and goes to the Demethanizer as the forth feed. The gases from the forth feed separator go to cold box and gets chilled to –164 °C, where most of the methane is liquefied and separated in a separator. The liquid from the separator, called LP methane gives its refrigeration to the cold box and itself gets heated in steps to 35 °C and goes to the methane compressor and thereafter goes to fuel gas system. The gas from this fifth separator is 95% pure H2 containing 0.2% CO and rest CH4 is methanated. Thus CO level comes down below 10 ppm. This hydrogen is ready for supplying of Pyrolysis Gasoline Hydrocarbon Unit (PGH) and after drying it can go to the Acetylene converter. In the Demethanizer H2, methane is stripped. The overhead is partially condensed at –96 °C in Ethylene refrigeration chiller. Condensed liquid is partly sent as reflux to the same column and partly sent to the cold box for refrigeration recovery. The bottom of the Demethanizer is mostly C2+ hydrocarbon containing ethylene, acetylene, ethane, propane, propylene & C4s etc.

The bottom of the Demethanizer goes as feed to the Deethanizer. The column reboiled with Propylene vapor from Propylene refrigeration system. The overhead is partially condensed in propylene refrigeration chiller. The vapor goes to acetylene converter and the liquid is refluxed to the column back. This column is reboiled with LP Steam. The vapor from the reflux drum is preheated in feed effluent and/or steam heated exchanger before feeding to acetylene converter. Here acetylene is converted to ethane or ethylene and the effluent after exchanging heat with its feed goes to green oil absorber where some heavies of C4 and green oil will be knocked down by C2 stream where ethylene fractionator. From this column ethylene is drawn from the9th tray as product and sent to storage. The overhead is condensed in propylene chiller at –30 °C . The liquid from the reflux drum is sent back to the column as reflux and vapor containing lighters like methane, hydrogen and ethylene refrigerant are sent to charge gas forth suction.

The column is reboiled with hit propylene vapor from propylene refrigerant system. The bottom product is ethane, which is either sent for cracking or fuel gas. The bottom of Deethanizer is rich in C3 and heavies. It leaves the column at 67 °C, cooled in cooling water exchanger to 43 °C and then fed to the depropanizer. Another feed is also coming from the condensate stripper where liquids from the charge gas forth suction and discharge drums are stripped of for C25.

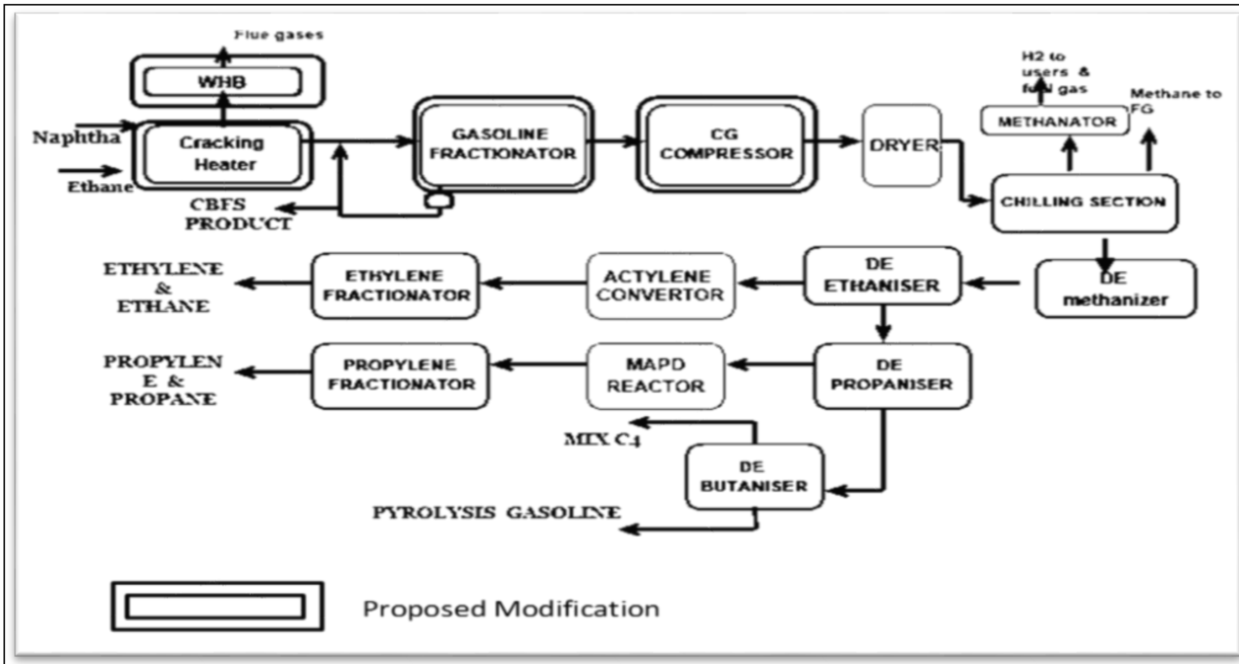
Depropanizer overhead is condensed by propylene refrigerant. The liquid from the reflux drum is partly sent to the same column and the balance to the MAPD reactors, where Methyl Acetylene and Propadiene are selectively hydrogenated to Propylene. The concentration of MAPD at outlet of the reactor will be less than 1500 ppm. This stream is then sent to Propylene fractionator.

The bottom of the depropanizer is going as feed to the debutanizer where overhead is condensed at 40 °C with water cooler. The liquid from reflux drum is partly sent as reflux and partly as mixed C4 as butadiene plant feed stock for storage. The column is reboiled with LP

Steam. The bottom of this column cooled to ambient temp. By cooling water exchanger and sent to storage in pyrolysis gasoline stripper bottom.

The propylene fractionator overhead is condensed at 40 °C. The liquid from the reflux drum is sent at PG Propylene product to storage and a large portion is sent back to the column reflux. Another product is drawn from 77th tray of this column as CG Propylene and sent to storage. The column is reboiled with quench water.

Block diagram NCP



Proposed Modification

Following modification will be carried out

- Radiant coil replacement of five (5) liquid cracking heaters from SRT-1.5 to SRT V design, and modifications to the Feed Preheat (FPH), and Mixed Preheat (MPH) coils in the convection section. Also, Dilution Steam Superheat (DSSH) coils have to be added to increase the heater load
- Heaters will be converted to induce draft type from natural draft type by installing common ID fan
- Installation of waste heat recovery boiler (WHB) to recover the heat from flue gases
- All existing Gasoline Fractionator internals will be replaced
- New RARFS feed piping from OSBL will be tied into the quench oil piping to the upper section of the Gasoline Fractionator
- New Dilution Steam Drum Feed Heater will be added upstream the existing Naphtha Feed Preheater II to provide extra capacity to the dilution steam system

- The internals of the Quench Tower will be replaced, with the exception of the top existing bed, which consists of IMTP 40. The existing IMTP 40 in the mid bed to be replaced with IMTP 50 for increased capacity, and the bottom six Angle Iron Trays will be replaced with Sultzer's Mellagrid – 64 X, a non-fouling structured packing with high capacity and high heat transfer. The installation of the grid will decrease the critical pressure drop between heater outlet and charge gas compressor inlet.
- A dilution steam drum preheater will be added.
- After cooler will be replaced by a new exchanger, as well as a new larger exchanger shall be installed. Cooling water system needs a new HELIX tube bundle design for the added capacity and pressure drop constraints.

Benzene Extraction plant

Extraction Section: The aromatic feed pumped from EDC Feed tank is preheated in, tube side, by hot circulating solvent on the shell side. The hydrocarbon is fed near the middle of the column at tray 35. The solvent fed at a controlled rate near the top of the column. The lean solvent selectively extracts the aromatics, i.e. the benzene/toluene into the bottoms, while purging the non-aromatics into the overhead.

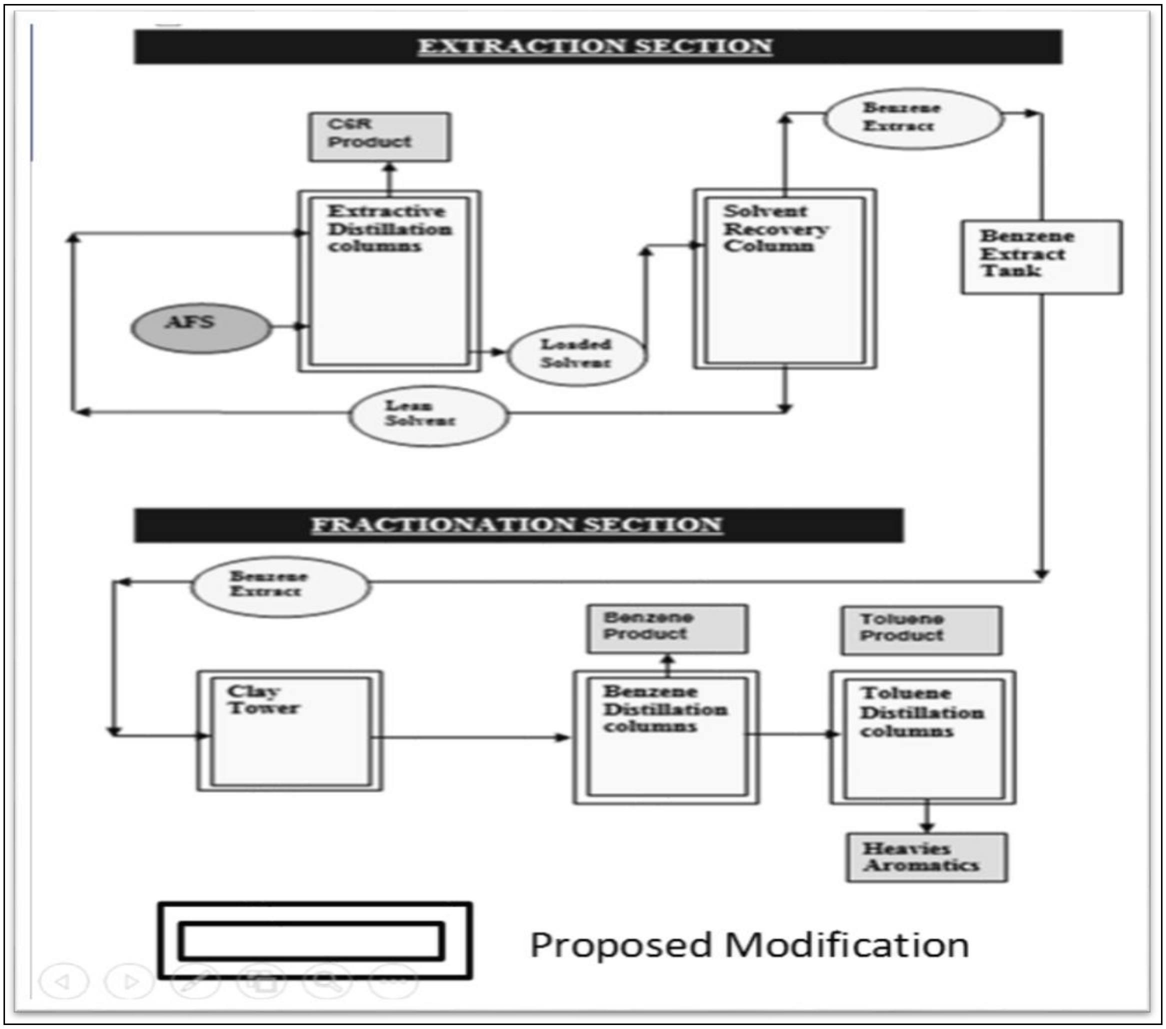
Solvent recovery is performed in the solvent recovery column (SRC). The rich solvent consisting of aromatics and solvent is fed on tray no. 15 of the SRC column with a total of 28 trays. The specially designed feed distributor at feed entry is provided to handle very high amount of vapor generated due to flashing of the feed. The 13 trays below the feed are designed to handle high liquid solvent traffic moving down the column. The rectification section ensures that the volatile aromatics are completely separated from solvent. Lean solvent is recovered at the bottom of the column and is recycled to the extractive distillation column, while the aromatics are stripped overhead.

Fractionation Section: The aromatic extract from the SRC overhead receiver, is routed to the clay tower charge tank. First the aromatic extract needs to be clay-treated for removing any traces of olefin compounds. The aromatic feed is preheated in up to 145ºC against the hot circulating effluent from clay tower and further. The final feed temperature of 195°C, is reached through heat exchanger using SH steam as heating medium. High-purity benzene product is obtained by distillation in benzene column.

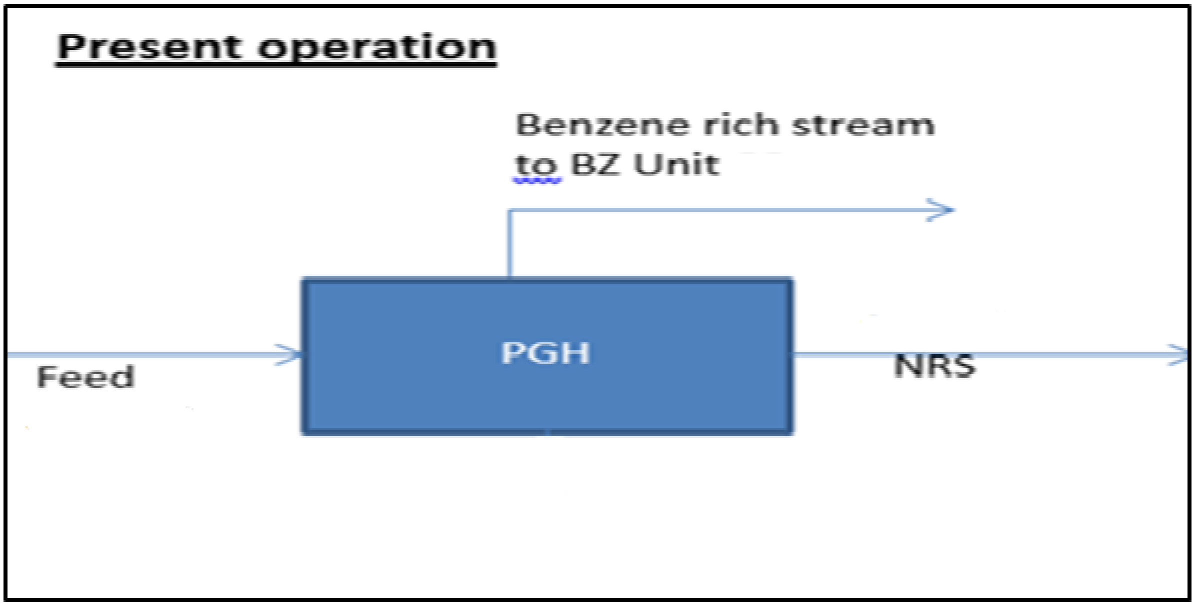
The benzene product is obtained as side-draw, withdrawn at constant flow rate (five trays below from the top of the column). The high-purity benzene product is first cooled down to 40°C through benzene cooler using cooling water. The benzene required at high pressure for LAB is pumped while balance benzene is supplied to benzene storage tank by gravity.

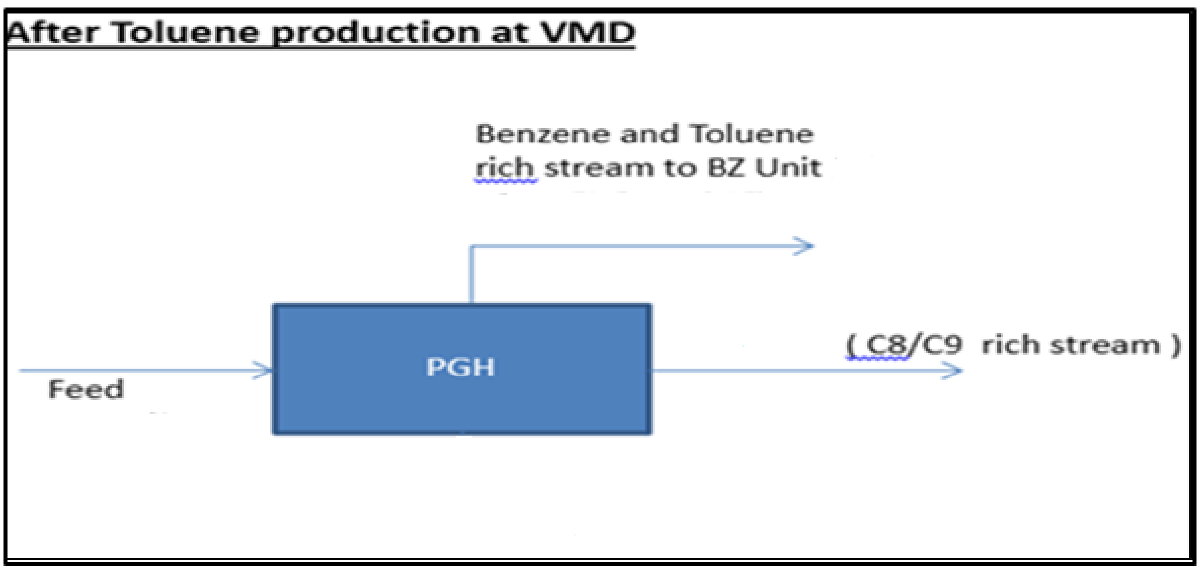
Bottom stream of benzene column is pumped to Toluene column, fully equipment with overhead and bottom auxiliary equipment. Toluene product is distilled as overhead product. The toluene bottom product consisting of heavy aromatics is removed by the Heavy Aromatics Pump at Toluene Column bottom.

Block diagram PGH UNIT



Toluene: In the proposed modification, the benzene column will be retrofitted with additional redundant column in series with new trays to ensure that the product purity of benzene is more than 99.95%. The proposed toluene separation facility will ensure that the product purity is more than 99.5%, it is expected that this stream will have less than 10 PPM of benzene against the current market grad of less than 200 PPM, thus fetching a premium. The old column of solvent stripper which is currently lying un-utilized is proposed to be used for the separation of Benzene and toluene in addition to existing benzene column.





Proposed Modification

Following modification will be carried out

- New extractive distillation column (in place of liquid-liquid extractor) and its condenser, reflux drum, reboiler and pumps is proposed to installed
- Existing SRC column will be used with its internals modification as proposed
- New SRC column condenser, reboiler and pumps is proposed to installed
- New steam generator and solvent regenerator is proposed to be installed
- Additional Clay tower proposed to be installed

- New benzene fractionation column and existing stripper column with internal change is to be used for benzene fractionation with new reboiler and pumps
- It is proposed to use Existing benzene column as toluene column with new reboiler and pumps

<u>**C2 Derivatives Including Vinyl**</u>

Ethylene Oxide/Ethylene Glycol (EO/EG) Plant

Ethylene Oxide is produced by the catalytic partial oxidation of the ethylene with oxygen at elevated temperature and pressure. The oxide is recovered from the reactor gases by water scrubbing and then removed from the dilute solution by stripping. In order to remove non-condensable gases from the oxide, the Ethylene oxide is absorbed again in water at low pressure. The ethylene oxide is then removed from the water solution in the recovery section and purified in the refining section. Hydrolysis of ethylene oxide to glycol is a liquid phase non-catalytic reaction. Heavy glycols like Di and Tri Ethylene Glycols are formed to a lesser extent.

The plant is divided into different sections.

Ethylene Oxide Reaction and Scrubbing Section: Ethylene, Oxygen, Methane (Ballast Gas), Nitrogen and Ethylene Dichloride (Moderator) are added to recycle gas and the mixture after preheating by reactor effluents in Gas-Gas Exchanger and is fed to oxide reactor. The oxide reactor is shell and tube type with catalyst packed inside the tubes. Heat of the reaction is removed by coolant oil, which is circulated on shell side of the reactor. The reactor effluents are scrubbed with water to remove Ethylene Oxide. Solution of ethylene oxide is fed forward for recovery. Unscrubbed gases are compressed and recycled to the reactor.

Carbon Dioxide Removal Section: Carbon Dioxide is formed by the undesirable complete combustion of ethylene. Excessive CO2 in the reaction gases has tendency to inhibit the reaction. Concentration of CO2 in the reactor feed gases is maintained by scrubbing of the cycle gas with hot potassium carbonate solution in a contactor/wash tower. The carbonate solution is regenerated by stripping carbon-di-oxide using steam in a regenerator.

Ethylene stripping and Recovery Section: Ethylene Oxide solution from scrubber is stripped off (dissolved ethylene oxide) with steam in stripper and the stripped gases are again scrubbed (Absorbed) with water in reabsorber at a lower pressure. Thus, a solution of only ethylene oxide in water is obtained. Traces of Carbon dioxide present in the solution is stripped off with steam in glycol feed stripper.

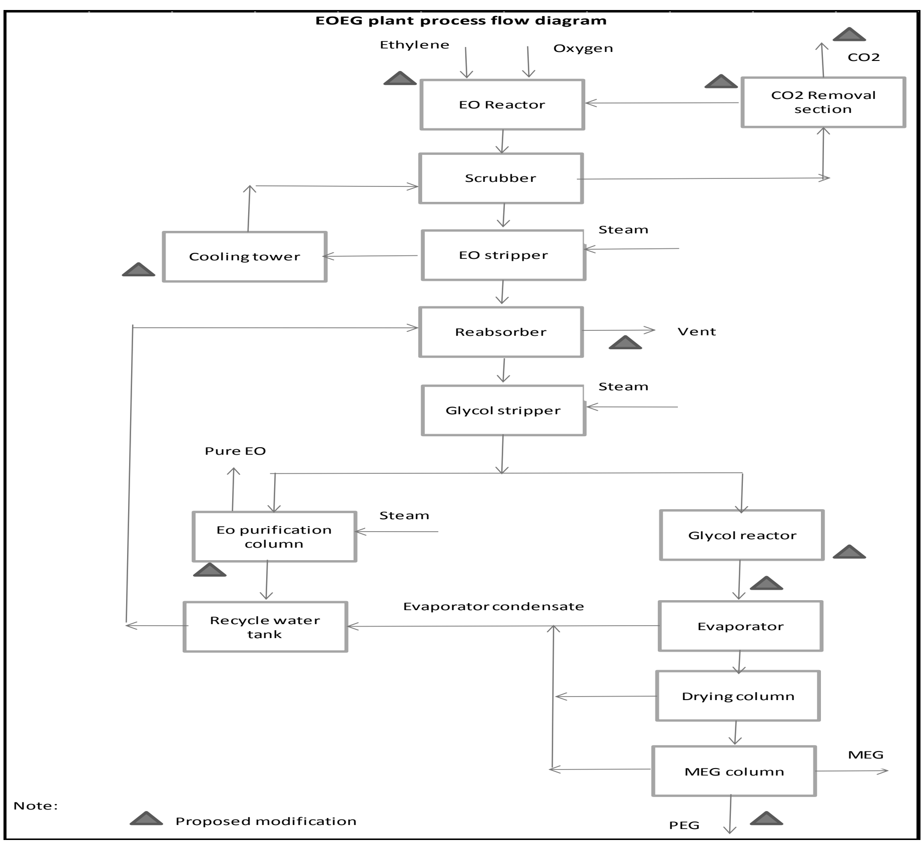
Ethylene Oxide Purification Section: Dilute ethylene oxide solution from glycol feed stripper (10 % Aqueous Solution of EO) is concentrated to pure ethylene oxide in purification column. Pure ethylene oxide is obtained from top of the column and is sent to ethylene oxide storage bullets.

Glycol Reaction and Evaporation Section: Ethylene oxide solution from glycol feed stripper is preheated and feed to glycol reactor. The glycol reactor is a long pipe, which provides sufficient residence time for glycol formation. Dilute solution of ethylene glycol from glycol reactor is then concentrated in a set of four effect evaporators.

Glycol Drying and Refining Section: Concentrated glycol from evaporators is fed to a drying column where remaining water is removed. The glycols are then fed into column where Mono Ethylene Glycol is separated from the heavier glycols. MEG and Heavy Glycols after cooling are sent to respective storage tanks. Diethylene Glycol (DEG) and Trietheylene Glycol (TEG) are separated in DEG/TEG batch column by distillation at different pressure and temperature.

Ethylene Oxide Storage Section: Pure ethylene oxide from the plant is refrigerated and stored in stainless steel bullets under nitrogen pressure. Mono Ethylene Glycol is stored in intermediate storage tanks.

EO/EG Plant Block Diagram:



Proposed modification

Following modification will be carried out

- EO reactor replacement with higher capacity
- CO2 removal section revamp
- Expansion of Ethylene oxide production capacity
- Installation of reclaim compressor for Ethylene recovery
- Additional cooling tower
- New smaller glycol reactor for minimizing glycol production
- Glycol section batch operation
- Batch column for DEG TEG separation
- Facility for Batch operation of glycol section.

Vinyl Chloride Monomer (VCM) Plant

The hydrochloric acid produced during cracking of ethane is oxychlorinated to ethylene dichloride. Ethylene Dichloride's (EDC) manufacture involves direct chlorination of ethylene and chlorine. EDC is thermally cracked. The cracked product is quenched and purified to produce Vinyl Chloride and Hydrogen Chloride acid gas. The recycle EDC (uncracked EDC) is chlorinated and purified to give furnace feed EDC.

$$C_2H_4 + Cl_2 \longrightarrow C_2H_4Cl_2$$
$$C_2H_4Cl_2 \longrightarrow C_2H_3Cl + HCl$$

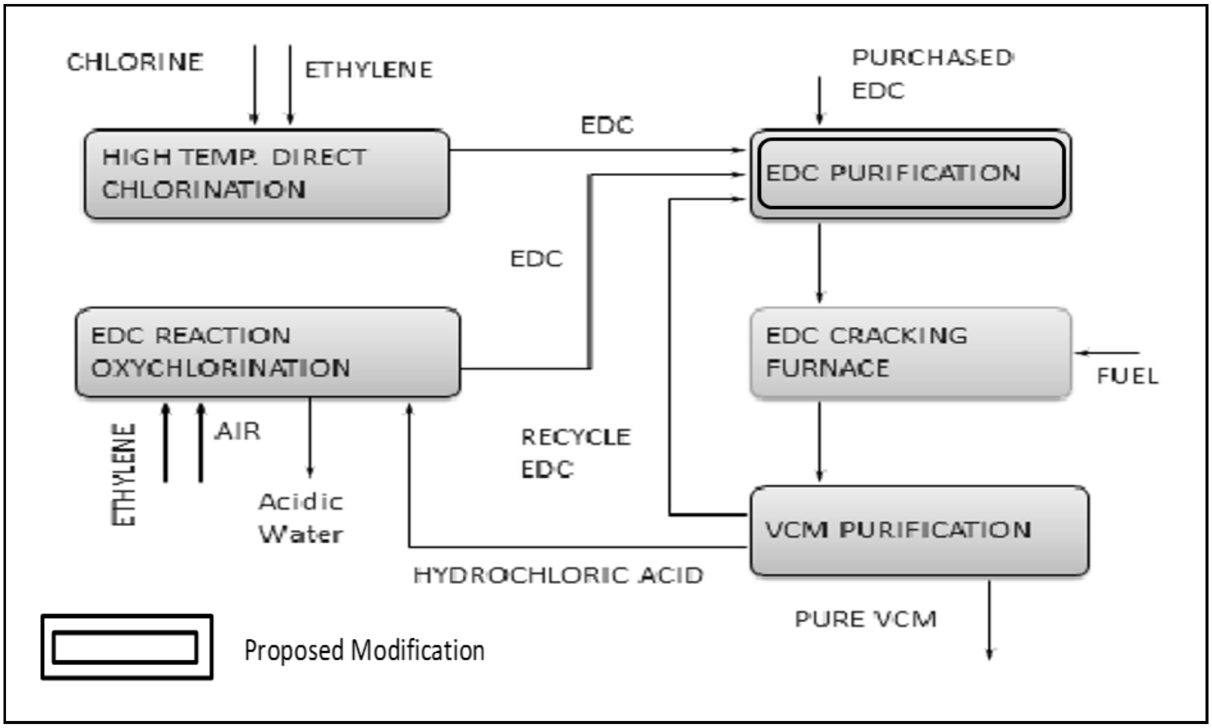
The hydrochloric acid is oxychlorinated with oxygen and ethylene to produce EDC in a fixed bed oxychlorination system. This EDC is sent to EDC treatment section to produce dry EDC.

$$C_2H_4 + \frac{1}{2} O_2 + 2HCl \longrightarrow C_2H_4Cl_2 + H_2O$$

Proposed Modifications:

- Installation of Drying column and recycle column for processing imported EDC
- Installation of EDC vaporizer and reboilers in all distillation columns
- Adiabatic loop to be installed at EDC furnace outlet to increase the conversion
- New higher capacity air compressor to be installed to increase the capacity in oxychlorination reactors
- Magnetic filters installed in oxy reactors feed lines Ethylene and Air, Alpha alumina bed in HCl feed
- Standby vent scrubber installation to improve reliability.

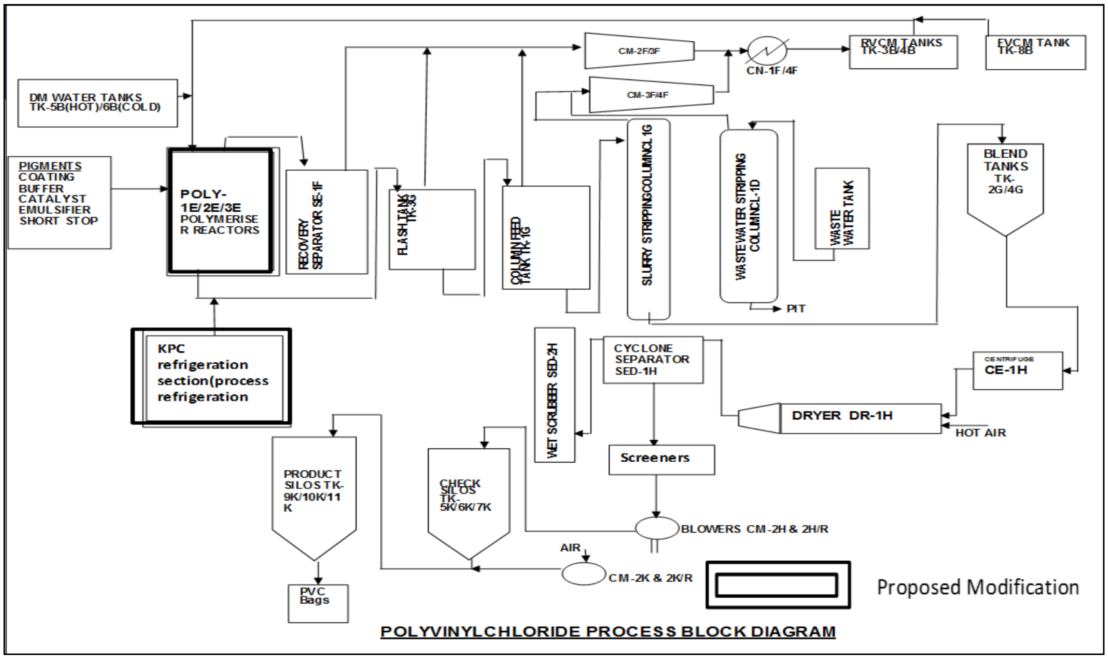
Block Diagram VCM Plant:



Poly Vinyl Chloride (PVC) Plant:

Vinyl Chloride Monomer (VCM) is the raw material required for PVC production and it is received from the VCM plant with VMD. Additives like buffer (Sodium bicarbonate), cold & hot DM water, VCM, RVCM, Emulsifier, catalyst are charged sequentially into the polymeriser reactor with the agitator running. Heat of reaction is removed by circulating cooling water (in jacket coils) and chilled water (in baffles). To maintain constant reactor volume, DM water is injected continuously throughout the reaction to compensate for the volumetric shrinkage. When the desired end point (conversion) is reached, short stop (ATSC) is pumped into the reactor and the reaction is terminated. Nitric oxide, the emergency short stop is used where there is no other way to safely handle the reaction. The PVC slurry is transferred from the polymerisers to the flash tank; and then to the stripper column feed tank where VCM is recovered. The slurry is further stripped off RVCM in the Stripper column using low pressure steam. Stripped slurry is sent to dryer blend tanks. From the blend tanks the slurry is sent to a centrifuge where the solid PVC is separated from water. This wet cake is fed to the rotary dryer where the PVC is dried with hot air. The resin out of the dryer is separated from the conveying air in a cyclone separator. The resin from the separator is passed through vibrating screens. Prime resin passing through the screens is fed to the product hopper. Resin from the product hopper is pneumatically conveyed to check silos (3 silos) using the product conveying blowers. Resin that does not pass through the screens is diverted to the tailing box. From the check silos the resin is further conveyed pneumatically to the product silos where it is bagged.

Block Diagram PVC Plant



Proposed Modification:

- Increasing the CW line size to reactor from 6" to 8" to increase flow of cooling water to reactor and reducing chilled water consumption (in 1 reactor)
- Addition of Front End Initiator in one reactor that helped in reducing the batch cycle time.

New Plant - Chlorinated Polyvinyl Chloride (CPVC)

In this proposed project a new CPVC manufacturing unit with 6000 MTM is planned within the VMD petrochemical plant. The feed stock for CPVC plant is PVC which will be sourced from existing PVC by pneumatic conveying line. All other process stream (Chlorine, caustic etc) and necessary utilities (DM Water, Cooling water, Service water, LP Steam, Instrument/ plant air etc) will be sourced from existing facilities within VMD petrochemical plant. Necessary piping tie-ins will be taken from existing facilities and routed to CPVC plant for this purpose.

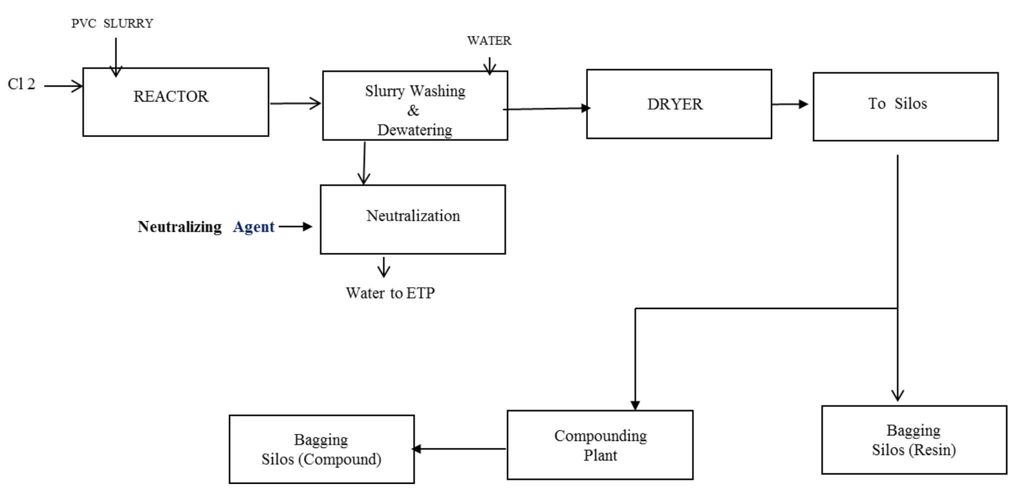
Calcium hydroxide $Ca(OH)_2$ requirement shall be purchased from the market in powder form. In this proposed project of CPVC minor construction is also planned such as Equipment foundation, Concrete and steel structure for equipment installation.

CPVC plant and its compounding unit shall be designed based on RIL's in-house technology. In CPVC plant, PVC slurry shall be prepared by mixing PVC powder and DM water in slurry preparation unit. Subsequently, PVC powder slurry shall be chlorinated in reactors. Typically the reaction is initiated by application of thermal LED energy to the PVC slurry. Chlorine gas decomposes into free radical which reacts with PVC by replacing hydrogen. Hydrogen reacts with chlorine and forms HCl as byproduct. With the result of reaction, CPVC is produced having 67 + 0.3 wt % chlorine content. Subsequently CPVC slurry is fed to vacuum belt filter for removal of HCL byproduct and further washed with DM water in series of vacuum belt filters and neutralized and dried in drying unit in two stages before sending dry CPVC resin to check silos for quality assurance. Dried CPVC resin is then transferred to the product silos through pneumatic conveying system. From the product silos CPVC is transferred to warehouse for bagging and also to compounding unit for converting in to value added product.

Major Sections of CPVC Plant
The CPVC Plant configuration shall comprise of following sections:

- PVC Feed Slurry Preparation
- CPVC Reaction section
- Slurry Washing and Filtering
- Vacuum Drying section
- Final Product Drying
- CPVC Compounding unit
- Neutralizing section
- Chlorine evaporation unit
- Chlorine Scrubbing unit

At the newly proposed CPVC plant, a primary effluent treatment facility is envisaged within the battery limits of CPVC. Primary effluent treatment facility shall be comprise of acid and Hypo neutralization facility. After the primary treatment within CPVC battery limit the effluent will be sent to central effluent treatment plant.



Block diagram of CPVC

C3 Derivatives

Polypropylene Co-polymer & Homo polymer (PPCP /PP-II) Plant:

Catalyst preparation and utilities: Our main catalyst is required for the feasibility of the reaction. It acts as the main active centers for the polymerization reaction to take place. The main catalyst batch is prepared in batch in vessel as per requirement. It comes in drums in the form of powders and is being fed directly in the Prepolymerizer.

CO catalyst (TEAL): The co catalyst TEAL is required for killing of poisons like moisture, dust for the main catalyst to act properly. TEAL batch is also prepared. As per the batch required. TEAL cylinders of 1200 KG weight are brought as per requirement. TEAL is diluted with hexane in vessel before its use in prepolymerizer and the three reactors.

CO Catalyst (C Donor): The co catalyst C DONOR is required for controlling the stereo regularity of the product to get maximum isotactic content in the final product. It comes in liquid form in drums and is first diluted with hexane in surge vessel and then transferred to prepolymerizer as per requirement of the batch.

Pre- Polymerization: The PrePolymerization is done basically to activate the centers in the main catalyst where the polymerization reaction can take place. The temperature in the prepolymerizer is maintained between 15 to 20 Deg C. It helps in controlling the reaction to only 15% of its final conversion. Cooling in the prepolymerizer is done by brine in the jacket and baffles. The feeds in the prepolymerizer are propylene, hexane, main catalyst, co catalyst.

Polymerization: The polymerization reaction takes place in three reactors. These reactors are used as per requirement of the product. The reactor along with the degasser sequence is shown below for two product:

- R201 R202 V202 V203 (for Homopolymer)
- R201 R202 V202 R203 V203 (for block copolymer)
- The total volume of the reactors is 100m3.Its specifications are as given below:
- Operating temperature: 70 0 C, 70 0 C & 60 0 C respectively.
- Pressure: 10, 7, 1-1.2 Kg/cm2
- Conversion: 80%
- Heat of reaction: 480 Kcal/KG

Powder drying section: The polymer slurry from 2nd degasser consists of both isotactic and atactic polymer. The atactic polymer is dissolved in hexane and the isotactic polymer is in suspension form. This slurry is fed to the centrifuges X301 A/B, where the copolymer powder gets separated, from the atactic polymer. From here, the copolymer powder is sent to the drying section and the atactic polymer to the hexane recovery unit and then atactic polymer is taken out as a byproduct. The polymer powder drying is carried out in mainly three stages:

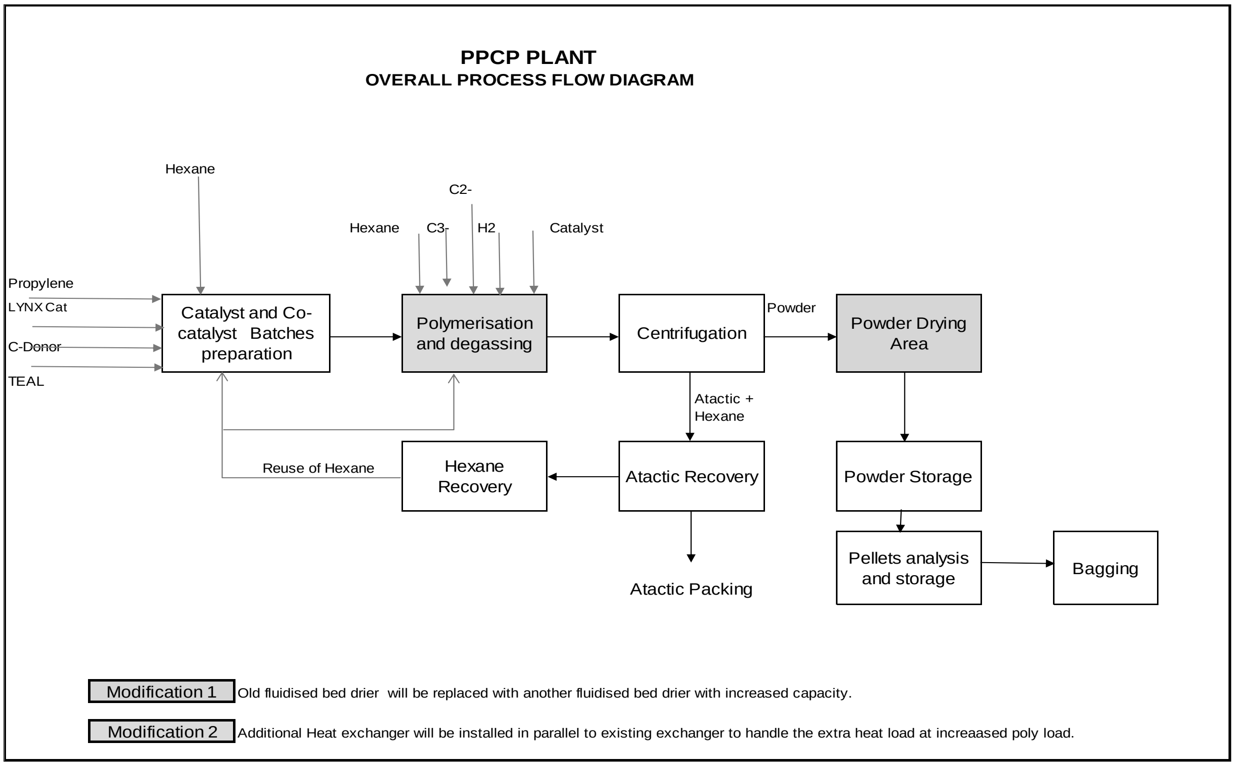
- Flash dryer.
- Steam third bed dryer.
- Final third bed dryer.

Solvent Recovery section: The gummy hexane from centrifuge is superheated by indirect heating with steam and flashed in the static concentrator. The vapor from concentrator are fed to a distillation column giving heavy tails as bottom product and fed to the concentrator and hexane at top product is used in monomer degassing, de-hexaning column and regenerating medium for molecular sieve dryer (whenever required). In hexane concentrated static from concentrator bottom is mixed with steam and transferred to a flash hopper where the rest of the hexane is removed as wet hexane vapor and molten atactic is batch wise removed from the bottom with the help of pump. The wet hexane from steamer top as well as from flash hopper is sent to neutralizing scrubber column. The vapors from top of neutralizing scrubber are condensed and settled, free water is removed. The wet hexane is finally dried up to required quality in a small drying column followed by molecular sieve dryer as guard bed. The dried hexane is fed to the distillation column (Heavy tail separation) as a second feed and from here pure hexane is sent to dry hexane storage tank for distribution to various consumers.

Extrusion and palletizing: Polymer powder from drying section is discharged by pneumatic heatage (Nitrogen) to Silo acting alternatively as feeding silos of the extruder, hence the powder is continuously proportionate by means of metering device to the continuous mixer and from this to the extruder. High and low melting additives are added separately into respective discharging device and then into slow mixers after complete mixing homogenized mass is fed to the extruder through mixer. In the extruder polymer powder are homogenized, gelled extruded and granulated by an underwater pelletizer. The extruder is attain screw type, where the homogenized powder additives mass is heated by electric heaters and steam. Then it is granulated by cutter with in continuous water circulation to carry the pellets. Downstream the pellets are fed to pneumatic heatage, which sends then to analysis silo.

Bagging and dispatch: The pellets are first sent to three is one-off grade silo to store the off-grade products during start-up and other times. The on-grade pellets are then sent to homogenization silos and then to the bagging silo. Then the pellets are bagged in 25 kgs. Polythene bags. Then they are transferred through belt conveyers to the ware house.

PPCP BLOCK DIAGRAM:



Proposed Modification

- Installation of Fluidized Bed Drier in place of present drier.
- Provision of High heat transfer capacity exchanger as a standby to Poly reactor DM Water cooler.
- Change in High Activity Catalyst.

Polypropylene Plant-IV (PP- IV) Plant

The Catalyst system consists of three components:

- Titanium catalyst supported on $MgCl_2$
- Aluminum Triethyl
- Donor C (a silane compound)

Preparation and storage of the catalyst dispersion in grease: The catalyst (a crystalline solid having controlled particle size) is dispersed in a mixture of paraffin oil and grease before being fed to the plant. The mixture consists of 33% paraffin grease and 67% oil. At first oil is kept circulating, and stirred and heated to remove presence of moisture, and then a pre-set quantity is transferred. During the transfer oil is filtered. The catalyst powder, stored in drums, is added to the oil/grease mixture. Catalyst dispersion is insured by the ribbon agitator. The vessel where dispersion is carried out is provided with a vacuum pump to remove any moisture in the oil /grease mixture after transfer, and get rid of any solvent traces. Water is recirculated inside the jacket. Water is heated during the filling and dispersing steps and cooled with chilled water to gel the mass and prevent catalyst settling. The catalyst paste is transferred to the metering syringes in the reaction section by catalyst loading syringes which are hydraulically operated.

Catalyst Paste metering: The syringes are fitted with a piston that compresses and feeds the paste to the reaction. The movement of the piston which determines the catalyst feed rate, is controlled hydraulically. Syringes switch over is automatic, controlled by limit switches.

Feeding criteria: The catalyst paste flow is an independent variable and sets the plant load through the yield. The aluminum alkyl fed to the plant is ratio to the propylene feed to the reaction. This is done to keep an alkyl concentration in the reaction that allows the plant not to be affected by any minor changes in the water, oxygen or alcohol contents of the propylene feed which would cause marked fluctuations in the yield and isotacticity index. The donor is also fed in a pre-set ratio to the aluminum alkyl. These ratios are set so as to maintain the resulting aluminum/titanium and donor/titanium ratios within the preset range under the normal operating conditions. In particular, donor/titanium ratio is the parameter through which the isotacticity index is controlled in the 94-99% insoluble range. Liquid additive flow rate is set by teal flow controller. The feeding criteria are to start gas phase reactor with an additive/teal ratio of 0.5 by wt. The level into gas phase reactor will be positioned in order to maintain the pressure value. The additive flow rate shall be increased until level into reactor increase of 10% and maintained at this level.

Pre-contacting and Pre-polymerization:
Pre-contacting: The catalyst suspension in the oil/grease mixture, the donor and the aluminum alkyl are pre-contacted at about 100 C. Here the reactive centers of the catalyst are activated for the subsequent contact with the monomers. The operation is carried out in a small agitated vessel (volume of about 3 liters) kept ata constant temperature by thermostatized water recirculating in the jacket. The feeds are sent in from the dip tubes and the mixture is made to overflow to prevent gas pockets.

Catalyst injection into the propylene: The catalyst mixture leaving the pre-contacting pot is injected into a stream of propylene cooled to 10-20°C. The propylene flow to the injectors (which will determine the catalyst residence time in the pre-polymerizer) must never be less than 1000 Kg/h to prevent the plugging of the pre-polymerizer feeding and discharge lines.

Pre-polymerization: The reaction is carried out in a small prepoly tubular reactor at the following conditions:

- Temperature: 200C
- Pressure: 32 kg/cm2 g
- Residence time: about 20 mins.

The reactor is operated completely full of liquid (pressure well in excess of the vapor pressure of the liquid). It has a geometric capacity of 0.68 m3. Circulation is ensured by the axial flow pump. The slurry velocity in the reactor is about 4m/sec. the heat of reaction is cooled by jacket cooling with chilled water. A constant flow rate is maintained in the jacket. Thermal regulation is obtained by adjusting the water temperature by cold make-up water. The axial flow pump has a double back to back mechanical seal. Continuous propylene flushing is provided towards the reactor inside (400 Kg/h) to prevent the polymer from reaching the seal surfaces. The pressure of the flushing surfaces sets the barrier/lubricating oil pressure between the two mechanical seals through the pressurizing piston. The piston designed so as to increase oil pressure by 10% versus propylene flushing. In case of emergency (propylene shortage, failure of Pump etc.) the reactor, the heat exchanger and all the piping involved are quickly discharged to blow down after automatic shut-off from the other plant section.

Liquid monomer polymerization:
Polymerization conditions: The polymerization reaction for the homopolymer and random copolymers takes place in the loop reactor.
Conditions are as follows:

- Reaction Temperature: 70°C
- Pressure: 33-34 kg/cm2 g
- Residence time: 1.5h
- Slurry concentration: 53% by weight
- Inert concentration (mainly propane): 40% by weight max.

Feed from pre-polymerization reaction.
Feed from prepoly reactor flows directly into the main loop reactor and is dispersed in the slurry that is kept circulating in the reactor. Slurry feed from the prepoly reactor has a concentration of approx. 14% wt. polymer, 67% wt. propylene and 19% wt. propane.

Slurry concentration in the reactor: Operating polymer concentration in the loop reactor is only limited by the energy required for slurry circulation. The industrial experience shows that the reactor can easily be operated up to a total slurry densities of 560-565 kg/m3 (corresponding to about 50% solid by weight) at the reaction temperature. Beyond these concentrations the power absorption of the pump rises very quickly and makes their operation unstable. Obviously the polymer concentration must be kept as high as possible to obtain the maximum productivity and yield. In order to maintain the solid concentration in the slurry, the density controller will adjust the total propylene flow to the reactor according to the amount of polymer produced plus the liquid that is carried to the reactor outlet. Solid concentration in the discharge can be appreciably different from that in the reactor because of the polymer centrifuging effect in the elbows. It is usually higher. An expansion drum together with an evaporator , keep the loop reactor always full and prevent at the same time any pressure fluctuations in case of unbalance between inlet and outlet or quick temperature changes in the reactor.

Reactor cooling system: Reactor temperature is controlled by circulating water in the jacket. The water flow rate is kept constant by the recycle pump. The heat of reaction is removed in the plate heat exchanger. The reactor temperature controller set at right reaction temperature (700C), controls I split range mode the jacket water flow rate by passing a part of the jacket water when the plant is not at full load and the design duty of the heat exchanger has not been reached. Corrosion is prevented by nitrogen blanketing of the expansion drum, by accurate pH control and passivation additive make-up.

Emergency devices: In case of emergency on the reactor (huge propylene leakage, failure of the slurry circulation pump etc.) the reactor can be automatically shut off and isolated from the rest of the plant.

- **Emergency killing:** Whenever it is necessary to stop the reaction quickly, a mixture of carbon monoxide and nitrogen can be injected into the lower part of each reactor leg. Killing is operated by the control room acting on automatic sequence.

- **Polymer discharge from the reactor bottom:** In case of failure of the slurry circulation pump and ineffective killing, the settled solid phase can be discharged to the high pressure blow-down vessel where the reaction stops because of the low temperature.

- **Safety valves:** As ultimate solution the reactor is protected by safety valves on the upper elbows connected to the high pressure blow-down.

High pressure degassing:

Flash and degassing: Since a large quantity of liquid monomers is discharged by loop reactors together with polymer, this must be recovered. The first operation consists of a complete evaporation of the liquid and it is performed in a pipe at high velocity. The required heat is supplied through a steam heated jacket. A cascade control sets the steam pressure to the jacket through a temperature controller on the vapors coming out the top of degassing stage. In case of upsets in the flash drum the reactor discharge can be aligned to the blowdown to dispose of all the reactor discharge flow during downtime. After leaving the flash piping, the solid is separated from the gas. The polymer collected from the bottom of the flash separator is discharged under level control to the recycle gas filter in case of homopolymer, random copolymer and terpolymer run or to gas phase reactor when high impact is produced. Temperature and flow rate of the gas leaving are controlled. The gas leaving is directly sent to the scrubbing tower.

Low pressure degassing: The polymer and monomer streams coming from the flash drum (homopolymer, random copolymer and terpolymer run or from the gas phase reactor (heterophasic copolymer reactor run) fed to the low pressure degasser together with scrubbing tower bottom drain and the gas stream recycled from polymer streaming section. This degasser is a bag type filter. The filter is automatically cleaned by counter-washing with propylene gas for the top of the propylene scrubbing after adequate pressure reduction. A liquid separator prevents liquid propylene from reaching the filter bags. The polymer collected at the bottom of the filter is continuously discharged to the steaming section under level control. The filtered gas is sent to washing and compression. A guard filter prevents any large mount of filters from reaching the compressor in case of any rupture of the bags of the primary filter.

Drying: Polymer leaving the streamer contains about 2.5% by wt. of condensed water. This moisture is removed in a fluid bed dryer operated with nitrogen in a closed loop. It is a vertical cylindrical vessel with a sieve plate on the bottom which works as a distributor for fluidization nitrogen. The polymer enters from top and is discharged from the bottom under level control. Inside the vessel, a spiral steel forces the polymer to proceed with a piston type movement, avoiding to discharge wet polymer fractions. Gas leaving dryer flows through the cyclone to separate the fine polymer fractions entrained. The fines are discharged to the extrusion pneumatic haulage through the receiver drum.

Propylene Purification:

- **Sulfur removal tower:** Propylene crossed the two towers that are filled with activated carbons catalyst to get the 1ppm wt. sulfur content specified for polymer grade. The second column acts as a guard and allows replacing the catalyst in the first one when it is saturated, without stopping the plant. No regeneration is required.

- **CO stripper:** Propylene is heated with heat exchanger before entering the CO stripping column. The CO is stripped out with a small amount of other light components and the propylene is purged from the top of the column to battery limit. The column bottom is sent under level control to the drying unit. A line is provided in order to feed the column with the recycled propylene in order to strip out the CO in case of reactor killing.A drying unit is provided in order to absorb moisture and guarantee a value less than 2 ppm in the propylene make-up.

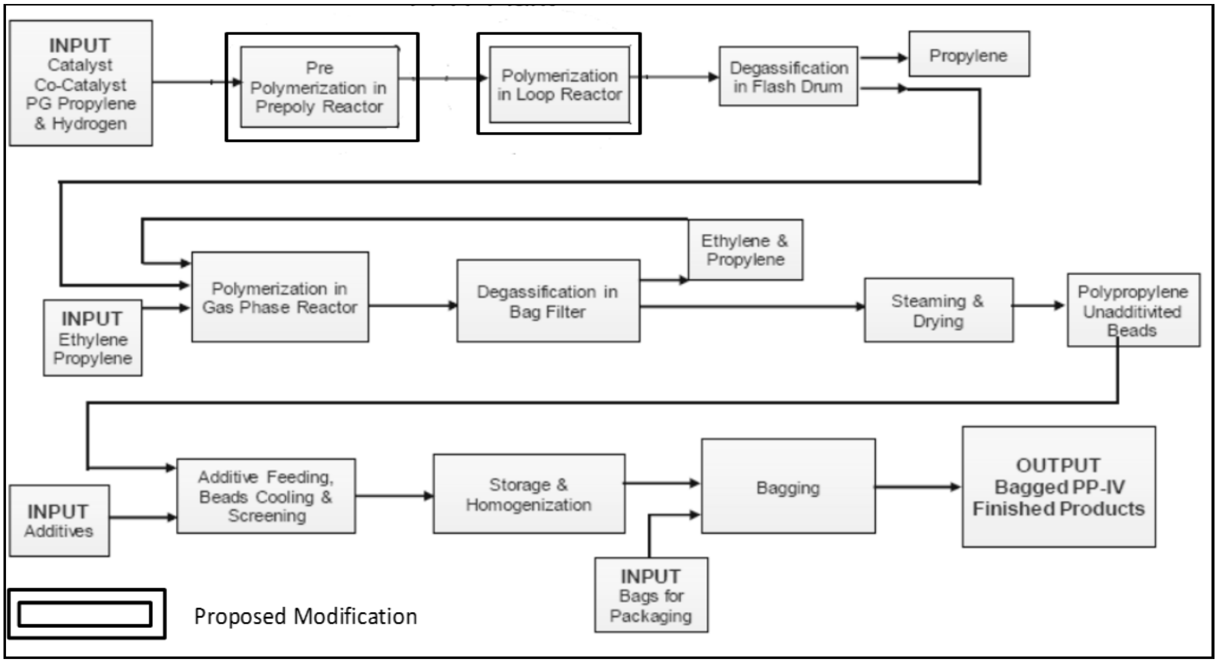
- **COS removal tower:** From the drying unit the propylene feeds the COS tower. There are two towers that work in series. The catalyst is replaced in the first tower when it is saturated (only one tower operates for the necessary time to replace the catalyst). One tower is filled with activated alumina catalyst while other is filled with lead oxide catalyst to remove COS and possible presence of Arsine and Phosphine (if any). Purified propylene is sent to reaction after filtration. Polymer discharge from the dryer is sent to the storage silos by nitrogen closed loop pneumatic conveyor. Another pneumatic haulage receives the polymer from the intermediate silos at ground level through rotary feeder and transfers the polymer to surge silo on the top of Addipol/extrusion building.

Additivation: The polymer is discharged through the rotary feeder into the polymer belt meter from where it is continuously proportioned (polymer/liquid additives continuous in line mixer). Liquid additives (atmer) and melted additives (antioxidants, GMS, STDP) are metered. These additives and solids at ambient conditions are fed to the melting drums through hoppers.

Beads Cooling: The polymer is discharged by the rotary feeder to the beads cooler under level control. The additivated polymer is cooled down to 50°C. From here after the course and fines separation in screen, polymer is conveyed to storage silos (500m3 capacity) by the pneumatic haulage which is a positive pressure type, air based conveying.

Additivated polymer blending and storage: The additivated product (unpelletized) from storage silos is conveyed to homogenizing silo. Product is recirculated for homogenizing purpose. Homogenization is obtained by mixing various samplings of product which are drawn off from multiple points of internal drilled pipes and discharged by gravity into a blending chamber. Product is fully homogenized by one complete turn over and by emptying of blender content. Conveying air of pneumatic haulages is vented from the top of storage and homogenizing silo to atmosphere after power separation in cyclone separator. Finally the homogenized product from silo is transferred to the bagging section (to the bulk loading silo)

Block diagram PP-IV Plant



Proposed Modifications:

1. The reactor outlet slurry line modification as per below:
   - Reactor outlet horizontal portion (non- jacketed)- size to be increased from 1.5" to 2 ".
   - 1st and 2nd vertical legs - size to be changed from 2" - 2.5"
   - 3rd vertical leg - size to be changed from 2.5" - 3".
   - Flash drum inlet line (non- jacketed) – to be jacketed and length to be increased by 4 meters.
   - Flash drum inlet to be diverted, HV- 301 size to be changed from 2.5" - 3".
2. Pre-poly Reactor safety valves set pressure to be changed from 38.5 kg/cm2 to 42 kg/cm2.
3. Main Reactor top three safety valves set pressure to be changed from 38.5 kg/cm2 to 42 kg/cm2.
4. Surge drum top two safety valves set pressure 38.5 kg/cm2 to be replaced with new safety valves of set pressure 42 kg/cm2.
5. Flash drum outlet to tower line size to be changed from 3" to 4".
6. Reactor cooling exchanger (plate type) capacity to be increased by adding 80 more plates.
7. Reactor Outlet Level control valve to be replace with high Cv (capacity) i.e. 48 against 42 control valve.

C4 Derivatives

Butadiene is recovered from the Mix C4 stream from the NCP by Extractive Distillation and Fractionation. The mix C4 feed from outside is received by road tanker and stored and taken to de-oxinizer column for removing oxygen and then feed to vaporizer iva static mixer.

Feed Vapourisation: Mixed C4 feed is mixed in static mixer. It is evaporated (vaporised) in evaporator. Mixed C4 is fed on shell side and is Heated by lean solvent flow in tube side.

Extractive Distillation –I : Main washer receives vapourised mixed C4 feed and vapour from Rectifier Upper Part (RUP) at bottom. It is washed with cooled lean solvent fed at top. Top vapour product of C4 reffinate consist of all Butenes, Butanes, etc. This is washed with reflux from reflux drum of top product of washer. Part of overhead vapour is mixed with acetylene washer overhead to maintain C4 acetylene level within safe limit. This overhead butene steam contains water. This wastewater is routed from reflux drum to acetelene washer reflux drum where it is degassed to flare before putting it to drain. Main washer bottom product is sent to the top of RUP. Here, butenes from loaded solvents are stripped off. The top of RUP is sent to main washer. Bottom of RUP is sent to Rectifier Lower Part (RLP). Stripping is done by top stream of RLP entering in the bottom of RUP.

Extractive Distillation – II: The function of second stage extraction is to strip 1:3 B.D. from loaded solvent. The loaded solvent from RUP and after washer bottom enters RLP top. It is stripped by recycle gas from degasser the stripping gas enters at the bottom of RLP. The bottom of the colomn RLP is divided into two compartments. From one compartment pump takes suction and passes through tower for degassing thermally. The second chamber of the column is flash chamber. Acetylene reachs solvent from flash chamber is pumped to flash pot. The vapour from flash pot goes directly to recycle gas compresser. Liquid from flash pot is pumped to degasser. RLP top product is partly sent to after washer for further purification. Balanced gas is returned back to RUP as stripping gas. Hydrocarbon vapour rich in 1:3 BD enters the Afterwasher at the bottom. Cooled lean solvents enters after washer above packed bed. This solvent which coming down absorbs more soluble solvants. The crude 1:3 BD is washed with reflux & bottom of after washer is sent to RLP.

Degasser and Compression: RLP, bottom under level control of flash compartment is pumped to flash drum (which is not shown in diagram) where it gets flashed and vapour from flash drum directly taken to compressor suction after condensation. Liquid from flash drum is pumped to degasser for flashing of desolved gases at the top of column. Hydrocarbons are removed by stripping the solvents with water and NMP vapours from recoiler. The concentration of water and NMP in the gas phase is decreases from bottom to top of the degasser while total HC concentration goes up. C4 acetylenes are more soluble NMP. The concentration of C4 acetylene is maximum at the mid part. To keep acetylene level in a safe limit flow rate of side withdrawal is kept such that minimum 1:3 BD concentration is 20 Wt.% of total HC before dilution with raffinate gas. Lean solvents will contain about 8.3% water. C4 acetylene side withdrawal is taken to acetylene washer at bottom. The VA concentration in column (wt. basis) kept around 30wt.% NMP is washed with reflux stream of water. Normal makeup of water is done through reflux drum. Reflux flow is adjusted to keep water percent in lean solvent leaving the bottom of water solvent at 8.3 Wt.% . NaNO2 is also injected in reflux. Acetylene is withdrawn in vapour form to VA flare / VA hydrogenation.

Solvent Loop, Heat Recovery: Solvent withdrawn from degasser bottom is cooled against loaded solvent from RLP. Solvent from is taken into exchanger & cooled in evaporator. The final cooling upto 40°C is carried out & will be used as slope NMP tank, solvent make up and withdrawal can be done.

Product Purification: The crude 1:3 BD is pumped to Propyne column. The propyne is removed from the top. The propyne stream withdrawn from the top should not contain more than 50 Vol. % of propyne, because of decomposition at high concentration. For this overheat temperture is kept 45°C. The dissoved water in crude butadiene from after water is removed from reflux drum boot. p-tert butyl catachol (TBC) is injected after dilution with reflux stream to the overhead vapour before overhead condenser. The bottom product is fed to final column. The pure butadiene from reflux drum is sent to storage tank.

Poly Butadiene Rubber-I (PBR-I) Plant:

Catalyst and Additive Preparation/Metering: The catalysts DEAC, DM water and Cobalt octoate are used in the polymerization section. The butadiene 1:2 is used as a modifier that modifies the molecular weight. Water which is used as a shortstop is added at the outlet of the last reactor. All the catalyst vessels are kept under a positive nitrogen pressure in order to prevent the oxygen and moisture ingress. Dosing of the catalyst in metered quantity is done via positive displacement pumps.

Polymerization: The dry feed is received in this section for polymerization. In this section two or three reactors are taken in line depending upon polymerization feed rate. All reactors are used in series. Dry feed stream is mixed with precise quantities of catalyst (catalyst water, 5% cobalt octoate, diluted 12% DEAC) and modifier (butadiene 1:2) before feeding to the first reactor. Mixed feed is precooled with refrigerant ammonia. Reaction, which takes place, is exothermic in nature hence pressure & temperature controls are very important to control the reaction .The refrigerant liquid ammonia is used for cooling down of hydrocarbon vapor. The reacted mass is transferred to next reactor by a screw pump with the auto level control device. Here further reaction takes place to achieve certain quality of product like Mooney & total solids. Modifier controls Mooney, which is important for the quality of finished product.

Polymerization process is highly fouling in nature hence cleaning of reactor is required after certain period. The product from the last reactor discharge, which contains polymer, solvents and unreacted monomers, is called as cement. Short stop is added to kill the reaction. Anti-oxidants like polygard & deenex are also added to prevent the product from oxidation rubber aging.

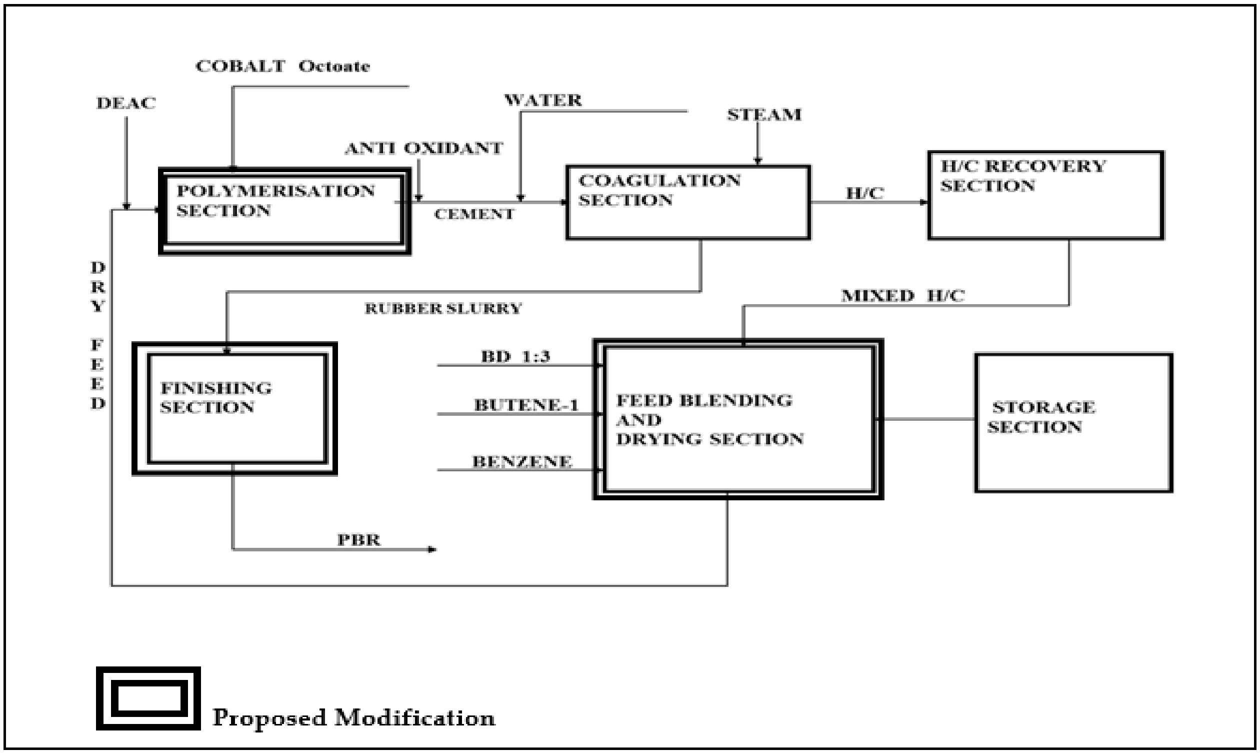
Coagulation and stripping: Here solution from polymer precipitates out and agglomerates to rubber particles called crumbs. For forming usual size of rubber particles the steam flow control is most important. For removal of hydrocarbon from crumbs, the pressure & temperature controls are necessary which gives the smooth flow of rubber slurry from one vessel to another through pipelines. Metered steam injection & steam through sparger ring in the coagulator removes hydrocarbons such as unreacted butadiene 1:3, butene-1, and benzene as overhead vapors. Pure condensate water & recycle water from finishing area is also added in coagulator which makes rubber slurry. To keep homogeneous slurry of rubber in water constant agitation is necessary. This slurry is transferred to next two strippers in series by keeping difference of pressure in individual vessels. No pump is used. In both the strippers remaining solvents are removed. The hydrocarbon free slurry is stored in a surge and vent tank to ensure complete removal of hydrocarbon and for surge purpose. Here all the vessels like coagulator & both strippers as well as surge & vent tank constant agitation & good agitation zones and levels are very important. Coagulator & strippers overhead are condensed separately in condensers. Condensed water is removed from drum boot. Hydrocarbons separated from these vessels stored in a recovery surge sphere, which is sent to Recovery section.

Hydrocarbon recovery and Purification: Hydrocarbon mixture stored in the recovery surge sphere is pumped to the extraction tower for removal of shortstop by using water. After this hydrocarbon stream is sent to a low boiler tower where from the top butadiene and butene-1 along with partly benzene concentration is separated out, which is after condensation sent to Recycle Surge sphere. The bottom stream of L.B. tower is fed to the third tower named as High Boiler tower to separate the solvent benzene by distillation. The top from H.B. tower is sent to recycle benzene tank after condensation. The H.B. tower bottom stream is high boiler fraction and is sent to the disposal tank. The recycle benzene & Recycle benzene and the recycle mix feed are used in feed blending.

Feed Blending and Drying: Monomer supplied from storage area containing TBC & carbonyls, which can create problems in reaction of polymerization hence the butadiene 1:3 passed from caustic wash & water system. After that it is stored in a surge Drum. The above monomer is blended with solvent hydrocarbon s benzene & butene–1. The feed composition is analyzed by an online stream gas chromatograph. The above wet feed containing water removed through bottom boots of on line vessels. Further moisture from feed is removed in the drying tower. Then feed is stored in a feed surge drum .The moisture content in feed is required to be less than 10 ppm.

Finishing Line: Slurry from surge & vent tank is passed through dewatering screen. Rubber containing around 50% of free water is fed to the expeller, where water content is reduced up to 8-10 %. The outlet rubber chunks are fed to in the ANDERSON expander, there are discontinuous worms which advance the rubber a long length and is pressurized ahead of the discharge die to high pressure. The moisture content at its downstream is less than 0.5%. The temperature ahead of the die- plate is in the range of 155-165 °C, the flash evaporation of moisture reduces the temperature around 80 °C. A hotbox is provided at the downstream of the ANDERSON expander with an exhaust blower. It passes through a spiral conveyor with a provision of hot air before baling. Rubber is compressed in balers by hydraulic oil pressure to make proper size of bales of 35 kg. Weight each. Bales are then passed through a metal detector. Lastly, it is wrapped with polyethylene film and packed in a crate and sent to users.

PBR-I Block Diagram:



Proposed modification
Following modification will be carried out

- Installation of New drying column (Standby to increase plant on stream hours.
- Installation of One additional reactor
- Installation new finishing for improve productivity
- Short stop Methanol is to be replaced with DM water.
- Reactor conversion to be increased by optimizing the catalyst dossing rate and BD 1:3 concentration in reactor feed.

Poly Butadiene Rubber-II (PBR-II) Plant

Monomer and Solvent Purification:

BD Purification: Fresh Butadiene 1:3 (BD 1:3) is received from storage area and is mixed with recycle stream of BD 1:3. This mixed stream is fed to a series of two distillation columns. 1st BD column removes moisture from BD. 2nd BD column removes heavies including TBC & top product sent to polymerization section. This section also consists of the Hot Water System. This Hot water is used as heating medium in reboiler of the columns of this section.

Solvent Purification: Solvents & unconverted BD1:3 from stripper is sent to 1st solvent column (C-103) to recover BD from wet solvent. The bottom of this column is fed to 2nd solvent column here the dry solvent is obtained from overhead and used in Polymerization process. Toluene rich make up solvent is obtained as a top product from 3rd solvent and used for catalysts batch preparation. Heavies (HBB) are removed from bottom & sent to GOP for solvent recovery.

Catalyst and Chemical Preparation: The catalyst, PPA, BMP to be used in the polymerization section, SODA, SDN to be used in the stripping section, and the TBC to be used in the Monomer and Solvent purification sections are all received by this section in which they are batch wise made up into solutions of the specified concentration and sent out. All the pressure vessels in this section are under nitrogen sealing in order to prevent oxygen and moisture dissolving into process fluid on contact with air.

Polymerisation Section: BD and solvent being purified in the purification are precooled in the respective pre-coolers by ammonia refrigeration system and mixed with catalyst (NIC, BRF and TAL) & fed to the reactor. There are four reactors in series having agitators for mixing of high viscosity polymer solution. These reactors are also provided with jackets where refrigerant (ammonia) is used as coolant to remove the heat of reaction. The temperatures of reactors are maintained in the range of 63 °C to 90 °C The reaction is terminated by adding PPA solution at the out let of final reactor. After this BMP (anti-oxidant) solution is mixed and polymer solution is sent to the blending section.

Homogenization/Blending Section: There are four blend tanks. The reactor effluent enters in to one of these four tanks. The polymer solution is so blended that desired values of Mooney viscosity is obtained. These tanks are provided with nitrogen sealing; and vapors leaving these tanks contain BD which is recovered in off gas washer. The polymer solution from one of these tanks is fed to the stripping section. There is provision to blend certain specific oils in this solution to get desired properties of polymer.

Stripping Section: The rubber solution form the blend tank enters into first stripper through cement slurry mixer in which it is mixed with hot recycle water. In first stripper the BD and solvent are stripped by steam and by vapor form top of second stripper. At the same time the rubber forms crumbs. The crumb slurry from first stripper is pumped to second and then to third in which residual solvent is stripped out. All the recovered solvent is sent to wet solvent tank in the storage area.

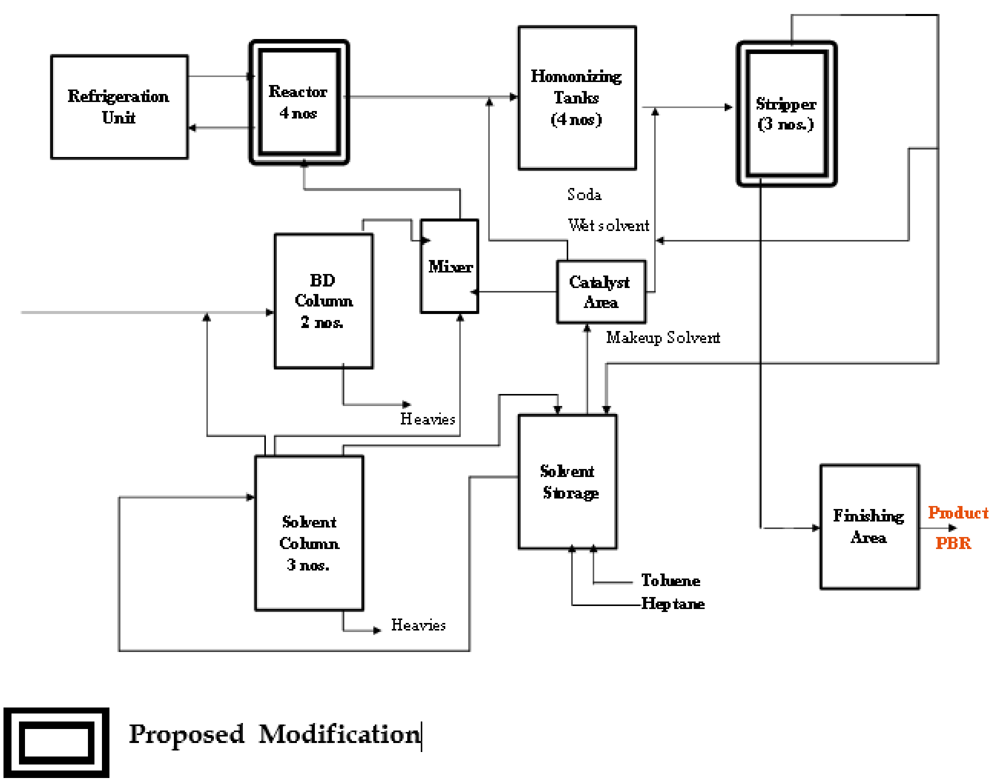
Finishing Section: The crumb slurry from the solvent recovery section is received in the crumb slurry tank. The crumb slurry from this is tank is fed to the shaker screen through distributors (60% water is removed) from the shaker screen, the crumbs pass to the expeller for dewatering the rubber. (40% to 9% water is removed) From the expeller, rubber then passes in to expander where the water is flashed off when the rubber in the form of small crumbs leaves expander. (9% to less than 0.5% water is removed). Rubber crumbs are compressed in balers by hydraulic oil pressure (around 2500 psig) to make proper size of bales of 35 kg. Each. Bales are then passed through a metal detector. Lastly, it is wrapped with perforated polyethylene film and packed in a Paper bags and sent to warehouse in metallic crates.

Refrigeration Section: Refrigeration section (Ammonia) is used to remove the heat of reaction generated in Polymerization section. It is designed for a capacity of 580 TR with Ammonia used as refrigerant. The section is divided into two stage Unit , one being Low Stage Compression unit which comprises of two screw compressors with Capacity of 231 TR 357TR and other being High Stage Compression Unit which has one screw compressor with a capacity of 734TR.

(Solvent Storage Section)BD sphere Area: Solvent Storage section comprises of following tanks:

- Wet solvent tank which is mainly filled with the solvent recovered from stripping section and is feed to Solvent Purification Section. Also, the fresh batch of solvent is prepared in this tank maintaining the solvent ratio of 55% by weight Heptane and 45% by weight Toluene.
- Dry Solvent tank has purified solvent which is the Product of solvent purification section.
- A fresh Toluene tank & fresh Heptane tank.
- Make-Up Solvent tank which has toluene rich (i.e. about 99% toluene by weight) solvent used to prepare catalyst batch. BD sphere contains the Butadiene.

Block diagram PBR-II Plant



Proposed Modification
Following modification will be carried out

- Installation of one additional reactor, one stripper to improve productivity.
- Addition of stand by slope stripper to improve on stream hours.
- Execution of Heat recovery system.
- Up-gradation of finishing line PLC.
- Use of waste stream HBB in craker.
- Implementation of ompro and alarm rationalization. Filter mesh size reduction, to reduce the solvent load in recovery section.
- Addition Hot water to outlet of Coalescer to dissolve the Nitrite in Wet solvent for enhancement of column run-length.
- High temperature nitriding after column cleaning for enhancing run length.
- Installation of wedge type screen with wire mesh in finishing to reduce finishing shutdown.
- Heat recovery by reducing Condensate drum pressure .
- Increasing the screen size in shaker screen minimizing the screen plugging & subsequent finishing S/D.

C6+ Derivatives

Linear Alkyl Benzene Plant (LAB)

LAB Plant consists of the following six process sections ::

1. Pre-fractionation Unit - Fractionation of Kerosene to produce Heart-cut.
2. Hydrobon Unit - Hydro de-sulphurisation and hydro de-nitrification of Superior Kerosene. (LAB Feed Stock)
3. Molex Unit – Separation of N-Paraffins from Kerosene using Molecular sieve as adsorbent.
4. Pacol Unit - Conversion of N-Paraffins to Olefins.
5. DeFine Unit - Selective Hydrogenation of Di-Olefins to Mono-Olefins.
6. Alkylation Unit - Alkylation of olefins and Benzene in presence of HF catalyst of LAB.

Pre fractionator Unit: Superior kerosene (LAB FS) received from Gujarat Refinery having range of C7 - C17 stored in Tanks & is processed in PF section to get Heart-Cut (C10-C13). Lighter part of LAB FS i.e. C7 – C9 is separated from the top of Stripper column and sent back as Return stream. Bottom material of Stripper further fed to Rerun column, where C10-C13 called Heart-Cut got separated from top & send to Heart-Cut storage. Bottom part of C14-C17 is send back as Return stream.

Hydrobon Unit : The sulphur and nitrogen compounds from the Heart-Cut feed are removed in Hydrobon unit. These compounds will adversely affect the Molex sieves. The heart-cut feed is mixed with recycle / make-up hydrogen and preheated and then fed to fired heater to bring the feed temperature to 290°C. The feed then enters Hydrobon reactor, which is charged with Cobalt – Molybdenum catalyst on Silica – Alumina base catalyst. At the reaction conditions (52 – 54 kg/cm^{2}g and 325°C), the sulphur in the Heart-cut is converted to H_2S and nitrogen is converted to nitrogenous compounds. The reactor effluent is cooled and the lighter components (mainly H_2) are separated and recycled to reactor. The hydro desulphurised / denitrified Heart-cut (less than 1 ppm of sulphur) is sent to Stripper column where the lighter fractions in the Heart-cut (below C10) are stripped-off. The stripper bottom product (desulphurised heart-cut) is sent as feed to Molex Unit.

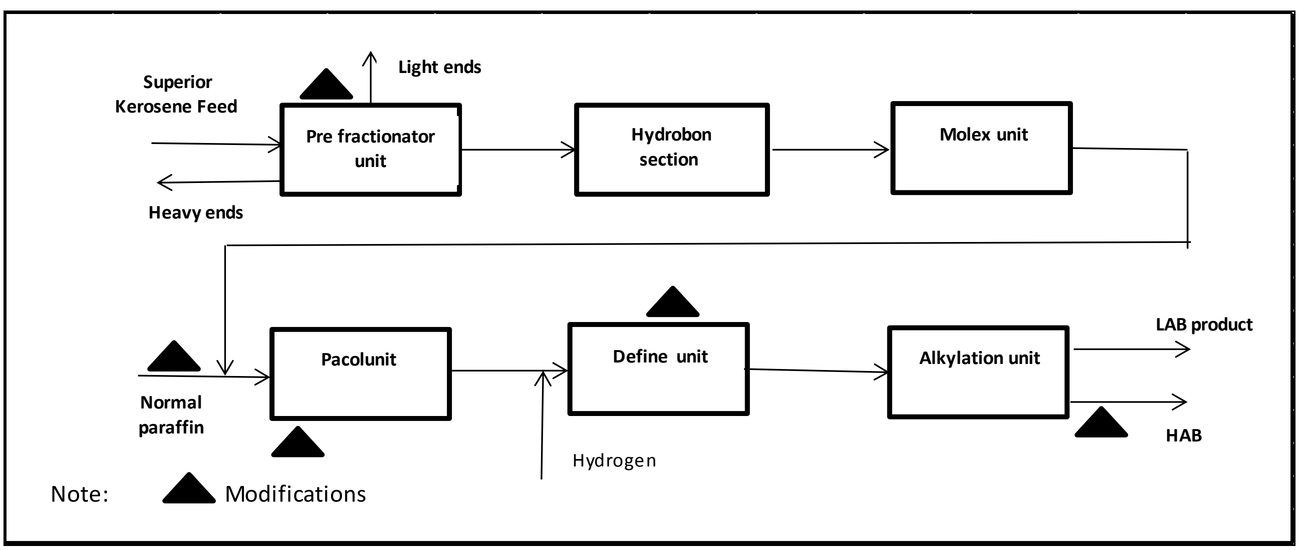
Molex Unit : The heart-cut feed consists of Normal Paraffin (straight chain compounds) and Non-normal compounds (branched chain and cyclic compounds). In Molex process, the N-paraffin is recovered from heart-cut by selective adsorption by molecular sieves. The adsorbent bed is then washed by non-desorptive liquid (iso-octane). Adosrbed N-Paraffin then desorbed by a desorbent liquid mixture of N-Pentane and Iso-Octane as extract. The N-Paraffin is separated from the extract in Extract column and further separated into N-Paraffin (Feed to Pacol) and Heavy N-Paraffin (HNP) in Product Splitter column. The regenerated adsorbent sieves are again returned to contact the Heart-Cut feed. The non-adsorbed (non-normal) paraffin is sent to Raffinate column, the bottom of which is sent to Refinery as kerosene return stream. The overheads of Extract column and Raffinate column are fed to Desorbent Splitter column and split into flush (Iso-Octane) and Normal Pentane streams for re-use in process. Till now N-paraffin was consumed as feed for pacol unit but depending upon market requirement flexibility needs to be created to directly sell in to market as product. Hence identified as one of the new by product.

Pacol Unit : The Pacol process is a catalytic process to dehydrogenate high purity linear paraffin to their corresponding mono-olefins. The conversion is about 13%. The N-Paraffin feed (from Molex) along with recycle paraffin (from Alkylation) is mixed with recycle hydrogen and pre-heated in charge heater and fed to Pacol reactor. The reactor effluent is cooled and sent to separator. The overhead of separator (hydrogen) is compressed and recycled to Pacol feed. Excess hydrogen is sent to Hydrobon make-up compressor. The separator bottom liquid is fed to stripper column, the bottom of which is fed to Alkylation Unit.

Define Unit : Define unit as a part of technology up gradation in Pacol Section of LAB plant, Baroda complex. Wherein Di-Olefins generated across the Pacol Reactor are selectively hydrogenated to their respective mono olefins and normal paraffin in presence of Ni catalyst at moderate pressure & temperature (13 - 18 Kg/Cm2g. & 180 – 200°C) and sulphidation is used to control the selectivity of hydrogenation to mono-olefin. This process enables overall yield improvements by 4 to 6 % in LAB Production through a reduction in the production of Heavy Alkylate and polymers. As an additional benefit, improved quality of the LAB product is achieved through a reduction in the tetralin content. Existing Pacol stripper feed is fed to DeFine booster pump suction. The discharge of booster pump is heated to define reaction temperature @ 180 to 220°C in Hot oil exchanger and fed to the define reactor along with controlled flow of hydrogen. There are three beds in reactor. The feed is mixed with hydrogen at the inlet of the charge heater and fed to first bed of the reactor at top. The outlet of first bed is again mixed with hydrogen in mixer and fed to the second bed. The outlet of second bed is again mixed with hydrogen in mixer and fed to the third bed. In reactor, diolefins is selectively converted in to mono olefins and normal paraffin. The reactor outlet from bottom is goes to Pacol stripper by pressure control. The reaction selectivity is controlled by injection of DMDS (Di Methyl Di Sulfide) in Pacol stripper feed before booster pump suction. Filter is provided at booster pump suction before DMDS injection and common hydrogen supply line. The normal source of hydrogen supply is from Naphtha cracker plant (NCP) at pressure of 32 Kg/Cm^2 g. The alternate source of hydrogen is from existing Pacol section at 29 Kg/Cm^2 g. in case of non-availability of hydrogen from NCP. Hot oil from existing header is supplied to the heat exchanger for heating of the define reactor feed.

Alkylation Unit : The Detergent Alkylate process is a catalytic process in which the mono-olefins + unconverted di-olefins in Define unit are reacted with Benzene in presence of HF acid (catalyst) to product Linear Alkyl Benzene (LAB) and by-product Heavy Alkylate & TAR. The feed from Pacol (Olefins + Paraffin) is mixed with excess Benzene (Fresh + Recycle) and circulating HF acid as catalyst is sent to reactors. The reaction is carried-out in two stage Reactor / Settler system. From Settlers HF acid is circulated back to the reactors. Apart from Catalytic function, HF extracts impurities like poly aromatics. HF having 95 % purity from the first stage settler is sent to HF regenerator. Regenerated HF acid having 98-99 % purity is sent back to second stage settler and from there to first stage settler. Extracted poly aromatics are removed in HF Regenerator as by-product. It is being neutralized in neutralization system. The reactor effluent consists of LAB, Heavy Alkylate, un-reacted Benzene, HF (traces) and Paraffin. HF is stripped from effluent in HF stripper and recycled to reactor feed. Benzene is separated next as overhead product in Benzene column and recycled to reactor feed. The bottoms of Benzene column are fed to Paraffin column to separate N-Paraffin as overhead and sent to Pacol Unit for conversion to olefins. The Paraffin column bottom is fed to Rerun column where it is split into LAB (overhead product) and Heavy Alkylate (bottom product). Rerun column bottom (contains 25 to 35 % LAB) is sent to Recovery column to recover LAB from Heavy Alkylate.

LAB Plant Block Diagram:



Proposed modification

Following modification will be carried out

- Prefractionator unit: This unit helps to separate desired range of feed composition C10 to C 13 from Kerosene feed C7 to C 17. The separated part C7 to C9 and C14 to C 17 will be sent as return stream.
- Define unit: Di olefins produced during the dehydrogenation of normal paraffins in Pacol section will be hydrogenated to mono olefins in Define unit using Ni catalyst hence reducing HAB generation and increasing LAB production from the plant.
- Recovery column for LAB rerun column: Single column is existing for separation of LAB from HAB. Additional column, recovery column will help to increase no of stages for sepration and reduced energy consumption for LAB production.
- Helitower for pacol unit for pacol heater offloading, After the expansion of plant capacity, the existing feed bottom exchanger will be limiting, increasing the energy consumption in Pacol heater. The new exchanger, Heli tower will help to reduce the heat load in pacol heater.
- Single reactor /settler operation of Alky section: Hydrofluric acid HF is utilized as a catalyst during the production of LAB . HF being highly toxic, its inventory will be reduced in the plant by stopping one reactor and settler with out affecting product yield and quality.
- APH for hot oil heater : Hot oil is used in Lab plant as heating medium for all column reboilers. The return stream from reboilers is heated up in Hot oil heater. In order to heat up the combustion air using the hot air from the stack, Air pre heater will be installed thus reducing stack temperature and thus increasing efficiency of the heater.

Utilities

The VMD facility plant has an integrated utilities system which includes plants for the treatment and distribution of raw water steam/condensate, cooling water, DM water, fire water, compressed air, nitrogen and oxygen, and power plant. Whereas offsite facilities includes the storage, receipts & transfer, loading and unloading of chemicals, products and by-products. The areas covered under utilities are listed below, the proposed project shall utilize the existing utilities during its operations and no expansion is proposed.

- Air Separation Unit
- Compressed air system
- DM water plant
- Raw water system
- Cooling towers
- Captive Power Plant
- Fire water system
- Tank farm
- Effluent Treatment Plant (ETP)

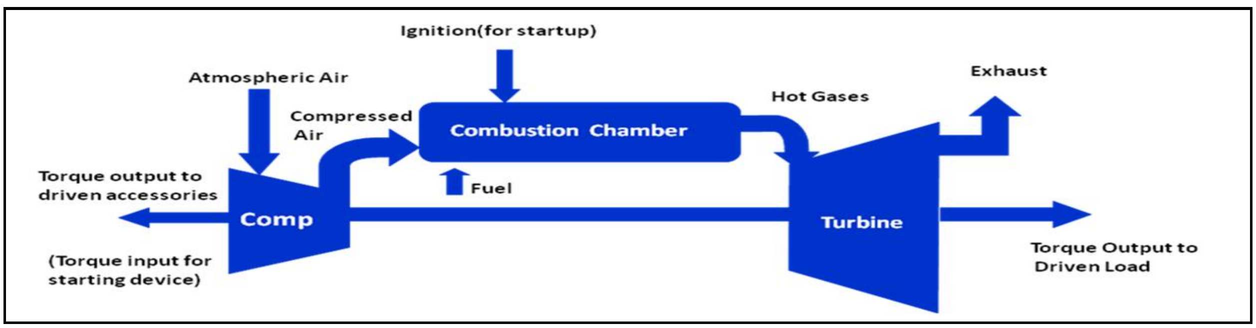
Captive Power Plant (CPP)

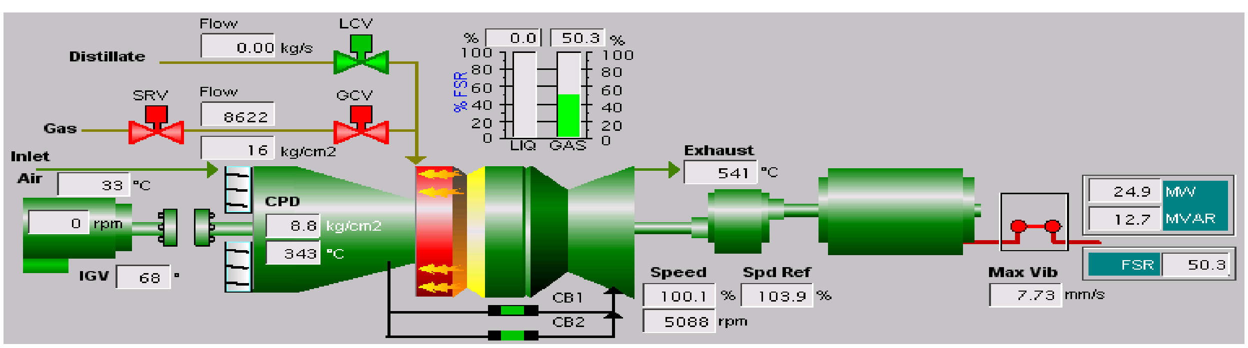
The steam & power required for the manufacturing facility is supplied by the CPP at VMD and also backed up by supply from GEB, DG sets are used during any emergencies. The steam is generated by the boilers using Natural Gas, FO, LSHS as fuel. The steam is supplied to various units at different pressures through pressure settings and also to generate power. The proposed project involves DBN of the existing GTPP to enhance steam & power generation.

Gas Turbine Power Plant (GTPP)

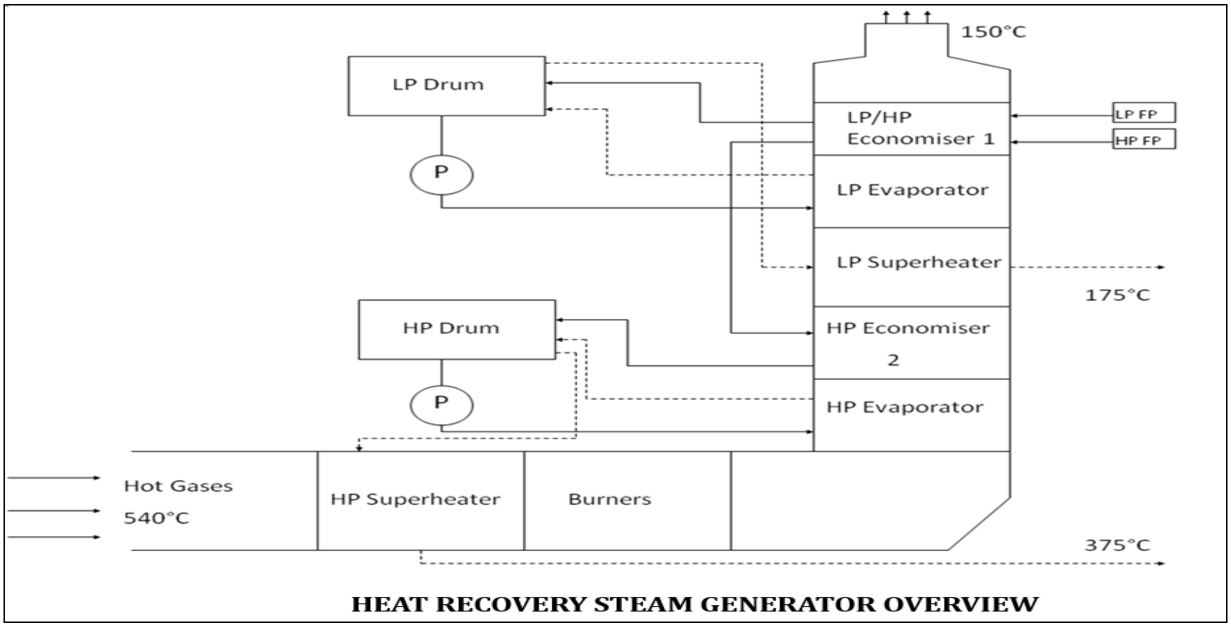
Process Description

- The Gas Turbine Power Plant is equipped with 2 gas turbine which are erected with the purpose of generating captive power at RIL for supplying power to different plants of RIL.
- Other than the power generation it is equipped with Heat recovery system capable of generating 100 MT per hour at 43Kg/cm2 at 395 C and 10 MT per hour of Low steam at 5.5 Kg/185 C.



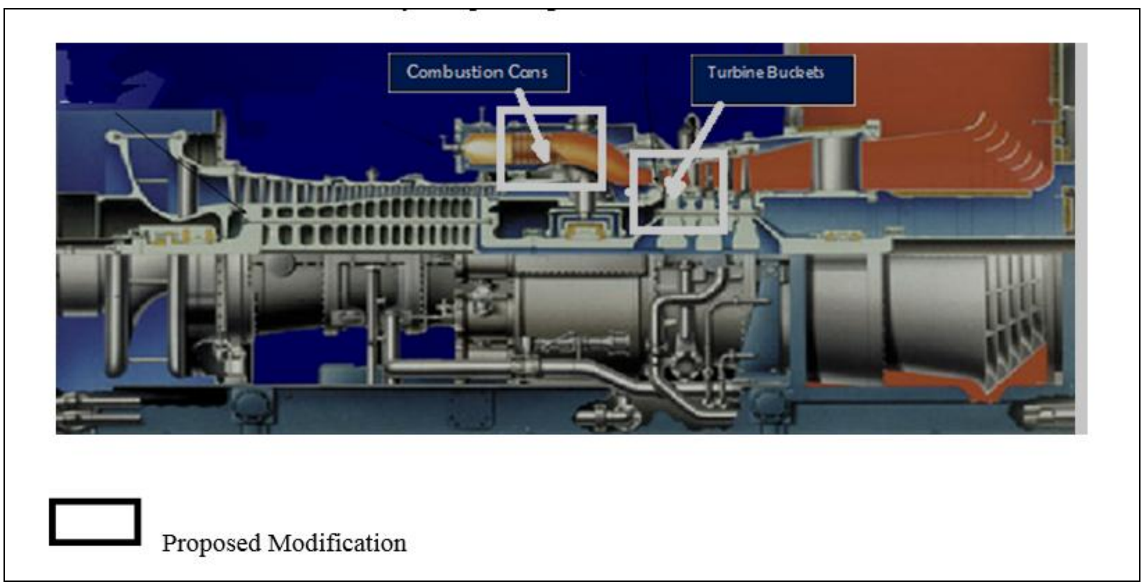


Existing Gas Turbine Setup Diagram



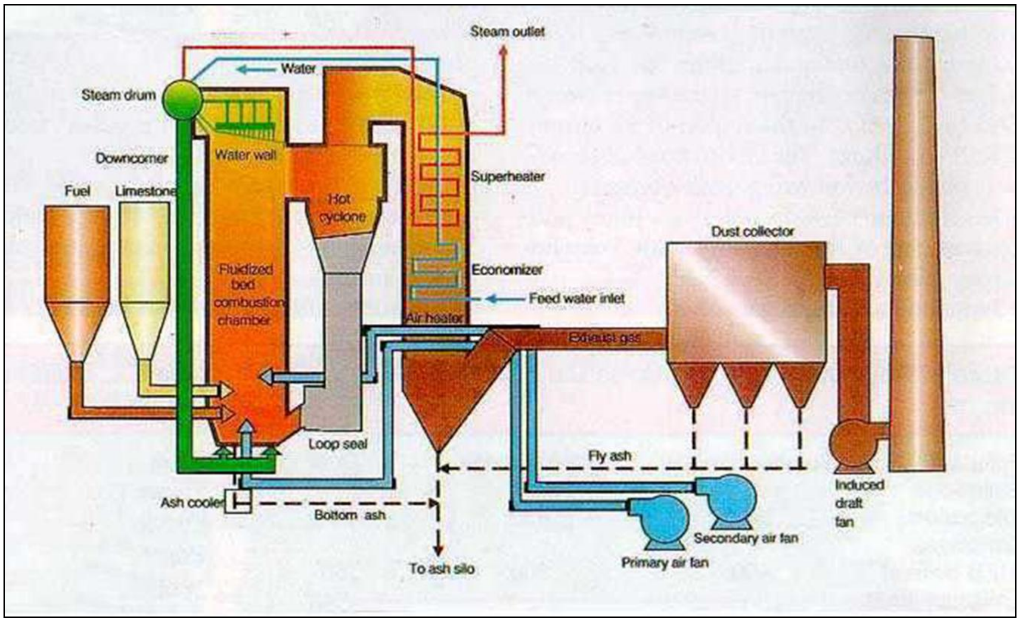
Proposed Modifications:

Combustion section & the turbine blades will be replaced with superior firing temperature material to increase the efficiency and power generation.



Pet-coke Boiler

In the proposed project, a petcoke based 500 TPH (2 x 250) boilers are planned as a stand-by for generating steam & power at VMD. This will create a flexibility in the existing scenario fuel mix of gas/liquid. The CFBC technology is proposed to be used at VMD.



CFBC Technology: CFBC boiler consists of a boiler and a high-temperature cyclone as a solid separation device. A coarse fluidizing medium and char in the flue gas are collected by the high-temperature cyclone and recycled to the boiler. Recycling maintains the bed height and increases the denigration efficiency. To increase the thermal efficiency, a pre-heater for the fluidizing air and combustion air, and a boiler feed water heater, are installed. In CFBC boilers, combustion takes place at temperatures in the range of 800-900°C resulting in reduced NOx emissions compared with pulverized fuel fired units. SO2 emission is reduced by the injection of limestone in the combustion chamber.

Circulating beds use a higher fluidizing velocity, so the particles are constantly held in the flue gases, and pass through the main combustion chamber and enter into a cyclone, from which the larger particles are extracted and returned to the combustion chamber. Combustion conditions are relatively uniform through the combustor, although the bed is somewhat denser near the bottom of the combustion chamber. There is a great deal of mixing, and residence time during one pass is very short. The bed material is preferred either as crushed refractory or from the fuel ash or as sand in some cases. Due to the large heat capacity of the bed, combustion is stable and no supporting fuels are required, provided the fuel heating value is sufficient to raise the combustion air and the fuel itself above its ignition temperature. The intense turbulence ensures good mixing and combustion of the fuel. The controlling parameters in the CFB combustion process are temperature, residence time and turbulence.

Limestone Feed and Control Mechanism: Sulphur capture in CFBC boilers happens by injecting Limestone along with fuel. The fuel and Lime mixture enters into combustion chamber through multiple feed points located in furnace front close to the bottom primary zone. Limestone undergoes decomposition by taking heat from the hot bed material (endothermic) and converts into Calcium Oxide (CaO).This process is called as Calcination. The calcined Limestone being porous in nature gets entrained in flue gas and enters the top section of furnace where the mixture of Oxygen and Sulphur Dioxide reacts with Calcium Oxide and converts into Calcium Sulfate ($CaSO_4$).This Process is called Sulfation. This process is an exothermic reaction. Thus, the Limestone converts gaseous SO_2 emission to solid Calcium Sulfate and gets removed from the system. Attributing higher particle residence time and recirculation, the Sulphur capture efficiency in CFBC boliers can be achieved to almost 95%.

Limestone injection control consists of Limestone variable speed rotary feeder. The amount of limestone that is required for a given amount of fuel depends on the sulphur content of coal. An increase in sulphur dioxide emissions will necessitate in an increase in the amount of limestone that is required for a given fuel flow to the furnace. The limestone demand is a function of the main fuel flow. An increase in fuel flow demand will result in a corresponding increase in the limestone demand to provide the demand signal to the Limestone Variable Rotary Feeder.

The petcoke required (~42 TPH) is planned to be transported via rail, or by conveyor system from the neighboring refinery, depending upon its availability. Limestone required (~22 TPH) will be locally sourced and will be transported via rail or road.

Petcoke Analysis Specification

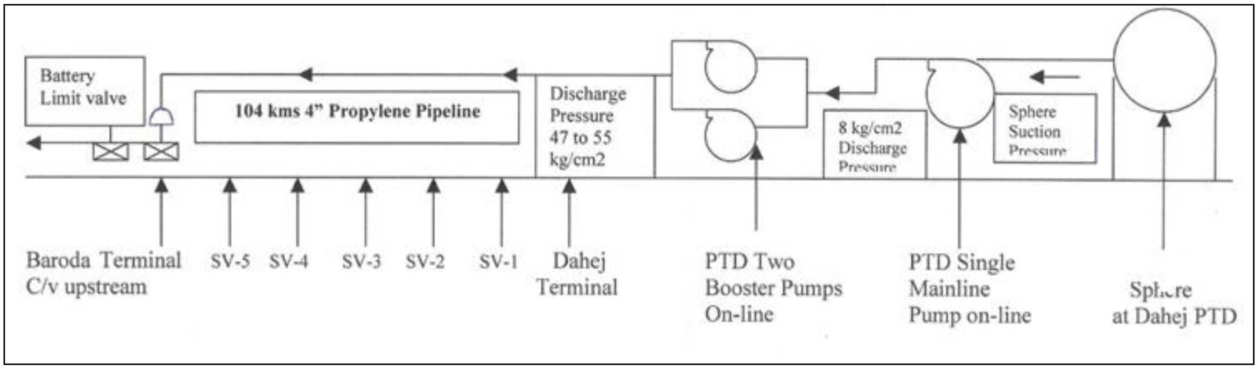
Attributes	Units	Range
Moisture Content as received	% wt	8-12
Moisture Content after Initial Drying	% wt	2.0-2.5
Ash on dry basis	% wt	0.2-0.9
Volatile matter	% wt	8-11 (max)
Density (dry)	kg/cu.m	550-570
Fixed carbon (dry)	% wt	85-91
Hydrogen	% wt	3.5-4.5
Nitrogen	% wt	0.5-1.2
Total sulphur (dry)	% wt	4.5-7.5
Hardgroove Grindability Index	min	30-50
Sieve analysis size	mm	50-100
Gross Calorific Value	kcal/kg	8100-8350

Lime Stone Analysis

Attributes	Units	Typical Value
$CaCO_3$	%	89
$MgCO_3$	%	5.5
$Ca(OH)_2$	%	0
$Mg(OH)_2$	%	0
H_2O	%	0.5
Inert	%	5

Baroda –Dahej Pipe line:

Three pipe lines for transfer of ethylene, Propylene and Naphtha from RIL-DMD to RIL-VMD covering are distance of 104.5 km is in place and also same can be used to supply ethylene from RIL-VMD to RIL-DMD. The same shall be utilized for this proposed project as well. A schematic pipeline schematic is shown below:



Rail Gantry:

The railway gantry at VMD consists of three railway track for managing shunting of wagons and one loading/unloading bay. In the proposed project, the existing rail gantry shall be modernization for better handling of material, reduction in loading/unloading time and also to replace the obsolete and extra aged tracks and sleepers.

ENVIRONMENTAL ASPECTS

The proposed expansion & debottlenecking at VMD shall not have any significant adverse impact on the environment setting of the region. However, this section provides the details of the environment considerations of the proposed project.

Air Emissions

The expected air emissions from a petrochemical plant are PM, SO2, NOx, HCs & VOCs, PM. These are emitted continuously from stacks (point sources) associated with fuel combustion as well as process units. Besides small quantities of Cl2, HCl, CO and HC will be released from process stacks. SO2 will also be released due to the combustion of petcoke in the CFBC boilers as and when they are operated as a standby to the existing steam & power generation. Such emissions will be controlled and will be within stipulated standards by in-situ lime injection and stacks shall be provided to effectively disperse the emissions. In the proposed project, additional stacks are proposed for the CFBC boilers & the CPVC units. The details of the stacks will be provided in the EIA report after detailed engineering.

Noise

The major source of noise generation shall be from process plants, compressors, pumps, etc. In the proposed project there is no anticipated increase in noise level. However, adequate precaution will be in place to maintain noise level within prescribed limits.

Water Consumption and Effluent Generation

The proposed project requires water for operation of its processes, process cooling, utilities cooling, domestic consumption, fire water make up and greenbelt development etc. No adverse environmental impact is envisaged due to withdrawal of water by VMD. The existing water requirements at VMD are 31000 m3/d. In the proposed project, an incremental water quantity of 9300 m3/d is envisaged taking the total water requirement at VMD to 40300 m3/d. This total water requirement will be met by Vadodara Irrigation Division, Govt. of Gujarat, which has sanctioned 40915 m3/d (9 MGD) of water to VMD. The sanctioned letter for water is given at **Annexure 1.** Water is withdrawn from two French well in Mahi river at Khandi and Jalampura village and pumped ~20 km through pipeline. The present allocated quantity of water is sufficient for the proposed project as well.

Also water management plan at VMD is being implemented which includes water conservation measures such as to reduce the net raw water requirement by way of recycle/reuse of treated wastewater to the maximum possible extent wherever it is feasible. The effluent generated from the existing VMD operations is ~ 12500 m3/d. Post the proposed project, the effluent generation from VMD facility is envisaged to be ~18800 m3/d which is an addition of ~6300m3/d from the existing effluent generation. This effluent shall be treated within the existing Effluent Treatment Plant (ETP) which has a capacity of ~24000 m3/d. The treated effluent of ~26,400 m3/d which also includes CT blow down and along with treated effluent from dry spun acrylic fibre (DSAF) plant will be discharged into the Vadodara Effluent Channel Limited (VECL) for further final disposal to Estuary of River Mahi. VMD has a permission to discharge ~ 40,000 m3/d into the VECL.

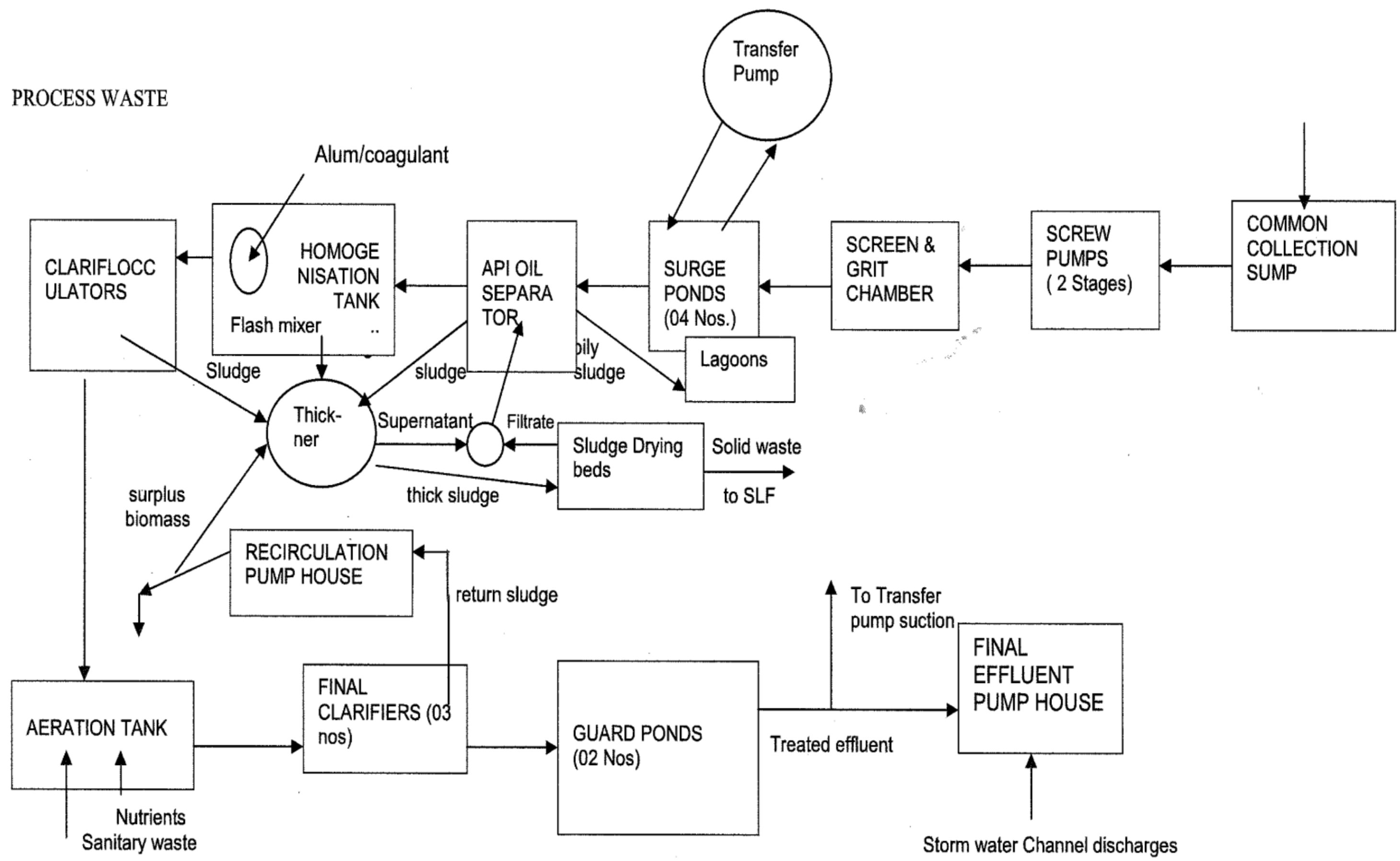
Effluent Treatment Plant (ETP): In state-of-the-art wastewater management system, the first stage of effluent treatment is at source by inside battery limit (ISBL) pre-treatment facilities at individual process plants. Second stage is the Biological treatment at ETP after the removal of oil and other specific pollutants. Domestic sewage is mixed with the industrial effluent at the inlet of Secondary Treatment facility. The existing ETP shall suffice the proposed project as well.

The wastewater samples from each plant, ETP units are collected and analyzed for the parameters specified by GPCB. All the treatment units of the effluent treatment plants are adequate and working efficiently. Online effluent monitoring at final effluent discharge for parameters of COD, BOD, TSS, Ammonical nitrogen and pH have been installed and monitored regularly.

The treated effluent is reused within the process and green belt and excess treated effluent is discharged to Gulf of Cambay near estuary of river Mahi through a common effluent channel maintained by VECL with a capacity of 40,000 m3/d. This facility is provided by & operated by a consortium of industrial units of central as well as Gujarat govt. The same shall be extended to the proposed project as well.

Hazardous / Non Hazardous Waste Management: The major sources of solid wastes due to proposed project will consist of oily sludge, used oil, molecular sieve, biological sludge, canteen/office wastes, metal scraps, batteries, surplus drums, etc. Present practice of solid/hazardous wastes management as per Hazardous Wastes Management and Handling Rules 2016 will be extended to the proposed project as well. VMD operates its own TSDF as well a solid waste incinerator to dispose its wastes generated. The same shall be extended to this proposed project as well. The quantification of Hazardous and Non-Hazardous waste from the proposed project shall be carried out during the EIA studies after detailed engineering.

Ash management: The expected quantities of ash to be generated from the combustion of pet coke ~ 30 TPH. Only dry ash handling & management is proposed and will be stored in silos. Ash in dry form is transferred from the hoppers to storage silos through pneumatic conveying. The fly ash will be utilized for various purposes like brick making, additive to cement and additive to concrete. The bottom ash of CFBC boilers will have minimum unburnt carbon and will prove suitable for use in cement manufacture as it will be clinkered to the required levels. Ash disposal will be carried out in closed type, top loaded, ash trucks.



CENTRAL WASTE WATER TREATMENT PLANT (CWWTP)
PROCESS BLOCK DIAGRAM

PROJECT IMPLEMENTATION

Execution Strategy

Execution of the project includes engineering, procurement, construction, installation and start-up the facilities and it will follow the disciplined and orderly project management approach. Established Project management processes and procedures of RIL shall be adopted to complete the project safely within approved Budget, Schedule and Quality.

The Basic engineering package shall be provided by Reliance Project Management Group (RPMG) in consultation with Reliance R&D Department. Detailed Engineering for this project shall be executed by Detail Engineering Consultant i.e. Mumbai Engineering Center (MEC). Detail engineering activities includes development of overall engineering deliverables for all disciplines.

Procurement shall be done with the help of Procurement and Contracts department. Engineering deliverables for procurement such as SOQ for construction contracts, MRs for all tagged equipment and PR for all bulk items shall be developed by MEC.

Commissioning and Start-up of the plant shall be joint responsibility of R&D, RTG Projects and VMD Site operations. After successful start-up and handover of facilities, Maintenance and Operation of the facility will be performed by the VMD Operations with routine inspections and surveillance throughout the design basis life cycle.

Project Schedule

The proposed project is scheduled to be commissioned in stages starting within one year after EC is granted. Following are the major activities which will be scheduled based on logical interdependencies in order to complete this project as per schedule:-

Engineering:

- Basic Engineering design package (Process description, PFD, P&ID, PDS etc.)
- Detail Engineering of the project (P&ID, HAZOP, MDS, IPDS, 3D model, MRs, SOQ, MTO, Layouts, SLD, Loop diagrams etc)

Procurement:

- Long lead items (Compressors, Booster Pumps , In tank Pumps)
- Other Tag items i.e. Heater, vessels, Electrical Switchgears, Instruments, vaporizer, Control Valves
- Bulk materials (piping, cables, trays, Instrument panels , Electrical Panel, valves etc)

Project Management

An experienced and well-equipped project management team shall be deployed to execute, monitor and control the project throughout the engineering, procurement phases till start-up. Major activities in project management includes the following:-

- Interface with various internal and external stakeholders supporting the project
- Ensuring compliance with all regulatory requirements
- Coordinating the development of "Basic Engineering design package"
- Leading the detailed engineering phase and directing detail engineering consultant (MEC) for development of engineering deliverables to enable procurement and construction activities.
- Timely communication (review meetings, written communication, reports etc) with all stakeholders.
- Enabling procurement activities by providing necessary inputs i.e. MR for long lead items, SOQs for contracts, bids/ tender evaluation, contract award etc.
- Materials Management & Quality Assurance.
- Co-ordination for overall activities at site.
- Project Control activities such as planning, scheduling, monitoring/ controlling, cost control, variance analysis etc.
- Reporting of project progress.
- Co-ordination for commissioning and start-up activities to ensure successful "performance guarantee test run" of the project.
- Handover of plant to Asset owner and Close-out of the project

REGIONAL PLANNING BRIEF

The followings sections provide a brief on the regional setting taken from secondary sources. The details shall be provide during the EIA studies.

Planning concept (Type of industries, facilities, transportation etc.)

The proposed DBN activities and expansion plants are located within the existing VMD petrochemical plant located in the industrial area of GIDC. The other industries falling in the vicinity of VMD petrochemical plant are IOC-Gujarat Refinery, GACL, GIPCL, SABIC, GSFC, etc,

Demographic Structure

The salient features of the study area of 10 km radius from the RIL- VMD; as per 2011 census the study area consists of 7,09,305 persons inhabited in the study area of 10 km radial distance from the periphery of the proposed project site. The males and females constitute 52.21% and 47.79% in the study area respectively. The sex ratio in the region is 915 this shows that male population is higher in the region as compared with the female. The literacy level is 81.28%. 3.74% population belong to Scheduled Tribes (ST) and 7.81% Scheduled Castes (SC) indicating that about 11.54% of the population in the study area belongs to socially weaker sections.

Assessment of Infrastructure Demand (Physical and Social)

The infrastructure resource base of the area with reference to education, medical facility, water supply, post and telegraph, transportation and communication facility and power supply etc. are described below:

Education: All the villages have the facility of only primary school 31, Secondary school 5 and 4 senior secondary schools in villages. Availability of further educational facilities i.e. higher secondary school is in nearest town Vadodara

Drinking Water: Mode of drinking water supply are mainly through, well and tank. Other source of drinking facilities are Hand pump, river and others sources**.**

Communication and Transportation: Most of the villages have Post Office and telephone connections as communication facility available in the region. Bus services are available almost in all villages and approach routes are either paved road, mud road or foot path

Power Supply: Power supply is available in most of the villages

Medical/Primary Health Care: Medical facilities are available in the form of primary health center and primary health sub centers in the region.

ANNEXURE-I

Sh. B.K. Pyar / Sh. D. T. Karchandani

કાર્યપાલક ઇજનેર, વડોદરા સિંચાઇ વિભાગ, ૭ મો માળ, રૂમ નં. ૭૧૭, આઇ-બ્લોક, કુબેર ભવન, વડોદરા. ૩૯૦૦૦૧		Executive Engineer, Vadodara Irrigation Division, 7th floor, Room No.717, " I "Block, Kuber Bhavan, Vadodara. 390001. E-mail address: vidvadodara@gmail.com
ફોન નં. ૦૨૬૫-૨૪૧૫૩૭૬	Fax No.0265-2418639.	Phone No.-0265-2415376.

No. VID/AB/IND/REQ.2016-17/RIL-Vadodara/ 1114 OF 2016.

Date: 16 /03/2016.

To,
The Managing Director.
Reliance Industries Ltd.
Vadodara Manufacturing Division.
P.O. Petrochemicals,
Dist : Vadodaran - 391 346.

Sub : Water Drawal for the Non-agriculture purpose from Notified River / Reservoir - Requirement for the Year 2016-17.

Ref : 1. Govt. Resolution No. WTR/2005/41/P /Dt. 3.2.2007.
2. T.O. letter No.VID/AB/IND/D.W.REQ.QTY/RIL-V/375 Dt.28/01/2016.
3. Your letter No.RIL/VMD/CAD/ VID/15-16/01 Dt.25/01/2016.

With reference to above subject, it is hereby inform you that your company has demanded to reserve 9.00 MGD (0.28 MGD for Drinking & 8.72 MGD for Industrial purpose) water for the year 2016-17 vide letter under reference (3).

The demand for the year 2016-17 is same as per the quantity sanctioned for the previous year i.e. 2015-16.

There is no change in your demand for the year 2016-17. Hence it is accepted as per prevailing Government Rules & 9.00 MGD (0.28 MGD for Drinking & 8.72 MGD for Industrial purpose) Qty. is continued for the year 2016-17. This is for your information and further necessary action please.

(J. K. Patel)
Executive Engineer,
Vadodara Irrigation Division,
Vadodara

Copy respectfully submitted to the Superintending Engineer, Vadodara Irrigation Circle, Vadodara, for information please.

Copy fwd. to the Deputy Executive Engineer, Irrigation Sub-Division, Vadodara, for information please.

Sanction Letter Of Qty.2014-15

2197

Sachivalaya, Gandhinagar, 6th May, 1975.

GUJARAT INDUSTRIAL DEVELOPMENT ACT, 1962.

No. GHU/75/41/GID 1974/4084 (vi)Ch.—In exercise of the powers conferred by section 16 of the Gujarat Industrial Development Act, 1962 (Guj. XXIII of 1962), the Government of Gujarat, with effect on and from the date of its publication in Government Gazette.

(1) declares that the provisions relating to notified areas as contained in Chapter XVI-A of the Gujarat Municipalities Act, 1963 (Guj. 34 of 1964) and other provisions of that Act as specified in Schedule I annexed hereto, shall extend to and be brought into force in the Petrochemical Complex Industrial Area specificed in Schedule II annexed hereto;

(2) appoints the Senior Officer, Gujarat Industrial Development Corporation, Baroda, for the purposes of assessment and recovery of taxes, when imposed under the provisions so extended and in order to arrange for the due expenditure of the proceeds of such taxes and for the preparation and maintenance of proper accounts and generally for enforcing the provisions so extended; and

(3) directs that the provisions of the Gujarat Panchayats Act, 1961 (Guj. VI of 1962) which are in force in the said industrial area shall cease to apply thereto.

SCHEDULE—I

The provisions of the Gujarat Municipalities Act, 1963- Sections : 2,5, 44(1), 64 to 98, 105 to 264, 267 to 270-271 (subject to the restriction that no rules shall be made in relation to matters covered by clause (b) of sub-section (*1*) of section 264-B), 272, 273 and 275 to 280 and Schedules: II to VI.

SCHEDULE—II

(Petrochemical complex Industrial Area declared under Government Notification, Industries, Mines and Power Department No. GHU/72/115/IND/1672/13541/CH, Dated the 30th December, 1972).

Land consisting of :—

Revenue Survey Numbers of following villages of Baroda Taluka of Baroda District :

(i) Revenue Survey Numbers of Village Koyli 1120 Eastern Part (Hct. 0 Ars. 02 Sq.Mts. 02), 1125 Eastern Part (Hct. 0 Ars. 82 Sq.Mts. 96), 1126, 1127, 1128, 1129, 1130/1, 1130/2, 1130/3, 1131/1, 1131/2, 1132, 1133, 1134/1, 1134/2, 1135/1+1135/2, 1136, 1137, 1138, 1139, 1140, 1141, 1142, 1143/1, 1143/2, 1144, 1145, 1146, 1147/1, 1147/2, 1147/2/5, 1147/3, 1147/4, 1147/2/6, 1147/5, 1147/6, 1148, 1149/1, 1149/2, 1150, 1151, 1151/1, 1151/3, 1152, 1153, 1154, 1155/1, 1155/2, 1156, 1157 Northern Part. (Hct. 0 Ars. 18 Sq.Mts. 73), 1158, 1159, 1160, 1161, Eastern part (Hct. 0 Ars. 38 Sq. Mts. 45), 1162, North-east part (Hct. 0 Ars. 08 Sq. Mts 09) 1163/1, 1163/2 Northern part (Hct. 0 Ars. 38 Sq. Mts. 44), 1283 Northern part. (Hct. 0 Ars. 00 Sq.Mts. 75), 1284 Northern part (Hct. 0 Ars. 30 Sq.Mts. 35), 1289 Northern part (Hct. 0 Ars. 07 Sq.Mts. 08), 1290 Northern part (Hct. 0 Ars. 52 Sq.Mts. 61), 1291, 1292 Northern part (Hct. 0 Ars. 58 Sq.Mts. 68), 1293 Northern part (Hct. 0 Ars. 84 Sq.Mts. 98), 1294, 1295, 1296, 1297, 1298/1, 1298/2, 1298/3, 1299, 1300, 1301, 1301/1 1302/1, 1302/2, 1302/3, 1303 Northern Part. (Hct. 0 Ars. 18 Sq. Mts 20), 1310 Northern Part (Hct. 0 Ars. 31 Sq.Mts. 40), 1311, 1312, 1313, Northern part (Hct. 0 Ars. 30 Sq. Mts. 35) & 1333, Northern part (Hct. 0 Ars. 34 Sq. Mts. 84), 1334 Northern part (Hct. 0 Ars. 04 Sq.Mts.05), 1335, Northern part (Hct. 2 Ars. 50 Sq.Mts. 76), 1336, 1337, 1338, 1339, 1340, 1341, 1342/1, 1342/2, 1343/1, 1343/2, 1344, 1345, 1346/1, 1346/2, 1346/3, 1347, 1348, 1349, 1350, 1351, 1352, 1353/1, 1353/2, 1354, 1355, 1356, 1357, 1358, 1359/1, 1359/2, 1360, 1361, 1362, 1363, 1364.

(ii) Revenue Survey numbers of village Karachia:—160 Northern Part (Hct. 0 Ars. 23 Sq.Mts. 23), 161 Northern part (Hct. 0 Ars. 06 Sq.Mts. 72), 194 Northern Part (Hct. 0 Ars. 04 Sq.Mts. 04), 197 Western Part (Hct. 0 Ars. 64 Sq.Mts. 37), 198 Western part (Hct. 0 Ars. 60 Sq.Mts. 22), 199 Northern part (Hct. 0 Ars. 23 Sq.Mts. 30), 200, 201 Northern part (Hct. 0 Ars. 15 Sq.Mts 25), 202 Northern part (Hct. 0 Ars. 22 Sq.Mts.90), 203 Northern part (Hct. 0 Ars. 17 Sq.Mts.39), 204 Northern part (Hct. 0 Ars. 26 Sq.Mts. 30), 205, 206, 207, 208, 209, 210, 211, 212, 212/1,+ 212/2 Western Part (Hct. 1 Ars. 12 Sq.Mts.28), 213 Western part (Hct. 0 Ars. 41 Sq.Mts.60), 214/1, 214/2, 215, 216, 217, 218/1, 218/2, 219, 220, 221/1, 221/2, 222, 223, 224, 225, 226/1, 226/2, 226/3, 226/4, 226/5, 227/1, 227/2, 228, 229, 230/1, 230/2, 231, 232, 233/1, 233/2, 234, 235, 236, 237, 238/1, 238/2, 239, 240, 241, 242/1, 242/2, 243, 244, 245, 246/1, 246/2, 247, 248, 249, 250/1, 250/2, 251/1, 251/2, 252/1, 252/2, 253, 254, 255, 256, 257, 258, 259, 260, 261/1, 261/2, 262+ 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279+ 280, 281, 282, 283,+ 284, 285/1, 285/2, 286, 287/1, 287/2, 288, 289, 293, 297, 298, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313/1, 313/2, 314, 315, 316/1, 316/2, 317, 318 319, 320 Western part (Hct. 1 Ars. 67 Sq.Mts. 95), 327/1+2 western part (Hct. 0 Ars. 59 Sq.Mts. 69), 328, 329, 330, 331/1, 331/2, 332 Northern part (Hct. 0 Ars. 24 Sq.Mts. 28), 333 Western part (Hct. 0 Ars.20 Sq.Mts. 23), 336 Northern part (Hct. 0 Ars. 13 Sq.Mts. 65), 337 Northern part (Hct. 0 Ars. 02 Sq.Mts. 02), 353/2, Eastern part (Hct. 0 Ars: 02 Sq.Mts. 02), 354/1 North East part (Hct. 0 Ars. 41 Sq.Mts. 48), 361 + 362 North east part (Hct. 0 Ars. 01 Sq.Mts. 01), 363 + 364 Eastern part (Hct. 0 Ars. 66. Sq.Mts. 77), 365 + 366, 367/1+2 Western part (Hct. 1 Ars. 54 Sq.Mts. 79), 368/1+2 Western part (Hct. 0 Ars. 62 Sq.Mts. 73), 369 Western part (Hct. 0 Ars. 44 Sq.Mts. 52), 370/1 Western part(Hct. 0

Ars. 17 Sq. Mts. 20), 371 West-north part (Hct. 0 Ars. 03 Sq.Mts. 04); 372/2 Northern part (Hct. 0 Ars. 24 Sq.Mts. 28); 373, 374/1, North east part (Hct. 0 Ars. 01 Sq.Mts.01), 376 East-West south part (Hct. 0 Ars. 78 Sq. Mts. 92), 377 South-West part (Hct. 0 Ars. 42 Sq.Mts. 24), 378 South-west part (Hct. 0 Ars. 96 Sq. Mts. 00), 389, 390, 391, 392, 393, 394, 395, 396/1+2+3 Southern part ((Hct. 0 Ars. 12 Sq.Mts. 13), 397 Southern part (Hct. 0 Ars. 20 Sq.Mts. 23), 398 eastern part (Hct. 0 Ars. 55 Sq.Mts. 62), 399 South east part (Hct. 0 Ars. 03 Sq.Mts. 04), 402/1/5 Southern part (Hct. 0 Ars. 13 Sq.Mts.65), 403+ 404 Southern part (Hct. 0 Ars. 19 Sq.Mts. 80), 405/1/5, 406, Western part (Hct. 0 Ars. 35 Sq. Mts. 90), 407 Western part (Hct. 0 Ars. 28 Sq. Mts. 70), 408 Eastern part (Hct. 0 Ars. 31 Sq.Mts. 94), 409, 410, 411, Eastern part (Hct. 0 Ars. 03 Sq.Mts. 04), 412 Western part (Hct. 0 Ars. 10 Sq.Mts. 61) 413/1+3 Western part (Hct. 0 Ars. 36 Sq.Mts. 85), 414, 415, 416, 417, 418, 419/1, 419/2, 420/1+2+3+4 Eastern part (Hct. 0 Ars. 03 Sq.Mts. 04), 422 Western part (Hcts. 0 Ars. 03 Sq.Mts. 04), 426 Eastern part (Hct. 9 Ars. 65 Sq.Mts. 76), 427, 428, 429 eastern part (Hct. 0 Ars. 84 Sq. Mts. 99), 430 Eastern part (Hct. 0 Ars. 35 Sq.Mts. 41), 431 eastern part (Hct. 1 Ars. 23 Sq.Mts. 43), 432, 433, 434, 435, 436, 437/1, 437/2, 438, 439, 440, 441, 442, 443/1, 443/2, 444 Western part (Hct. 0 Ars. 48 Sq.Mts. 58), 445+449 Western part (Hct. 0 Ars. 06 Sq. Mts. 71), 450, 451, 452, 453, 454, Western part (Hct. 0 Ars. 55 Sq.Mts. 68), Western part (Hct. 0 Ars. 34 Sq.Mts. 48), 455/1, 455/2, 456/1, 456/2, 457, 458, 459, 460, 461/1, 461/2, 462, 463, north-west part (Hct. 0 Ars. 86 Sq. Mts. 00), 464 North-West part (Hct. 0 Ars. 08 Sq.Mts. 09), 465 Northern part (Hct. 0 Ars. 32 Sq.Mts. 37), 466 northern part (Hct. 0 Ars. 31 Sq. Mts. 36), 467, 468, 469/1, 469/2, 470, Northern part (Hct. 0 Ars. 50 Sq.Mts. 59), 474 West-north part (Hct. 0 Ars. 02 Sq.Mts. 02),

(iii) Revenue Survey numbers of village Dhanora. 8 North-east part (Hct. 0 Ars. 04 Sq.Mts. 05), 10, 11, 12, 13, 14, 15, 16/1, 16/2, 17, 18, 19, 20, 21, 22/1, 22/2 Part, 22/3, 23/1, 23/2, 24/1, 24/2, 24/3, 25 North-East part (Hct. 1 Ars. 50 Sq.Mts. 74), 26 Northern part (Hct. 0 Ars. 55 Mts.64), 27- East-North part (Hct. 0 Ars. 01 Sq.Mts. 01), 28 North-East part (Hct. 0 Ars. 33 Sq.Mts. 39), 30 North-East part (Hct. 0 Ars. 96 Sq.Mts.11), 31, 32, 33/1, 33/2, 34, 35, 36, 37, 38/1, 38/2, 38/3, 39, 40, 41, 42,43/1, 43/2, 44, 45/1, 45/2, 45/3, 46, 47, 48/1, 48/2, 48/3, 48/4, 49, 50, 51/1, 52/1, 52/2, 52/3, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63/3 part (Hct. 0 Ars. 33 Sq.Mts.39), 64 South-east part (Hct. 0 Ars. 38 Sq. Mts.45), 65, 66 Southern part (Hct. 0 Ars. 03 Sq.Mts. 04), 67 Southern part (Hct. 0 Ars. 36 Sq.Mts. 42), 68 southern part (Hct. 0 Ars. 27 Sq.Mts. 32), 73 Southern Part (Hct. 0 Ars. 10 Sq.Mts. 12), 74 Southern part (Hct. 0 Ars. 47 Sq.Mts. 55), 75, 76, 77, 78, 79, 80/1, 80/2, 81, 82, 83, 84, 85/1, 85/2, 86/1, 86/2, 86/3, 87, 88, 89/1, 89/1 Part (Hct. 0 Ars. 20 Sq. Mts. 99), 89/2, 90, 91/1, 91/2, 92/1, 92/2, 92/3 92/4, 93/1, 93/2 95 Eastern part (Hct. 0 Ars. 06 Sq. Mts. 07), 226 East-South part (Hct. 0 Ars. 02 Sq.Mts.02), 324 North-East part (Hct. 0 Ars. 73 Sq.Mts. 85).

(iv) Revenue Survey numbers of village Karodia:— 20, 20/1 South-West Portion (Hct. 0 Ars. 0 Sq. Mts. 50), 22/2 Western part (Hct. 0 Ars. 38 Sq. Mts.45), 23 + 23/1 Western part (Hct. 1 Ars. 86 Sq.Mts. 16).24, 25, 26, 27, 28. 29, 30, 31/1, 31/2, Western part (Hct. 0 Ars. 18 Sq.Mts.21), 32/1, 32/2 Western part (Hct. 0 Ars. 27 Sq.Mts. 32), 33, 34, 35, 36, 37, 38/1, 38/2, 39, 40, 41, 42, 43, 44/1, 44/2 Western part (Hct. 0 Ars.22 Sq. Mts.26), 44/2 Western part (Hct. 0 Ars. 33 Sq.Mts. 39), 50 Western part (Hct. 0 Ars. 22 Sq.Mts. 26), 51, 52, 53 North-South-West part (Hct. 0 Ars. 30 Sq.Mts.35), 54 South-West part (Hct. 0 Ars. 04 Sq.Mts.05).

(v). Revenue Survey numbers of Undera:— 2/1, 2/2, 2/B, 2/5, 3, 4/1 4/2, 5, 6, 7, 8, 9/B, 10, 11, 12/1, 12/2, 12/3, 13, 14 Southern part (Hct, 0 Ars. 04 Sq.Mts.05), 15/B, 17/B, 18, 19/A/2. 57/B, 131/B, 132/B, 133/1B. 133/2/B. 134/1/B. 134/2. 135. 136 Southern part (Hct. 0 Ars. 35 Sq.Mts.41), 138 East-South-Part (Hct. 0 Ars. 10 Sq.Mts. 12), 139. 140, 141 Southern part (Hct. 0 Ars. 22 Sq. Mts. 26). 142 East-South part (Hct. 0 Ars.24 Sq. Mts. 28), 143/1A, 143/1B, 143/1C. 143/1/2; 144. 145. 146. 147, 148, 149 eastern part (Hct. 0 Ars. 90 Sq.Mts. 04). 150/1, 150/2. 150/3, 151/1 151/2. 152, 153, 154, 155, 156, 157, 158, 159, 160/1, 160/2, 161, 162, 163, 164/1, 164/2, 165. 166, 167/1, 167/2, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182. 183. 184/1, 184/2, 185, 186 Northern part (Hct, 0 Ars. 46 Sq.Mts. 54) 187. 188/1, 188/2, 189, 190. 191, 192, 193/1, 193/2B, 193/3B. 194/B. 195/B. 206/1B, 206/2, 207/B 292/B, 293/B, 294/B, 295, 296/B. 297/B, 298/B. 299/B.

(vi) Revenue Survey Numbers of village Raroli. 18. 630. 631, 632. 633, 634, 635, 636, 637, 638/1, 638/2. 639, 640, 641. 642. 643. 644. 645, 646/1, 646/2, 647, 648, 649. 650. 651 + 653. 652. 654. 655, 656, 657, 658, 659, 661/1. 661/2. 661/3. 662/1. 662/2. 663. 664/1. 664/2, 665,666, 667, 668. 669. 670. 671. 672 673. 674. 675. 676. 677. 678, 679. 680, 681, 682 + 900. 683, 684. 685. 686. 687. 688. 689. 690. 691, 692, 693, 694 + 695. 696, 697. 698, 699. 700. 701. 702. 703 704. 705. 706. 707, 708, 709. 710. 711, 712. 713. 714, 715. 716. 717. 718. 719. 720, 721, 722, 728/2 Eastern part (Hct. 0 Ars. 88 Sq Mts. 12). 844 Southern Part (Hct. 0 Ars. 56 Sq.Mts.15), 845. 846, 847. 848. 849. 850. 851. 852. 853/1, 853/2, 854, 855 Southern part (Hct. 0 Ars. 69 Sq. Mts. 31), 856, 857, 858, 859, 860/1, 860/2. 861 Southern part (Hct. 0 Ars. 16 Sq.Mts. 18), 862, 863. 864, Western part (Hct. 0 Ars. 46 Sq. Mts. 54). 865. 866/1, 866/2. 867. 868. 869. 870. 871, 872 873. 874 875 876 + 877. 878 879/1, 879/2, 880. 881, 882. 883, 884 + 885. 886. 887. 888. 889. 890, 891, 892, 893, 894, 895, 896. 897. 898. 899. 900. 901, 902. 903. 904, Northern part (Hct. 0 Ars. 65 Sq. Mts. 76). 905. 906 Northern part (Hct. 1 Ars. 46 Sq. Mts. 70), 907 West-North part (Hct. 0 Ars. 15 Sq. Mts. 18), 908, 909, northern part (Hct. 0 Ars. 91 Sq.Mts. 05), 910. 911. 912, 913 North-East part (Hct. 1 Ars. 16 Sq.Mts. 35), 914, 914/1, 915. 916, 917, 940, 941.

and all other lands of villages of Koyali, Karodia, Dhanora, Undera, Karachia & Ranoli of Taluka Baroda of District Baroda situated within the following limits.

Petro Chemical Industrial Area.

Northern Boundary:—Starting from the West-North corner from S.No. 844/P, 855-P, 862, 863, 864, 865, 866, 941, 876, 877, 878, 723-P, 707, 706, 630, 631, 632, 633, 637, 638, 643, 644, 645, 656, 657, 658, 659, 661 and 662 of village Ranolli.

Eastern Boundary:—Starting from the North-East Corner from S. No. 662, 663, 665, 666, 667 then it comes road and S.No. 910, 911, 917, 916, 915 of village Ranoli and S. No. 365-P, 368-P, 369-P 370-P and then turned it to North side of S. No. 372-P, 373-P, 354/P/1, 363-P of village Karachia.

Southern Boundary:—Starting from the South-West Corner S. No. 1163-P, 1164-P, 1157-P, 1283-P, 1293-P, 1242-P, 1289/P, 1303-P, 1309-P, 1310-P, 1313-P, 1333-P, 1334-P, 1394-P, 1393-P of village Koyali and the S. No. 160-P, 161 and then Nal Land and then S. No. 204--P, 203-P, 202-P, 201-P, 199-P, then Nal Land and S.No. 194-P, then turned it to North side of S. No. 196, 198, 197,212-P, 213-P, 422-P, 421-P, 420-P, 412-P, 413-P, 407-P, 406-P, 402-P, 403-P, 289-P, 320-P, 327-P, 333-P, then turn it to eastern side of S.No. 332-P, 336-P, 337-P of village Karachia S. No. 903, 904, 906, 907, 909 and 913 of village Ranoli and Passing along the northern township road.

Western Boundary:—Started it from the West-North corner fromS.No. 844-P, 845, 846, 847, 728-P/2, and 18 of village Ranoli then S.No. 16, 14, 13, 10, 9, then Nal land and S. No. 8-P, 26-P, 25-P, 28-P, the Nal land and S. No. 30-P, then Nal land and S. No. 64-P and turn it to western side S. Nos. 66-P, 67-P, 68-P, then Nal land and S.No.75-P, 74-P, 73-P, then Nal land and S.No. 226-P, Then turn it to south side S. No. 226-P, then Nal land and S. No. 96-P, 90-P, 93-P, 92-P of village Dhanora S. No. 1125, 1120-P, then Nal land and S. No. 1161 and it ends at S. No. 1162 of village Koyali.

Calico and G. E. B. Sub-Station Area.

Eastern Boundary:—Starting from the North-East corner from S. No. 376-P, 377-P, 379-P and then Nal land and S. No. 444-P, 445-P, 453-P, 451-P, 450-P, and then Nal land and S. No. 463-P of village Karachia.

Southern Boundary:—Starting if from East-South corner S.No. 463-P, 464-P, 465-P 466-P, and the Nal land and S. No. 474-P and 470-P of village Karachia.

Western Boundary:—Starting it from South-West corner the S. No. 470-P, 426-P, 429-P, 425-P, 430-P, 431-P and then Nal land and S.No. 420-P, and 411-P, of Karachiya.

Northern Boundary:—Starting from North-East Corner from S. No. 376-P, 396-P, 397-P, 399-P, 375-P, 408-P and then Nal land of village Karachiya.

And at the South, Southern Township Area.

Northern Boundary :—Starting from the North-West corner from S. No. 17-P/1, 18-P, 19-P, 143-P/1, 142-P, 141-P and then Nal land and S. No. 138-P, 137-P, 131-P of village Undera.

Eastern Boundary:—Starting from the North-East Corner from S.No. 131-P/1, 132, 133-P/1, 134-P/1, of village Undera and from S.No. 53-P, 54-P, 50-P, 44-P, and then Nal land and S.No. 32-P, 31-P, and the Nal land and S. No. 22-P/2, 23/1, 20/1, 20 of village Karodia.

Southern Boundary:—Starting from the East-South from S. No.195-P, 194, 193-P and then Nal land and S. Nos. 206/P-1, 207-P and then Nal land and S. No. 186 and then Nal land and S. No. 292-P, 293-P, 294-P, 299-P, 298-P and then Nal land of village Undera.

Western Boundary:—Starting from the West-North from S.No.17-P/1, 18, 12, 13, 10, 57-P, 7-B, 2-B and then Nal land and S. No. 297-P, 296-P and then Nal land of village Undera.

સચિવાલય, ગાંધીનગર, ૬ઠ્ઠી મે, ૧૯૭૫.

ગુજરાત ઔદ્યોગિક વિકાસ અધિનિયમ, ૧૯૬૨.

ક્રમાંક:—જીએચયુ/૭૫/૪૧/જીઆઈડી૧૯૭૪/૪૦૮૪(૬)-ચ.—ગુજરાત ઔદ્યોગિક વિકાસ અધિનિયમ, ૧૯૬૨ (સન ૧૯૬૨ના ગુજરાતના ૨૩માં) ની કલમ ૧૬થી મળેલી સત્તાની રૂએ, ગુજરાત સરકાર આથી, સરકારી ગૅઝેટમાં પ્રસિધ્ધ થયાની તારીખે અને તે તારીખથી—

(૧) જાહેર કરે છે કે, ગુજરાત નગરપાલિકા અધિનિયમ, ૧૯૬૩ (સન ૧૯૬૪ના ગુજરાતના ૩૪માં) પ્રકરણ ૧૬-એ માં સમાવિષ્ટ, જાહેર કરેલા વિસ્તારો અંગેની જોગવાઈઓ અને આ સાથે જોડેલી અનુસૂચિમાં ૧માં નિર્દિષ્ટ કર્યા પ્રમાણેની તે અધિનિયમની અન્ય જોગવાઈઓ આ સાથે જોડેલી અનુસૂચિ ૨માં નિર્દિષ્ટ કરેલા પેટ્રોકેમીકલ કોમ્પલેકસ ઔદ્યોગિક વિસ્તારને લાગુ પડશે અને તેમાં અમલમાં આવશે.

(૨) એવી રીતે લાગુ પાડવામાં આવેલી જોગવાઈઓ હેઠળ નાખવામાં આવ્યા હોય ત્યારે વેરાની આકારણી અને વસુલાતના હેતુઓ માટે અને આવા વેરાની આવકના યોગ્ય ખર્ચની વ્યવસ્થા કરવા માટે અને યોગ્ય હિસાબો તૈયાર કરી રાખવા માટે અને એવી રીતે લાગુ પાડેલી જોગવાઈઓનો સામાન્યત: અમલ કરવા માટે, ગુજરાત ઔદ્યોગિક વિકાસ કોર્પોરેશન, વડોદરાના સીનીયર અધિકારીને નીમે છે, અને

(૩) ફરમાવે છે કે, સદરહુ ઔદ્યોગિક વિસ્તારમાં અમલમાં હોય તેવી, ગુજરાત પંચાયત અધિનિયમ, ૧૯૬૧ (સન ૧૯૬૨ના ૬ઠ્ઠા)ની જોગવાઈઓ, તેને લાગુ પડતી બંધ થશે.

ANNEXURE: III

REVENUE SURVEY NOS. OF RELIANCE VADODARA SITE LAND

Sl.No.	Plot Description	Revenue Survey Nos.
1	Transferred by GIDC between Road No.2 & 3	DHANORA -
		55/P, 56/P, 57, 58, 59, 60, 61, 62/P, 63, 64/P, 65/P, 61/P, 68/P, 73/P, 74/P, 75/P, 76/P, 77
		78, 79, 80/1+2, 81, 82, 83, 84, 85, 86/1+2+3, 87, 88, 89, 90, 91/1+2, 92/1+2+3+4/P, 93/1/P, 324/P
		KOYALI -
		1125/P TO 1163/P, 1284/P , 1290/P TO 1313/P, 1333/P TO 1364/P.
		KARACHIA -
		160/P, 197/P TO 232/2, 275 TO 287/P, 405/1/P, 414/P TO 419/1+2/P
2	Road No.2	KARACHIYA : 231/P, 233/1/P, 234/P, 235, 236, 237, 238/1, 238/2, 239, 240, 241,
		242/1, 242/2, 243, 244, 245, 246, 247, 248, 249, 250/1+2/P, 251/P,
		KOYALI : 1360/P.
3	North of Road No.2	252/P, 253, 254/P, 255/P, 256, 257/P, 258/P, 259, 260, 261/1+2, 262,
		263, 264/P, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274/P, 276/P,
4	Triangular por.adj. to Road No.2	283, 284/P, 285/1+2/P, 288/P, 289+290+291+292+294+295+296+299+300+301/P
		293, 297/-, 298/P, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313/1+2,
5	East part of NT	KARACHIYA : 314, 315, 316/1, 316/2, 317, 318, 319, 320/P TO 324, 327/P, 328/P, 329, 330/P,
		331/1+2, 333/P, 331/P, 331/1+2, 332, 336, 337, 233/1+2/P, 234/P, 230/P, 231+232/P,
		276/P, 275/P, 280/P, 279/P, 274/P, 298/P, 297/P, 281/P, 282/P, 284/P, 285/P, 286/P,
		287/P, 288/P, 289/P, 277/P, 299/P, 402/1 TO 4/P, 403+404/P, 405/P, 406/P, 407/P,
		412/P, 413/1+2/P AND CART TRACK.
		DHANORA : 11/P, 12/P, 15/P, 16/1/P, 17/P, 18, 19, 20, 21, 22/1+2, 23/1+2, 24/1+2+3,
		25/P, 28/P, 30/P, 31/P, 32, 33/1+2+3/P, 34, 35, 36, 37/P, 38, 39, 40, 41, 42, 43/1+2, 44,
		45/1+2, 46, 47, 48, 49, 50, 51, 52/P, 53/P, 54/P, 56/P, 30/P, 54/P, 62/P, 52/P, 53/P,

		55/P, 56/P.
		RANOLI : 892, 893, 894/895, 896, 897, 898, 668, 669, 670, 671+673, 672, 680+681,
		682+900, 683, 698, 897, 898, 899, 901, 902, 903, 904, 905, 906, 907, 908 AND
		CART TRACK
6	North of Road No.1	RANOLI : 18/P, 683/P, 684/P, 694+695+696/P, 697/P, 698/P, 699, 700+701, 702, 703,
		704, 705+708/P, 706/P, 709, 710/P, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720,
		721, 722/P, 723/P, 728/2/P, 746/P, 747+748/P, 844, 845/P, 848/P, 849/P, 850, 851,
		852, 853/1, 853/2, 854/P, 855/P, 856, 857, 858, 859, 860/1, 860/2, 861/P, 864/P, 865/P,
		866/1/P, 866/2/P, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876+877+881/P, 878/P,
		879/P, 880, 882, 883, 884+885, 886, 887, 888, 889/P, 890/P, 891/P, 893/P, 894, 940/P,
		941/P AND NAL LAND.
		KARACHIYA : 251/P, 252/P, 255/P, 257/P.
7	Road No.1	DHANORA : 17/P
		KARACHIYA : 250/P, 251/P, 252/P, 254/P, 255/P, 257/P, 258/P, 264/P AND NAL LAND
		RANOLI : 18/P, 890/P, 891/P, 892/P, 893/P, 894/P, 700+701/P, 896/P, 897/P, 699/P,
		698/P, 603/P, 889/P, 940/P.
8	Railway Siding on Road No.1	RANOLI : 897/P, 898/P, 699/P, 683/P, 682+900/P, 685/P, 680+681/P, 679/P, 671+
		673/P, 672/P.
9	Road No.3	KOYALI : 1157/P, 1158/1159+1160, 1161/P, 1162/P, 1163/1+2/P, 1283/P, 1284/P,
		1289/P, 1290/P, 1291/P, 1293/P, 1302/P, 1302/3/P, 1303/P, 1310/P, 1311/P, 1312/P,
		1313/P, 1333/P, 1334/P, 1335/P, 1363/P, 1364/P AND NAL LAND
		KARACHIYA : 160/P, 161/P, 198/P, 199/P, 200/P, 201/P, 202/P, 203/P, 204/P, 207/P,
		220/P, NAL LAND 194/P, 197/P, 198/P, 212/P, 213/P, 214/P, 405/P, 412/P, 413/1+2/P,
		414/P, 416, 417/P, 418/P, 419/1+2/P, 420/1+2/P, 422/P, AND NAL LAND 289+290+
		291+292/P, 323+322+324/P, 327/P, 330/P, 331/P, 333/P, 405/P, AND NAL LAND
		RANOLI : 897/P, 898/P AND NAL LAND.

10	8/12 Mtr. Strip on Road No.1	DHANORA : 25/P TO 28/P, 30/P, 64/P, 66/P TO 68/P, 71/P, 73/P, 74/P
11	South of Petrofils	RANOLI : 728/1/B/P, 728/2/P, 758/P, 814+819+820/P, 815, 816, 817, 818, 824/P,
		825, 826, 827, 829, 830, 831, 832, 836/P, 837+838+839/P, 841/P, 842/P, 843/P,
		844/P, 845/P, 846/P, 847/P, 848/P, 938/1/P, 938/2/P, 938/3/P & NAL LAND.
		DHANORA : 12/P, 13, 14/P, 15/P, 16/1/P, 16/2/P, 322/1
12	Triangular plot behind NT	RANOLI : 668/P, 669/P, 672/P
13	Land of Plot 'Y'	KOYALI : 1017/1/P, 1089, 1098, 1105, 1106, 1108/4, 1109, 1110,1111, 1112, 1113/1/P,
		1113/2/P, 1114/1, 1114/2, 1115/1, 1115/2, 1115/3/P, 1116/1, 1117, 1118/1, 1119,
		1120, 1120, 1121, 1122, 1123, 1124, 1125, 1160/2, 1161, 1162, NAL LAND, 94, 95, 96,
		93, 324, NAL LAND 1089, 1109, 1110, 11121113, 1114, 1118, 1119, 1114, 1223,
		WESTERN SIDE LAND 1089, NAL LAND 1115, 1116, 1117, 1120, 1161, 1162.
		DHANORA : 93/1, 93/2, 94/1, 94/2, 95, 96, 97, 98, 99, 100, 101, 102/1, 102/2/P,
		102/3/P, 102/4, 103/P, 104/1/P, 110/P, 104/2, 105/P, 108/P, 109/P, 226/P, NAL LAND
14	Land of Plot 'Z'	KOYALI : 1017/4/P, 1113/1/P, 1113/2/P, 1162/P, 1167, 1168, 1173/P, 1174, 1175,
		1176, 1177, 1178, 1179, 1180+1182+1183, 1181, 1184, 1185, 1186/1, 1186/2, ,
		1187/P, 1188, 1189, 1190/P, 1191/P, 1192, 1193+1194+1216, 1195/1, 1194/2, 1196,
		1197, 1198, 1201/1, 1201/2, 1202/1, NAL LAND
15	Land of Raojibhai Patel	RANOLI : 728/3/P, 751/P, 757/P, 844/P, 855/P, 861/P, 862/P, 863, 864/P
		DHANORA : 5/P, 319, 322/2/P
16	South of PCGL(GSFC)	RANOLI : 751/P, 757/P, 749 + 750/P AND NAL LAND
17	Land of Kanchanbhai Patel	RANOLI : 728/6/P.
18	ECP Land - Dhanora	DHANORA : 5 TO 10, 320 TO 322/2, 322/13
19	Road between Plot 'Y' & 'Z'	KOYALI : 10/7/4, 1113/1, 1113/2, 1115/1, 1115/2, 1115/3, 1162, 1167 AND NAL LAND
20	Road between	KOYALI : 1120/P, 1124/P, 1125/P, 1158/P, 1161/P, 1162/P

	ACN corner & P&I Gate	DHANORA : 8 TO 17/P, 25/P TO 31/P, 64/P TO 68/P, 74/P TO 76/P, 90/P, 92/P, 93/P,
		96/P, 226/P, 324/P
		RANOLI : 728/2/P, 842 TO 849, 854
21	Transferred by IOC - NT	KARACHIYA : 323, TO 327, 333/1 & 2 TO 339, 341/1 TO 360/1&2 , 402/1TO5 , 404
		RANOLI : 904, 906, 907, 909