PRE-FEASIBILITY REPORT
FOR
CPCL'S 9 MMTPA CAUVERY BASIN REFINERY PROJECT (CBR)
CPCL

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1. INTRODUCTION

Chennai Petroleum Corporation Limited (CPCL) a group company of Indian Oil Corporation Limited (IOCL) has planned to set up a grassroots refinery of capacity 9 MMTPA at Nagapattinam, Tamilnadu at the same location of the existing 1 MMTPA Cauvery Basin Refinery after dismantling the existing facilities. This new refinery which will produce the fuels of BS-VI specifications will able to meet the growing demands of fuels in southern region and nearby location.

Engineers India Ltd have been retained by CPCL to provide services for the following:

(i) Preparation of Basic Engineering Design Package of CDU/VDU.
(ii) Preparation of Basic Engineering Design Package of SWS & ARU.
(iii) Preparation of Basic Engineering Design Package of Utilities & offsites facilities.
(iv) Review of Basic Engineering Design Package of all licensed units & coordination with Licensor during preparation of BDEP.
(v) Licensor selection of licensed units like VGO-HDT, MS Block, PP unit, SRU, LPG treating unit.
(vi) Preparation of Project DFR with +/- 10% accuracy, including development of Plot plan, project schedule and implementation etc.
(vii) Preparation of DFR for Desalination plant
(viii) Preparation of DFR for SPM and pipeline facilities
(ix) EIA and RRA study

2. PROJECT LOCATION & DETAILS

Project location and details	
State/Country	Tamil Nadu / India
Nearest Railway Station	Nagore (5 km)
Nearest Village	Panangudi
Nearest City/Town	Nagapattinam (12 Km)
Nearest Airport	Tiruchirappalli - 145 km
Nearest Port	Karaikal – 5 Km
Source of Water	1.Sooranur wells 2.Sea
Rainy season	October to December

Power Source
Power required for the Refinery complex will be generated captive through CFBC-STG configuration.

Construction and Permanent water source Site has proximity to the sea. A desalination plant will be set up near the shore to treat the sea water and supply the treated raw water to Refinery, which is around 8~10 km from the Desalination plant site. Sooranur well is an alternate source of water.

Environmental requirements
No Ecologically sensitive area like national monument / bird sanctuary / major settlement is located within 25 Km of site.

Defense requirements

No Defense base within 25 Km of the site.

Downstream Industry
No downstream industry related to Petrochemical in the vicinity.

Topography of site & development requirement
The topography of the proposed area is flat terrain.

2.1 Project Description

The process facilities with capacities are described in **Table 1**.

Table 1: Process Unit Capacities		
Sl.No.	**Process Units**	**Capacity KTPA**
1	CRUDE UNIT/ VACUUM UNIT	9000
2	NAPHTHA HYDROTREATER (NHT)	1500
3	ISOMERISATION UNIT (ISOM)	570
4	REFORMER UNIT	625
5	DIESEL HYDROTREATER (DHDT)	5000
6	VGO HYDROTREATER UNIT (VGO HDT)	3000
7	INDMAX	2430
8	INDMAX GASOLINE HDS	700
9	OCTAMAX UNIT	125
10	POLYPROPYLENE UNIT (PP)	475
11	DELAYED COKER UNIT (DCU)	2500
12	HYDROGEN PLANT	98
13	SULFUR BLOCK	2 X 144
14	SR LPG TREATING UNIT	255
15	CRACKED LPG TREATING UNIT	1300
14	FUEL GAS AND SR LPG AMINE TREATING UNIT	MATCHING

2.2 Material Balance

Overall material balance of the Refinery Complex is given in **Table 2**.

Table 2: Over All Material Balance			
		CASE-1	**CASE-2**
Sl.No.	**FEED**	**KTPA**	**KTPA**
1	NATURAL GAS	17.8	17.8
2	IRANIAN LIGHT	0	9000
3	COKE BUY	0	279
4	BASRAH LIGHT	4500	0
5	BASRAH HEAVY	4500	0
Sl.No.	**PRODUCT**	**KTPA**	**KTPA**
6	MIXED LPG'S	750	816
7	EURO VI REGULAR GASO	1247	1260
8	EURO VI PREMIUM GASO	540	540
9	ATF	300	300
10	EURO VI DIESEL	3949	4495
11	POLYPROPYLENE	425	424

12	SULFUR	241	116
13	COKE	139	0

- CASE-1 Crude Mix: 50 % BASRAH HEAVY : 50 % BASRAH LIGHT
- CASE-2 Crude Mix: IRANIAN LIGHT

3. Process Description

A brief process description for each of the process units Envisaged as part of the shortlisted refinery configurations are provided in this section.

- **Primary processing units:** Integrated *CDU/VDU*
- **Secondary Processing unit:** V*GO-HDT,INDMAX*
- **Treatment units:** *DHDT,MS Block (NHT, CCR, ISOM), Gasoline HDS unit & Octamax, ATF Merox unit*
- **Residue upgradation:** *DCU*
- **Petrochemical Unit :** *PolyPropylene*
- ***Associated treating units:*** *SWS, ARU, SRU with TGTU****,*** *LPGTU, FGTU*
- ***Offsites & utility facilities***

3.1 Crude /Vacuum Distillation Unit

Crude from offsite storage is received at CDU/VDU plant battery limit. The crude is subsequently heated in preheat exchangers by hot streams of CDU/VDU. Crude picks up heat in the preheat exchangers before being routed to Crude desalter. After desalter, crude picks up heat from hot streams of CDU/VDU and finally routed to crude heater. Heated and partially vaporised crude enters crude column through feed nozzle. The column has five side draws, namely, Light Naphtha (SN), Heavy Naphtha(HN), Kerosene (Kero), Light Gas Oil (LGO) and Heavy Gas Oil (HGO).

3.1.2 Vacuum Distillation Unit

Hot RCO from Crude column bottom is pumped by RCO pumps to Vacuum heater. Each coil outlet of vacuum heater joins the transfer line and is routed to Vacuum distillation column. The mixed vapour & liquid stream from the heater is introduced to the Flash zone of Vacuum column. Heated & partially vaporised RCO from Vacuum Heater enters the Vacuum Column. An open ended tangential entry device and a large empty space above flash zone ensure optimal vapour liquid separation. Major product from VDU is Vacuum Diesel, LVGO, HVGO, slop and VR.

3.2 Naphtha Hydrotreating Unit

Naphtha Hydrotreating process is a catalytic refining process employing a select catalyst and hydrogen rich gas stream to decompose organic sulphur, oxygen and nitrogen compounds contained in hydrocarbon fractions. In addition, hydrotreating also removes organo-metallic compounds and saturates olefinic compounds.
The purpose of NHT unit shall be to produce hydro treated naphtha suitable for processing in downstream Isomerisation unit and CCR Unit.

3.3 Naphtha Isomerisation Unit

Isomerization is the conversion of low octane straight chain compounds to their higher octane branched isomers. The purpose of the Isomerisation Process Unit is to improve the research and motor octane number of the hydrotreated light naphtha feed (predominantly C5/C6) from the NHT unit before blending into the gasoline pool in order to meet the required target of the gasoline pool production.
The hydrotreated light naphtha fraction from NHT unit is typically high in normal isomer content resulting in a low octane number (typically < 68). The isomerization process converts an equilibrium proportion of these low octane normal isomers into their higher octane branched isomers. Isomerate product is the blend of light and heavy isomerate from Deisohexaniser column.

3.4 Poly Propylene Unit

Fresh propylene from OSBL is fed through propylene dryer to the reactor along with the required catalyst, co-catalyst, hydrogen and stereo-modifier. For production of two special grades with small ethylene content, ethylene vapor is also fed to the reactor. The polymerization reactors each have a nominal volume of 75 m3 with identical stirrer and drive systems. Polymerization itself is carried out in a gas phase stirred reaction. Heat removal is managed by evaporative cooling. Liquid propylene entering the reactor vaporizes and thereby removes the exothermic reaction energy. Reaction gas is continuously removed from the top of the reactor and filtered. Reactor overhead vapor ("Recycle Gas") is condensed and pumped back to the reactor as coolant. Noncondensable gases (mainly H2 and N2) in the recycle gas are compressed and also returned to the reactor. The polypropylene product powder is blown out of the reactor under reactor operation pressure. The carrier gas and powder pass into the powder discharge vessel where powder and gas are separated. The carrier gas is routed through a cyclone and filter to remove residual powder, then scrubbed with white oil and sent to compression. Powder from the discharge vessel is routed via rotary feeders to the purge vessels which are operating in parallel. Nitrogen is used to purge the powder off residual monomers. The overhead gas from the purge vessels is sent to a common membrane unit for monomer/nitrogen recovery. As refrigerant for the membrane unit fresh Propylene is used. The recovered nitrogen is sent back to the purge vessels for further use. The condensed monomers from the purge gas are combined with the filtered carrier gas, and then sent to scrubbing and subsequently to carrier gas compression. The PP powder from the purge vessels is pneumatically conveyed by a closed loop nitrogen system to the powder silos. The powder product from these silos is fed to the extruder where polymer powder and additives are mixed, melted, homogenized and extruded through a die plate, which is heated by hot oil. The extruding section is electrically/steam heated.
Pelletizing of the final product is carried out in an underwater pelletizer where the extruded polymers - after passing the die plate - are cut by a set of rotating knives. The polymer/ water slurry is transported to a centrifugal dryer where polymer and water are separated. Water is recycled to a pellet water tank, for which demineralized water is used as make-up. The cooled pellets (~60°C) are pneumatically conveyed to the pellet blending silos by an air conveying system. After homogenization in the blending silos the pellets are conveyed to the bagging and palletizing system. The stream of carrier gas (including recovered monomers from the membrane system from compression is split: half of the carrier gas is fed back to the reactors. The balance/remainder is sent to an OSBL FCC unit for subsequent purification of the propylene. In addition this balance carrier gas can be sent to the fuel gas system in case of FCC unit shut-down.

3.4 Diesel Hydrotreating Unit

The processing objective of Diesel Hydrotreater (DHDT) Unit shall be to hydrotreat a mixture of Kerosene, Light Diesel and Heavy Diesel from Crude Distillation Unit (CDU), Vacuum Diesel from Vacuum Distillation Unit (VDU), Coker naphtha and Light Coker Gas Oil (LCGO) from Delayed Coker Unit (DCU) and Light Cycle Oil from INDMAX.

The main objective of this unit is to hydro treat the Diesel feed to meet the target BS-VI Diesel specification. Other by products from this unit include Naphtha, Kerosene and Fuel gas.

Flexibility is provided in unit design to recover maximum potential of ATF as and whenever required. Normally that will be blended to diesel pool within unit battery limit itself.

3.5. VGO Hydrotreater Unit

VGO HDT unit shall treat the LVGO and HVGO from the CDU/VDU and coker gas oil from DCU. The VGO HDT unit shall process the straight run VGO , hydrotreat it to achieve low sulfur and low nitrogen spec fit to meet the downstream Indmax unit feed specification.

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3.6 INDMAX

INDMAX is a fluidized catalytic process for selectively cracking a variety of feed stocks to light olefins. INDMAX unit is being set up to convert hydro treated VGO from VGO Hydrotreater unit to lower boiling, high value products, primarily propylene and other C3-C4 LPG products, high octane gasoline, and light cycle oil. The complex features a converter section, a fractionator section, a wet gas compression section, an integrated unsaturated gas plant (USGP) section and propylene recovery section.

Key products from the INDMAX complex are polymer grade propylene, LPG, refinery fuel gas, light naphtha, heavy naphtha and light cycle oil.

3.7 Delayed Coker Unit

The Delayed Coking Process is a thermal cracking process for upgrading heavy petroleum residues into lighter gaseous and liquid products and solid coke (green coke). The petroleum residue feedstock is heated in a specially designed heater to high temperature with a brief residence time. The thermal cracking reactions start in the heater coils and are completed in Coke Drums (accumulator vessels with long residence time). The thermal cracking reactions in the heater are carefully controlled to minimize coke build up in the heater coils. The solid product (Green Coke) is retained in the Coke Drums. Coke Drum effluent vapor is quenched to arrest further cracking reactions and then fractionated into various distillate and light end products.

3.8 LPG Treating Unit

The objective of LPG Treating Unit is to treat the straight run LPG and Cracked LPG to primarily reduce the sulfhur content and also to meet the final LPG product specification.

3.9 Fuel Gas Treating Unit

The basic purpose of the unit is to remove H2S from fuel gas. Sour fuel gas generated in various units is combined and routed to sour fuel gas knock out drum. Liquid particles in the fuel gas are separated in this drum. From the drum, the gases are routed to the bottom of the fuel gas amine absorber. Lean amine from ARU is introduced on the top the absorber. H2S from the sour gas gets absorbed in to the lean amine. The rich amine flows out under level control to ARU for regeneration. Rich amine from column bottom is routed to ARU for regeneration.

3.10 Propylene Recovery Unit (Polymer Grade)

The function of the PRU is to remove contaminants from the C3's, and to separate the propylene and propane to produce the following products:

- Polymer Grade Propylene
- Propane, to be blended with LPG from the Gas Plant

3.11 Hydrogen Generation Unit

The Hydrogen Generation Unit design is based on catalytic reforming and pressure swing adsorption (PSA) system is to produce 99.9 mole% pure hydrogen gas. Hydrogen is produced by steam reforming of Regasified Natural Gas and Refinery Fuel Gas.

3.12 Sour Water Stripper Unit

3.12.1.Refinery Sour Water Stripper

Refinery Sour Water Stripper is designed to treat sour water from CDU/VDU, HGU, DCU and intermittent sour condensate from SRU & TGTU. The H2S recovered is sent to SRU for reduction to elemental merchant-grade Sulphur. The Ammonia-rich stream is considered to be disposed off by burning in the SRU Ammonia Incinerator. The stripped water from Single Stage SWS is sent to CDU desalter make-up, and to ETP for disposal. Sour water from above described units is received from a common line in a sour water surge drum floating on acid gas flare header back pressure. This surge drum is a three phase (V-L-L) separator. Flashed hydrocarbon vapors are separated and routed to acid gas flare. Oil carryover, if any, is skimmed off from drum and drained to OWS.

3.12.2 Hydroprocessing Sour Water Stripper

Hydroprocessing Sour Water Stripper Unit-II is designed to treat sour water from VGO HDT, DHDT and NHT. The stripped water from two stage stripper is sent separately to OHCU, DHDT and NHT or to ETP. Hot Sour water from VGO HDT, DHDT and NHT is mixed with ammonia rich recycle (to keep H2S in solution & for constructive recovery), cooled in a water cooler to 37 deg C, and received in a surge drum, a three phase (V-L-L) separator. Any hydrocarbon that
flashes is separated out and joins ammonia stripper overhead line to be routed to incinerator. The entrained oil, if any, is skimmed off from drum and drained to OWS. The sour water is sent to sour water storage tanks under level control.

3.13 Amine Regeneration Unit

The process objective of ARU is to regenerate the rich amine streams received from Vacuum Gas Oil Hydrotreater and Diesel Hydrotreater (VGO HDT+DHDT), HP & LP Fuel Gas ATU, LPG ATU, VDU off gas & DCU.
After regeneration, the lean amine shall be re-circulated back to the refinery units through lean amine distribution network. The H2S rich acid gas from amine regenerators shall be further processed in the downstream Sulfur Recovery Units (SRU) for recovery of sulfur.

3.14 Sulfur Recovery Unit (With Tail Gas Treatment Unit)

The process objective of Sulphur Recovery unit is to convert sulphur species present in feed gas streams i.e. acid gas from Amine Regeneration unit, sour gases from Sour Water Stripper Units to recover it as elemental sulphur product. The plant should be designed for minimum of sulphur recovery 99.9 wt% from feed gases. The sulphur recovery in Claus section shall be minimum 96 %wt and balance in TGTU. All process guarantees specified are applicable for each train & shall be met by each train independently. Tail gas, after sulphur recovery containing residual sulphur species, is incinerated in Thermal Oxidizer before venting to atmosphere.

3.15 TAIL GAS UNIT

The processing objective of Tail Gas Treating Unit (TGTU) shall to remove remaining sulphur from Claus unit tail gas.
The TGT unit shall be designed to enhance overall sulphur recovery from 94 wt% to 99.9 wt% (min.)
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4.0 UTILITIES DESCRIPTION

This chapter provides the utility requirements and description of utility systems for various process and auxiliary units, utility and offsite and infrastructure envisaged for the selected refinery configuration.
The total utility consumption in the complex for the selected case are estimated based on EIL in-house data and are tabulated in Tables 4.1

Table 4.1

Utilities & Offsites	Capacity	Remarks
Steam & Power (CFBC)	• Steam : ~950 TPH • Power : 146 MW (Total)	Petcoke / Ebulated Bed bottoms based system
Compressed Air System	• Nitrogen Plant – 7500 Nm3/hr • Plant Air – 5046 Nm3/hr • Instrument Air – 8705/ Nm3/hr	
Cooling Water	Total Requirement – 75000 m3/hr	
Raw Water System	Desalinated Water rate– 4000 m3/hr	
RO Based DM Plant	850 M3/hr	
Condensate Polishing Unit	(2+1) 75 m3/hr	
Effluent Treatment	1030 m3/hr	

Flare System	1400 TPH (HP+LP) 44 TPH (Sour Flare)	

Based on the data provided in Table 4.1 the following utility systems are considered for cost estimation.

- Raw water system
- Cooling water system
- DM water system
- Compressed air system
- Nitrogen system
- Steam, power and BFW system
- Condensate system

4.1 Raw Water System

Source of raw water will be treated water from Desalination Plant located near the shore. Total Raw water demand for the project is estimated to be 4000 m3/hr.
Raw water shall be used for the following purpose:

i. Cooling tower make-up
ii. Service water
iii. DM Plant feed
iv. Fire water system make up
v. Drinking water system / Raw water requirement
vi. Pump bearing /seal cooling

The estimated treated water requirement for various purposes in the complex and total raw water requirement of the complex are summarized in following table 4.2 :-

Table 4.2

S. No	UNIT	Normal m^3/hr
1.	Cooling Tower Makeup	2660
2.	DM Plant	210
3.	Service Water	300
5.	other miscellaneous	100
6.	Gardening requirement	Note-1
8.	Total Estimated Treated Raw Water Demand; m^3/hr	3270
8.	Treated raw water demand considering zero recycle from ETP, m3/hr	3790
9.	Total treated raw water demand with design margin, m3/hr	4000

Note-1: Requirement to be met from treated effluent.

4.2 Cooling Water System

The cooling water system envisaged for the refinery complex is closed loop recirculation type. Cooling water system will cater to the requirements of process units, offsite & CPP

within the complex. The cooling water system includes cooling towers, pumps, cooling water treatment facilities and other auxiliary items.
Cooling water system configuration: 19 working + 3 stand by cell of 4000 m3/hr capacity each.

4.3 De Mineralised Water System

DM water in the refinery complex is required as Boiler feed water make-up, process water for dilution, reaction and washing. DM water for the refinery shall be produced in the DM water plant.
The capacity of DM plant is estimated to be 850 m3/hr of DM water on continuous basis.

4.4 Compressed Air System

The Compressed air is required in the complex for following usages:-

- As instrument air
- As plant air
- As service air for hose stations and for other requirements of the complex.

Total compressed air requirement for the Refinery complex is 13750 Nm3/hr
A common plant and instrument air system will be provided for the integrated refinery complex. This will consist of LP Air Receiver and Instrument Air Drier. Dedicated instrument and plant air distribution headers will be provided which will supply the compressed air to all the consumers in the refinery complex. Suitable controls shall be provided to accord priority to instrument air supply. Following facilities shall be provided for meeting the plant air & instrument air requirements.

4.5 Nitrogen system

The inert gas (Nitrogen) is required in the refinery for initial purging, dry out and for catalyst regeneration. The inert gas is also required in Offsite for blanketing and in flare header purging. Nitrogen plant is provided to cater to the inert gas requirement of the complex.
Continuous requirement: The continuous supply of Nitrogen will be required for the following purposes:

- Seal purging of compressors in unit
- Blanketing of tankages

Intermittent requirements

- Start-up & Shutdown of unit
- Catalyst Regeneration in plants

Gaseous nitrogen from the nitrogen plant is meant for meeting the continuous demand in the refinery.
Normal N2 demand for the refinery is 7500 NM3/hr considering 10%-margin for leakage, design etc.

4.5 Steam, Power and BFW System

The steam and power for the entire complex shall be produced in the Circulating Fluidised Bed Combustion Boiler (CFBC). The fuel to CFBC shall be petcoke generated from delayed coking unit. There are four levels of steam in the refinery viz: VHP, HP, MP and LP. The steam is being generated / consumed in process units at these levels. The steam consumption in the various units for different purposes such as:

- Process use (Chemical reaction, Stripping steam,etc.)
- Internal fuel oil atomization,

- Steam tracing of lines (congealing service)
- Tankage heating
- Deaerator
- Intermittent requirement like snuffing, decoking, soot blowing, purging etc.
- Air conditioning units for the Control rooms and the administrative building

Total Steam requirement in the Refinery is provided in the table below.

Table 4.5.1 Steam requirement (TPH)

S No.	UNIT	STEAM T/HR		
	Main Processing Unit	HP	MP	LP
	TOTAL REQUIREMENT	207.7	336.6	84.2

The total power requirement of the complex is around 146 MW under normal operating conditions. And BFW requirement for the refinery is ~ 196 TPH.

Broad configuration of the CPP shall be as below:

No of CFBC Boilers : 3 Working+1 Spare
Fuel : Petcoke
Capacity : 350 TPH
Steam Turbine Generator: 85 MW x 2
Facilities for handling of Petcoke feed to boilers and slug generated from CFBC for safe disposal have been considered in the configuration and plot plan.

4.6 Condensate System

Steam is being used in the refinery as process steam motive fluid for the steam turbine drives, for heating etc. Condensate results from the condensing steam turbine drives, steam re-boilers and ejector condensers. Within the each individual units suspect condensate and pure condensate shall be segregated. Depending upon the requirements, each unit shall have separate header for these two condensates. The suspect condensate shall be required to be treated in centralised condensate polishing unit before use. Pure condensate shall be directly used for steam generation. The condensate being generated which shall be recovered can be categorized under following headings:-

- Condensate coming from the exchangers, which may be consuming either
  - MP or LP steam.
- Individual units generating MP level condensate shall flash it to LP level, cool the condensate to the required temperature of 90 degC and supply the condensate at their respectively B/L. A single condensate header shall be routed through the refinery for collection of this condensate. This condensate will then flow to the respective deaerator under header pressure control and flow control respectively.
- Condensate obtained from the steam drives in the process unit.
- Any such condensate will need to be pumped to the respective LP condensate header, after appropriate polishing, if required.
- The contaminated condensate from various units .This shall not be recovered and instead routed to ETP through CRWS/OWS system.

The condensate recovered as per point number (a) to (d) shall meet the specifications of pure condensate. In order to utilise the condensate collected as per point number (e) above for steam generation, it shall be routed through a condensate polishing unit.

Condensate polishing unit

Condensate polishing system shall be provided for suspect condensate recovered from process units.

Condensate polishing system:

No of Trains: 2W+1S
Capacity of Each Train: 75 m3/hr
System components:
Broadly the CPU plant will consist of the following:

- Two preheat exchangers
- Two oil coalescers
- (4+2) Activated Carbon filters (ACF)
- (2+1) Mixed bed (MB)

4.7 Flare System

The flare system will be provided for safe disposal of combustible, toxic gases, which are relieved from process plants and offsite during start-up, shutdown, and normal operation or in case of an emergency such as:

- Cooling water failure
- Power failure
- Combined cooling water and power failure
- External fire
- Any other operational failure
  - Blocked outlet
  - Reflux failure
  - Local power failure
  - Tube rupture

The refinery complex shall have two flare systems, one for Hydrocarbon flare for process units & off-sites handling hydrocarbon and the other for the sulphur block handling sour flare

5.0 OFFSITE STORAGE FACILITIES

This section describes the storage facilities for feed / intermediate and finished product of the Refinery.
The philosophy and facilities for storage and transfer is discussed below.
Offsite facilities are divided into three sections:

- Crude oil storage and transfer
- Intermediate Feed / Intermediate product storage and transfer
- Finished product storage and transfer

5.1 Crude Storage and Transfer

15 days storage is considered for Crude.

Table 5.1

Service	No. of tanks	Stored Capacity of each tank (m^3)	Type of tank
Crude	11	60,000	Floating roof

Crude water drain	1	3765	Cone roof
Surge Relief	1	425	Cone roof

5.2 Intermediate Feed Storage and Transfer

Intermediate feed storage tanks are considered based on 3 days intermediate storage basis. The list of intermediate Tankages considered in Table below.

Table 5.2

Service	No. of days Storage	No. of tanks	Pumpable Capacity per tank , m3	Type
NHT Feed	3	2	22400	IFR+N2
ISOM Feed	3	1	8600	Dome+N2
CCR Feed	3	1	8500	IFR+N2
VGO HDT unit Feed	3	2	26200	CR+N2+coil
DHDT FEED	3	2	26300	IFR+N2
DCU / EB feed	3	3	11500	CR+ coil
INDMAX Feed	3	2	26500	CR+N2
DRY SLOP Light		2	4000	FR
DRY SLOP Heavy		2	3000	CR+coil
GASOLINE SELECTIVE HDS unit feed	3	1	9300	FR
ISOMERATE	3	1	7900	Dome+N2
REFORMATE	3	1	6900	FR
ISO Octene	3	1	1700	cone roof+N2
FUEL OIL TANK	3	2	7950 (H)	CR+N2
HCGO	3	1	5200	CR+N2+coil
FLUSHING OIL	3	2	5000 (H)	FR
INDMAX HDT GASOLINE	3	1	9300	FR
HGU Feed	3	1	5100	Dome+N2
PROPYLENE	3	4	3200	Mounded Bullets
OCTAMAX UNIT FEED	3	2	3200	Mounded Bullets
CRACKED LPG		6	3600	Mounded Bullets

5.3 Finished Product Storage

Finished product tankage in the refinery has been designed to cater only to the minimum operational flexibility in the refinery and subsequent testing/certification/ despatch to marketing terminal. It is assumed that the despatch to marketing terminal can be carried out at any hour during the day. The finished product storages are considered for 7 days basis.
Finished product tankage summary is tabulated as below.

Table 5.3

Service	No. of days Storage	No. of tanks	Pumpable Capacity per tank , m3	Type
MS-VI Premium/Regular	7	6	17000	Floating Roof
ATF	7	4	4500	Internal Floating Roof
Diesel	7	7	25300	Floating Roof
LPG	7	11	3700	Mounded Bullets

6.0 Logistics

Various Crudes viz: Basrah crude, Iranian crude, other Opportunity Crudes, etc shall be processed in CPCL New CBR Refinery. Crudes shall be off loaded from new SPM planned at proximate location to refinery through subsea pipeline followed by onshore pipeline to new Crude Oil Terminal (COT) located within the proposed Refinery. Crude blending facilities will be considered in the COT area to maintain consistent feed quality to refinery.
Natural Gas shall continue to be received as per existing pipeline from GAIL.

6.1 FINISHED PRODUCTS

The final products from refinery as listed below:

1) LPG
2) Polypropylene
3) Regular BSVI Gasoline
4) Premium BS VI Gasoline
5) BS VI Diesel
6) ATF (Aviation Turbine Fuel)
7) PetCoke
8) Sulphur

Existing CPCL CBR refinery products are marketed by IOCL through marketing terminal located adjacent to CPCL CBR Refinery.
In this Project no additional investment towards Marketing terminal shall be considered. However, cost provision for product pipeline for evacuation purpose shall be considered in the Project capex.
CPCL CBR refinery is located close to Existing Karaikal Port, through which the products can be exported through coastal route. Investment towards connecting product pipelines shall be considered in the project CAPEX.

7.0 Other Associated facilities

7.1 Marine facilities

The marine facilities shall primarily consist of:

- Single Buoy Mooring
- PLEM (Pipeline End Manifold).
- Subsea pipeline connected to PLEM at one end and to onshore facility at the other end.
- Intake and outfall subsea lines for desalination plant.

SPM terminal is designed to accommodate range of vessel sizes ranging from 80,000 DWT to 3,25,000 DWT (VLCC). For this a relevant and representative range of vessels considered are given in the following table:

Vessel Type	DWT (tonnes)	LOA (m)	Beam (m)	Draft (m)
VLCC	3,25,000	330	60	22.8
Suezmax	2,00,000	285	45	16.2
Aframax	80,000	245	34	14.8

The largest vessel VLCC has been considered to arrive at the draft requirement at the SPM location. The loaded draft for the VLCCs (3,25,000 DWT) is 22.8m. Giving due allowance as per the guidelines given in American Bureau of Shipping (ABS), the minimum water depth required for safe mooring and discharging of the tankers is around 30m. Accordingly, preliminary location of SPMs is targeted in & around water depths of 30-32m. The location will be further fine tuned based on actual bathymetry survey to minimize offshore pipeline length.

The proposed SPM facility will be installed at approximately 19 km within sea limits, where the water depth is around 32 m. Proposed LFP shall be at Nagapattinam coast area. The pipeline corridor falls into the Nagapattinam port limits.

7.2 Onshore Pipelines

Apart from 02 nos. of Crude Oil pipeline from proposed SPM to Crude Oil Tank Area (COT), pipeline of different petroleum products shall be installed to despatch finished products from refinery to Jetty area. One Treated Raw Water Pipeline from proposed intake facility at sea to desalination plant & one discharge line shall also be installed.
Proposed Pipeline corridor survey shall be carried out for a total of 19 (Nineteen) Nos. of pipeline (i.e. 02 Nos. Crude Oil pipeline from LFP (Land Fall Point) to COT area, 15 nos. of product pipelines from CBR to Kariakkal Port, One no. of Treated Raw Water pipeline from Sea to CBR Desalination Plant area & One Reject line from Desalination Plant to Sea). Pipeline sizes shall vary from 12” to 60” (broad size of pipeline shall be 12” to 24” for Product pipelines, 48” for Crude Oil pipeline & 48” / 60” for Raw Water pipeline).

7.3 Desalination Plant

To meet the complete treated water demand for the Refinery Complex, a new sea water Desalination plant is envisaged for the production of Desalinated water equivalent to treated raw water quality.

Overall Desalination Facility shall consist of the following:

- Intake facilities
- Desalination plant
- Reject Disposal.

Feed sea water to the Desalination Plant shall be received from the Intake Well facilities located near the shore.The treated water shall be storted in two treated water storatge tank from where it will be pumped to the refinery complex to meet the requirements of various consumers.A separate treated water storage reservoir of 364200 m3 capacity has been considered in the refinery complex.

The Desalination system will comprise of

- Desalination plant
- Treated water storage tank and pumping.

Treated water from the Desalination Plant shall be used to meet the following requirements.

- Cooling water make-up
- Service water demand of the complex
- Potable water including safety showers, eyewash and drinking water
- Fire water make-up
- DM plant feed water (net / balance requirement of feed water to DM plant).

The Total treated water requirement from the Desalination plant is as tabulated below:

Utilization	**Normal demand (m3/hr)**	**Peak demand (m3/hr)**
Cooling water make up	2660	2660
Service water	300	300
Drinking water	90	90
Fire water make up	10	10
DM plant feed	210	660
Total	**3270**	**3720**

Design capacity of the Desalination Plant shall be 4000 m3/hr of treated water considering ~10% design margin on the treated water demand.
Feed sea water requirement for the Desalination plant shall be 10743 m3/hr with a TDS of 40000 ppm and reject warer quantity shall be 6743 m3/hr with a TDS of ~63700 ppm.