HPCL-Mittal Energy Limited

# PRE FEASIBILITY REPORT ON BS-VI FUEL QUALITY PROJECT OF GURU GOBIND SINGH REFINERY

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## Chapter 1: Introduction

### 1.1 General:

HPCL-Mittal Energy Limited (HMEL) is a joint venture between Hindustan Petroleum Corporation Limited (HPCL) Government of India Enterprise with a Navratna Status and Mittal Energy Investment Pte Ltd, Singapore, a Lakshmi N Mittal Company. Both the JV partners hold a stake of 49% each in the company and the remaining 2% is held by financial institutions. An investment of more than Rs.22,610 crores has already been made in the Guru Gobind Singh Refinery project at Bathinda.

The refinery is built to help fulfill India's energy security needs. Given the strategic location of Bathinda, the refinery serves fuel requirements of the northern States of India. The Refinery was dedicated to the Nation on April 28, 2012 by Hon'ble Prime Minister of India, Dr. Manmohan Singh.

The refinery is designed to produce fuels conforming to EURO III/ IV specifications while processing high sulfur and heavy crudes (Arab Heavy & Doba in ration of 90:10 by weight and 100% Arab medium crude). The refinery produces products like LPG, Naphtha, MS, ATF, HSD Pet coke & sulfur. It also produces various grades of Polypropylene which is a petrochemical. Currently the refinery is being operated at its full nameplate capacity of 9 MMTPA & refinery capacity expansion project from 9 MMTPA to 11.25 MMTPA is under implementation.

The refinery configuration consists of Crude and Vacuum Distillation Unit (CDU/VDU), VGO Hydro treating Unit , Naphtha Hydro treating unit (NHT) , Isomerization Unit (ISOM) , Continuous Catalyst Regeneration Unit (CCR), Diesel Hydro treating unit (DHDT), Fluidized cracking Unit – Petrochemical (FCC-PC Unit) ), Delayed Coker Unit (DCU) ,Polypropylene Unit (PPU) and other associated facilities such as Amine Regeneration Unit (ARU), Sulfur Recovery Unit(SRU), Sour Water Stripper (SWSU), Bitumen Blowing unit etc.

The expansion project (under implementation) for 9 MMTPA to 11.25 MMTPA was accorded Environmental Clearance from Ministry of Environment & Forest vide letter No IA/PB/IND/26087/2013 dated 12th January, 2015.

Punjab Pollution Control Board issued the "No Objection Certificate" (Consent to Establish) vide their letter no 2493 dated 8th Sept 2015.

### 1.2 Accolades:

HMEL has won many national and international awards/ accolades for excellence in various fields since its inception in July 2007. Some of notable once are:

- **Best Design Stall Award – IndPlas 2012**

HMEL was awarded the "Best Designed Stall in over 18 sq m" category at the IndPlas 2012 exhibition held from 5th to 8th October 2012, at Kolkata

Fitch Rating Certification - August 2012 HMEL rated as 'Fitch AA-(ind)'/ Stable. The ratings reflect the existence of HMEL's firm 'take-or-pay' product off-take agreement with HPCL for the evacuation of produced liquids (about 80% of the total production) and the credit strength of its promoters. Fitch notes that HMEL's liquid output is fulfilling the refined products requirements of HPCL's distribution network in northern India, increasing the latter's downstream integration. The ratings also benefit from the high refinery complexity, which would enable HMEL to command high refining margins.

- **SAP ACE Awards**

HMEL was awarded two prestigious SAP Awards on October 19 at a glittering 'SAP ACE Awards Ceremony' held at Mumbai for the year 2012. HMEL won the 'best run implementation' award in 2 categories -namely 'HR' (joint winner with Indian Oil) and 'Sourcing & Procurement' (sole winner). **CFO, Mr. Harak Banthia** along with the HMEL team.

- **Partners in Progress Award**

HMEL was awarded the CIDC "Partners in Progress" Award at a ceremonial function on March 07, 2013 at New Delhi. The award was bestowed on HMEL for display of utmost commitment and drives to

create a vibrant work environment for the construction fraternity especially for achieving targets of **"Mission Skilling India"**.

- **Petrofed 2012 Award**

HMEL receives the Petrofed 2012 Award for "Human Resources - Management Company of the Year" from Hon'ble Minister for Petroleum and Natural GasMr. Veerappa Moily on 28 June, 2013. The Award was presented to HMEL for best people management practices. MD & CEO, Mr. Prabh Das, Head – Strategy & Feed Stock, Mr. Manu Sehgal along with VP – HR, Mr. Ashok Kumar received the award.

- **Best Change Intervention Asia Award**

HMEL won the II Runner's Up Award at the Learning & Organisation Development Roundtable on 2nd July 2013. The award was presented to HMEL for its HR initiatives of achieving the objectives of setting up of Business Processes and enabling them through SAP and MES applications, thereby creating an integration framework for the organisation. HMEL was among the top five from a total of 40 participants.

- **Golden Peacock Occupational Health & Safety Award**

HMEL received the 'Special Commendation' for the 'Golden Peacock Occupational Health & Safety Award' for the year 2013. Union Minister of State for Information and Broadcasting, Mr. Manish Tewari presented the award to the HMEL Team on 19 July 2013, during the 15th World Congress on Environment Management.

- **IPMA - Project Excellence Award 2013**

HMEL received the **"International Project Management Association Award - Bronze"** at a gala awards function on 01 October, 2013 at an august gathering of the global community in Dubrovnik, Croatia. The IPMA International Project Excellence Award is the highest international honour for excellent project performance. This is a real proof for extraordinary internationally recognised excellent projects around the world and this was awarded for the project Guru Gobind Singh Refinery in the Mega Projects Category.

- **SAP ACE Award 2013**

HMEL won the SAP Ace Award 2013 for Excellence in Green Initiatives and Sustainability. HMEL was awarded in the category "Jury Recognition for Excellence in Green Initiatives and Sustainability" for SAP Environment, Health and Safety module.

This award demonstrates Team HMEL's commitment to be the best refiner operating with world class People, Processes and Technologies. The award was presented to the HMEL Team at the seventh SAP ACE Awards ceremony held in Mumbai, on 17th October, 2013.

- **Silver Edge 2013**

HMEL won the "Silver Edge 2013" award from Information Week for Project 'PRISM' from over 200 nominations. The award was presented at the fifth EDGE - Enterprises Driving Growth and Excellence Awards ceremony held at Mumbai, on 25th October 2013.

- **APAC Procurement Leaders Award – 2013**

HMEL won the Highly Commended "Award for Excellence" at the Asia Pacific Procurement Leaders Award Ceremony at Singapore on November 13, 2013. HMEL was among one of the 14 Asia Pacific entries to receive this prestigious award.

The "Award for Excellence" recognizes exceptional achievement to the team that has undertaken the most successful project or activity and helped raise procurement's profile to the rest of the business world.

- **Special Technical Award - PETROTECH 2014**

HMEL received the "Special Technical Award" in the category Project Management Team Award at the Petrotech 2014 held on January 13th 2014. The Award was conferred on the HMEL Team for extraordinary Project Management skills in successfully completing and commissioning the GGSR project which is aimed at servicing the demand for fuel in Northern India.

- **Leadership & Excellence Award 2014 - Oil & Gas World Expo 2014**

HMEL MD & CEO, Mr. Prabh Das was conferred the prestigious "Outstanding Achievement (Refining) Oil & Gas Leadership & Excellence Award 2014" at the Oil & Gas World Expo 2014. The Awards Committee unanimously chose Mr. Das for his exemplary role and leadership in building a world class

state- of-the- art refinery. The prestigious award was presented at a gala event on February 10, 2014 in Mumbai.

- **CIO Impact Award**

HMEL was awarded the CIO Impact Award in Mobility Category by M/s Frost and Sullivan - an acclaimed global consulting organization. The award is a recognition of our state-of-the-art IT initiatives and early adoption of key technologies like Mobility.

The award was received by Mr. Vimal Goel, DGM-IT on behalf of the organization on 11th Feb 2014 at a glittering event held at San Francisco, USA.

- **Guru Gobind Singh Refinery gets BS OHSAS 18001:2007 Certification**

The Guru Gobind Singh Refinery received the BS OHSAS 18001:2007 certification in February 2014 given by the British Standards Institution (BSI) for Occupational Safety Management system. The BSI is the world authority on management systems and having been certified with 18001:2007 it is symbolic of HMEL's testament to committed quality of sound Health, Safety and Environmental practices.

- **CFO 100 Award – 2014**

CFO, Mr. Harak Banthia was awarded the CFO 100 Award by the CFO India Magazine. The CFO 100 Award is an annual initiative that recognizes India's finance leader's extraordinary contributions to the corporate world. The award was presented to Mr. Banthia in the Category: “Winning Edge in the Use of Technology” for implementation of SAP &MES in the building of the Guru Gobind Singh Refinery. The ceremonious event took place on March 14th in Mumbai.

- **Excellence in Customer Services Award**

HMEL received the prestigious award for “Excellence in Customer Services” for the year 2014-15 presented by the “World HRD Congress”.

The award was conferred for our efforts in areas of Marketing, Sales and Customer Support. Mr. Rajendra Gupta (Regional Manager-West Zone), received the award on behalf of HMEL on 27 June at a glittering event in Mumbai.

- **Golden Peacock Environment Management Award – 2014**

HMEL received the prestigious "Golden Peacock Environment Management Award – 2014" presented by the Institute of Directors at the 16th World Congress on Environment Management on Friday, 11th July at New Delhi. The award recognizes HMEL's sound environment management practices and our commitment to environment sustainability. Mr. K.K.Shrivastava – GM – Project Control & Ms. Sangeetha Chakravarthy – Head – Corporate Communications received the award on behalf of HMEL.

- **Energy Performance Award – 2013-14**

HMEL bagged the prestigious Energy Performance award given by the Ministry of Petroleum and Natural Gas for 2013-14. The award was conferred for running Furnace/Boilers most efficiently among Indian Refineries having design heat duty of more than 1000 mm kcal/hr. The Petroleum Secretary, Mr. Saurabh Chandra presented the award to the HMEL Team represented by COO, Mr. Martin Hawkins, VP – Technical Services – Mr. Ramesh Chugh during the Refinery Technology Meet organized by Centre for High Technology at Chennai on November 12.

- **SAP Customer COE Award – 2014**

HMEL was the Bronze winner in the prestigious SAP Customer COE (Center of Excellence) - 2014 in the "Innovation" category. The winners were announced at the 18th International Customer COE Info Forum on 19th November in Frankfurt (Germany). HMEL was recognized for the innovative ways in which it has used SAP's Audit Management tool, Governance Risk and Appliance, Root Cause Analysis, Business Planning & Consolidation. The award was received by CFO, Mr. Harak Banthia, AGM – ERP & IS, Mr. Girish Ghildiyal, AGM – ERP & IS, Mr. Manoj Kumar.

- **CFO 100 Award – 2015**

CFO, Mr. Harak Banthia was selected to be amongst CFO India's 5th Annual CFO 100 Roll of Honour by the CFO India Network. He was selected in the category: Exceptional contribution to Corporate Finance: Fund Management. The award was presented by Mr U.K Sinha, present Chairman of SEBI on 19th March 2015 in Mumbai.

- **Golden Peacock Award for Risk Management 2015**

HMEL received the Prestigious "Golden Peacock Award for Risk Management 2015" presented by the Institute of Directors at a grand ceremony, on 18th Dec-15, at the National Convention on Risk Management held in Bengaluru.

HMEL was felicitated with the award by Shri R.V. Deshpande - Hon'ble Minister for Industries & Tourism (Govt. of Karnataka) and Ms. Ratna Prabha K. (IAS) Addl. Chief Secretary, Commerce & Industries, Govt. of Karnataka.

- **Golden Peacock Award for Environment Management 2016**

HMEL received the Prestigious "Golden Peacock Award for Environment Management 2016" presented by the Institute of Directors at a grand ceremony during the 18th World Congress on Environment Management held on July 8 2016 at New Delhi.

HMEL was felicitated with the award by Justice (Dr.) Arijit Pasayat, Co-Chairman, Institute of Directors & former Judge, Supreme Court of India. HMEL had also won this award in 2014.

- **PetroFed 'HR - Company of the Year' Award**

HMEL was adjudged the 'Human Resources Management - Company of the Year' in Oil & Gas sector by Petroleum Federation of India (PetroFed). The prestigious award was presented on Monday, August 8 2016 during a glittering ceremony at New Delhi.

Mr M K Surana, Chairman, HMEL was present during the function when Mr Prabh Das, MD & CEO accompanied by Senior Executives received the award.

The award honors our excellence across the spectrum of HR Management while meeting expectations of internal and external customers to achieve strategic goals of the business.

- **Sustainability Award for Excellence in Safety**

HMEL won the FICCI 'Sustainability Award for Excellence in Safety' in the petrochemical sector at the ninth edition of India Chem Exhibition at Mumbai on Sep 1, 2016. The award recognizes the leaders who ensured sustainable growth in the Chemicals industry of India and set benchmarks for the others to follow.

The award was received by Mr Ian Thorpe, VP – HSE on behalf of HMEL team.

- **ISO 9001 & 14001 Certification**

Guru Gobind Singh Refinery has received accreditation from BSI (British Standard Institution) for Quality Management System: ISO 9001:2008 and Environment Management System – ISO 14001:2004. Certification audit was conducted in Feb 2016. Both the certificates are valid till September 2018.

### 1.3 BS-VI Fuel Quality Project:

Government of India has decided to implement the BS-VI auto fuel standards by 2020 and has directed oil companies to supply BS-VI quality (sulfur max = 10 ppmw) auto fuels across the country from 1st April 2020. In order to meet stringent timeline and to provide sufficient time for dilution of inventories, both High Speed Diesel (HSD) and Motor Spirit (MS) produced from the process units should meet the BS-VI specifications by 1st October 2019.

Existing MS block can produce BS-VI quality MS. Thus no modification is envisaged for MS. The production of BS-VI quality HSD requires capacity enhancement of DHDT by 1.9 MMTPA (46% of existing capacity) and HGU unit revamp by capacity enhancement (2x11KTPA).

### 1.4 Scope of Pre-Feasibility Report:

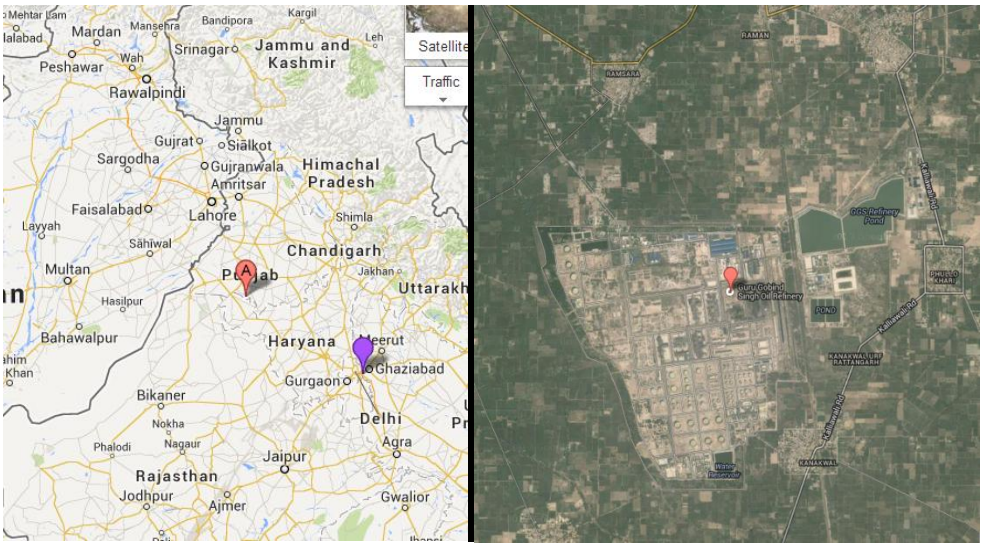
This report includes description of the new facilities being added. It also covers the effluents and emissions from the refinery.

## Chapter 2: Overview of the Existing Facilities

### 2.1 Location Details:

The Guru Gobind Singh Refinery is located at Village Phullokhari, at distance of approximately 35 km from Bhatinda in Punjab. While most of the tank-farms are located to the south and south-east of the process-facilities, the Crude Oil tank farm is situated to the north-west, while both the road and rail loading gantries are situated along the eastern perimeter of the facility. The project site measures approx. 1943 acres. The Green belt has been developed over an area of approx. 300 acres

**Figure 2.1- Location of GGSR in Bathinda, Punjab**




The existing facility layout is given in Annexure: 2.1

## 2.2 Production Throughput:

The designed production throughput for Refinery is 9.0 MMTPA. Year wise crude processing details are as under:

| S. No. | Financial Year | Crude Process (in MMT) |
|---|---|---|
| 1. | 2012-13 | 4.9 |
| 2. | 2013-14 | 9.27 |
| 3. | 2014-15 | 7.3 |
| 4. | 2015-16 | 10.7 |

## 2.3 Process Unit Detail

**Table 2.1 Existing, under implementation and proposed unit capacities**

| S.No | Description | Licensors | Existing Configuration | Under Implementation Configuration | Proposed Configuration post BS-VI @11.25 MMTPA |
|---|---|---|---|---|---|
| 1 | CDU/VDU | EIL | 9 MMTPA | 11.25 MMTPA | 11.25 MMTPA |
| 2 | NHT/CCR | Axens | NHT 0.94 MMTPA | NHT 1.18 | NHT 1.18 MMTPA |
| | | | CCR- 0.5 MMTPA | CCR 0.63 MMTPA | CCR 0.63 MMTPA |
| 3 | Isomerization Unit | Axens | 0.32 MMTPA | 0.40 MMTPA | 0.40 MMTPA |
| 4 | Diesel Hydrotreater | Axens | 4.2 MMTPA | 5.71 MMTPA | 5.71 MMTPA |
| 5 | New Diesel Hydrotreater | Haldor Topose | - | - | 1.9 MMTPA |
| 6 | Delayed Coker | CBI Lummus | 2.76 MMTPA | 3.45 MMTPA | 3.45 MMTPA |
| 7 | Hydrogen Generation Unit | HTAS | 2 x 0.044 MMTPA | 2 x 0.044 MMTPA | 2 x 0.044 MMTPA + 2 x 0.011 MMTPA |
| 8 | Sulphur Recovery Unit | PROSERNAT | 2 x 300 TPD | 2 x 375 TPD | 2 x 375 TPD |

| | | | | | |
|---|---|---|---|---|---|
| 9 | Sour Water Stripper | EIL | 300 + 100 M3/HR | 435.6 + 127 M3/HR | 435.6 + 127 M3/HR |
| 10 | Amine Regeneration Unit | EIL | 820 TPH | 1 x 880 TPH | 1 x 880 TPH |
| 11 | Mild Hydrocracker/ VGO-HDT | Axens | 3.0 MMTPA | 3.82 MMTPA | 3.82 MMTPA |
| 12 | LPG Sweetening Unit/ Treating Unit | EIL | 0.15 & 0.94 MMTPA | 0.15 & 0.94 MMTPA | 0.15 & 0.94 MMTPA |
| 13 | Kerosene/ATF sweetening Unit | UOP | 0.55 MMTPA | 0.55 MMTPA | 0.55 MMTPA |
| 14 | FCC with PRU | Technip Shaw stone & Webster | 2.2, 0.5 MMTPA | 3.053 , 0.69 MMTPA | 3.053 , 0.69 MMTPA |
| 15 | Poly Propylene Unit (PPU) | Novolen | 0.44 MMTPA | 0.51 MMTPA | 0.51 MMTPA |
| 16 | Captive Power Plant | BHEL | 165 MW | 165 MW | 165 MW |
| 17 | Hexane Recovery Unit (HRU) | EIL | 0.005 MMTPA | 0.005 MMTPA | 0.005 MMTPA |
| 18 | Bitumen Blowing Unit | PORNER | - | 0.52 MMTPA | 0.52 MMTPA |

**2.4 Types of crude processed:**

The refinery has been designed to process crudes like Arab Heavy, Doba, Arab Medium & Maya in different ratios as to achieve a crude blend having the following properties:

- API Gravity : 26-32 degree API
- Sulfur Content: 3% by weight max.
- TAN – 0.5 Max

During the last couple of years the Refinery has processed various crudes in addition to the design crude basket. Some of the additional crudes processed are Khafji , Basrah Light, Kuwait blend, Arab Light, Ras Gharib, Maya, Castilla, Iranian Heavy, Van Gogh etc.

### 2.5 Refinery Configuration and Manufacturing process

#### 2.5.1 Crude and Vacuum Distillation Unit

Facilities provided in the unit battery limit are:

1) Heat integrated Crude & Vacuum Distillation Units

2) Naphtha Stabilisation section

3) Naphtha caustic wash

The products are Fuel Gas, LPG, Stabilised Naphtha, Swing/Heavy Naphtha, Light Kerosene, Heavy Kerosene, Light and Heavy Gas Oils, Atmospheric Residue, Hot-well Gases, Hot-well Slop Oil,Vacuum Diesel, Light Vacuum Gas Oil, Heavy Vacuum Gas Oil, Vacuum Slops and Vacuum Residue.

#### 2.5.2 Naphtha Hydro-Treater Unit

The Naphtha Hydro-treater unit protects the Reforming and Isomerisation catalysts by eliminating or reducing to acceptable levels of impurities, detrimental to catalyst activity, such as, sulphur, nitrogen, water, halogens, di-olefins, olefins, mercury, arsenic and other metals. The naphtha is treated by passing it over a fixed bimetallic catalyst bed in adiabatic reactors, in the presence of hydrogen. There are two fundamental reactions occurring in the unit – hydro refining and hydrogenation. In hydro-refining, sulphides, di-sulphides and mercaptans are reacted with hydrogen to convert them to the corresponding alkanes and arenes, with the release of hydrogen sulphide. With hydrogenation, alkenes and di-alkenes are converted to alkanes. The reactions take place in two reactors employing bimetallic catalysts, followed by a stripper column. While the overhead vapours produced are routed either to the Fuel gas Treating Unit or to the VGO Hydro Treater, while the bottoms product is sent to a splitter column where three cuts are obtained – light naphtha, hexane and heavy naphtha.

#### 2.5.3 Naphtha Isomerization Unit

Isomerisation of light hydro-treated naphtha is carried out in two fixed bed reactors in series. The C5/C6 Isomerisation Section converts normal C5/C6 paraffins to their isomers, i.e. to a higher octane branched arrangement, over a proprietary platinum catalyst, in the presence of hydrogen. The conversion of normal paraffins to their isomers in each pass is determined by the equilibrium conditions of the reaction under the operating conditions of the reactor. A stabilizer column is used to remove the light ends from the reactor effluent, before routing the effluent to the De-iso-hexanizer column. A De-iso-hexanizer tower is used for recovering and recycling the low octane methyl-pentanes and the unconverted n-hexane from the reactor effluent. The De-iso-hexanizer distillate and the bottoms streams are combined to produce the final isomer product. The stabiliser reflux drum vent gas contains hydrogen and chloride, which are removed by neutralization with caustic soda in a Caustic Scrubber.

### 2.5.4 Catalytic Cracking Unit

Conversion of paraffins and naphthenes to high-octane aromatics is achieved by passing the naphtha over a slow moving bimetallic catalyst bed in four adiabatic reactors, in the presence of hydrogen at a relatively high temperature and low pressure. The coke laid down on the catalyst is removed in a continuous catalytic regeneration section. In this process, catalyst is withdrawn from the reaction section at a fixed rate, regenerated in the continuous catalytic regeneration section and returned afresh to the reaction section.

### 2.5.5 Diesel Hydro-Treater Unit

The processing objective of the Diesel Hydrotreating Unit is to hydrotreat diesel pool streams produced from various processing units & Coker Naphtha to produce treated diesel meeting Euro IV specifications. The treated diesel produced in the unit will have a minimum CI of 46.5. The unit will also produce the required quantity of ATF and MTO products in blocked out mode. The raw feed streams to the DHDT unit comprise straight run Light & Heavy Gas Oils, Vacuum Diesel, Light & Heavy Kero, Heavy Naphtha from the CDU/VDU, Coker Naphtha, Lt Coker Gas oil from the

FCC Unit and DSO (Disulphide oil) rich stream from the LPG treating Unit. The high purity hydrogen make-up gas (99.5 vol%) required for the unit will be obtained from a PSA unit. A reactor with three catalytic beds will be used for the reactions of the process. The olefin saturation, de-sulphurisation, de-nitrogenation and aromatic saturation reactions occurring on the catalyst are highly exothermic. The reactor is followed by a Hot Separator, a cold HP Separator and a cold LP Separator. In the cold LP separator three streams are separated, namely a liquid phase to the stripper section, a gas phase to the VGO-HDT Gas Plant and sour water to the VGO-HDT Sour Water Degasser.

### 2.5.6 Delayed Coker Unit

The purpose of the Delayed Coker Unit is to upgrade high sulphur residue from the Vacuum Distillation Unit. The Delayed Coker Unit is designed to produce Coker Fuel Gas, Coker LPG, LCGO and Naphtha, Heavy Coker Gas Oil (HCGO) and Green Coke. The feed to the DCU is either hot vacuum residue (240°C) from both the CDU and the VDU, or a cold (140°C) vacuum residue from storage. The process scheme for the Delayed Coker Unit includes two Coker Heaters, two pairs of Coke Drums, a Coker Fractionator with Side Strippers, Coker Fractionator Overhead System and a Vapour Recovery Section. The Vapour Recovery Section consists of a Wet Gas Compressor, Absorber, Stripper, Sponge Absorber, Debutanizer and LPG Amine Contactor. Coker Unit also features Decoking System, Blow-down System, and ISBL Coke Handling System.

### 2.5.7 VGO Hydro-Treater Unit

The purpose of the unit is to produce VGO with a maximum content of 200 ppm (wt) of Sulphur. The VGO HDT Unit processes a mix of Straight run VGO feedstock from the CDU/VDU and Heavy Coker Gas Oil from the DCU.

### 2.5.8 FCC-PC Unit Propylene Recovery Unit

The DCC complex unit will be designed to produce Polymer grade Propylene/ LPG and high octane

gasoline yields. DCC complex is to maximize Propylene Recovery. The Converter, Unsaturated Gas Plant and the Propylene Recovery Unit, which include the main fractionator and gas plant of the Deep Catalytic Cracking Complex involve the following equipment:

a. Combustion Air Blower

b. Reactor/Regenerator

c. Flue Gas Cooler

d. Main Fractionator

e. Wet Gas Compressor

f. Contaminant Removal Unit

g. Propylene Splitter

The Converter's role lies in the catalytic cracking of various oil feedstock into lower boiling high value products, primarily propylene, Motor Spirit, LPG and LCO. The Gas Plant separates and recovers light hydrocarbon vapors and hydrocarbon liquid streams produced by the cracking reactions of the DCC Reactor, such as LPG, Light and Medium Naphtha and Light Cycle Oil. The Propylene Recovery Unit removes contaminants from the C3 products, and separates propane from propylene to produce a polymer-grade of the latter.

### 2.5.9 Hydrogen Generation Unit

The Hydrogen Generation Unit comprises two trains with a common Pre-Desulphurisation section and a Pressure Swing Adsorption Unit. The plant is designed for operation with SR Naphtha and DHDT Naphtha as feedstock. Continuous operation with a mixture of SR Naphtha and DHDT Naphtha has also been envisaged. The PDS Unit desulphurises the raw naphtha feed, while the desulphurisation and reforming unit produces syngas and the PSA unit purified the syngas, to arrive at the hydrogen product. As an alternative to naphtha, refinery fuel gas may also be used. In addition to hydrogen, the unit also generates superheated high pressure steam at 38 kg/cm2.

### 2.5.10 Polypropylene Unit

Polypropylene unit has a parallel 75m$^3$ reactor configuration for producing homopolymers and is equipped with a double-screw extruder.

### 2.5.11 SR LPG Treating Unit

The treatment process is designed to remove H2S and mercaptans from LPG. The LPG coming from the CDU/VDU and the VGO-HDT is first treated in the Amine Absorption section, where the bulk of the H2S is removed, followed by the Continuous Film Contactor (CFC) unit, where the remaining H2S and mercaptans are removed using caustic, to meet product specifications.

### 2.5.12 Cracked LPG Treating Unit

This unit is identical to the SR LPG Treating Unit, except that the LPG stream comes from the Delayed Coker Unit.

### 2.5.13 Sulfur recovery Unit

Sulfur Recovery unit is designed to handle all the acid gases and Ammonia containing sour gases from the refinery complex to produce elemental sulfur.

### 2.5.14 Amine Regeneration Unit

Amine regeneration unit with capacity for regenerating all the rich amine produced in the refinery complex has been designed. ARU unit produces Lean Amine, which is supplied to various units for treating Fuel gas, LPG.

### 2.5.15 Sour Water Stripper Unit

Sour water stripper is utilized for:

- One SWS unit for treating Sour water from hydroprocessing units.
- Another unit for treating Sour water from other non-hydroprocessing units.

## 2.6 Utility facilities:

The utility facilities for the Refinery consist of the following:

- Steam, Power & BFW System
- Recirculating Cooling Water System
- DM water System
- Condensate system
- Fuel Gas and Fuel Oil System
- Compressed Air System
- Nitrogen System
- Raw Water system
- Lean Amine & Rich Amine System
- Sour water System
- Caustic System
- Effluent treatment System

The utility systems are an integral part of the refinery and constructed on the Refinery site. The refinery is self-sufficient in all its utility requirements except raw water is brought from outside (Kotla Canal, part of irrigation system of Punjab) the refinery.

Major utility systems of refinery are summarized as under

**Table 2.2 Major utility systems in refinery post 11.25 MMTPA expansion**

| S.No | Description | Specifications |
|---|---|---|
| 1 | **Recirculating Cooling Water System** | |
| The cooling water facilities are classified into 3 systems. | | |
| A | Refinery Cooling Tower | (11+1) cells of 4000 m3/hr each |
| B | FCC-PC Cooling towers | (9+1) cells of 4000m3/hr each |
| C | CPP Cooling Tower | (3+1) cells of 4000m3/hr each |

| | | |
|---|---|---|
| 2. **RO based DM Water system** | | |
| Feed to RO DM Plant is combination of raw water & recycle from ETP. The RO based DM water system caters to the requirement of process units and CPP DM water demand. The DM water system capacity is 850 m3/hr. | | |
| 3. **Condensate Polishing Unit** | | |
| The design capacity of condensate polishing unit is : (2+1) X 75 m3/hr (Two operating + one stand by) | | |
| 4. **Compressed Air System** | | |
| The design capacity of the compressed air system is (5+1) X 8963 m3/hr. The capacity requirement of major components in compressed air system is | | |
| Plant air capacity | 11652 Nm3/hr (max) | |
| Instrument air capacity | 8307 BSVI Nm3/hr (max) | |
| Emergency instrument air | 1 HP storage vessel for 30 min Instrument air requirement for safe shut down | |
| 5. **Nitrogen System** | | |
| Nitrogen is primarily required during catalyst regeneration, purging, blanketing etc. The Cryogenic Nitrogen requirement post LCEP is : 6977 Nm3/hr. Nitrogen plant design capacity is 7500 Nm3/hr. | | |
| 6. **Fuel Gas & Fuel Oil System** | | |
| ● Source of Fuel Oil is LCO from FCCU. Sulphur content of FO is in the range of 0.03 wt % | | |
| ● Fuel Gas is made available to refinery from the gas concentration section of FCCU PC and DCU. The sulphur content of the Fuel Gas is in the range of 0.001 wt % | | |
| 7. **Raw Water System** | | |
| The raw water system consists of | | |
| A | Raw Water Reservoir Capacity | 2 No's Total capacity 1,100,000m3 |
| B | Treated water Reservoir Capacity | 30,330 m3 |
| D | RWTP capacity | 5,400 m3/hr |
| 8. **Steam and Power** | | |
| The steam and power generation facilities consist of: | | |
| A | Utility Boilers (VHP Level) | 3+1 of 240 TPH each |

| | | |
|---|---|---|
| B | CFBC Boilers (VHP Level) | 2 x 300 TPH |
| C | STG (Extraction/ condensing type) | 2 x 35 MW each |
| D | STG ( back pressure type) | 1 x 32 MW |
| E | GTG | 2 x 34.5 MW |
| F | HRSG | 2 x 110 TPH |
| G | Grid Back up | 30 MW |
| H | DG Set( for emergency power) | 6.0 MW |
| 9. **Flare System** | | |
| The refinery flare system comprises of two flare systems. A hydrocarbon flare and a sour flare system.<br>The designed flare height is 140 m , capacity of the systems is<br>●The HC Flare size is 76" and has a design Capacity of 1580572.1 kg/hr (peak load)<br>●The Sour Flare size is 32" and has a design Capacity of 63020 kg/hr (peak load) | | |

**2.7 Offsite Facilities**

The offsite systems in existing refinery comprises of:

- Tank farm
- Interconnection of process lines between process units
- Dispatch facilities

The tank farm which is integral part to the refinery caters to (i) Storage tanks of crude feedstock, received through the crude pipeline, (ii) Intermediate and component storage needed from routine operations and blending. The summary of the feed, intermediate and product storage tanks and their pumps are tabulated below:

**Table 2.3 Storage Facilities post LCEP**

| Service | Tankages | | |
|---|---|---|---|
| | No of Tanks | Capacity Cu.M / Tank | TOTAL CAPACITY |
| **Crude Storage Tanks** | | | |
| Crude | 4 | 60000 | 240000 |
| Crude Water Drain Tank | 1 | 3758 | 3758 |
| Surge Relief Tank | 1 | 425 | 425 |
| **Intermediate Feed Tanks** | | | |
| NHT Feed | 2 | 29865 | 59730 |
| HGU Feed | 1 | 10565 | 10565 |
| VGO HDT Feed | 1+1 | 34410 | 68820 |
| DHDT Feed | 3 | 19990 | 59970 |
| DHDT Feed/Product | 1 | 19990 | 19990 |
| DCU Feed | 3 | 24420 | 73260 |
| FCC-PC Feed | 2 | 29980 | 59960 |
| Dry Slop(Heavy) | 2+1 | 3300 | 6600 + 10900 |
| Dry Slop(Light) | 2 | 4560 | 9120 |
| Heavy Naphtha | 1 | 5330 | 5330 |
| Reformate | 1 | 5860 | 5860 |
| Isomerate | 1 | 4230 | 4230 |
| CPP Fuel LCO | 2 | 8200 | 16400 |
| IFO/RFO | 2 | 5330 | 10660 |
| Sweet Naphtha | 1 | 1800 | 1800 |
| HCGO Storage Tank | 1 | 6300 | 6300 |
| Fuel Oil Tank | 1 | 1200 | 1200 |
| MS Component Tank | 1 | 9500 | 9500 |
| Bitumen Feed Tank | 1 | 24500 | 24500 |

| | | | |
|---|---|---|---|
| **Finished Product Storage Tanks** | | | |
| Hexane | 2 | 565 | 1130 |
| MS-III | 5 | 9150 | 45750 |
| MS-IV | 5 + 1 | 9150 | 45750 + 56070 |
| Naphtha | 3 | 9150 | 27450 |
| SKO | 5 | 4545 | 22725 |
| ATF | 3 | 9190 | 27570 |
| ATF | 2 | 8900 | 17800 |
| MTO | 2 | 1100 | 2200 |
| HSD-III | 5 - 1 | 56070 | 280350 - 56070 |
| HSD-IV | 2 + 1 | 56070 | 112140 + 30000 |
| Sweet SKO | 1 | 4545 | 4545 |
| Bitumen | 7 | 3300 | 23100 |
| **Day Storage Tanks** | | | |
| MS-III | 2 | 4545 | 9090 |
| MS-IV | - | | |
| HSD-III | 2 | 4545 | 9090 |
| HSD-IV | - | | |
| ATF | 2 | 4545 | 9090 |
| SKO | 2 | 4545 | 9090 |
| Naphtha | 2 | 4545 | 9090 |
| MTO | 1 | 285 | 285 |
| Hexane | 1 | 325 | 325 |
| MS-IV PREM. | 1 | 285 | 285 |
| Naphtha | 1 | 285 | 285 |
| MS-III | 2 | 285 | 570 |
| SKO | 1 | 285 | 285 |
| ATF | 1 | 325 | 325 |

| | | | |
|---|---|---|---|
| HSD-III | 2 | 285 | 570 |
| **Pressurised Storage** | | | |
| Hydrogen | 2 | 100 | 200 |
| Propylene | 3 | 2900 | 8700 |
| LPG | 8 | 2900 | 23200 |

**2.8 Product Dispatch Facilities:**

The dispatch of finished product is made through various modes i.e via Tanks Truck; Rail or Pipeline transfer. The product dispatch facility matrix is given below:

**Table 2.4: Product Dispatch Facilities post LCEP**

| Product Dispatch Facility | | | | | |
|---|---|---|---|---|---|
| **S No.** | **Products** | **By Rail** | **By Road** | **Pipeline 1( HMEL to HPCL, Bathinda)** | **Pipeline 2 (HMEL to HPCL, Bahadurgarh)** |
| 1 | LPG | ✓ | | ✓ | |
| 2 | MS | ✓ | ✓ | ✓ | ✓ |
| 3 | HSD | ✓ | ✓ | ✓ | ✓ |
| 4 | Naphtha | ✓ | ✓ | | |
| 5 | ATF | ✓ | ✓ | | ✓ |
| 6 | Kerosene | ✓ | ✓ | ✓ | ✓ |
| 7 | Petcoke | ✓ | ✓ | | |
| 8 | Sulfur | | ✓ | | |
| 9 | Hexane | | ✓ | | |
| 10 | MTO | | ✓ | | |
| 11 | Polypropylene | ✓ | ✓ | | |
| 12 | Bitumen* | | ✓ | | |

*This product dispatch facility is under implementation

### 2.9 Summary of Sulfur Balance Data (Before and After Expansion)

Summary of the emission scenario is presented in Table 6-4 and overall sulfur balance is presented in Table 6-5. It has been estimated that the total SO2 emissions will be maintained below the consented level of 1000 Kg/hr (24 T/day) as per the earlier environmental clearance conditions. In order to recover additional sulfur generation due to processing of additional crude in the plant, SRU revamp has been proposed. The total sulfur recovery in the facility after debottlenecking/ expansion project will be in the order of 680 T/day which will be about 70% of the total sulfur in the crude to be processed.

**Table - 2.5 Estimated Sulfur Balance in the Plant after BS-VI/ Expansion project**

| Stack connected to heaters and fuel combustion sources | Existing Configuration @ 9 MMTPA | Under Implementation Configuration @11.25 MMTPA | Proposed Configuration post BS-VI @11.25 MMTPA |
|---|---|---|---|
| | $SO_2$ Emissions | $SO_2$ Emissions | $SO_2$ Emissions |
| CDU & VDU | 3.034 | 0.15 | 0.15 |
| Naphtha Hydrotreater | 0.013 | 0.007 | 0.007 |
| ISOM | NA | NA | NA |
| CCR | 1.459 | 0.026 | 0.026 |
| VGO-HDT | 0.775 | 0.04 | 0.04 |
| DHDT | 0.622 | 0.031 | 0.031 |
| New DHDT | NA | NA | .010 |
| FCC-Furnace stack | 0.345 | 0.014 | 0.014 |
| FCCU – Flue gas stack | 0.307 | 0.307 | 0.307 |
| PRU | NA | NA | NA |
| PPU | NA | NA | NA |
| Delayed Coker unit | 2.13 | 0.081 | 0.081 |
| Flue gas HGU Train 1 | 0.002 | 0.002 | 0.0025 |
| Flue gas HGU Train 2 | 0.002 | 0.002 | 0.0025 |
| Naphtha Super-heater Stack (HGU) | 0.002 | 0.002 | 0.0025 |
| SRU (in TPD) | 0.571 | 0.6165 | 0.693 |

| | | | |
|---|---|---|---|
| SRU (in TPD) | 0.571 | 0.6165 | 0.693 |
| Utility Boilers | 1.244 | 0.249 | 0.249 |
| GT / HRSG Stack – 1 | 0.32 | 0.32 | 0.32 |
| GT / HRSG Stack – 1 | 0.32 | 0.32 | 0.32 |
| BBU | NA | 0.002 | 0.002 |
| BBU Incinerator | NA | 1.5 | 1.5 |
| Solid fuel fired boiler | NA | 9.677 | 9.677 |
| Solid fuel fired boiler | NA | 9.677 | 9.677 |
| **Total** | **11.717** | **23.640** | **23.804** |

*NA: Not Applicable*

**Table 2.6: Sulfur Balance in the Refinery after BS-VI/ Expansion**

| **Total crude to be Processed** | **T/day** | **33750** | **33750** |
|---|---|---|---|
| Average sulphur content in the crude | % | 2.7 | 2.7 |
| Total sulphur input through crude | T/day | 911 | 911 |
| Total sulphur in products | T/day | 287 | 162.6 |
| Total sulphur to be recovered in the SRU | T/day | 622 | 736.5 |
| Total $SO_2$ emissions from process stacks and heaters | T/day | 4.29 | 4.45 |
| Total $SO_2$ emission from proposed CFBC boilers (after SOx capture, based on worst case scenario of 100% Petcoke Firing) | T/day | 19.354 | 19.354 |
| Total $SO_2$ emissions into atmosphere | T/day | 23.64 | 23.804 |
| Total $SO_2$ emissions into atmosphere | Kg/Ton of crude | 0.70 | 0.71 |

## Chapter 3: Overview of Environmental permits

### 3.1 General

HMEL has developed a sound Health, Safety and Environment Policy. Adhering to the philosophy of the policy HMEL has ensured that an effective Environmental plan has been implemented from the Project phase. All permits / approvals from Govt. bodies / authorities required to implement the project and for Operation have been issued to HMEL.

### 3.2 Approval and Permits

Most important permits & approvals issued to HMEL are given in table below:

**Table 3.1 Approvals & Permits**

| Sr. No. | Approval Description | Issuing Authority | Reference number & Date of Permit |
|---|---|---|---|
| 1 | EC for Project | MOEF | J.11011/24/98-IA II dated 6th Nov 1998. |
| 3 | Revised EC for Project | MOEF | J.11011/275/2007-IA II (I), dated 16th July 2007. |
| 2 | Consent To Establish | PPCB | EE(ZP-II)2008/34648, dated 15th Sept 2008 |
| 5 | Water Consent | PPCB | ZO/BTI/BTI/WPC/2010/F-21, dated 31/12/2010 |
| 6 | Air Consent | PPCB | ZO/BTI/BTI/APC/2010/F-19, dated 31/12/2010 |
| 7 | Hazardous Waste | PPCB | HMC/BTI/2012-13/F-3, dated 09/01/2012 |
| 8 | Hazardous Waste | PPCB | HWM/BTI/2014/341256, dated 28/05/2014 |
| 8 | EC for Expansion Project | MOEF | IA/PB/IND/26087/2013, dated 12th January, 2015, Date of permit 22nd June, 2015 |
| 9 | Consent to Establish | PPCB | 2493, Dated: 08/09/2015 |
| 10 | Air Consent | PPCB | 2245, Dated: 31/05/2016 |
| 11 | Water Consent | PPCB | 2243 Dated: 31/05/2016 |

### 3.3 HSE POLICY:

The environment policy of HMEL is embedded in the Health, Safety, Environmental and Quality (HSEQ) Policy which was developed in September 2015 (Refer annexure 3.1). Under this policy the company has shown its commitment to control pollution & preserve the environment.

### 3.4 Environment Management Plans:

The Environment Management Plans developed and implemented at refinery are based on sound principles. The EMP extensively covers all aspects of environment as summarized below. The Environmental Management Plan for the project has been designed to ensure that the residual environmental impacts are minimized by incorporating the appropriate technologies. The EMP also considers all applicable statutory stipulations. The affected environmental attributes in the region are air quality, water quality, soil, land use, ecology and public health. The Management Action Plan aims at controlling pollution at the source level to the possible extent with the available and affordable technology followed by treatment measures before they are discharged.

#### 3.4.1 Air Environment

**i. Point / Stack Emissions**

Air Pollution control measures of the project covers, Better dispersion through higher stack heights and Usage of low sulphur fuel. Higher stack heights have been provided at CDU/VDU, NHT, CCR, DCU, SRU, DHDT etc as well as for Captive Power Plant against the minimum stack height stipulated by CPCB for better dispersion. Emission of oxides of sulphur has been controlled through usage of low sulphur fuels, like Fuel gas and Fuel oil in this project.

Flaring is the volatile organic compound (VOC) combustion control process using a specially designed burner tip, auxiliary fuel and steam to promote mixing for nearly complete combustion of the VOCs.

The flare envisaged in the project is of elevated type so that the products of combustion shall be dispersed above working areas to reduce the effects of Noise, Heat, smoke and objectionable odors. Following measures have been incorporated in flare design:

Ensure proper exit velocity at the flare tip depending on the calorific value of the gas streams. No visible emissions other than exception Period.

A Flame present at all times when emissions may be vented. The presence of a pilot flame is monitored using appropriate device.

Combustion units such as furnaces, boilers, turbines will generate emissions to Air that are related to combustion conditions (e.g. NOx, CO, Soot) and fuel composition (e.g. SO2, Metals, Soot). Following measures have been taken for the control of combustion gases from stacks:

- Energy Efficient Process Design to minimize fuel Requirement.
- Utilization of Low Sulfur fuel.
- Low NOx burners to be employed.

The minimum height of stacks has been considered taking in due consideration the "Guidelines for Minimum Stack Height" as per the notification of the Ministry of Environment and Forests dated 19th May 1993, which fixes the minimum stack height based on the sulfur Dioxide (SO2). This is given below as:

H = 14 (Q) 0.3

Where,

H is the stack height in Meters and

Q is the Sulfur dioxide emission in Kg/hr.

**ii. Fugitive Emission**

The fugitive emissions are primarily due to intermittent/ continuous leakages or evaporation of volatile organic carbons (VOC) from processing / storage area of the plant. Fugitive emissions refer to very tiny leaks of volatile organic compounds (VOC) that may occur from such sources as valves, pumps, compressors, and flanges. The designs minimize high pressure flanges and valves for safety as well as environmental considerations. Pumps are specified with mechanical seals suitable for design temperature and pressure. Compressors are equipped with seal oil systems to prevent leakage to the atmosphere. The major sources of such fugitive emissions of VOCs are the main processing area, and storage tanks. These fugitive emissions originate from the static pumps, valve packing and connections/ joints to the atmosphere like relief valves etc. In order to minimize the fugitive emissions of VOCs, the following measures have been adopted during design stage.

- High grade gasket material for packing.
- Usage of "State of the art" low leakage valves preferably with bellow seals.
- Usage of pumps with mechanical seals.
- Provision of seals in the drains and manholes

- Minimum number of flanges, valves etc.

**iii. Odor Control**

The odor from the complex originates due to fugitive emissions or leakages. Therefore, the design measures adopted above as a part of controlling fugitive emissions are also useful for odor control.

**iv. Noise Environment**

The statutory national standards for noise levels at the plant boundary and at areas near the plant have been met. The selection of plant equipment has been done with specification of low noise levels. Noise suppression measures such as enclosures, buffers and / or protective measures has been provided to limit noise levels within occupational exposure limits (OSHA) or equivalent standards). Areas with high noise levels are identified and segregated and wherever possible included prominently using display caution boards. Measures for noise control at the design stage have been followed in terms of the following:

- Noise levels specification of equipment shall be limited to noise to 85dB (A) at a distance of 1m
- Equipment layout has been done considering the segregation of high noise generating areas.
- Suitable enclosures have been provided, wherever required, to minimize the impact of high noise generating sources.

**v. Water Environment**

Several measures have been incorporated at the designs stage towards minimizing the generation of wastewater and treatment of the generated effluent. Some of these measures are described below:

Most of the stripped water from non-hydro processed Sour Water Stripper is reused as Desalter water make-up water and the stripped water from hydro processed Sour Water Stripper is reused in hydro processing units. This in-plant control measure reduces the net wastewater load to the ETP considerably. Also, a dedicated sour water storage tank for holding sour effluent is provided. Closed blow down system has been incorporated for hydrocarbon liquid discharges in all the process units, which will also reduce the wastewater load to ETP both in terms of quantum load and quality. This is another of the in-plant control measures. Appropriate segregation and collection philosophy (separate

sewers for process waste, contaminated rainwater, spent caustic, cooling tower blow down, boiler blow down, catalyst regeneration waste, etc. have been incorporated for various effluents depending on individual stream characteristics. Process areas are paved to avoid contamination of soil/sub-soil/ground water in case of accidental spill/leakage of hydrocarbon liquids.

The waste water streams shall comprise of oily effluents and Spent Caustic streams that shall be treated in the Effluent Treatment Plant of the Refinery. The treated effluent shall be partly recycled and reused as feed to the RO based DM plant in the complex and the rest shall be sent for disposal through the Ecological Pond. The Refinery employs a two systems approach in the treatment of wastewater:

- In-plant pre-treatment (sour water stripping, neutralization, etc); and
- Effluent Treatment Plant (ETP)
- The ETP consist of
- Physical Treatment (Oil / Water removal and separation);
- Chemical Treatment (Conversion of sulphides to sulphates);
- Two Stage Biological Treatment (biodegradation of organic impurities, removal of settle able solids in SBR an MBR units).

The refinery has a full-fledged Effluent Treatment Plant (ETP) consisting of physical, chemical and biological treatment facilities. The ETP provided at the site is of the following design:

**Table 3.2 : ETP Plant Capacity**

| **Effluent Treatment Plant (ETP)** | |
|---|---|
| The existing ETP design is based on the following | |
| Oily effluent flow | 500m3/hr |
| Sanitary flow | 25m3/hr |
| Spent caustic flow | 5 m3/hr |
| CRWS | 500 m3/hr |

**vi. Solid Wastes Handling, Treating and Disposal**

During the design stage itself due care has been taken to select the process technologies generating minimum solid wastes so that their handling, treatment and disposal do not cause any serious impact on the existing land environment. Also, efforts will be made to recycle some of the spent catalysts by way of returning to the original supplier for reprocessing. The solid wastes management plan is briefly described below.

The provisions of Hazardous Waste (Management & Handling) Rules, 2008 Amendments, are being complied with. There are primarily four types of solid wastes generated in a refinery:

- **Spent Catalysts**: Patented catalysts are used in various refinery process units. Some of the spent catalysts will be sent back to the original supplier for reprocessing. The other catalysts after proper disposal treatment steps are normally sent to existing landfill.
- **ETP Sludges:** The sludge separated in different units of ETP, viz., oily & chemical sludge from API/ TPI / DAF will be thickened in a thickener and the thickened sludge will be dewatered in a centrifuge. The dewatered sludge will treated in contained bioreactors explained above. Provision is also given to transfer this sludge to coker unit. The bio sludge from bio-treatment section will be separately thickened and dewatered in a thickener and centrifuge respectively and sent for land fill/reuse as manure
- **General Solid Wastes**: Small quantities of non-hazardous, non-recyclable solid waste consisting of waste refractory, spent insulation, used filter cartridges, spent charcoal, spent clay and sand will be generated. These wastes will be disposed off in the landfill. The oily sludge shall be treated through bioremediation route in a contained/confined unit using a batch bio-reactor, which shall degrade the oily sludge and make the sludge nonhazardous. The treated sludge can be safely disposed off in the following way:
  - Nonhazardous landfill
  - Land spreading
  - Reuse as asphalt paving
  - Use as soil top for landfill

- Thus, a proper solid and hazardous waste handling and management system is in place ensuring efficient disposal of solid and hazardous waste generated in the refinery.

**vii. Green Belt**

Green belt development is a high priority for refinery for both ecological and aesthetic reasons. A continuous tree plantation program and development of green belt has been implemented. This is not only providing greenery but also aimed at reducing cascading effect of pollution and wind. Approximately 2,00,000 Saplings have been planted in the Green Belt covering an area of approx. 300 acres.

**viii. Air Pollution and Meteorological Aspects**

- **Stack Monitoring**

  The emissions from all the stacks are continuously monitored for exit concentration of sulphur dioxide and nitrogen oxides as recommended by CREP. Sampling ports provided in the stacks according to CPCB guidelines.

- **Ambient Air Quality Monitoring**

  The concentration of SPM, SO2, NOx and HC in the ambient air outside the refinery boundaries and in the adjoining villages is being monitored as per the direction of the State Pollution Control Board.

- **Meteorological Observations**

  A permanent weather station has been installed within the plant premises. The dry bulb temperature, wet bulb temperature, wind speed, wind direction, cloud cover, rainfall etc are being monitored and recorded daily.

**ix. Water and Wastewater Quality**

Monitoring of important parameters is being done to identify any deviations in performance of effluent treatment plant. Appropriate measures have been taken if the treated effluent quality exceeds the permissible limits.

**x. Noise Levels**

Noise levels in the work zone environment are being monitored. The frequency is once in three months in the work zone. Similarly, ambient noise levels at three locations are monitored on a seasonal basis.

**xi. EMP Cost**

The implementation of EMP requirement is not only a systematic approach but is a continuous process. GGSR has not only chosen environment friendly technologies for refinery operation but also selected products which will be low in sulphur. Product sweetening like Fuel gas treating and DHDT and SRU are some of the example in which the capital expenditures to the tune of Rs. 1500 crores has been incurred.

**Table 3.3 Environment Management Plant Cost**

| **Capex on EMP already incurred** | **Rs: (Crores) Approx** |
|---|---|
| Continuous monitoring of stack emissions by on line gas analysers. | Rs: 10 Crores |
| Waste water treatment and tertiary treatment | Rs: 220 Crores |
| VOC control and oily Sludge treatment process | Rs: 10 Crores |
| Green Belt | Rs: 2.25 Crores |
| Vapour recovery system for truck and rail wagon loading facilities | Rs: 5.5 Crores |
| Ambient air quality monitoring stations | Rs: 5 Crores |
| Annual operating expenditure for waste water treatment tertiary treatment units, online ambient air quality monitoring and Refinery + Township Manual monitoring | Rs: 5.34 Crores |
| Annual Operating expenses for DHDT, SRU and treating units | Rs: 61.48 Crores |

**3.4 Accolades Received:**

HMEL has emphasized on the use of technology for implementation and monitoring of various aspects of environment & Safety. HMEL has received several awards as under for implementation of the EMP.

- **Golden Peacock Occupational Health & Safety Award**

HMEL received the 'Special Commendation' for the 'Golden Peacock Occupational Health & Safety Award' for the year 2013. Union Minister of State for Information and Broadcasting, Mr. Manish Tewari presented the award to the HMEL Team on 19 July 2013, during the 15th World Congress on Environment Management.

- **SAP ACE Award 2013**

HMEL won the SAP Ace Award 2013 for Excellence in Green Initiatives and Sustainability. HMEL was awarded in the category "Jury Recognition for Excellence in Green Initiatives and Sustainability" for SAP Environment, Health and Safety module.

This award demonstrates Team HMEL's commitment to be the best refiner operating with world class People, Processes and Technologies. The award was presented to the HMEL Team at the seventh SAP ACE Awards ceremony held in Mumbai, on 17th October, 2013.

- **Guru Gobind Singh Refinery Gets BS OHSAS 18001:2007 Certification**

The Guru Gobind Singh Refinery received the BS OHSAS 18001:2007 certification in February 2014 given by the British Standards Institution (BSI) for Occupational Safety Management system. The BSI is the world authority on management systems and having been certified with 18001:2007 it is symbolic of HMEL's testament to committed quality of sound Health, Safety and Environmental practices.

- **Golden Peacock Environment Management Award – 2014**

HMEL received the prestigious "Golden Peacock Environment Management Award – 2014" presented by the Institute of Directors at the 16th World Congress on Environment Management on Friday, 11th July at New Delhi. The award recognises HMEL's sound environment management practices and our commitment to environment sustainability. Mr. K.K.Shrivastava – GM – Project Control & Ms. Sangeetha Chakravarthy – Head – Corporate Communications received the award on behalf of HMEL.

- **Energy Performance Award – 2013-14**

HMEL bagged the prestigious Energy Performance award given by the Ministry of Petroleum and Natural Gas for 2013-14. The award was conferred for running Furnace/Boilers most efficiently among Indian Refineries having design heat duty of more than 1000 mm kcal/hr. The Petroleum Secretary, Mr. Saurabh Chandra presented the award to the HMEL Team represented by COO, Mr. Martin Hawkins, VP – Technical Services – Mr. Ramesh Chugh during the Refinery Technology Meet organized by Centre for High Technology at Chennai on November 12.

- **Golden Peacock Award for Environment Management 2016**

HMEL received the Prestigious "Golden Peacock Award for Environment Management 2016" presented by the Institute of Directors at a grand ceremony during the 18th World Congress on Environment Management held on July 8 2016 at New Delhi.

HMEL was felicitated with the award by Justice (Dr.) Arijit Pasayat, Co-Chairman, Institute of Directors & former Judge, Supreme Court of India. HMEL had also won this award in 2014.

- **Sustainability Award for Excellence in Safety**

HMEL won the FICCI 'Sustainability Award for Excellence in Safety' in the petrochemical sector at the ninth edition of India Chem Exhibition at Mumbai on Sep 1, 2016. The award recognizes the leaders who ensured sustainable growth in the Chemicals industry of India and set benchmarks for the others to follow.

The award was received by Mr Ian Thorpe, VP – HSE on behalf of HMEL team.

- **ISO 9001 & 14001 Certification**

Guru Gobind Singh Refinery has received accreditation from BSI (British Standard Institution) for Quality Management System: ISO 9001:2008 and Environment Management System – ISO 14001:2004. Certification audit was conducted in Feb 2016. Both the certificates are valid till September 2018.

## Chapter 4: Summary of Safety measures adopted

### 4.1 Safety measures in design

HMEL has adopted a philosophy of designing all its systems in the refinery to meet Indian & International standards followed for various systems & equipment's at the process and detailed engineering standards are tabulated below:

**Table 4.1 Standards for safety of all equipment's & systems used**

| Name of standard | Title of standard | Equipment /system designed with standards |
|---|---|---|
| OISD-STD-118 | Plant layout | Inter Unit & Inter equipment distances maintained as per this standard. |
| OISD-STD-116 | Fire protection | Fire Protection facilities for Petroleum Refineries and Oil/Gas Processing Plants |
| OISD-STD-150 | LPG mounted storage facility to minimize BLEVE & Mounded Bullets | Design and Layout of Liquefied Petroleum Gas Mounded Storage Vessels |
| OISD-STD-206 | Safety management & all PSM elements like Work Permit System, Process safety information | Guidelines on Safety Management System in Petroleum Industry |
| API-620/650 | Tank Design | API 650 applies to vertical cylindrical tanks, API 620 to tanks formed by a surface of revolution |
| OISD STD 108 | Based on applicability | |
| OISD STD 106 | Flare & relief system | Pressure Relief & Disposal System |
| API RP 520/521 | Safety valves | API RP 520 Used for sizing and selection of pressure relief devices used in refineries and API RP 521 design, installation, and operation of pressure-relieving and depressurizing |

| | | |
|---|---|---|
| | | systems, Supplements API Recommended Practice 520 |
| OISD STD 116 | Gas detector | HC, H2S & H2 gas detectors in process units, offsite & crude oil terminal line. |
| OISD STD 163 | Refinery Building | This covers standard for blast resistant buildings for refinery control room & satellite rack room. |
| OISD STD 211 | Laboratory | This standard relates for Safety in Petroleum Laboratories |
| IS 1893-2002 & Seismic Zone 3 | Buildings | This Standard provides provisions for Earthquake resistant design of building |

**4.2 Fire water facilities at refinery**

**4.2.1** Basis of design of firewater network. Fire water facilities in the refinery designed as per OISD-116 guidelines.

**Table 4.2 Fire water demand based on two major fire scenarios**

| | |
|---|---|
| Total fire water demand for two major fires | 5508 m3/hr |
| Fire water system design flow rate | 7000 m3/hr |
| Fire water system design pressure<br>Fire water Residual pressure at remote location | 13.5kg/cm2g<br>7.0 kg/cm2g |

**4.2.2 Fire water Reservoirs:**

- Number of compartments in fire water reservoir : 2 nos
- Capacity of fire water reservoir : 50,000m3 (2x25,000m3)
- Fire water reservoir storage capacity is adequate to fight 2 major fires simultaneously for 6 hours.
- Replenishing of fire water reservoir through Raw water reservoir of capacity: 11,00,000m3

### 4.2.3 Fire water pumps:

**Table 4.3 Fire water pumps**

| Type of pump | Capacity(m3/hr) | Nos. |
|---|---|---|
| Electric motor driven main pump | 1000 | 5 |
| Diesel engine driven main pump | 1000 | 6 |
| Jockey pump | 175 | 4 |
| Fire water make up pump | 350 | 2 |

All fire pumps are auto start enabled to ensure fire water header pressure is maintained.

### 4.3 Fixed installations:

**Table 4.4 Fixed installations**

| | |
|---|---|
| Fire station network of 51kms | All facilities in the refinery |
| Hydrants 1030 Nos. | All equipment |
| Water monitor 135 Nos. | All equipment |
| Manually operated medium velocity water spray system | Storage tanks / Process columns above 45 m / Pumps handling hydrocarbons above auto ignition temperature |
| Automatic fixed water spray system | Pressurized storage (mounded bullets) for LPG/Propylene & Transformers above 2000 ltr oil capacity |
| Automatic Argonite (Clean Agent) system | Main & OMS control rooms, and all Satellite Rack Rooms (SRRs) |
| Automatic FM200 (Clean Agent) system | IT Data Centre (Server room) |
| Automatic DCP Total Flooding system | TEAL areas in Poly Propylene Plant |
| Automatic CO2 Total Flooding System | Gas Turbine protection |

### 4.4 Fire stations:

One main fire station and one satellite fire station has been provided in the refinery to house men and equipment for responding to emergencies. The main fire station has a large number of safety related

equipment like gas masks, fresh air breathing apparatus, rescue equipment, oxygen cylinders; In addition it has mobile firefighting equipment as given below:

**Table 4.5 Mobile firefighting equipment's at refinery**

| S No. | Name of equipment's | Nos. |
|---|---|---|
| 1 | Water cum foam tender | 4 |
| 2 | Dry chemical powder tender | 3 |
| 3 | Foam nurser | 2 |
| 4 | Emergency rescue tender | 1 |
| 5 | Water tender | 1 |
| 6 | Mobile fire trailer pump | 2 |
| 7 | Foam tank trailer with water cum foam monitor | 3 |
| 8 | Trailer mounted water cum foam monitor 2000 US GPM | 6 |
| 9 | Truck mounted gully sucker | 1 |
| 10 | Ambulances: 1 BLS (Basic Life Support) & 1 ALS (Advanced Life Support) | 2 |
| | **Total NO. of equipment's** | **25** |

**4.5 Risk Assessment & Mitigation:**

A Risk Assessment RA study has been conducted to study the consequences arising from the selected failure scenarios. The scenarios selected concern a range of hazardous events that could occur due to a loss of containment, *i.e.* scenarios with low and high likelihood of occurrence. Hazardous distances for all of the scenarios considered for consequence analysis are restricted to within the Refinery Complex. For most of the cases, the effect zones are limited to the unit area although in some they can affect the units in the immediate vicinity of the unit which is the scene of the occurrence.

**Important Mitigation measures adopted are tabulated below:**

**Table 4.6 Summary of Risk Mitigation Measures**

| S No. | Recommendations of Risk Assessment Study | Mitigation Measure Implemented |
|---|---|---|
| **1** | It is suggested that the installation of hydrocarbon, hydrogen sulphide and Chlorine detectors be considered at strategic locations in the process units for immediate identification of any leak, thereby reducing the time required for mitigation and control. | Hydrocarbon detectors has been placed at all strategic locations in the vicinity of the pumps, the ROVs, the bullets and in the LPG loading gantries. |
| **2** | It is recommended that active and passive fire-fighting facilities be provided for all process units, offsite areas and associated facilities in keeping with the standards applicable and international codes and practices. | Water Sprinkler systems have been provided for the tanks, the LPG and Propylene Pumps and the Rail and Road Loading Gantries, in accordance with OISD guidelines |
| **3.** | The failure of equipment and pipes is influenced by the maintenance practices followed. Periodic health checks and maintenance of all equipment and plant piping is required. | Preventive maintenance practices have been implemented. |

| | | |
|---|---|---|
| **4.** | Remote isolation of vessels and equipments having high hydrocarbon inventory should be considered during detailed engineering. | I. Remote isolation and shut down systems have been provided for the security of the LPG and Propylene bullets, which also have fire-proof ROVs and deluge valves.<br>II. An Emergency Shut-Down (ESD) system has been envisaged for the White-oil and LPG Rail gantries. |

**4.6 OCCUPATINAL HEALTH CENTRE DETAILS**

HMEL believe that human resource is one of the main assets of the company which is committed to provide safe and healthy working place to its employees. We provide health services with aim to have healthy, effective and productive employees by encouraging personal health improvement, health education and wellness training.

We have full-fledged occupational health cum medical center where all occupational health activities are carried out under the guidance of medical professionals. Availability of doctors and paramedical is ensured at OHC round the clock in case of any emergency.

In occupational health center we have equipment's like ECG, audiometer and spirometery to carry out pre and periodic medical examination as per factory act which allows us to have baseline data of the health of prospective employees, any medical condition he/she is suffering which may not be compatible with his job or which may affects his co –employees. After all the general physical examination is done by the doctor along with consultation and treatment if needed.

Two ACLS ambulances & three beds in OHC (extending three more beds) with all lifesaving medical equipment like ECG, Oxygen concentrator, cardiac monitor, ventilator with defibrillator and all emergency medicines to meet demand in any emergency situation in refinery .

## 4.7 OCCUPATIONAL HEALTH SURVEILLANCE PROGRAM

Details of year wise surveillance program:

**Table 4.7 Details of year wise surveillance program**

| **Pre-employment medical examination** | | |
|---|---|---|
| **Sr.No.** | **YEARS** | **TOTAL** |
| 1 | 2010-2011 | 126325 |
| 2 | 2011-2012 | 72000 |
| 3 | 2012-2013 | 22538 |
| 4 | 2013-2014 | 12925 |
| 5 | 2014-2015 | 19994 |
| 6 | 2015-2016 | 17448 |
| **Periodic medical examination** | | |
| **Sr.No.** | **YEARS** | **TOTAL** |
| 1 | 2012-13 | 229 |
| 2 | 2013-14 | 627 |
| 3 | 2014-15 | 904 |
| 4 | 2015-16 | 790 |

## Chapter 5: Facilities Proposed Post BS-VI Fuel Quality Project

### 5.1 General

Government of India has decided to implement the BS-VI auto fuel standards by 2020 and has directed oil companies to supply BS-VI quality (sulfur max = 10 ppmw) auto fuels across the country from 1st April 2020.

Existing MS block can produce BS-VI quality MS with a minor reduction in volume of 5-6 KT/month (3-4% of current production). Thus no modification is envisaged for MS. The production of BS-VI quality HSD requires capacity enhancement of DHDT by 1.9 MMTPA and HGU by 22 KTPA.

### 5.2 New process units/ Revamp:

Following new process units/revamp are proposed under BS-VI fuel quality project:

- New DHDT Unit (1.9 MMTPA)
- HGU Unit Revamp ( capacity enhancement by 2 x 11 KTPA)

### 5.3 Major equipment

Major equipments in the new DHDT unit are:

1) DHDT Reactor
2) Furnace
3) Make-up gas Compressor
4) Recycle gas compressor
5) Stabilizer
6) Stripper
7) Cold HP Separator Drum
8) Hot HP Separator Drum

Major equipments in HGU Revamp are:

1) 2 HTER (1 in each train)
2) 4 PSA beds
3) 1 Additional Surge drum

### 5.4 Refinery configuration post BS-VI

**Table 5.1- Unit wise change in capacity/throughput**

| S.No | Description | Configuration @ 9 MMTPA | Configuration @11.25 MMTPA | Proposed Configuration post BS-VI @11.25 MMTPA |
|---|---|---|---|---|
| 1 | CDU/VDU | 9 MMTPA | 11.25 MMTPA | 11.25 MMTPA |
| 2 | NHT/CCR | NHT 0.94 MMTPA<br>CCR- 0.5 MMTPA | NHT 1.18<br>CCR 0.63 MMTPA | NHT 1.18 MMTPA<br>CCR 0.63 MMTPA |
| 3 | Isomerization Unit | 0.32 MMTPA | 0.40 MMTPA | 0.40 MMTPA |
| 4 | Diesel Hydrotreater | 4.2 MMTPA | 5.71 MMTPA | 5.71 MMTPA |
| 5 | New Diesel Hydrotreater | - | - | 1.9 MMTPA |
| 6 | Delayed Coker | 2.76 MMTPA | 3.45 MMTPA | 3.45 MMTPA |
| 7 | Hydrogen Generation Unit | 2 x 0.044 MMTPA | 2 x 0.044 MMTPA | 2 x 0.044 MMTPA +<br>2 x 0.011 MMTPA |
| 8 | Sulphur Recovery Unit | 2 x 300 TPD | 2 x 375 TPD | 2 x 375 TPD |
| 9 | Sour Water Stripper | 300 + 100 M3/HR | 435.6 + 127 M3/HR | 435.6 + 127 M3/HR |
| 10 | Amine Regeneration Unit | 820 TPH | 1 x 880 TPH | 1 x 880 TPH |
| 11 | Mild Hydrocracker/ VGO-HDT | 3.0 MMTPA | 3.82 MMTPA | 3.82 MMTPA |
| 12 | LPG Sweetening Unit/ Treating Unit | 0.15 & 0.94 MMTPA | 0.15 & 0.94 MMTPA | 0.15 & 0.94 MMTPA |
| 13 | Kerosene/ATF sweetening | 0.55 MMTPA | 0.55 MMTPA | 0.55 MMTPA |

| S.No | Description | Configuration @ 9 MMTPA | Configuration @11.25 MMTPA | Proposed Configuration post BS-VI @11.25 MMTPA |
|---|---|---|---|---|
| | Unit | | | |
| 14 | FCC with PRU | 2.2, 0.5 MMTPA | 3.053 , 0.69 MMTPA | 3.053 , 0.69 MMTPA |
| 15 | Poly Propylene Unit (PPU) | 0.44 MMTPA | 0.51 MMTPA | 0.51 MMTPA |
| 16 | Captive Power Plant | 165 MW | 165 MW | 165 MW |
| 17 | Hexane Recovery Unit (HRU) | 0.005 MMTPA | 0.005 MMTPA | 0.005 MMTPA |
| 18 | Bitumen Blowing Unit | - | 0.52 MMTPA | 0.52 MMTPA |

**Product Slate:** The estimated product slate of the refinery post BS-VI Fuel Quality Project is summarized in Table below along with the existing slate.

**Table 5.2 – Existing and Proposed Product Slate**

| S No. | Products | Existing Configuration@9MMTPA, KTPA | Configuration@11.25 MMTPA, KTPA | Proposed Configuration post BS-VI, KTPA |
|---|---|---|---|---|
| 1 | LPG | 737 | 963.9 | 963.9 |
| 2 | Naphtha | 396 | 871.7 | 369 |
| 3 | Gasoline | Bharat IV REG 750<br>Bharat IV PRE 250 | Bharat IV REG 1306.4<br>Bharat IV PRE 25 | EURO VI 1540 |
| 4 | ATF | 500 | 500 | 250 |
| 5 | Kerosene | 200 | 200 | 200 |
| 6 | Diesel | 3692 | Bharat IV 4842.6 | Bharat VI 5018 |

| | | | | |
|---|---|---|---|---|
| 7 | Sulphur | 198 | 227 | 245.5 |
| 8 | Coke | 904 | 991.5 | 943.5 |
| 9 | Hexane | 5 | 5 | 5 |
| 10 | Motor Turpentine Oil | 25 | 25 | 25 |
| 11 | Polypropylene | 358 | 500 | 500 |
| 12 | Bitumen | - | 520 | 520 |

### 5.5 Offsite Storage Systems

No additional tankage is envisaged for BS-VI fuel quality project.

## Chapter 6: Utilities Requirement

### 6.1 Introduction:

The adequacy of the utility generation facilities has been checked for processing 11.25 MMTPA post BS-VI fuel quality project.

### 6.2 Steam and Power

The unit wise steam and power consumption for 11.25 MMTPA throughput post BS-VI is tabulated in tables below:

**Table 6.1: HP steam consumption (TPH) (Rated Consumption)**

| UNITS | FOR 9.0 MMTPA | FOR 11.25 MMTPA | ADDITIONAL REQUIREMENT POST BS-VI |
|---|---|---|---|
| CDU/VDU | — | 18 | |
| NHT/NSU | 17.5 | 22.4 | |
| ISOM | 8.2 | 17 | |
| CCR | -5.2 | -6.9 | |
| HGU | -62.1 | -29.5 | -20.7 |
| DHDT | 35.9 | 54.5 | |
| New DHDT | - | - | 6.7 |
| DCU | 33.6 | 33.6 | |
| VGO HDT | 53.1 | 49.4 | |
| FCCU | 107.7 | 101.7 | |
| PP | 1 | 1.5 | |
| BBU | — | 0 | |
| **S-Block** | **189.7** | **-6.8** | |
| **Utilities & Offsites** | **209** | **0** | |

**Table 6.2: MP Steam Consumption (TPH)**

| UNITS | FOR 9.0 MMTPA | FOR 11.25 MMTPA | ADDITIONAL REQUIREMENT POST BS-VI |
|---|---|---|---|
| CDU/VDU | 69.7 | 60.6 | |
| NHT/NSU | 23.5 | 33.5 | |
| ISOM | 29.3 | 45.8 | |
| CCR | 2.5 | 2.5 | |
| HGU | -21 | -24.2 | -9.5 |
| DHDT | -5.7 | -5.3 | |
| New DHDT | — | — | 9.9 |
| DCU | 28.8 | 48 | |
| VGO HDT | -20.5 | -27.8 | |
| FCCU | 120.2 | 37 | |
| PP | — | 0 | |
| BBU | — | -7 | |
| FG/LPGTU (included in HP steam) | — | 13.3 | |
| SRU-Block | 65.5 | -6.8 | |
| Utilities & Off sites | 20 | 0 | |
| Tracing | 5 | - | |
| Soot blower | 9.1 | - | |
| **NET TOTAL** | 326.4 | 169.6 | |
| **With 10% Margin** | **359** | **186.6** | |

**Table 6.3: LP Steam Consumption (TPH)**

| UNITS | FOR 9.0 MMTPA | FOR 11.25 MMTPA | ADDITIONAL REQUIREMENT POST BS-VI |
|---|---|---|---|
| CDU/VDU | 0.5 | 15.1 | |
| NHT/NSU | -1.5 | -3.1 | |
| ISOM | 1.0 | 6.1 | |
| CCR | -0.9 | -0.9 | |
| HGU | 0.9 | 1.3 | 2.3 |
| DHDT | -6.5 | 2.8 | |
| New DHDT | - | - | 2.6 |
| DCU | -0.1 | 1.9 | |
| VGO HDT | 14.9 | 0.4 | |
| FCCU | 37.1 | 96 | |
| PP | — | — | |
| BBU | — | -2 | |
| FG/LPGTU | 1.5 | 2.5 | |
| SRU-Block | - | 5.5* | |
| Utilities & Offsites | 15 | 22.3 | |
| Tracing | 5 | - | |
| MCR | 3.5 | 3.5 | |
| Evaporator | 7.2 | - | |
| **NET TOTAL** | 77.5 | 145.9 | |
| **With 10% Margin** | **85** | **160.5** | |

***SRU Block consumes MP steam and it is depressurized to LP within unit. Thus, it is not included in LP steam consumption net total.**

**Table 6.4: Estimated Power Consumption (KWH) (Normal)**

| UNITS | FOR 9.0 MMTPA | FOR 11.25 MMTPA | ADDITIONAL REQUIREMENT POST BS-VI (KW) |
|---|---|---|---|
| CDU/VDU | 10333.8 | 14500 | |
| NHT/NSU | 2030.4 | 2900 | |
| ISOM | 2042.1 | 2800 | |
| CCR | 5073.3 | 5900 | |
| HGU | 2292.3 | 3400 | 700 |
| DHDT | 9270 | 7300 | |
| New DHDT | - | - | 5200 |
| DCU | 6588 | 5900 | |
| VGO HDT | 11641.5 | 12500 | |
| FCCU | 5781.6 | 6000 | |
| PP | 14084 | 14500 | |
| BBU | - | 1000 | |
| CFBC Boilers (MW) | - | 13700 | |
| FGTU | 180 | 1300* | |
| LPGTU | 180 | - | |
| SRU- Block | 7969.5 | 10100 | |
| LPG plant | 900 | - | |
| Utilities & Offsites | 32383.3 | 38200 | |
| **NET TOTAL** | **110749.8** | **138700** | **5900** |

***FGTU power is inclusive of LPGTU and LPG plant.**

### 6.3 Adequacy of Fire Water System post BS-VI Fuel Quality Project

The adequacy of the fire water system has been checked for the post BS-VI fuel quality project scenario and the findings are summarized below:

- The fire water network of the refinery shall be extended along with Fire Hydrants, water Monitors, long range monitors etc. to cater to the additional facilities envisaged under BS-VI fuel quality project.
- Water spray system required for new equipment in the new process units shall be provided as per OISD guidelines.
- With the above augmentation, the existing Fire water storage and pumping systems are adequate to cater to the fire water system requirements for new DHDT and HGU revamp.

### 6.4 Cooling Water System

The unit wise cooling water demand for the refinery post expansion is tabulated below:

**Table 6.5: Cooling water consumption (m3/hr)**

| UNITS | FOR 9.0 MMTPA | FOR 11.25 MMTPA | ADDITIONAL REQUIREMENT POST BS-VI |
|---|---|---|---|
| CDU/VDU | 6401 | 11170 | |
| NHT/NSU | 828 | 869 | |
| ISOM | 403 | 443 | |
| CCR | 2340 | 2340 | |
| HRU | 500 | 410 | |
| HGU | 723 | 900 | 248 |
| DHDT | 2630 | 3691 | |
| New DHDT | - | - | 1760 |

| | | | |
|---|---|---|---|
| DCU | 4484 | 4935 | |
| VGO HDT | 3105 | 3600 | |
| PP | 5577 | 6280 | |
| BBU | - | 10 | |
| CFBC Boilers | - | 506 | |
| Treating units | 300 | 2039 | |
| S-Block | 3200 | 7100 | |
| SRR & Sub-Stations | 1060 | 1060 | |
| Utilities & Offsites | 3375 | 1375 | |
| BCW | 1000 | 1000 | |
| **Total- Refinery CT** | **35926** | **47728** | **2008** |
| **Total- FCC CT** | **30679** | **31937** | |

### 6.5 Nitrogen System

Nitrogen is primarily required during catalyst regeneration, purging, blanketing etc. Post BS-VI Fuel Quality Project nitrogen consumption will increase by 16.8 Nm3/hr in HGU revamp and 85.5 Nm3/hr in new DHDT.

### 6.6 Compressed Air System

Post BS-VI Fuel Quality Project, the instrument air & plant air requirement is expected to increase marginally by 1455 Nm3/hr & 802 Nm3/hr respectively.

### 6.7 Flare System

The refinery flare system comprises of two flare systems. A hydrocarbon flare and a sour flare system. The design capacity of the flare systems is as under:

- HC Flare Capacity : 1580572.1 kg/hr **(peak load)**
- Sour Flare Capacity : 63020 kg/hr **(peak load)**

Flare load mitigation strategies will be implemented during Basic engineering phase to minimize any hardware modifications in the flare systems.

### 6.8 RO based DM Water System

The RO based DM water system caters to the requirement of process units and CPP DM water demand. The DM water system capacity is 850 m3/hr. Post BS-VI, additional DM water requirement is 62.4 m3/hr in new HGU unit.

### 6.9 Condensate Polishing Unit

Design Capacity: (2+1) X 75 m3/hr **(Two operating + one stand by)**

Condensate polishing unit may require augmentation for BS-VI Fuel Quality Project.

### 6.10 Effluent Treatment Plant (ETP)

The existing ETP design is based on the following:

- Oily effluent flow : 500 m3/hr
- Sanitary flow : 25 m3/hr
- Spent caustic flow : 5 m3/hr
- CRWS : 500 m3/hr

The existing ETP shall be adequate post BS-VI fuel quality project and no capacity augmentation envisaged for existing ETP.

## Chapter 7: Project Management

**7.1 Scope of work of project:** The scope of work of project is summarized below:

1. Addition of new Diesel Hydrotreater Unit.
2. Revamp of Hydrogen Generation Unit
3. Modifications to existing utility & offsite facilities.

**7.2 Project cost:** The capital cost required for executing BS-VI project is estimated as under :

**Table 7.1: Project cost**

| S.No. | Description | Capital cost (Rs in crores) | Remarks |
|---|---|---|---|
| 1 | Land | - | Existing |
| 2 | Site development | - | |
| 3 | Loyalty /know how/ PMC charges | - | |
| 4 | Plant & machinery(including U & O) | - | |
| 5 | New DHDT | 500 | |
| 6 | HGU Revamp | 350 | |
| 7 | Offsite modifications/facilities | 150 | |
| 8 | Roads & buildings | - | |
| 9 | Railways siding | - | |
| 10 | Township | - | |
| 11 | Startup & commissioning | - | |
| 12 | Contingency | 100 | |
| **Total Capital Cost** | | **1100** | |

**7.3 Project implementation plan:**

**The implementation methodology shall include the following:**

A) For the entire job HMEL shall appoint Overall EPCM consultant.

B) New DHDT & HGU revamp shall be executed on EPCM basis.

C) Offsite & utility modifications and other schemes shall be done on EPCM basis

The planned implementation schedule is approximately 36 months.

The zero date for the project shall be the award of job (21-Oct-17) to the EPCM Consultant for the BS-VI Fuel Quality Project.

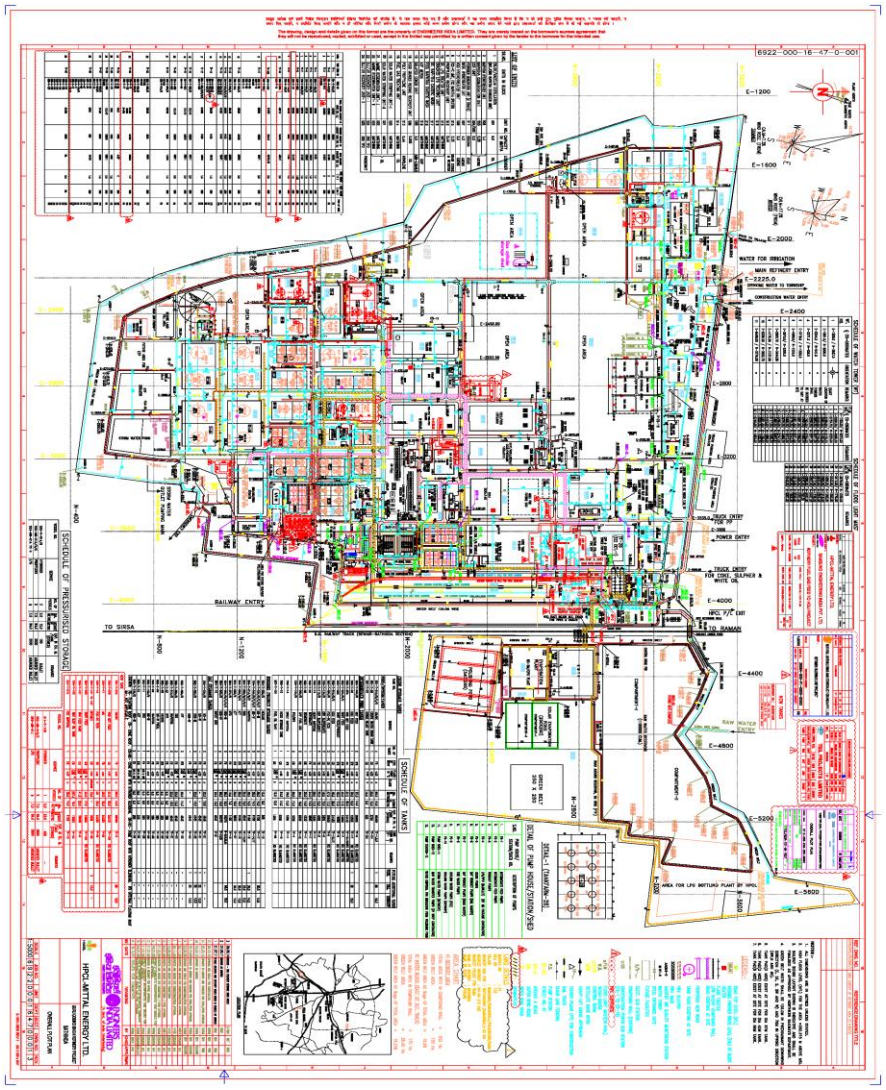
The integration requirements with existing plant and modification which require plant shutdown shall be carried out during the turnaround Mar'17 or opportunities as and when available.

## Chapter 8 : Glossary

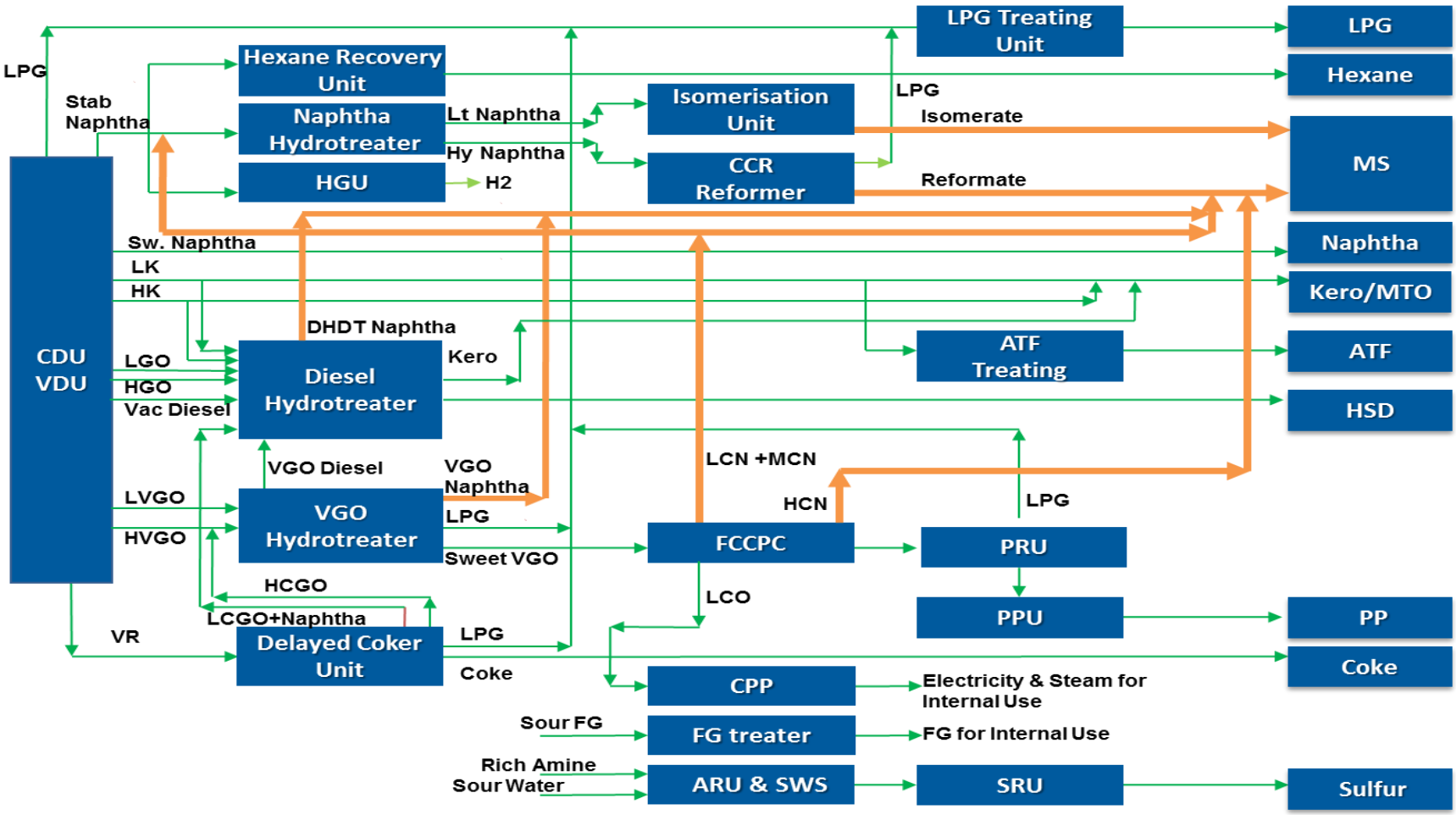
### Table 8.1- Glossary

| | | |
|---|---|---|
| 1 | CDU/VDU | Crude distillation unit/Vacuum distillation unit |
| 2 | NHT/NSU | Naphtha Hydrotreating Unit / Naphtha Splitter Unit |
| 3 | CCR | Continuous Catalytic Regeneration |
| 4 | ISOM | ISOMERIZATION |
| 5 | DHDT | Diesel Hydrotreater |
| 6 | FCC-PC | Fluid Catalytic Cracking- |
| 7 | VGO HDT | Vacuum Gas Oil Hydrotreating Unit |
| 8 | HGU | Hydrogen Generation Unit |
| 9 | SRU | Sulfur Recovery Unit |
| 10 | SWS | Sour Water Stripper |
| 11 | ARU | Amine Recovery Unit |
| 12 | LPG | Liquefied Petroleum Gas |
| 13 | ATF | Aviation Turbine Fuel |
| 14 | PPU | Polypropylene Unit |
| 15 | DCU | Delayed Coker Unit |
| 16 | CPP | Captive Power Plant |
| 17 | MTO | Mineral Turpentine Oil |
| 18 | MS | Motor Spirit |
| 19 | PRU | Propylene Recovery Unit |
| 20 | HSD | High Speed Diesel |

## Annexure 2.1: Existing Plot Plan



## Annexure – 2.2 Block Flow Diagram – Current



**Annexure 2.3 HSEQ Policy**

## HEALTH, SAFETY, ENVIRONMENTAL AND QUALITY (HSEQ) POLICY

HPCL-Mittal Energy Limited and its subsidiaries (HMEL Group) are committed, as part of its core values, to conduct all business activities in a socially responsible manner to protect health, well-being and safety of our employees, the communities around, environment and assets, and exceed stakeholders and customers expectation. HMEL Group requires active commitment to and accountability for HSEQ from all employees, contractors, and business associates. The line management has a leadership role in the communication and implementation of, and ensuring compliance with, HSEQ policies and standards.

**We are committed to**:

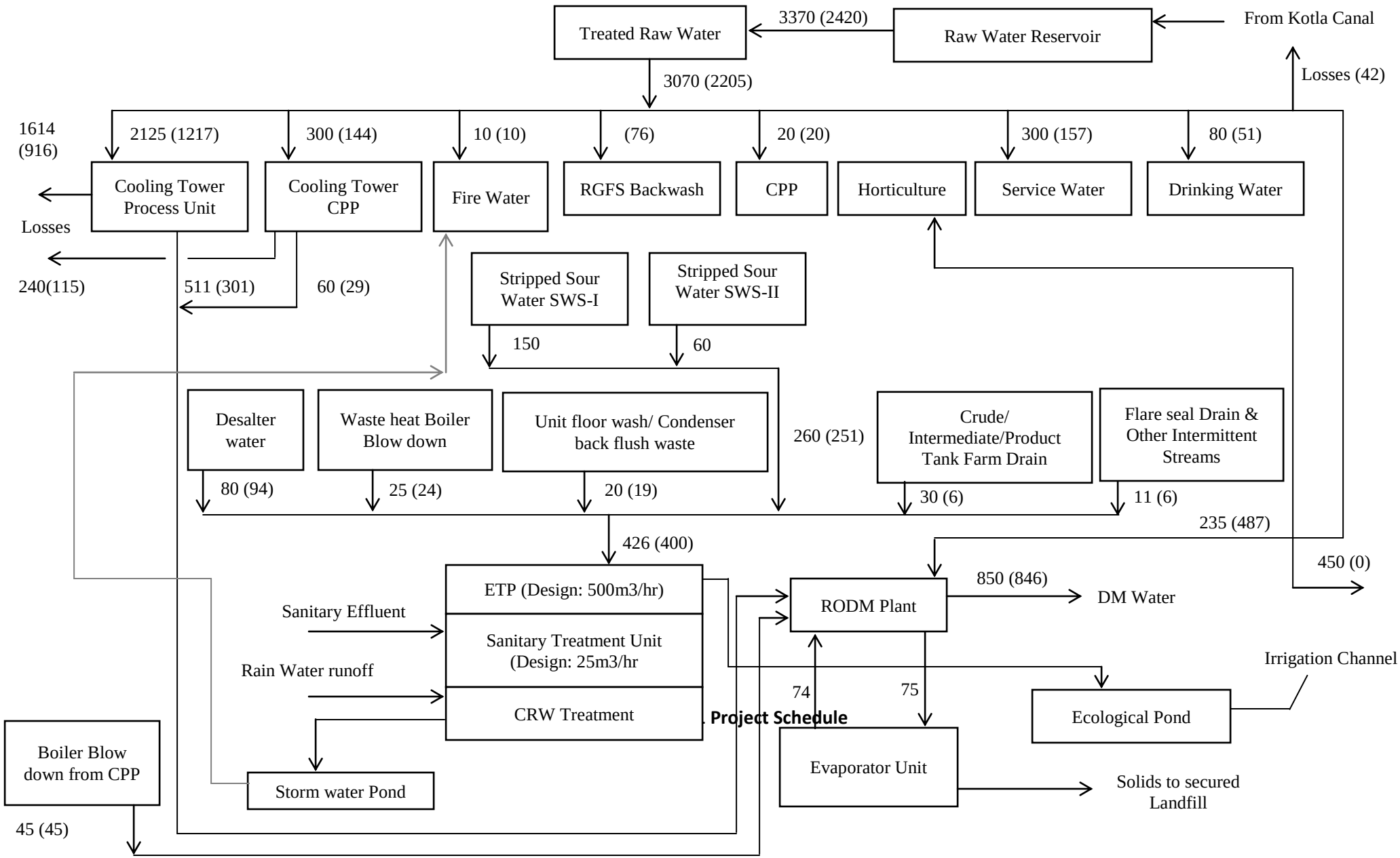
- ✓ Integrate HSEQ aspects and sustainable development principles in our injury, unsafe practices, occupational illness, environmental and quality business plans
- ✓ Assess and minimize risks from our activities with the aim of prevention of injury, ill health and environmental damage
- ✓ Educate, train, motivate and empower employees to conduct their activities in a safe , environmentally responsible and quality oriented manner at all the times during their employment
- ✓ Efficiently use energy and resources, minimize waste, and prevent pollution
- ✓ Work with our suppliers, partners and customers to mutually improve HSEQ performance
- ✓ Foster openness, dialogue and consultation with our employees and stakeholders
- ✓ Strive to continually improve health, safety, environmental and quality management systems and performances to help achieve the company goal of business excellence.
- ✓ Provide quality products that meet or exceed customer requirement
- ✓ Comply with or exceed all applicable legal and other requirements

Martin Hawkins 19/9/15

**Martin Hawkins- COO** **Prabh Das – MD & CEO**

19th September 2015

## Annexure 6.0: Water Balance diagram with capacity 11.25 MMTPA




**Project Schedule**

**Annexure 2.5 Project Schedule**

| S No. | Major Milestones | Completion Date |
|---|---|---|
| 1 | Award of contract - EPCM Consultant | 24-Oct-16 |
| 2 | MTO for procurement of turnaround tie-ins/ turnaround scope of work material | 15-Nov-16 |
| 3 | +/-20% cost estimate for the project | 30-Nov-16 |
| 4 | Engineering work package for turnaround tie-ins/ scope of work | 13-Dec-16 |
| 5 | Licensor Selection for DHDT & HGU | 27-Dec-16 |
| 6 | Process datasheets of long lead items viz. DHDT Reactor, HTER | 7-Mar-17 |
| 7 | Ordering for DHDT Reactor, HTER | 2-Apr-17 |
| 8 | Basic engineering completion for DHDT & HGU | 16-May-17 |
| 9 | +/- 10% Cost estimate for the project | 8-Aug-17 |
| 10 | Start of construction activity at site | 16-Jul-17 |
| 11 | Ordering of long lead items (viz. MUG compressor, RGC) | 26-Dec-17 |
| 12 | 90% completion of detail engineering of DHDT & HGU | 17-Apr-18 |
| 13 | Delivery of DHDT reactor at site | 26-Aug-18 |
| 14 | Delivery of RGC, MUG compressor, DHDT feed pump & HTER at site | 19-Feb-19 |
| 15 | Delivery of all Items at site (Mechanical completion - 3 months) | 21-Apr-19 |
| 16 | Mechanical completion for DHDT &HGU | 21-Jul-19 |
| 17 | BS-VI product out from DHDT ( Commissioning and PGTR completion) | 6-Oct-19 |
| 18 | HGU commissioning & PGTR completion (including PSA) | 6-Oct-19 |