The POWER of ENGINEERING

AscenTrust-Ghana, Ltd.
REFINERY PROJECT SCOPE DOCUMENT
ESTIMATED COST: $5,000,000,000.00
(Five Billion American Dollars)

Prepared for: AscenTrust-Ghana, Ltd.
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Founder and Principal Engineer
AscenTrust, LLC.

SCOPE OF PROJECT

At the request of Dr. Evans Gawu, for our strategic partners in the Sovereign Nation of Ghana, the Principal Engineer of **AscenTrust, LLC.** (The Company) is pleased to present this proposal for the **Engineering, Procurement and Construction**, of a new petroleum refinery to be located in the vicinity of Port of Tema/Takoradi, Ghana. This document includes technical details and some financials for the proposed design, procurement and construction of an approximately 200,000 barrel per day capacity refinery. The study includes a Material Balance Estimate, and related flow diagrams for the required process units, including equipment summaries. It should be noted that all capacities of storage tanks, process units, crude throughput, and cost analyses, are preliminary estimates, and are subject to final determination after the engineering analyses has been completed.

1.0 EXECUTIVE SUMMARY

PART ONE: INTRODUCTION

1. **PROPOSED PROJECT: AscenTrust, LLC.** (The Company)**,** here-in proposes to provide Business Development, Project Financing, Project Design, Project Engineering, Project Management, Procurement and Construction Management to build and operate a 200,000 barrel a day refinery on a suitable piece of property located in the vicinity of the Port of Tema or Takoradi. The project also includes the construction of a port facility on the Atlantic Ocean to offload the crude oil stock from our suppliers.

2. COMPANY DESCRIPTION

A. **AscenTrust, LLC.** (**The Company**) is a Limited Liability Company registered and domiciled in the State of Texas. The Company, through its Founder, Principal Engineer and Scientist, is an Architect-Engineering firm, with extensive background in Business Development, Project Financing, Project Design, Project Engineering, Project Management, Procurement and Construction Management. The Company also provides sophisticated solution to complex commercial and industrial projects.

B. The Company is wholly owned by its Founder and Principal Engineer: Mr. Joseph Fournier, B.Sc.E.E., M.Sc.E.E.

C. The Company has ongoing strategic working relationship with the following Companies:

- **a.** Land and Sea Enterprises, Inc.
- **b.** Three TM Consulting, Inc.
- **c.** Marsalus Shale Water Group
- **d.** International Refinery Consultants, Inc.
- **e.** Refinery Technologies, Inc.
- **f.** LandPlan Engineering, Inc.
- **g.** Basic Engineering, Inc.
- **h.** Bexer Engineering, Inc.

D. AscenTrust, LLC. will provide the following service to **mPower Ghana, Inc.**(The in-country owner of the refinery in Ghana).

- Project Management
- Storage Tank Design and Engineering
- Process Design and Analyses of Piping Systems
- Marine Facilities Design and Engineering
- Fire Protection System Design and Engineering
- Power Generating System Design and Engineering
- Equipment Specification and Selection
- Code Interpretation
- Material Supply, Inspection, and Shipping
- Construction
- Subcontract Management
- Quality Assurance and Control
- Pre-commissioning and Start-up
- Final Documentation and Operating and Maintenance Manuals
- Operator Training

E. AscenTrust Ghana Ltd. And mPower Ghana, Inc. will form the Joint-Ventures and Strategic Partnerships required for the successful financing and licensing of the refinery and other associated facilities.
AscenTrust Ghana Ltd. And mPower Ghana, Inc. will provide the long term operation of the asset for the Joint Venture Partners. The sites for the refinery and the port will be owned directly by this Corporation or one of its subsidiaries.

3. THE TEMA/TAKORADI REFINERY PROJECT: The **Company** and its strategic Partners, International Refinery Consultants (**IRC**) and Refinery Technology, Inc. (**RTI**) of Houston, Texas, will evaluate the proposed sites and verify its suitability for the construction of a 200,000 Barrel per day refinery. The site selection will be influenced by the proximity of the site to the shores of the Atlantic Ocean. Our preliminary discussion with our strategic partners have included sites at Tema and Takoradi.

- **The refinery will initially have a capacity of approximately 200,000 barrels per day.**
- **Acceptable feedstock for the proposed refinery will be between 30 and 40 API Gravity.**
- **Crude supply will be arranged through the Central Government of Ghana.**
- **The local Ghanian demand for finished products, such as gasoline, low sulfur marine and truck diesel, and jet fuel is high and growing so we expect the price level for finished products to be stable and growing.**

This preliminary technical evaluation covers the general aspects of this project.

PART TWO: DESIGN ASSESSMENT

As is well known, crude oil production greatly exceeds refining capacity, worldwide. The major source of crude production comes from the Middle East. The West African Nation of Nigeria has a long history of oil production. Ghana, on the other hand has just recently identified major deposits of oil offshore. Furthermore, the majority of gasoline production is in United States Refineries. Due to increased environmental concerns, the cost of building a new refinery in the United States is not economically feasible. Therefore, it is logical and economically sound, to build a refinery in Ghana to be able to absorb the increased production of offshore crude oil in Ghana, Nigeria and Cameroon. The basis for the design of this refinery is to maximize gasoline production using environmentally sound technologies. The initial design team, namely Refinery Technology (RTI), and other engineering companies, in Houston, Texas have been given the requirement from the Company to produce fifty percent (50%) of the crude feedstock of 200,000 barrels per day, as unleaded gasoline. This means the new refinery will produce over 100,000 barrels of various grades of unleaded gasoline per day. The design criteria is based on the current, most stringent standards of low sulfur content for motor gasoline and diesel fuels. The approximate product yields from a barrel of oil that can be produced from this Refinery are as follows:

Propane /Butane	10%
Gasoline	50%
Jet Fuel	10%
Diesel/Heating Oil	25%
Heavy Fuel Oil	5%

RTI is already working on the design of the proposed facility we are working on a four year time frame for the **Engineering, Procurement and Construction** of the facility. This refinery will be built to integrate the technology to produce the products that its customers require. As the demand for low sulfur fuels increases, both for gasoline and diesel fuels, this refinery will have the capability to meet international limits in the United States, Europe, the Middle East, and the Far East. To as much extent as possible, the plant will focus on modular construction, to enable units, pumps, filters, fluid chemical and catalyst treatment units, to be redundant and easily revamped. The refinery will have a sulfur recovery plant, in conjunction with Merox technologies to reduce mercaptan sulfur, and to treat various petroleum fractions. Also, certain mercaptans will be converted to less-objectionable disulfides. These processes will be used to treat gasolines, diesels, LPG liquids, napthas, kerosines, jet fuels, and heating oils. The process units will include an LPG plant, an ultra advanced Fluid Catalytic Cracking Unit, Hydrocracking Units, Hydrotreating Technology, Isomerization Units, Reformate Units, a water treatment plant with extensive capabilities, and desalination and irrigation quality water are being addressed.

This refinery will have the capability of producing its own electrical energy requirements on site, utilizing RTI's design of an expander off the FCCU, utilizing the flue gas as a source for cogeneration. A Hydrogen Plant (depending on properties of crude oil, and requirements of finished products) is being evaluated. Other potential additions to this facility include a Methyl Tertiary Butyl

Ether (MTBE) Plant, or an Ethanol Plant to be more environmentally green. The Refinery will be digitally controlled in a central control room, with a state of the art computer system that will control every aspect of the various process units in the flow of crude in order to maximize the desired product yields. The plant will have an extensive gasoline blending and delivery system. RTI has just completed an advanced digital control system for an Exxon Refinery in Baton Rouge, Louisiana that is being hailed as an exceptional logistical and efficiency addition. When it is completed, the Refinery will be one of the most advanced refineries in operation. Construction time is estimated to be between 40 and 60 months.

PART THREE: DESIGN ENGINEERING

The primary Engineering and Project Manager team, in the U.S. will be **AscenTrust, LLC.** The design team for the refinery components and the calculation of mass flow rates will be Refinery Technology Inc. (RTI), from Houston Texas. They will allocate certain design parameters to firms such as Fluor, Bechtel, Foster Wheeler, Stone and Webster, and UOP. It is noted that several of the large firms shall be involved in certain technologies and processes for this project. The Company will be involved in all the aspects of design, fabrication, inspection, training and commissioning in order to have all the components of the refinery delivered to Ghana at the appropriate time. The contracting in Ghana will be controlled by **AscenTrust Ghana Ltd.** And will use a minimum of 80% local subcontractors, fabricators and assembly companies.

PART FOUR: LOCATION OF REFINERY

The refinery will be located in, or near the ports of Tema or Takoradi, Ghana on land allocated through our Joint Venture partners. The land required for the refinery totals approximately 800 hectares, and has to have access to the Ocean, the electrical grid and a large natural gas pipelines.

PART FIVE: SOURCE AND ACCESS OF CRUDE FOR FEEDSTOCK

The refinery will receive crude from pre-arranged sources. The oil will be able to be delivered by pipeline or ship to the site selected for the refinery in Ghana. Crude can be accepted from Nigeria, Cameroon and Togo.

PART SIX: PRODUCT YIELD

The Refinery is designed to provide the maximum yield of unleaded gasoline. The yield of this Refinery will be in excess of 50% gasoline. Other important products will be LPG, aviation jet fuel, diesel oil, and fuel oils. All these products are in great demand through the adjoining regions to this Refinery. It is assumed that production from this refinery will be for local consumption. The computer controlled Refinery will be capable of changing final products, depending on market demands.

The Refinery will be monitored by a central computer system coupled with digitally controlled sensors and valves, which will mean the entire refinery can be controlled, monitored, and changes made to guarantee maximum efficiency and minimum downtime.

PART SEVEN: OPERATIONS

- The Refinery will be operated by **AscenTrust Ghana Ltd.** and their technical people. Training of local engineers will begin during construction. After this training, the majority of the operations of the refinery will be handled by local personnel. **AscenTrust Ghana Ltd** will operate the refinery for a minimum period of 15 years. The owners of the refinery will be **mPower Ghana, Inc.**

PART EIGHT: ECONOMICS

Preliminary cost estimates indicate that the Refinery including the unloading and loading terminal will cost approximately $5 Billion USD, including housing for personnel. These preliminary figures take into account all corporate overhead and salaries, all engineering costs, all fabrication costs, all construction costs, all tank batteries, loading and unloading facilities, and all operating and marketing expenses. These costs also include complete living quarters for personnel and their families. The site will also have complete dining, shopping, medical and recreational facilities. Since this Refinery estimates it will produce over 100,000 barrels of gasoline per day, and over 20,000 barrels of jet fuel per day, in addition to 50,000 barrels of diesel per day, the cash flow from this income stream is tremendous. These three products are the most profitable sources of income. The price of crude oil will not have a large impact on this refinery, since finished products will always reflect the current rate of demand, as far as price is concerned. Because this Refinery is driven by customer requirements for finished products and design criteria, profit margins will be high. Local markets have a huge demand for gasoline, diesel fuel, and jet fuel. The price of crude is somewhat insignificant to the refinery profits, since the price of finished products provide a good margin. A Delayed Coking Unit is being evaluated in order to produce more quantities of diesel fuel, and less asphalt.

PART NINE: FUNDING AND OWNERSHIP

The Central Bank of Ghana, in conjunction with HSBC in Accra will provide for a Standby Letter of Credit to be issued to **AscenTrust, LLC.** The face amount of the **SBLC** will be One Billion Euros. The **SBLC** will be held at **HSBC** in London for a period not to exceed 50 weeks and will be returned, unencumbered, to the issuing Bank before the due date of one year. The **SBLC** will be used as collateral for an approved buy-sell program. This program will produce in excess of twelve Billion Euros of project funding for the sovereign Nation of Ghana.

After a period of time, and under certain guidelines, the Company will transfer ownership to the pre-approved strategic partner in the Sovereign Nation of Ghana.

PART TEN: RECOMMENDATION AND SUMMARY

This Refinery project by IRC will be the most advanced Refinery that has been built to date. The technologies that will be an integral part of this plant will maximize products that are in high demand, particularly gasoline, jet fuel, low sulfur diesel, and petrochemical feed stocks.

- This project needs approval of the Ghanian Government.
- The Refinery is strategically located to receive crude by barge or tanker
- The Refinery will process the Feed Stock into some 100,000 barrels of gasoline per day.
- The Refinery will produce some 20,000 barrels of different qualities of Jet Fuel per day.
- **AscenTrust Ghana Ltd** will operate the refinery for a minimum period of 15 years. The owners of the refinery will be **mPower Ghana, Inc.**
- The crude is easily processed into finished projects.
- The markets for the finished products are local and intensive, both for refined products and also potentially for petrochemical feed stocks.
- The economic and cash flow estimates indicate a payout of ten years, after refinery is operational.
- This Refinery will be a major asset for the area, and will be a model of how refineries will be built for the next fifty years. Integrating pollution and environmental controls, reducing sulfur emissions, along with emerging technologies, will produce widespread international support, both politically and economically.
- The refinery will be capable of adjusting finished products, depending on market requirements.

PART ELEVEN: FEASIBILITY STUDY

REFINERY PROCESS FLOW DIAGRAM

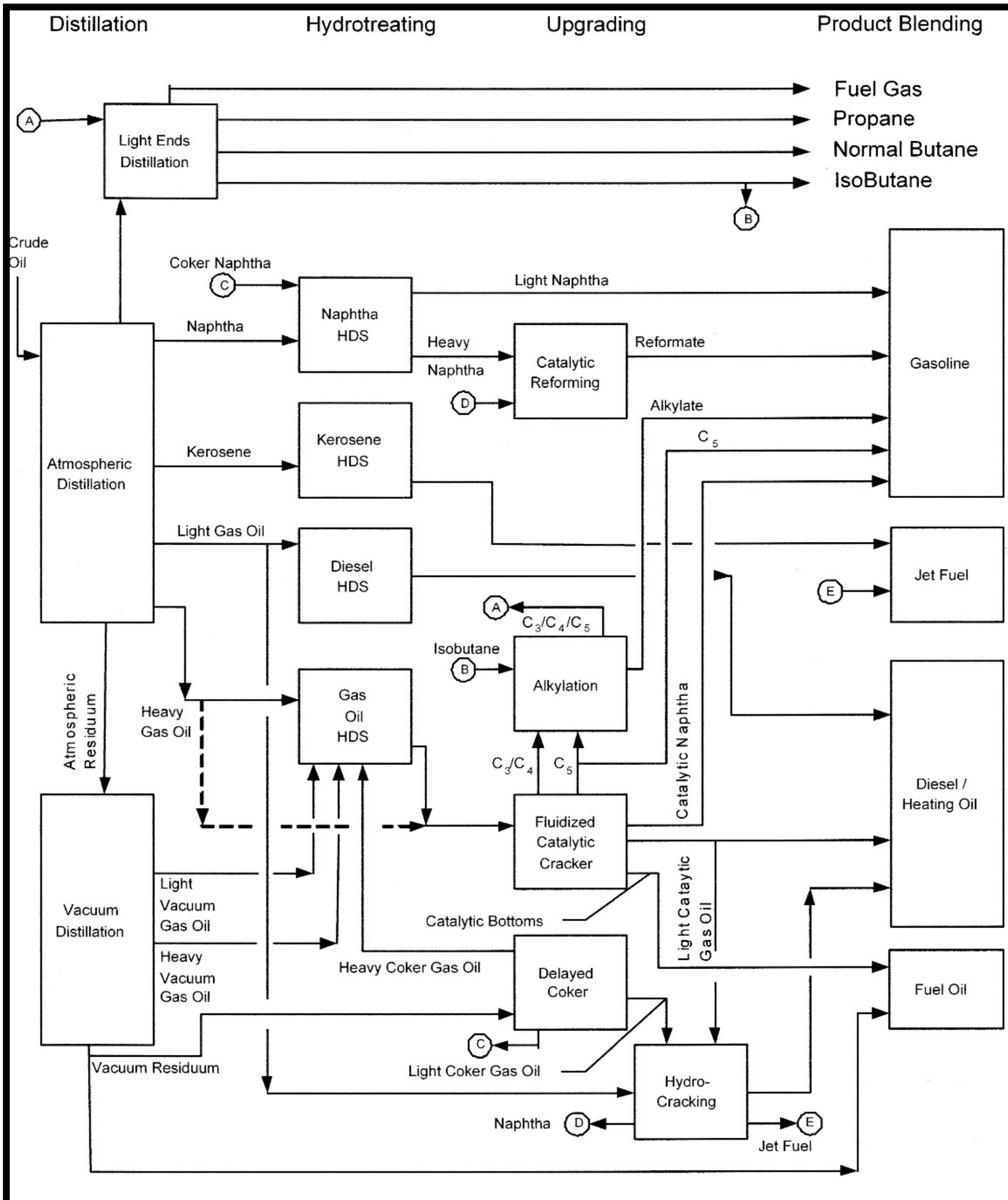

Figure 1 - Simplified Refinery Process Flow Diagram

I. INTRODUCTION

The proposed Class I / Title V application for a Permit to be submitted to the governmental agency, having jurisdiction, of the Sovereign Nation of Ghana under the rules of new construction. This application, submitted by **AscenTrust Ghana, LTD for mPower Ghana, Inc.,** is for the licensing, construction and operations of a petroleum refinery.

The proposed refinery will be located on a site whose location and size are to be determined when the Senior Engineer flies to Ghana for the due-diligence. The proposed refinery will have the capacity to refine approximately 200,000 barrels per day (BPD) of crude oil. The primary products of the refinery would be gasoline, jet fuel, propane, and diesel fuel.

The air quality control region in which the subject facility is located either is unclassified or is classified as being in attainment of the **National Ambient Air Quality Standards (NAAQS**) for all criteria pollutants: particulate matter less than 10 microns (PM10), nitrogen dioxide (**NO_2**), sulfur oxides (**SO_x**), carbon monoxide (**CO**), lead (**Pb**), and ozone (**O_3**).

II. PROCESS DESCRIPTION

The Company is proposing to design, permit, construct and operate a petroleum refinery that will operate under **Standard Industrial Code (SIC) 2911.** The facility will operate 24 hours a day and 365 days a year. The proposed refinery will have the capacity to refine approximately 200,000 **Barrels per Day** (BPD) of crude oil and natural gasoline. Additional raw materials for the refining process may include natural gas, propane, and butane. Other inputs include natural gas, for use as supplemental fuel within the refinery, and products such as alkylate and oxygenates, for blending into the gasoline produced at the refinery. This proposed refinery will supply cleaner-burning gasolines and other fuels to the local markets. The product slate of the proposed refinery consists of:

- Regular and premium reformulated gasoline,
- Liquified petroleum gas (**LPG**),
- Aviation jet fuel,
- Diesel fuel.

A sulfur recovery plant (**SRP**) will capture sulfur contained in the crude oil feedstock and produce liquid sulfur product. In addition, the proposed refinery configuration includes a **Delayed Coker Unit** for the production of petroleum coke, a solid by-product that can be sold as a fuel.

The design of the proposed refinery will utilize current technologies that incorporate means to reduce air emissions. Throughout the design process, air emission reduction measures shall be included to meet or exceed stringent American federal standards that apply only to new refineries. Per unit of product, the planned refinery will have lower emissions of criteria pollutants than comparable older, existing refineries.

This project represents the first facility in West Africa to be built specifically for the production of newer clean fuels. Several specialized commercial technologies are to be incorporated in the refinery process units to reduce fuel aromatics and sulfur, which in turn reduces emissions from vehicles. The proposed refinery will include numerous process units. The major process units which we propose to include in the refinery are:

1. A Crude Distillation Unit,
    - Atmospheric Distillation Unit
    - Vacuum Distillation Unit
2. Delayed Coking Unit,
3. Hydrocracker Unit,
4. Naphtha Hydrotreater Unit,
5. Distillate Hydrotreater Unit,
6. Catalytic Reforming Unit,
7. Butane Conversion Unit,
8. Benzene Reduction Unit,
9. An Isomerization Unit.

Proposed supporting process units may include:

1. Gas Concentration Plant,
2. Hydrogen Plant,
3. Sulfur Recovery Plant,
4. Amine Regeneration Unit
5. Sour Water Stripper.

Each of these process units comprises several distinct components such as distillation columns, reactors, fired heaters, heat exchangers, pumps, and compressors to achieve specific refining objectives. Following is a partial breakdown of the proposed components of our new refinery. Of course the composition and placement of these components are liable to change as the design process proceeds.

Proposed Components:

1. Crude Distillation Unit

 

The function of the Crude Distillation Unit is to provide primary separation of the crude oil and natural gasoline feed-stocks for subsequent processing by downstream units. The charge capacity of this unit is 142,000 **Barrels per day (BPD)** of crude oil and 10,000 **BPD** of natural gasoline.

Crude oil and natural gasoline are preheated by exchange with hot products, passed through an **Electrostatic Desalter** to remove entrained brine, and are heated further in the **Atmospheric Crude Charge Heater.** The heated feed is then routed to the **Atmospheric Crude Distillation Column**, where it is separated into five liquid products at approximately atmospheric pressure.

The lightest (i.e., lowest boiling point) product is naphtha, which is processed in a **Naphtha Stabilizer** to remove light hydrocarbons. This yields a stabilized naphtha with a vapor pressure low enough for safe storage. The light hydrocarbons in the overhead streams from the **Naphtha Stabilizer** and the **Atmospheric Crude Distillation Column** are sent to the Gas Concentration Plant for recovery.

Kerosene, diesel, and atmospheric gas oil (**AGO**) liquid products from the **Atmospheric Crude Distillation Column** are steam stripped to control flash point. Condensed stripping steam (including a small quantity of hydrogen sulfide) is recovered in the column overhead system and is sent to the sour water collection system. Atmospheric residuum is the remaining liquid fraction and is composed of predominantly high boiling point components. This material is withdrawn from the bottom of the **Atmospheric Crude Distillation Column.**

The atmospheric residuum from the **Atmospheric Crude Distillation Column** is heated in the **Vacuum Crude Charge Heater**, where it is partially vaporized. The two-phase feed then enters the flash zone of the **Vacuum Crude Distillation Column** where it is distilled under vacuum conditions to prevent thermal decomposition. Light and heavy vacuum gas oil (**LVGO** and **HVGO**) are produced as liquid products.

Vacuum residuum is the remaining liquid fraction and is withdrawn from the bottom of the column. This vacuum residuum material can be used as feed material in the **Delayed Coking Unit** or can be sold as asphalt. Condensed stripping steam (including a small quantity of hydrogen sulfide) is recovered in the column overhead system and is sent to the sour water collection system. Products of the Crude Distillation Unit and the Vacuum Unit are referred to as "straight-run" products because they have not yet been subjected to either thermal or catalytic conversion processes.

2. **Gas Concentration Plant**

Light ends (i.e., gaseous, low boiling-point hydrocarbon streams) are produced as by-products from several process units at the proposed refinery. These light ends are routed to the **Gas Concentration Plant**, where propane and butane are recovered as finished products. Ethane and lighter hydrocarbons are treated to produce a gas stream suitable for use as refinery fuel. Pentane and heavier components are recycled to the **Crude Distillation Unit** for recovery as naphtha. The nominal design capacity of the Gas Concentration Plant is 13,000 **Barrels Per Day (BPD)** of propane and butane products.

The primary sources of light ends fed to the Gas Concentration Plant include:

- Overhead vapor from the **Crude Distillation Unit** and its Naphtha Stabilizer;
- Offgas or purge streams from the Naphtha Hydrotreater Unit, Distillate Hydrotreater Unit, and Hydrocracker Unit;
- Hydrocarbon gas produced as the result of thermal cracking at the **Crude Distillation Unit** and **Delayed Coking Unit**;
- Debutanizer overhead products from the **Catalytic Reforming Unit** and **Hydrocracker Unit**.

Sulfur in the form of hydrogen sulfide (**H_2S**) is removed from the feed streams by counter-current absorption with an aqueous amine solution in three contactor columns. The **H_2S**-rich amine is sent to the **Amine Regeneration Unit** for regeneration and returned to the gas plant as lean amine. Sulfur in the form of mercaptans is removed from the propane and butane products by reaction with caustic soda in the Caustic Treater Unit. The mercaptan sulfur leaves the refinery as a solute in the spent caustic.

The fractionation objectives are achieved in three steam-reboiled columns operating in series: the De-ethanizer, Depropanizer, and Debutanizer. There are no fired heaters in the **Gas Concentration Plant.**

3. Hydrocracker Unit

The Hydrocracker Unit processes gas oil, primarily from the **Crude Distillation Unit** and the **Delayed Coking Unit**, to convert it into gasoline, jet, and diesel blendstocks. The nominal design charge capacity of this unit is 40,000 **BPD** of gas oil.

The gas oil feed streams are mixed with recycle and make-up hydrogen and are then heated in a gas-fired charge heater. The heated feed enters a series of two fixed-bed reactors where the hydrocracking reactions occur under conditions of high pressure and high temperature. The reactors contain fixed beds of aluminum catalyst impregnated with noble metals.

The catalyst must be regenerated approximately every 18 to 24 months to remove carbon deposits and other catalyst deactivators. For the regeneration, the unit is shut down and the catalyst is removed from the unit and regenerated off-site.

In the hydrocracking reactions, the cracked, unsaturated hydrocarbons (e.g., olefins) are converted to completely saturated species (e.g. paraffins). The hydrogen also combines with sulfur and nitrogen to produce hydrogen sulfide and ammonia, which can then be removed. Hot reactor effluent gas is washed with water, and is then scrubbed in an amine contactor to remove hydrogen sulfide and ammonia. The scrubbed gas is compressed and returned to the reactor section for additional conversion. Condensed stripping steam and wash water are sent to the sour water collection system. Amine, rich with hydrogen sulfide, is sent to the **Amine Regeneration Unit.**

The hydrocarbon liquid effluent from the hydrocracking reactors is sent to a group of fractionators where the various product streams are separated. The first fractionator in this chain has a gas-fired feed heater. Subsequent fractionators operate at successively lower temperature ranges, and have steam-heated re-boilers. Products from the fractionators include off-gases which contribute to the refinery fuel gas supply, gaseous light-ends that are routed to the **Gas Concentration Plant**, light and heavy naphtha supplied to the gasoline blending operation, kerosene, diesel, and an internal recycle stream (fractionator bottoms).

4. Naphtha Hydrotreater Unit




The **Naphtha Hydrotreater Unit** pre-treats naphtha streams prior to the streams being processed in the **Catalytic Reforming Unit** and the **Isomerization Unit.** The **Naphtha Hydrotreater Unit** removes contaminants such as sulfur, nitrogen, and oxygen by promoting hydrogenation reactions (i.e. addition of hydrogen to the hydrocarbon chain) in a fixed bed reactor containing nickel/molybdenum-promoted aluminum catalyst.

The nominal design charge capacity of the **Naphtha Hydrotreater Unit** is 32,000 **BPD** of naphtha. Naphtha streams are fed to the **Naphtha Hydrotreater Unit** from the **Crude Distillation Unit**, the **Gas Concentration Plant**, the **Distillate Hydrotreater Unit**, and the **Delayed Coking Unit**. The mixed liquid naphtha streams are mixed with recycle and make-up hydrogen, heated in the **Naphtha Hydrotreater Charge Heater**, and passed over the catalyst bed.

The hydrogen reacts with the sulfur and nitrogen contaminants to produce hydrogen sulfide and ammonia. Some of this hydrogen sulfide and ammonia is absorbed in a water wash section just downstream of the reactor. The resulting sour water product is collected in a separator and sent to the sour water collection system. The reactor effluent is separated into fuel gas and light and heavy naphtha in the **Stripper and Naphtha Splitter** fractionation columns. The fuel gas is routed to the **Gas Concentration Plant** for further processing. Light naphtha and heavy naphtha are sent to the **Isomerization Unit** and **Catalytic Reforming Unit**, respectively, for further treatment.

5. Catalytic Reforming Unit

The **Catalytic Reforming Unit** processes the heavy naphtha stream to make it more suitable for the production of motor gasoline. The nominal design charge capacity of this unit is 30,000 **BPD** of heavy naphtha.

The reforming process involves chemically rearranging the hydrocarbon molecules to produce higher-octane materials. [The octane number is a key measure of motor gasoline performance. The **Catalytic Reforming Unit** can produce reformate of up to 102 research octane number

(**RON-Clear**).] Hydrogen gas is produced as a byproduct of reforming, and is used as feed to the **Naphtha Hydrotreater Unit**, **Distillate Hydrotreater Unit**, **Hydrocracker Unit**, and **Isomerization Unit.**

The heavy naphtha feed streams, primarily from the **Naphtha Hydrotreater Unit** and **Hydrocracker Unit**, are mixed with recycle hydrogen and are passed through three reactors in series. Each reactor is preceded by a gas-fired feed heater. The reformed naphtha product (reformate) is separated from the by-product hydrogen. A portion of the hydrogen is compressed and recycled to be mixed with heavy naphtha feed material. The remaining hydrogen is compressed for use in other refinery processing units.

The reformate product is fractionated in the debutanizer for separation of light ends, which are sent to the **Gas Concentration Plant** for recovery. The reformate liquid product is sent to storage, for use in motor gasoline blending.

Heat is provided to the debutanizer through the gas-fired **Debutanizer Reboiler.** The **Catalytic Reforming Unit** reactor catalyst is continuously regenerated in the **Catalytic Reforming Unit Catalyst Regenerator**. Catalyst regeneration takes place in dedicated equipment and uses nitrogen, air, and perchloroethylene as regenerating agents.

The **Catalyst Regenerator** performs two principal functions – solid catalyst regeneration and circulation. Spent catalyst from the final **Catalytic Reforming Unit** reactor vessel is conveyed to the **Catalyst Regenerator,** where it is regenerated in four steps:

- **A.** Coke burning with oxygen,
- **B.** Oxychlorination with oxygen and chloride,
- **C.** Catalyst drying with air/nitrogen,
- **D.** Reduction of catalyst metals to “reduced” oxidation states.

Exiting the Catalyst Regenerator, the regenerated catalyst is conveyed back into the first Catalytic Reforming Unit reactor. Small quantities of hydrochloric acid and chlorine are generated in the Catalyst Regenerator. The vent gas from the Catalyst Regenerator is scrubbed in two stages with caustic solution and water in the Vent Gas Wash Tower for removal of acid gases, in particular hydrochloric acid. From the Wash Tower, the cleaned vent gas is discharged to the atmosphere.

6. Isomerization Unit

The **Isomerization Unit** processes the light naphtha stream to produce a liquid product, called “isomerate,” which is more suitable for the production of motor gasoline. The nominal design charge capacity of this unit is 18,000 **BPD** of light naphtha.

The **Isomerization Unit** increases the octane number of the light naphtha stream. [The octane number is a key measure of motor gasoline performance. The **Isomerization Unit** typically produces isomerate with a **research octane number** (**RON**-clear) of 83 to 85.]

Hydrogen gas is produced as a by-product of reforming, and is used as feed to the Naphtha Hydrotreater Unit, Distillate Hydrotreater Unit, Hydrocracker Unit, and Isomerization Unit.

Heated light naphtha is mixed with hydrogen gas and a small amount of chloride reagent, and is then passed through two fixed bed catalytic reactors in series. The reactor effluent is separated in the Stabilizer fractionation column into fuel gas and isomerate. The fuel gas stream is scrubbed with caustic solution and water to remove acid gases, and is then routed to the **Gas Concentration Plant** for processing. The isomerate is sent to storage for use in motor gasoline blending.

7. Distillate Hydrotreater Unit

The **Distillate Hydrotreater Unit** reduces the levels of sulfur and other contaminants in kerosene and diesel fuel products to meet regulatory specifications. The nominal design charge capacity of this unit is 34,000 **BPD** of distillate feedstock. The unit will be capable of reducing the sulfur content in the liquid fuel products to less than 0.05 percent by weight.

The distillate feedstocks, including straight-run kerosene and diesel liquid streams from the **Crude Distillation Unit** and distillate from the **Delayed Coking Unit**, are mixed with recycle hydrogen and heated to the reaction temperature in a gas-fired heater.

The feed mixture is passed over two reactor beds with inter-bed quench. To promote different reactions, one bed contains a cobalt-molybdenum catalyst and the other contains a nickel-molybdenum catalyst.

Hydrogen sulfide and ammonia by-products are removed in a water wash section and an amine contactor downstream of the reactor. The aqueous wash fraction containing some hydrogen sulfide and ammonia is removed in a Separator, and routed to the sour water collection system. The **H_2S**-rich amine from the contactor is sent to the **Amine Regeneration Unit** for regeneration before being returned to the recycle gas scrubber as lean amine.

Liquid organic effluent from the reactor is steam stripped to remove light end hydrocarbons, which are routed to the **Gas Concentration Plant** for processing.

The Hydrocarbon materials in the petroleum refining industry are frequently classified and described based on the number of carbon atoms per molecule. For example, "**C_3**" refers to materials with three carbon atoms per molecule, such as propane (**C_3H_8**) and propylene (**C_3H_8**); "**C_4**" refers to materials with four carbon atoms per molecule, such as butane (**C_4H_{10}**) and butylene (**C_3H_8**).

The remaining hydrocarbon stream is separated into naphtha, kerosene, and diesel fractions in a fractionator column with a gas-fired reboiler. Naphtha-cut boiling point material is removed as the overhead stream and is sent to the **Naphtha Hydrotreater Unit**. The hydrotreated kerosene and diesel streams are sent to storage for use in jet fuel and diesel fuel blending.

8. Butane Conversion Unit

The proposed refinery will include a **Butane Conversion Unit** utilizing a new proprietary technology. This process uses a mixed **C_3/C_4** feedstock material:

A. It produces both a low vapor pressure alkylate stream and a high-octane "poly-gasoline" stream for fuel blending. The nominal design charge capacity of this unit is 28,000 **BPD** of mixed **C_3/C_4** feedstock. Mixed **C_3/C_4** feed, primarily from the **Gas Concentration Plant**, enters the process at the Iso-stripper, which has a gas-fired re-boiler.

B. Polymerization of **C_4** materials is enhanced by treatment of a side stream from the Isostripper in the Butamer reactor. This catalytic reactor uses a platinum-containing catalyst to produce an increased quantity of isobutane, which is returned to the Iso-stripper. Off-gas from the Butamer reactor, which contains light ends, can be recycled to the **Gas Concentration Plant** or can be used as refinery fuel gas (**RFG**). The overhead stream from the Iso-stripper, which is enriched in isobutane, is processed in the **Dehydrogenation Reactor**. The isobutane stream is mixed with recycle hydrogen and heated in a gas-fired charge heater.

C. Dehydrogenation takes place in a multi-stage, catalytic reactor having a gas-fired interheater. In the reactor effluent stream, the **C_3/C_4** components are separated from residual hydrogen, a portion of which forms the recycle stream.

D. After preheating, the reactor effluent is compressed and passed through a Separator to remove excess hydrogen before being fed to a catalytic condensation reactor that polymerizes these molecules to form a **C_8** to **C_{12}** product blend.

E. Under proper conditions, normal butane and isobutane can be selectively polymerized to form an iso-octane product with a high octane number for gasoline blending. The Stabilizer column separates this octane product from unreacted **C_3/C_4** material. Catalyst used in the dehydrogenation reactor is continuously regenerated by the **Butane Conversion Unit Catalyst Regenerator.**

F. Catalyst regeneration takes place in dedicated equipment and uses nitrogen, air, and perchloroethylene as regenerating agents. The **Catalyst Regenerator** performs two principal functions – solid catalyst regeneration and circulation. Spent catalyst from the final dehydrogenation reactor bed is conveyed to the Catalyst Regenerator.

In this unit, spent catalyst is regenerated in four steps:

1. Coke burning with oxygen,
2. Oxychlorination with oxygen and chloride,
3. Catalyst drying with air/nitrogen,
4. Reduction of catalyst metal to “reduced” oxidation states.

Exiting the regeneration vessel, the regenerated catalyst is conveyed back into the first dehydrogenation bed. In this manner, freshly regenerated catalyst is continuously circulated through the dehydrogenation reactors. Small quantities of hydrochloric acid and chlorine are generated in the regeneration processes. The vent gas from the Catalyst Regenerator is scrubbed with caustic solution and water in a Vent Gas Wash Tower for removal of acid gases, in particular hydrochloric acid. From the Wash Tower, the cleaned vent gas is discharged to the atmosphere.

9. Benzene Reduction Unit

The proposed refinery will include a **Benzene Reduction Unit** using proprietary technology to reduce the content of aromatics, such as benzene, in materials used as gasoline blending components. The nominal design charge capacity of this unit is 14,000 **BPD** of naphtha or reformate. Depending upon product requirements, the **Benzene Reduction Unit** can process light naphtha from the **Naphtha Hydrotreater Unit**, straight run naphtha from the **Crude Distillation Unit**, or light reformate streams. The initial step in the **Benzene Reduction Unit** is selective reaction of benzene (**C_6C_6**) in a Saturation Reactor.

Hydrogen is fed with the hydrocarbon stream in slightly above stoichiometric amounts to promote benzene saturation. A **Sulfur Guard Bed** is provided to adsorb sulfur compounds from the feed and avoid sulfur poisoning of the reactor catalyst.

Downstream of the Saturation Reactor is a Stabilizer column that separates the liquid hydrocarbon stream, now enriched in saturated **C_6** compounds, from light ends and residual hydrogen. Both the Reactor Preheater and Stabilizer Reboiler are steam heated. There are no fired heaters within the **Benzene Reduction Unit**.

10. Delayed Coking Unit

The Delayed Coking Unit processes vacuum residuum oil and other heavy crude oil components using a thermal cracking process to produce lighter liquid products and solid coke. The nominal design charge capacity of this unit is 32,000 **BPD** of vacuum residuum feed.

The **Delayed Coking Unit** uses a semi-continuous process and employs two parallel coke drums. These coke drums are alternately switched on-line and off-line after filling with coke.

The primary feed material for the **Delayed Coking Unit** is vacuum residuum, which is the **Vacuum Crude Distillation Column** bottoms product from the **Crude Distillation Unit**. The feed material enters the bottom of the coker main fractionator where it mixes with condensed recycle material in the column. The combined stream is heated in one of the gas-fired coker charge heaters to initiate coke formation in the corresponding coke drum. Coke drum overhead vapor, the product of the thermal cracking reactions during coking, flows back to the coker main fractionator.

This column separates the coke drum overhead vapor into various light hydrocarbon constituents to be returned to other refinery process units. These include:

A. Coker naphtha which is sent to the **Naphtha Hydrotreater Unit** for further processing into gasoline blendstocks;

B. Light coker gas oil, which is sent to the **Distillate Hydrotreater Unit** for further processing into jet and diesel blendstocks

C. Heavy coker gas oil, which is sent to the **Hydrocracker Unit** for conversion and upgrade to additional gasoline and distillate fuel products.

D. Sour water is sent to the sour water collection system.

After coking reactions are complete, the full coke drum is switched off-line and is steamed out and cooled. (The other coke drum is brought on-line and the coking process continues in that reactor train.) Vapors emitted from the opened coke drum are captured by the enclosed blowdown system and are recovered in the main fractionator. When cool, the coke drum bottom and top heads are removed. The coke is cut from the drum with a water jet and dropped into the Coke Pit.

11. Petroleum Coke Storage, Handling, and Loading

Petroleum coke from the **Delayed Coking Unit** is dropped into the Coke Pit. In the Coke Pit, free water is separated from the coke and recycled. A bridge crane is used to transfer the moist coke from the Coke Pit to the Coke Pad, where it is stored in piles. A bridge crane is also used to transfer coke from the Coke Pad to the Coke Crusher.

The crushed, moist coke is then transferred via an enclosed belt conveyor to the Coke Silo. Coke from the **Delayed Coking Unit** is transferred via an enclosed belt conveyor to the Coke Loading Facility. This facility includes a coke storage silo and a coke railcar loading operation.

12. Amine Regeneration Unit

Rich amine solution from the **Gas Concentration Plant**, **Distillate Hydrotreater Unit**, and **Hydrocracker Unit** is circulated to the **Amine Regeneration Unit** for regeneration. The **Amine Regenerator** is a liquid stripper column with a steam-heated re-boiler. Mixed rich amine solutions are fed to the column yielding an overhead product rich in H_2S (i.e., "acid gas") that is routed to the **Sulfur Recovery Plant** as feed.

The stripped amine bottoms liquid is cooled and filtered and then recycled back to a storage tank as lean amine. This nitrogen-blanketed storage tank supplies make-up solution to the various amine contactors in the **Gas Concentration Plant**, **Distillate Hydrotreater Unit**, and **Hydrocracker Unit,** and contains the amine solution inventory during a shutdown. There are no fired heaters in the **Amine Regeneration Unit.**

13. Sour Water Stripper

Sour water streams containing H_2S, other organic sulfur compounds, ammonia **(NH_3)**, and oil, are collected from various refinery process units and combined in a feed surge tank.

Liquid hydrocarbons are decanted from the water and returned to the recovered oil tank. The **Sour Water Stripper** (**SWS**) removes H_2S/NH_3 from the sour water using a stripper tower having a steam-heated re-boiler.

Feed sour water is preheated by exchange with the stripper bottoms stream. The re-boiler is heated with low-pressure steam to generate vapor traffic up the stripper column. Vaporization of water strips H_2S, and NH_3 from the down-coming sour water.

Overhead vapors are cooled by an overhead condenser. Condensed water reflux is returned to the top tray in the stripper tower. The overhead, non-condensible materials, primarily H_2S, and NH_3, are routed to the **Sulfur Recovery Unit** as feed. The stripped water is reused at the crude desalters and at process units requiring wash water (e.g., for ammonia removal). Any remaining stripped water is routed to the **Wastewater Treatment Plant.** There are no fired heaters associated with the **Sour Water Stripper.**

14. Sulfur Recovery Plant

The **Sulfur Recovery Plant** provides for safe disposal of the acid gas product streams from **the Sour Water Stripper** and the **Amine Regeneration Unit**. The plant comprises three processing steps:

A. Two parallel Claus sulfur recovery units,

B. a tail gas treatment unit (TGTU),

C. A tail gas thermal oxidizer.

The capacity of the **Sulfur Recovery Plant** is 608 long tons per day of liquid elemental sulfur product. Each Claus sulfur recovery unit (SRU) uses a three-stage reactor train to convert approximately 94 to 97 percent of the feed sulfur into elemental sulfur.

The TGTU uses catalytic reduction and amine absorption technology to recover additional sulfur compounds from the Claus SRU tail gas and recycles them back to the SRU. The unrecovered sulfur compounds are oxidized to sulfur dioxide (**SO_2**) in the tail gas thermal oxidizer. For reliability, two complete 3-stage Claus trains are employed in the proposed refinery design; each normally operated at 67 percent of maximum acid gas throughput capacity.

In the first (non-catalytic) reaction furnace section, ammonia is converted to nitrogen and water, and a portion of the **H_2S** is converted to **SO_2** and water. The acid gas then flows through two catalyst beds in series where the Claus reaction occurs (**H_2S** and **SO_2** partially react to form sulfur).

The sulfur in the vapors from the thermal section and each of the three catalyst beds are condensed and flow through seal legs to a covered tank termed the “Sulfur Pit.” The vapor from the last sulfur condenser then flows to the **TGTU.** Liquid sulfur in the Sulfur Pit is loaded into tank trucks or tank cars for sale. A steam-powered ejector draws sweep-air through the headspace of the Sulfur Pit tank to capture vapors containing reduced sulfur compounds. This sweep-air stream is routed to the inlet of the Claus SRU trains for recovery of the sulfur. There is no point in the SRU process when solid sulfur is produced or handled.

Tail gas exiting the last stage of Claus SRU is combined with hydrogen or methane (natural gas) and passed through the **TGTU Reducing Reactor** and a catalytic **Hydrogenation Reactor** to convert the residual sulfur dioxide back to **H_2S**.

Downstream of these reactors, additional recovery of reduced sulfur is accomplished in an amine absorber column that uses an aqueous methyl diethanolamine (MDEA) solvent to scrub **H_2S** from the TGTU tail gas.

The overhead stream from this contactor, containing very low sulfur levels, is sent to the tail gas thermal oxidizer for disposal. The rich MDEA solvent is regenerated in the TGTU amine stripper and **H_2S** is returned to the inlet of the Claus SRU trains to be recovered. Regenerated MDEA solvent is recirculated back to the TGTU amine absorber column.

There will be instances when upset conditions or maintenance events at the **Sulfur Recovery Plant** are such that compliance with the **SO_2** emission limitations cannot be maintained indefinitely. The proposed refinery design includes several measures intended to avoid excess emissions during these periods:

A. The Claus SRU trains are designed with excess capacity. In the event of an upset condition or maintenance event on one of the Claus SRU trains, the other train will be operated at full capacity.

B. The Sour Water Tank will be sized to provide continuously available sour water storage capacity of at least 3.78 million gallons. This will allow the feed to the **Sour Water Stripper**

to cease for at least 24 hours, while the refinery process units continue operating and generating sour water streams. The cessation of Sour Water Stripper operations can be implemented within minutes, so that excess emissions are minimized even during unplanned outages of a Claus SRU train or the TGTU.

C. The Rich Amine Tank will be sized to provide continuously available rich amine storage capacity of at least 210,000 gallons, and the Lean Amine Tank will be sized and the lean amine solution will be managed to provide a continuously available supply of at least 210,000 gallons.

These measures will allow the feed to the **Amine Regeneration Unit** to cease for a minimum of 24 hours, while the refinery process units continue operating and generating rich amine solution. The cessation of **Amine Regeneration Unit** operations also can be implemented within minutes, so that excess emissions are minimized even during unplanned outages of a Claus SRU train or the TGTU.

When implemented simultaneously, these measures can reduce or stop the processing of acid gas in the Claus SRU trains during outages of the TGTU or both Claus SRU trains.

For longer-term outages of a single Claus SRU train, to avoid exceeding the acid gas processing capability of a single train, reduced sulfur crude oil would be inventoried at the plant and could be used to substitute some or all of the normal feed to the refinery process units.

15. Hydrogen Plant

The Hydrogen Plant will manufacture hydrogen by converting light hydrocarbons into hydrogen using a steam reforming process. The plant can use as feedstock either natural gas, a mixture of RFG and natural gas, a mixture of RFG and propane, or a mixture of RFG and butane. The nominal design capacity of this plant is 120 million standard cubic feet per day of hydrogen with purity in excess of 99.9 percent. The Hydrogen Plant conversion process consists of four steps:

- **A.** Feed pretreatment,
- **B.** Steam reforming,
- **C.** Shift-reaction conversion,
- **D.** Purification.

A. Feed Pretreatment

The feed pretreatment step removes or converts contaminants in the feedstock that would otherwise poison or damage downstream catalysts.

B. Steam Reforming

Next, the feed is combined with steam and is fed to the Hydrogen Reformer (also called the **Steam-Methane Reformer**). This process unit consists of a group of catalyst-packed tubular reactors within a gas-fired furnace that is maintained at the proper reaction temperature. Within the catalyst tubes, steam and hydrocarbons react to form hydrogen and carbon dioxide. The reactor effluent is cooled in a steam boiler and heat exchanger before being fed to a fixedbed Shift Reactor, which drives the reaction to a greater extent of completion. High purity hydrogen is separated from the reactor effluent in a Pressure Swing Adsorption (PSA) unit. The PSA purge is routed to the Hydrogen Reformer Heater as fuel. The PSA purge gas, supplemented by RFG, is combusted in the reformer furnace containing the catalyst-filled reactor tubes.

16. Group “A” Storage Tanks

The Tank Farm includes eight dome-roof storage tanks that are equipped with nitrogen blanket systems and closed-vent systems vented to a compression system.

The compressed vapors from the Group “A” Storage Tanks are routed to the RFG system. These storage tanks are designed to store raw materials and intermediates such as natural gasoline, isomerate, light naphtha, vacuum residuum, and slop oil.

17. Group “B” Storage Tanks

The Tank Farm includes twenty-seven fixed-roof storage tanks that are equipped with internal floating roofs and closed-vent systems vented to a thermal oxidizer. These storage tanks are designed to store volatile organic liquids such as light and heavy naphtha, alkylate, reformate, gasoline, jet fuel, diesel fuel, and ethanol.

18. Group “C” Storage Tanks

The Tank Farm includes twenty petroleum liquid storage tanks that are equipped with external floating roofs. These storage tanks are designed to store petroleum liquids such as crude oil, light and heavy naphtha, distillate oil, gas oil, and flushing oil

19. Group “D” Storage Tanks

The Tank Farm includes six pressurized, spherical storage tanks that are designed to operate with no emissions. These storage tanks are designed to store volatile organic liquids such as butane, butylene, and liquefied petroleum gas.

20. Group “E” Storage Tank

The Tank Farm includes one asphalt storage tank. This tank will be used to store asphalt that is produced at the proposed refinery.

21. Truck and Rail Car Loading Racks

The liquid products produced at the proposed refinery will be transported by rail cars and tank trucks. The proposed refinery will have two terminals for liquid transfer; one for railcar loading and unloading, and one for tank truck loading. Facilities for the loading and unloading of petroleum liquids have been designed to maximize the recovery of evaporative VOC emissions. Residual VOC emissions from loading of liquid products will be controlled using two thermal oxidizers, one serving the rail car loading racks and one serving the tank truck loading racks.

Each loading rack will have a maximum delivery rate of 600 gallons per minute (GPM) per loading arm. All gasoline product and distillate product loading racks are designed for bottom loading. LPG loading racks are designed for top loading. Displaced vapors from the LPG loading operations are routed back to storage.

22. Benzene Waste Operation

The **Benzene Waste Operation** comprises the refinery equipment used to manage aqueous and non-aqueous waste streams that contain benzene. This will include the equipment in the Wastewater Treatment Plant, and may include other equipment. For the purposes of the proposed Class I permit, equipment used for Benzene Waste Operations is grouped for administrative convenience, due to the unique regulatory requirements applicable to this equipment under subpart FF of 40 CFR part 61.

23. Wastewater Treatment Plant

The wastewater treatment plant (WWTP) is designed to maximize water recycle and reuse. Treatment facilities include wastewater collection, primary treatment, secondary treatment, brine concentration, sludge treatment and sludge dewatering.

The treatment vessels and sumps comprising the WWTP will be enclosed tanks or similarly covered vessels. Open impoundments or uncovered tanks will Air drawn from the headspace of several WWTP vessels will be treated in a dedicated WWTP Thermal Oxidizer.

The wastewater collection system comprises a system of covered sewers for collection of oily wastewater. Oily water streams include de-salter water, crude and product tank water draws, and neutralized spent caustic. Other potentially oilcontaminated wastewater streams such as storm water from process units and tank farm dikes are collected on a “first flush basis” (i.e., the water that initially runs off an area).

The remainder of the storm water runoff after the first flush and all other clean runoffs from other non-process surface drainage will be collected in the storm water pond for reuse as makeup water to the cooling tower. The oily water sumps, which normally receive contaminated oily wastewater, will have double containment for spill prevention and leak detection. These sumps will be vented to the atmosphere either via a dedicated carbon adsorption system (i.e., “local carbon canister”) or via the WWTP Thermal Oxidizer.

The primary treatment system comprises an API separator (i.e., an oil-water separator designed in conformance with the specifications of the American Petroleum Institute), a dissolved air flotation (DAF) unit, and an equalization basin. Exhaust streams from these three vessels are routed to the WWTP Thermal Oxidizer. The primary treatment system is designed to remove free oil and suspended solids from the refinery wastewater. The API separator will be an above-ground enclosed rectangular vessel in which the wastewater flows horizontally while the free oil particles rise due to buoyancy forces. The free oil floats to the surface of the tank and is skimmed into a slop oil compartment for recovery in the refinery. Solids settle in the bottom of the tank, where they are scraped into sludge hoppers by a flight scraper.

The settled solids are removed from the sludge hopper by a sludge pump to an oily sludge tank for possible recycle to the **Delayed Coking Unit**. Effluent from the API separator containing residual emulsified oil is further treated by the DAF unit.

Wastewater is fed continuously at a controlled rate to the DAF system via the flocculation chamber. Polymer is added in the flocculation chamber to facilitate flocculation of the colloidal suspended solids and oil.

A portion of the DAF clarified effluent is pressurized with air in the DAF saturation tank. The dissolved air flotation system blends recycled effluent saturated with air, at elevated pressure, with the incoming coagulated wastewater to release microscopic air bubbles that cling to the oil and solids particles forcing them to float to the top of the flotation cell where they are skimmed off as “float.”

Heavier solids settle in the bottom of the DAF and will be treated and dewatered prior to disposal. The DAF treated effluent flows by gravity through the DAF effluent chamber into the equalization basin, from which it is pumped to the secondary treatment system.

The secondary treatment system comprises an activated sludge biological treatment system (i.e., “biotreater”), a clarifier, a warm lime softener, and a reverse osmosis system.

The activated sludge process in the biotreater is an aerobic biological treatment that involves the stabilization of organic matter by microorganisms, which oxidize organic compounds present in wastewater to carbon dioxide. Phosphoric acid is added to the wastewater stream to provide the nutrient phosphorus as required by the microorganisms in the biological aeration treatment system.

Powdered activated carbon treatment provides added treatment by the addition of powder activated carbon to remove refractory and non-biodegradable organics in the wastewater. Exhaust from the biotreater is routed to the WWTP Thermal Oxidizer.

Mixed liquor (sludge and water) from the biotreater flows by gravity to the clarifier, where biosolids and powdered activated carbon settle to the bottom of the clarifier. Treated wastewater flows by gravity to the warm lime softener, where it is treated to remove silica and hardness by adding magnesium chloride, soda ash, and caustic.

Effluent water from the warm lime softener is polished through multi-media filters and routed to the reverse osmosis system. Clean water from the reverse osmosis system is recycled for further use in the refinery.

A portion of the recovered mixture of biosolids and powdered activated carbon from the clarifier is recycled to the biotreater, while the remainder is sent to a wet air oxidation unit for the regeneration of powdered activated carbon. Regeneration of the powdered activated carbon is achieved by oxidizing the biosolids, in liquid phase, under high temperature and high pressure, using high-pressure steam as the heat source. (There is no fuel input to the wet air oxidation unit.) Regenerated powdered activated carbon is recycled to the biotreater. Ash from the wet air oxidization unit and sludge from the warm lime softener are routed to a belt press for dewatering prior to landfill disposal.

“Reject” water from the reverse osmosis system has elevated levels of dissolved solids and is known as brine solution. This brine solution is heated and routed to an induced-draft cooling tower for further concentration. The brine slurry from the concentration cooling tower is pumped to a spray dryer, which uses an integral natural gas-fired air heater. In the spray dryer, dissolved solids are recovered as a powdered salt material. Dry powder salt collected at the bottom of the spray dryer is conveyed pneumatically to a collection system and is placed in containers for offsite disposal. The pneumatic conveying system exhausts through a fabric filter baghouse.

24. Equipment Leaks

The proposed refinery includes piping and a large number of screwed and flanged connectors, valves, pumps, compressors, and similar components for movement of gas and liquid raw materials, intermediates, and feedstocks. These components are potential sources of volatile organic compounds (VOC), hazardous air pollutants (HAPs), and **H_2S** emissions due to leakage.

25. Emergency Flares

The proposed refinery will include a pressure relief system designed to contain non-routine hydrocarbon releases and route these releases to two elevated flares. One flare (Refinery Flare 1) will be centrally located near most of the refinery process units, and the second (Refinery Flare 2) will be located near the Delayed Coking Unit. In the event of a process upset or a sudden shutdown that causes hydrocarbon material to be released from any of the pressure relief devices and emergency depressurizing equipment throughout the refinery, the emergency flares will safely combust the released material and discharge the combustion products to the atmosphere.

Each of the two elevated flares is nominally designed to combust 2.0 million pounds per hour of gases (based on gases having a design average molecular weight of 28 pounds per pound@mole and released at a design temperature of 236 degrees Fahrenheit (°F)). This reflects the estimated maximum process vessel venting case and corresponds to the emergency scenario of a total refinery power failure. Steam is supplied to the flare tip to allow smokeless operation up to a release rate of 300,000 pounds per hour, with a VOC destruction efficiency of approximately 98 percent, under design conditions. The features of the flare design include a continuous natural gas pilot flame and stack purge, and steam assist to improve VOC control and prevent soot formation. Pipeline natural gas is constantly purged up the flare stack column and is ignited at the top by the continuous pilot flame. This operation keeps the flare ready to immediately receive and safely combust released gases, without relying on pilot ignition. The pilot is continually monitored by remote camera or other means to confirm pilot operation, and to effect a restart of the pilot if necessary.

26. Steam Boilers

Steam is distributed throughout the plant at three nominal pressure levels of 600 lbs of pressure per square inch gauge (psig), 150 psig, and 50 psig. Two boilers are to be constructed that will generate steam at 600 psig and 700°F. Each boiler has a rated heat input of 419 million British Thermal Units (MMBTU) per hour and will be fired exclusively with pipeline-quality natural gas. Each boiler is sized to provide approximately 50 percent of the maximum projected steam demand. It is planned that both boilers will be operated continuously, but generally at 40 to 50 percent of capacity, to provide hot standby capacity for emergencies. When required, one boiler can be shutdown for maintenance and inspection, and the other can operate at full capacity to meet the plant needs.

27. Cooling Tower

Water will be used in several areas of the proposed refinery to remove process heat, condense vapor streams, and cool products before storage. Warm cooling water from the process areas is circulated through a direct-contact cooling tower. A fraction of the water evaporates and the circulating cooling water temperature is reduced. The cooled water is then pumped back to the process areas for re-use. Water lost to evaporation is replaced with make-up water. Cooling water use has been minimized in the proposed refinery design to minimize evaporative losses and thereby conserve water. The system is sized for a cooling water circulation rate of 80,000 GPM. Emissions from the cooling tower include VOC, due to leaks in indirect contact heat exchangers in refinery process units, and particulate matter, due to residual solids in aerosol drift particles released from the tower that subsequently evaporated.

28. Internal Combustion Engines

The proposed refinery will include an on-site emergency electrical generator and two on-site fire water pumps. Each will be driven by a compression-ignition, diesel fired, internal combustion engine. The emergency electrical generator will allow for a safe and orderly shutdown of the refinery, or individual refinery process units, in case of an emergency. The fire water pumps will be used to pump water as needed for extinguishing fires. The emergency electrical generator and the fire water pumps will also be operated for a few hours per month for routine testing and maintenance.

29. Mobile Sources and Fugitive Dust Sources

The construction and operation of the proposed refinery will involve mobile sources and dust-generating operations such as land clearing, earthmoving, excavating, construction, demolition, material handling, storage or transporting operations, and vehicle use.