REFINERY PROJECT 2021

30,000 BPD full conversion refinery

UOP TECHNOLOGY FULL CONVERSION REFINERY

The purpose of a full conversion refinery is to utilize as much of the crude oil in to make as much clear product as possible. Clear product is gasoline and diesel.

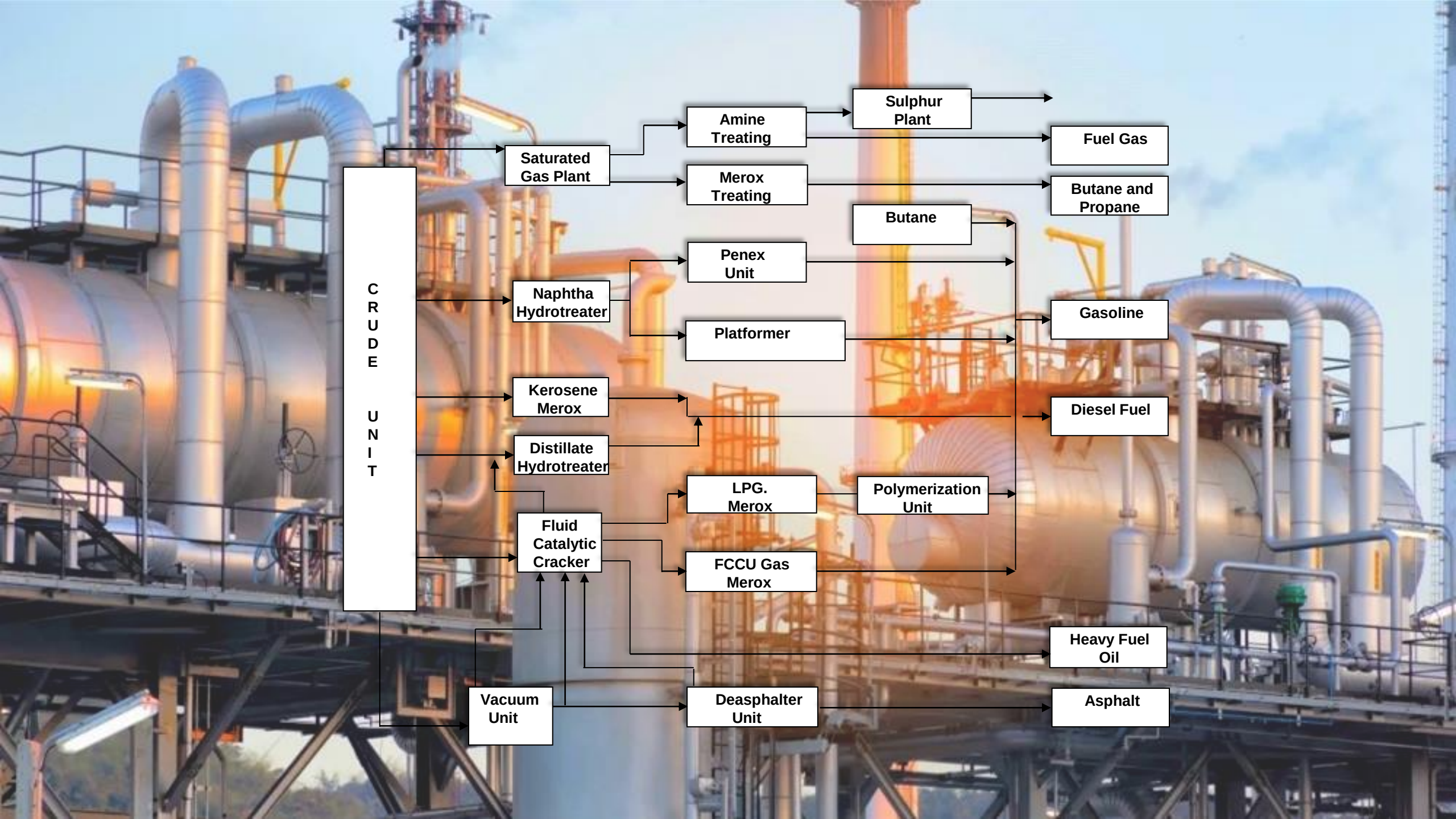
These units are also designed to treat each individual product to that it meets or exceeds the required specification.

A full conversion plant will make the products:

Gas- used to fire the heater furnaces

Propane and Butane. Butane can be added to gasoline for specifications and propane is sold.

- LSR – Light Strait Run Gasoline that is hydrotreated and then octane is improved through the Penex unit and then goes to the gasoline pool.
- HSR – Heavy Straight Run Gasoline is hydrotreated and then sent to the Reformer for Octane specification.
- Light Diesel-Kerosene-Jet Fuel goes into the diesel pool or is sold as individual products.
- Regular Diesel is hydrotreated and sent to storage for distribution.
- Atmospheric Gas Oil- AGO is sent to the FCCU again to split the bottom product into LPG'S, two different cuts of gasoline and a diesel product. All of these products are put into the gasoline and diesel pools.
- The bottom of the crude tower will then go to the vacuum tower where Light vacuum gasoil, heavy vacuum oil along with the bottom of this tower will go to the FCCU unit.
- All these different products will have specification and limitation as per the actual design of the refinery.
- This is just a very brief summary of the operation and capabilities of the refinery package.
- The following sheet is a simplified process flow sheet showing the product flows.


CRUDE UNIT
Saturated Gas Plant
Amine Treating
Sulphur Plant
Fuel Gas
Merox Treating
Butane and Propane
Butane
Penex Unit
Naphtha Hydrotreater
Platformer
Gasoline
Kerosene Merox
Diesel Fuel
Distillate Hydrotreater
LPG. Merox
Polymerization Unit
Fluid Catalytic Cracker
FCCU Gas Merox
Heavy Fuel Oil
Vacuum Unit
Deasphalter Unit
Asphalt

Refinery Product

- The refinery is designed to make on specification product using the individual process equipment to utilize design specifications.
- The refinery is very flexible for distillations, octanes and cut points.
- The main products, Regular and Premium gasoline, Diesel and Kerosene (Light Diesel), Propane, Butane and a small % of clarified oil.
- With crude that we ran, we did not produce any vacuum bottoms as it was directed straight to the FCCU unit along with the vacuum products and gas oil cut from the crude unit.
- The Sarir-Messla blend is an excellent fit for the refinery design.
- Gasoline and diesel product can vary about 20% depending on product demand and cut point selection.
- From engineering documentation clean yield runs about 94% and then propane, butane and clarified oil makes total yield to about + 98% total.

UNITS	DESIGN
	MAX
	m3/D
CRUDE	4,700
NHT	1,800
PLATFORMER - UOP	1,307
PENEX - UOP	500
DHT	1,275
FCCU - UOP	2,000
POLY -UOP	402
FCC MEROX - UOP	868
LDL MEROX - UOP	846
SAT LPG MEROX - UOP	138
UNSAT LPG MEROX -UOP	509

Equipment

Saturated Gas Plant - 2,100 B.P.D.

- This unit splits the light hydrocarbon stream from the crude unit, as well as from the FCCU and Platformer units, into propane and butane products. Ethane and methane are removed and eventually used as fuel gas, with the balance of propane and butane sent to storage.

Fuel Gas Treating Unit - 4.5 MMSCFD 96,000 #/hr DEA Circ.

- To reduce Sulphur dioxide emissions, hydrogen sulfide is removed from the fuel gas before it is burned in any refinery process furnace. Amine is used to absorb the hydrogen sulfide from the gas. The hydrogen sulfide is boiled off the amine and sent to the adjacent Petrogas Processing plant to make Sulphur.

Merox Unit - 4 Units Unsat LPG (2,600 B.P.D.)

- Sat LPG (900 B.P.D.)
- Kerosene (6,000 B.P.D.)
- FCCU Gas (6,000 B.P.D.)
- These units produce products which are non-corrosive, with a sweet or low-odor level and free from dirt and moisture. Various treatment processes involving washing, filtering and chemical reactions are used.

Equipment

- **Naphtha Hydrotreater** - 11,300 B.P.D. (700 psi)
- In this unit sour naphtha containing Sulphur and nitrogen is treated for the removal of these two components.

- **Platformer** - 8,200 B.P.D. (180 psi)
- This unit increases the octane of the naphtha received from the naphtha hydrotreater. The product from the Platformer, called Platformate, provides the bulk of the high-octane components for Turbo's gasoline sales.

- **Diesel Hydrotreater** - 8,000 B.P.D. (1,000 psi)
- This unit removes Sulphur and nitrogen contained in diesel produced by the Crude Processing Unit. These compounds, if not removed, would cause plugging, fouling and noxious fumes when diesel is combusted in a diesel engine.

Equipment

Fluid Catalytic Cracking Unit (FCCU) - 11,500 B.P.D.

- Gas oils and heavy fuel components are upgraded with the aid of this unit into gasoline and other light products. Residual processing capability with catalyst cooling and lift gas technologies is installed on the unit.

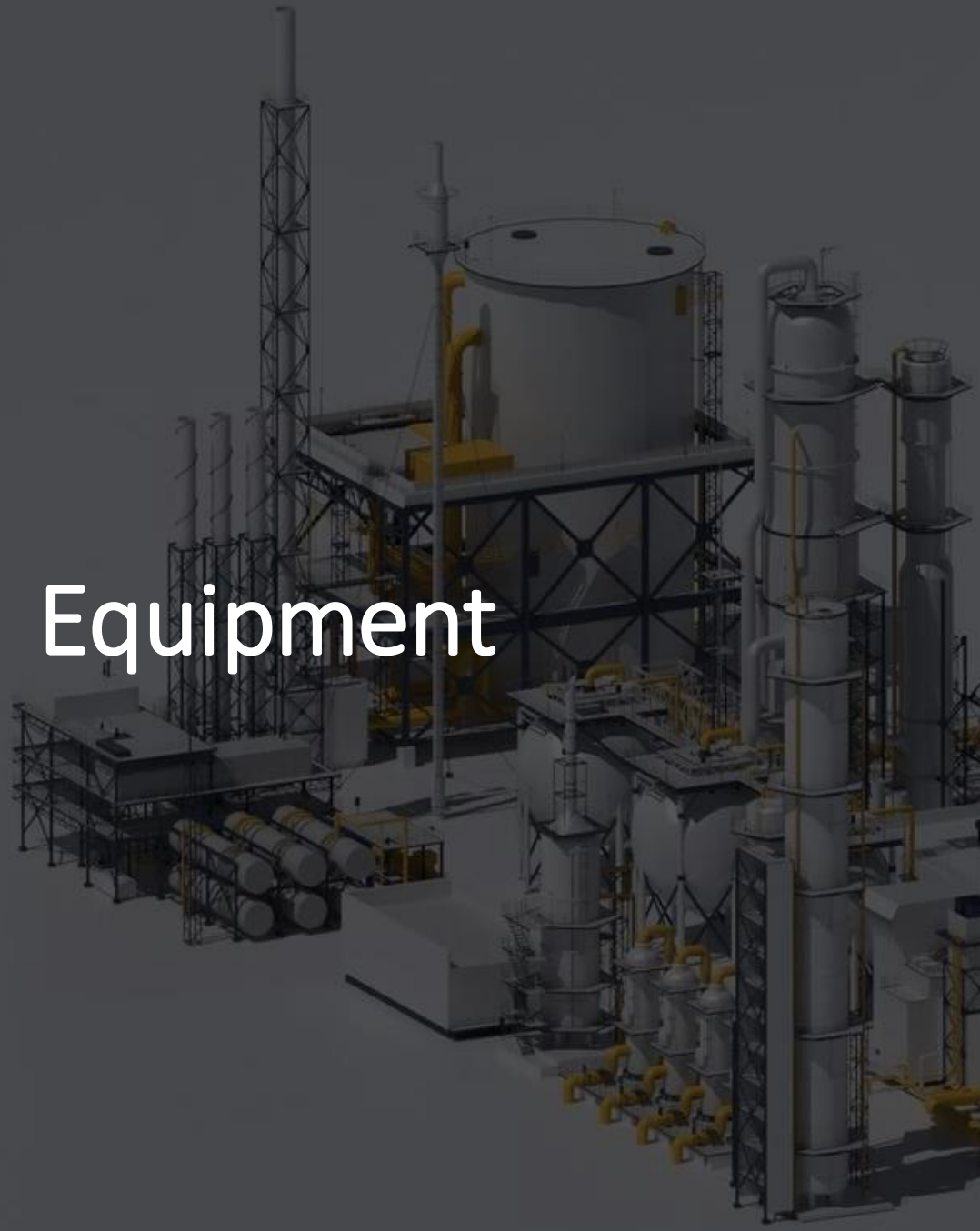
Polymerization Unit - 2,530 B.P.D. (Chamber Unit)

- This unit produces a gasoline blending product with a high octane rating which is necessary in producing various blends of gasoline.

Penex - 3,000 B.P.D. UOP

- This unit reformulates pentanes and hexanes to increase octane for unleaded gasoline.

Equipment



Sour Water Stripping Unit

- Water which is used in the various process units becomes saturated with hydrogen sulfide and ammonia. This unit is designed to eliminate such gases picked up in the water wash streams.

Feedstocks

- The feedstocks for the Turbo plant include light to medium gravity southern Alberta crude oils and pentanes plus streams from local gas plants.

Steam

- Three gas fired boilers, capable of producing 45,000 pounds of steam per hour each, provide the main steam supply. Steam is used for refining processes, for heating and to drive turbines. Steam is also produced by three waste heat converters in the process area, minimizing energy waste.

Air

- Air compressors are used to supply dry air to run instruments and to supply power to air driven tools and equipment.

Site

SITE ACREAGE	ACRES	HECTARES
TERMINAL	6.52	2.63
TANK FARM	169.21	68.48
PROCESS AREA	46.24	18.72
ADMINISTRATION	6.26	2.54
PONDS	21.00	8.49
TOTALS	249.20	100.86

CRUDE FEED

DESCRIPTION		METHOD
Density@ 15 °C, g/ml	0.8360	ASTM D-4052
Specific gravity@60/60 0 F	0.8368	Calculation
API gravity	37.6	Calculation
Flash point (PMCC), o C	<-35	ASTM D-93
Reid vapour pressure, psi	11140	ASTM D-323
Hydrogen sulphide, ppm	44354	IP 103
Water and sediment content, vol.%	0.050	ASTM D-4007
Sulphur content, wt.%	0.128	ASTM D-4294
Pour point, oC	+15	ASTM D-97
Kinematic viscosity @ 70 o F, cSt	-	ASTM D-445
@ 100 o F, cSt	763905	ASTM D-445
Asphaltenes content, wt.%	0.16	IP 143
Conradson carbon residue, wt. %	3.192	ASTM D-189
Ash content, wt.%	0.011	ASTM D-482
Characterisation factor	12.2	UOP 375
Salt content (as Nacl) mg/l	4.0	IP 77
Vanadium, ppm	0.157	ASTM D 5708
Nickel, ppm	2.781	ASTM D 5708
Sodium, ppm	1.561	Dry ashing
Potassium, ppm	<0.030	Dry ashing

We have a simple refinery simulation program for optimization purposes
The initial crude feed is critical to determine optimization of the plant.
The following is an example of a full distillation of a crude.

Simulation Model

THE FOLLOWING IS A TYPICAL MODEL LOOKING AT THE PRODUCTION, COSTS AND PRODUCT AMOUNTS FOR OPTIMIZATION OF THE PROCESS EQUIPMENT.

THIS IS AN EXAMPLE OF ONE CRUDE, BUT THE MODEL MUST BE SIMULATED TO REFLECT THE CRUDE THAT IS GOING TO BE USED.

REFINERY ECONOMICS REVIEW

REFERENCE PRICE

Bonney Light	0
	0

PLATFORMING OPERATION

Enter the desired factor

POF (2)	0.83

BUY	Volume m3/d	Tons/d	COST US/m3	TOTAL US
Bonney Light	4770.0	3776.9	0.0	0.00
	0.0	0.0	0.0	0.00
Others				
TOTAL	4770	3776.9		0.00

	Capacity Utilization	
CRUDE FEED	100.0	OK
VACUUM	98.3	OK
FCC FEED	79.5	OK
CC in FCC feed	0.66	OK
NHT	80	
Diesel HTU	97	
Platforming	68.1	
Penex	111	
Poly	72	
Overall Yield %	98.8	

SELL	Volume m3/d	Tons/d	PRICE US/m3	TOTAL US
Propane	125.3	63.6	0.0	0.00
Butane	162.1	94.7	0.0	0.00
Premium Gasoline	212.1	168.3	0.0	0.00
Regular Gasoline	1918.7	1523.1	0.0	0.00
Low Oct. Gasoline	0.0	0.0	0.0	0.00
Jet	751.5	607.3	0.0	0.00
Diesel	1253.3	1056.8	0.0	0.00
Mazut (1)	157.3	166.7	0.0	0.00
Asphaltenes	130.8	137.4	0.0	0.00
TOTAL	4711.0	3817.9		0.00

PRODUCT MARGIN	0.00
MARGIN/m3 CRUDE	0.00

NOTES:

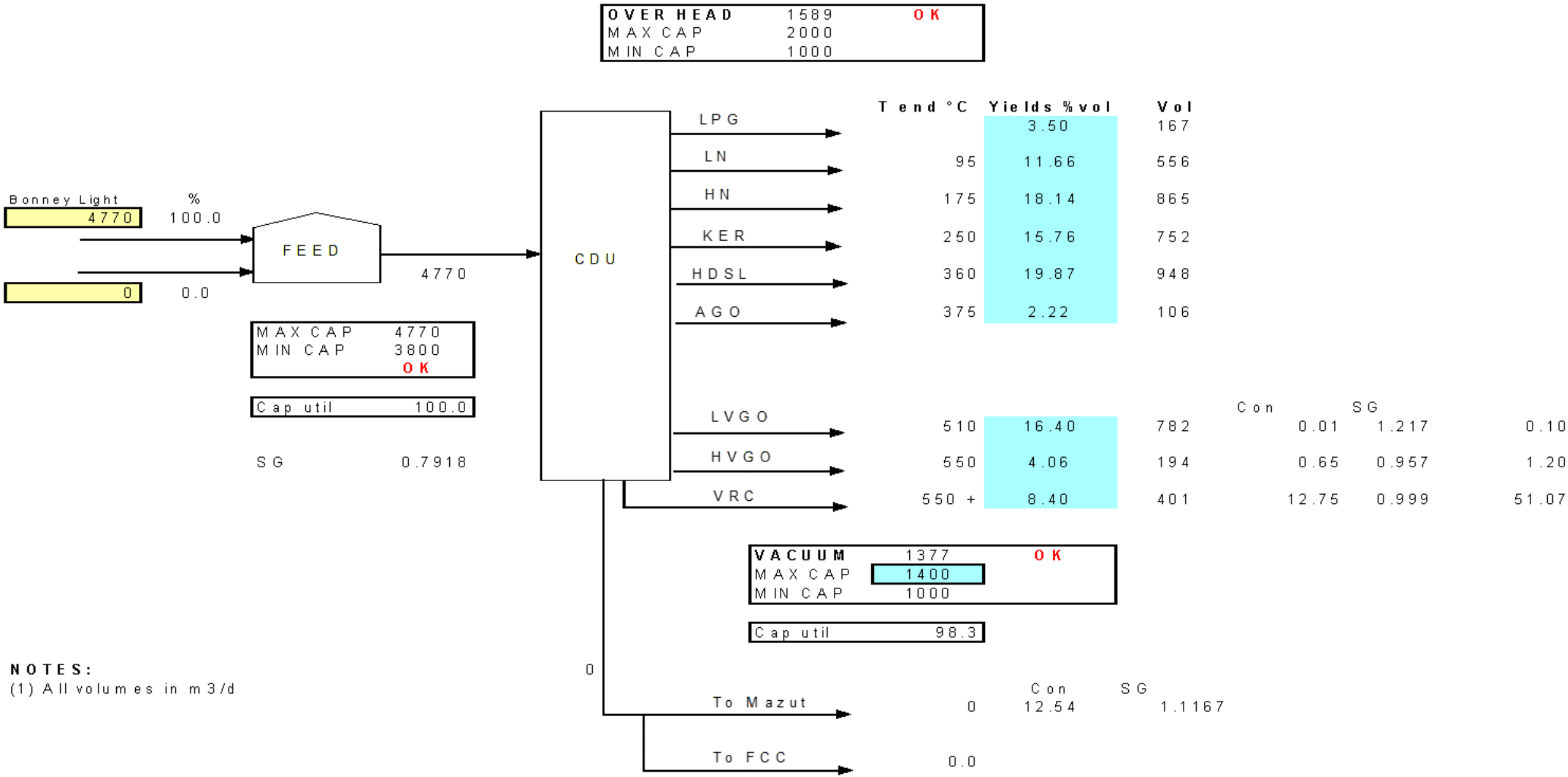
(1) Mazut: Cat slurry oil + Vacuum Bottoms. Does not meet Mazut specifications.

(2) Platforming Operation Factor = RON 97 Platf operation / Platf operation

(3) Assumed price for Asphaltenes is 105 US/M3

REMARKS: No Extra Vacuum Capacity

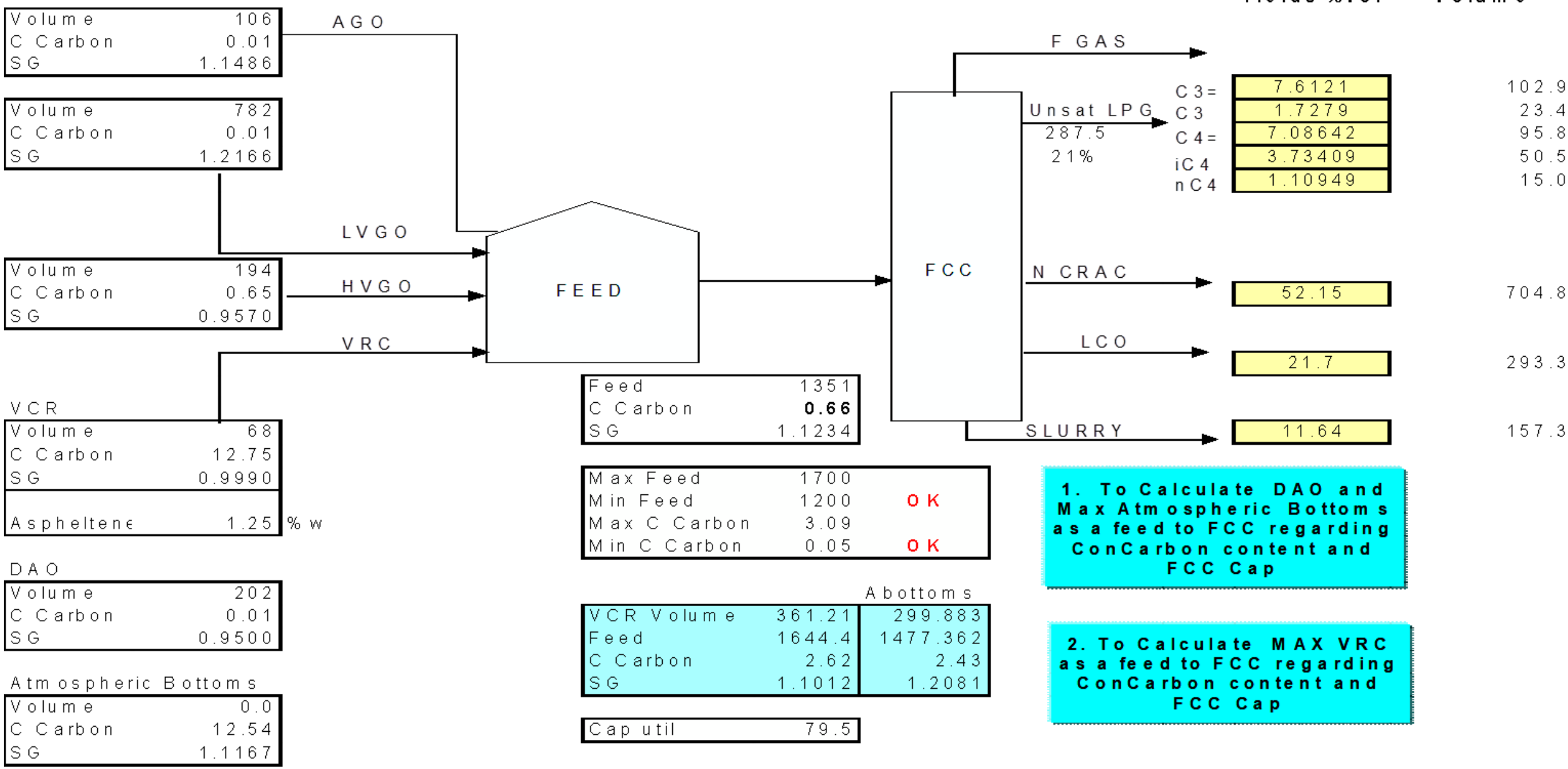
CRUDE DISTILLATION UNIT



NOTES:

(1) All volumes in m3/d

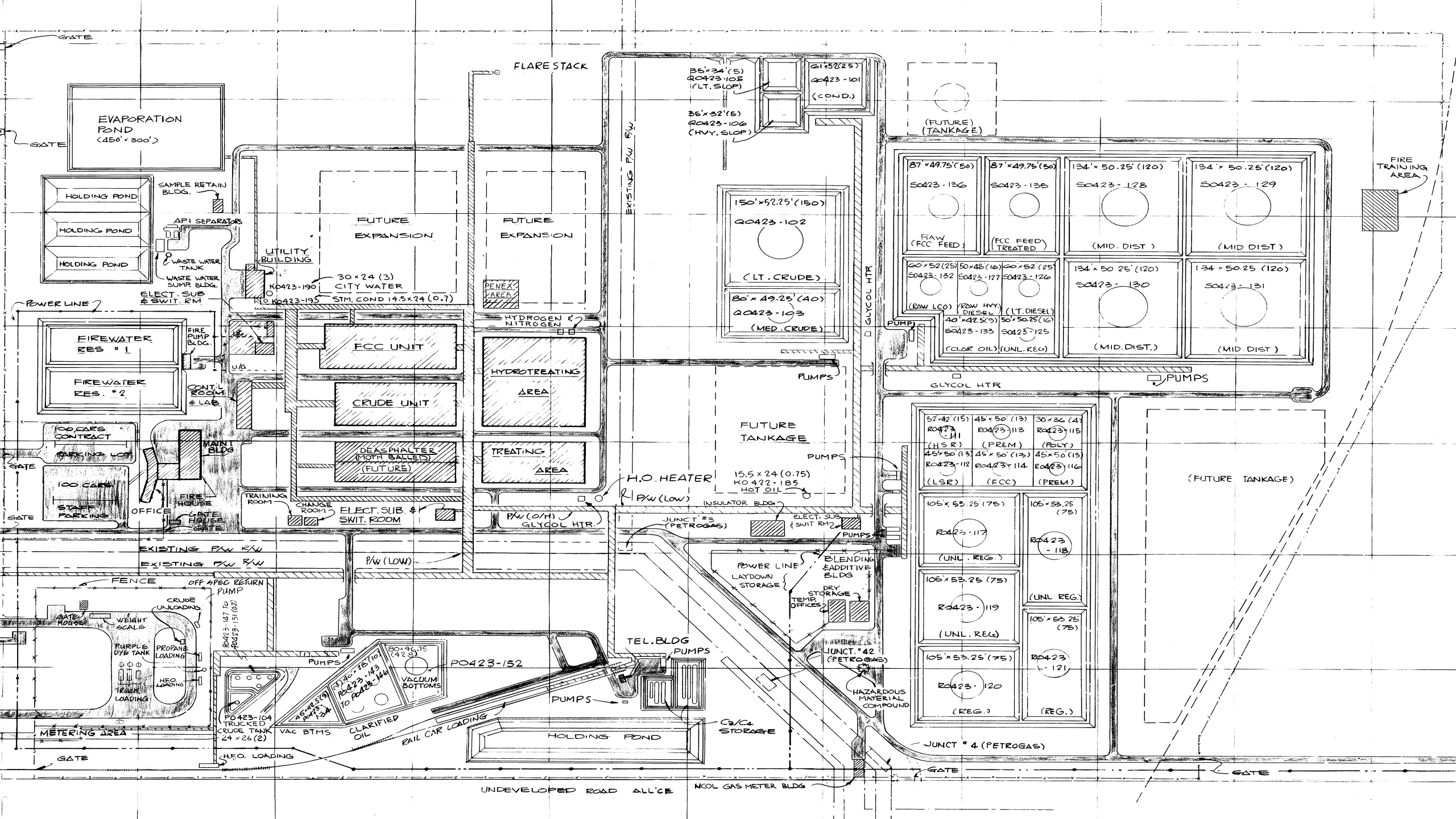
FLUID CATALYTIC CRACKING UNIT

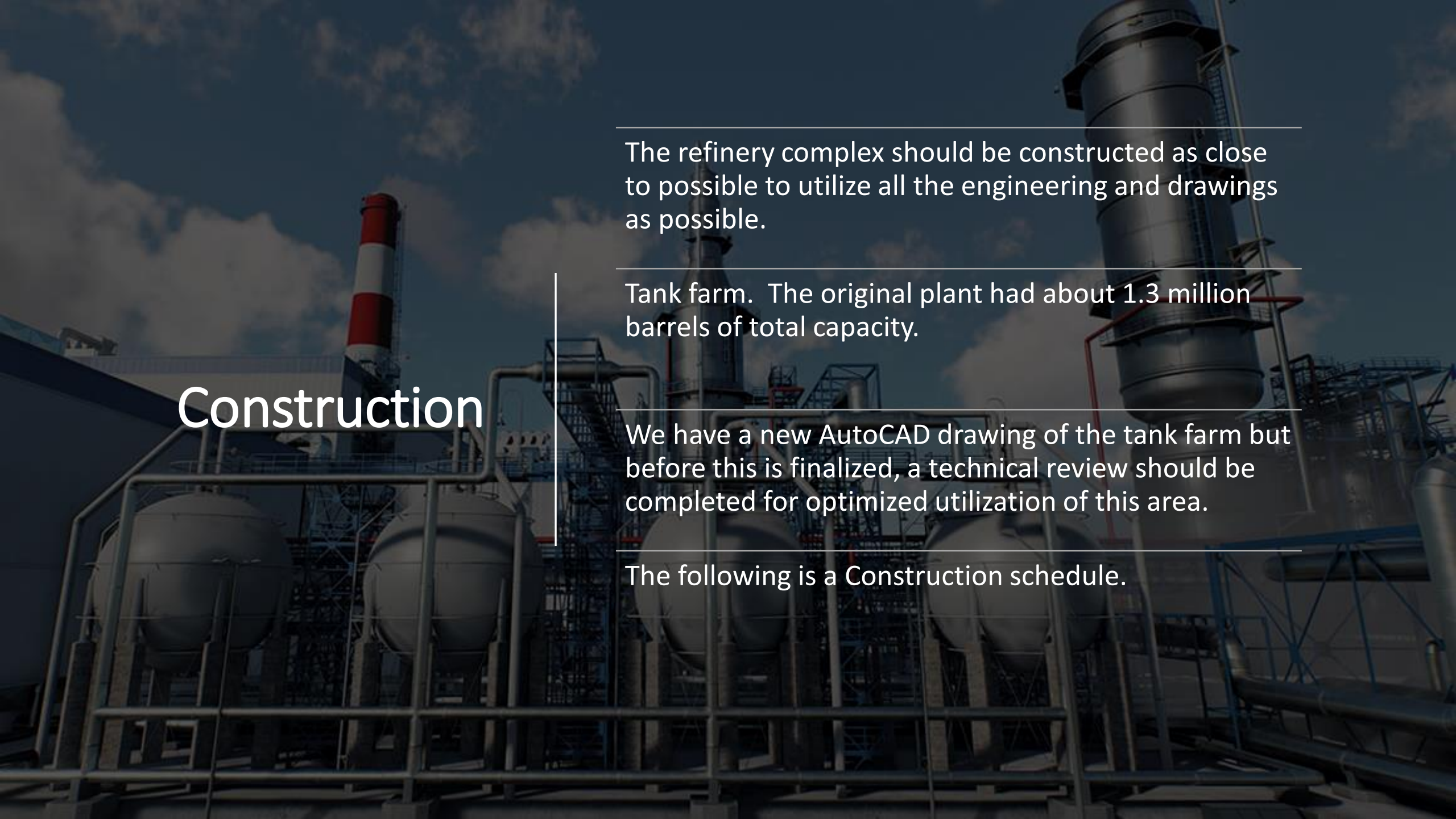


NOTES:

(1) All volumes in m3/d

(2) Maximizing VRC to FCC, limitation ConCarbon Content


GATE
EVAPORATION POND (450' x 300')
GATE
HOLDING POND
HOLDING POND
HOLDING POND
SAMPLE RETAIN BLDG.
API SEPARATORS
WASTE WATER TANK
WASTE WATER SUMP BLDG.
UTILITY BUILDING
FUTURE EXPANSION
FUTURE EXPANSION
FLARE STACK
EXISTING P/W R/W
30 x 24 (3) CITY WATER
KO 423-190
KO 423-195
STM. COND 14.5 x 24 (0.7)
ELECT. SUB & SWIT. RM
POWER LINE
FIREWATER RES. # 1
FIREWATER RES. # 2
FIRE PUMP BLDG.
U/G
CONT'L ROOM & LAB
100 CARS CONTRACT PARKING LOT
100 CARS STAFF PARKING
MAIN BLDG
OFFICE
FIRE HOUSE
GATE HOUSE
GATE
GATE
GATE
FCC UNIT
CRUDE UNIT
DEASPHALTER (MOTH BALLED) (FUTURE)
HYDROTREATING AREA
TREATING AREA
PENEX AREA
HYDROGEN & NITROGEN
TRAINING ROOM
CHANGE ROOM
ELECT. SUB. & SWIT. ROOM
P/W (O/H) GLYCOL HTR.
P/W (LOW)
H.O. HEATER
P/W (LOW)
INSULATOR BLDG
JUNCT #3 (PETROGAS)
ELECT. SUB & SWIT RM
PUMPS
36'x34'(5) Q0423-105 (LT. SLOP)
36'x32'(5) Q0423-106 (HVY. SLOP)
21'x52'(25) Q0423-101 (COND.)
(FUTURE) (TANKAGE)
150'x52.25'(150) Q0423-102 (LT. CRUDE)
80'x49.25'(40) Q0423-103 (MED. CRUDE)
GLYCOL HTR
PUMPS
FUTURE TANKAGE
15.5 x 24 (0.75) KO 422-185 HOT OIL
PUMPS
87'x49.75'(50) SO423-136 RAW (FCC FEED)
87'x49.75'(50) SO423-135 (FCC FEED) TREATED
134'x50.25'(120) SO423-128 (MID. DIST)
134'x50.25'(120) SO423-129 (MID DIST)
60'x52(25) SO423-132 (RAW LCO)
50x48(16) SO423-127 (RAW HVY. DIESEL)
60'x52'(25) SO423-126 (LT. DIESEL)
40'x42.5(9) SO423-133 (CLOR OIL)
50'x50.25(16) SO423-125 (UNL. REG)
134'x50.25'(120) SO423-130 (MID. DIST.)
134'x50.25'(120) SO423-131 (MID DIST)
GLYCOL HTR
PUMPS
FIRE TRAINING AREA
52'x42'(15) RO423-111 (HSR)
45'x50'(13) RO423-113 (PREM.)
30'x36'(4) RO423-115 (POLY)
45'x50'(13) RO423-112 (LSR)
45'x50'(13) RO423-114 (FCC)
45'x50'(13) RO423-116 (PREM)
105'x53.25'(75) RO423-117 (UNL. REG.)
105'x53.25 (75) RO423-118 (UNL REG.)
105'x53.25'(75) RO423-119 (UNL. REG.)
105'x53.25 (75) RO423-121 (REG.)
105'x53.25'(75) RO423-120 (REG.)
(FUTURE TANKAGE)
EXISTING P/W R/W
EXISTING P/W R/W
P/W (LOW)
FENCE
OFF SPEC RETURN PUMP
RO423-147 TO RO423-151 (0.7)
CRUDE UNLOADING
GATE HOUSE
WEIGHT SCALE
PURPLE DYE TANK
PROPANE LOADING
H2O LOADING
TRUCK LOADING
PUMPS
PO423-152
(2) 40'x48'(10) RO423-143 TO RO423-144
80'x96.75 (42.8) VACUUM BOTTOMS
45'x48.5(9) RO423-134
PO423-104 TRUCKED CRUDE TANK 24 x 26 (2)
VAC BTMS
CLARIFIED OIL
RAIL CAR LOADING
H.F.O. LOADING
METERING AREA
GATE
HOLDING POND
PUMPS
TEL. BLDG
C3/C4 STORAGE
POWER LINE
LAYDOWN STORAGE
BLENDING & ADDITIVE BLDG
DRY STORAGE
TEMP. OFFICES
JUNCT. #2 (PETROGAS)
HAZARDOUS MATERIAL COMPOUND
JUNCT # 4 (PETROGAS)
GATE
GATE
UNDEVELOPED ROAD ALL'CE
NCOL GAS METER BLDG



Construction

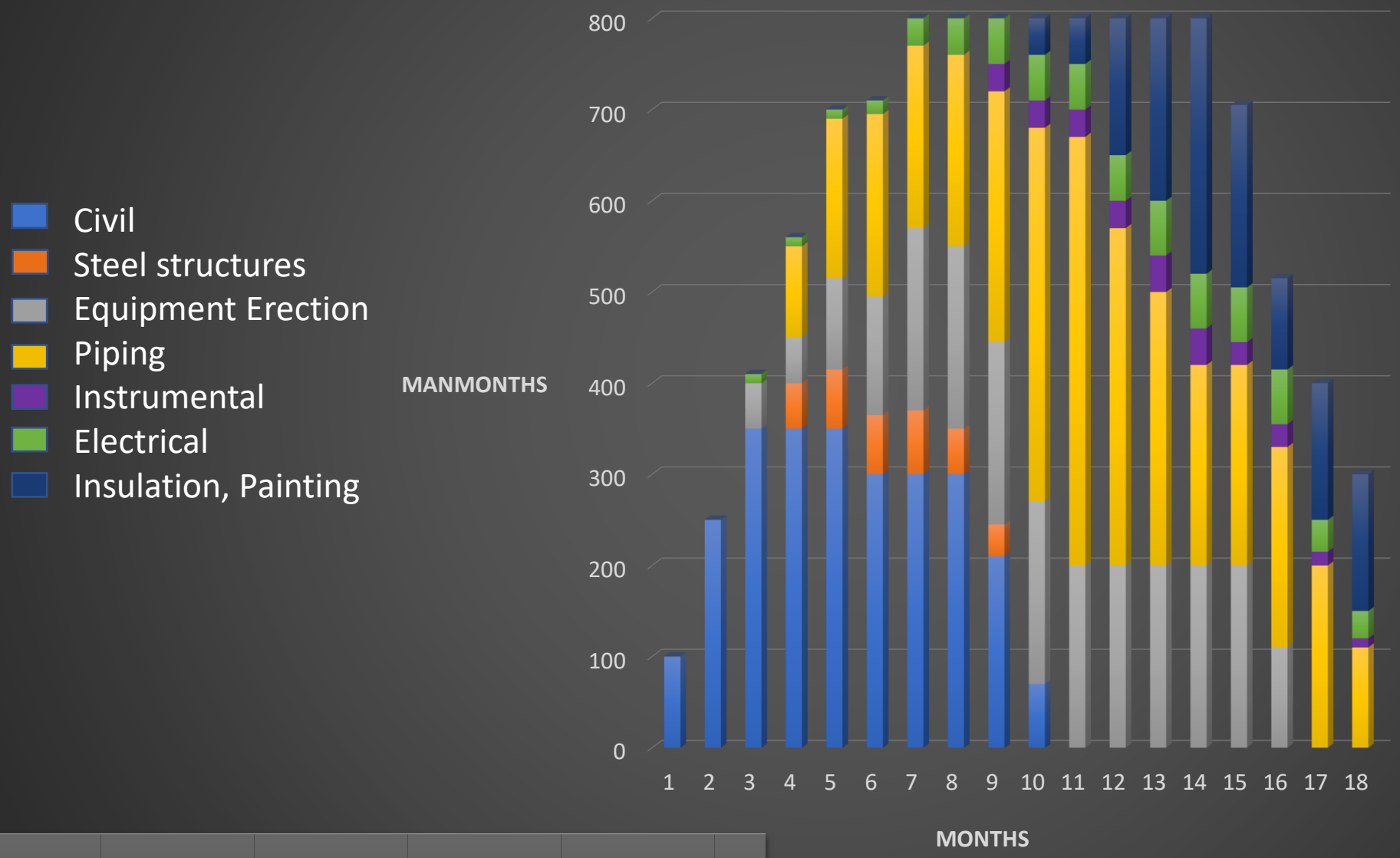
The refinery complex should be constructed as close to possible to utilize all the engineering and drawings as possible.

Tank farm. The original plant had about 1.3 million barrels of total capacity.

We have a new AutoCAD drawing of the tank farm but before this is finalized, a technical review should be completed for optimized utilization of this area.

The following is a Construction schedule.

CONSTRUCTION SCHEDULE



100	250	410	560	700	710	800	800	800	800	800	800	800	800	705	515	400	300
1	2	5	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

Estimates of Manpower Loadings as per the Construction schedule

There is a total loading of 11,000 man months which includes the following:

- 1. Civil
- 2. Steel structures
- 3. Equipment Erection
- 4. Piping
- 5. Electrical
- 6. Instruments
- 7. Insulation, Painting

DRAWINGS AND DOCUMENTATION

- 3200 drawings of piping locations, undergrounds, electrical, instrumentation, foundations.
- Another 1500 drawings of vendor or as built drawings.
- Spool drawings
- Isometric drawings.
- P&ID drawings, mechanical drawings and as built,

These drawings are not replaceable so that we must have control at all times so that they are under strict control.

Piping Specifications

- We have a detailed list of all specifications related to material required for these line requirements.
- We also have the engineering Specification book that is used for quality control in all aspects of the refinery equipment.

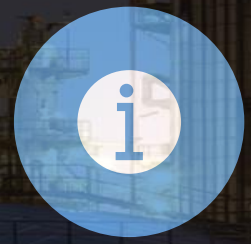
Match Marking

WHEN THE REFINERY WAS TAKEN DOWN AN ENGINEERING COMPANY DID THE MATCH MARKING FOR THE COMPLETE FACULTY.

PICTURES OF ALL DIFFERENT PIECES.

DETAILED LOCATION OF THE PIECES.

SET OF DRAWINGS TO MATCH THE PICTURES AND DOCUMENTATION.



ALL THIS INFORMATION CAN BE CROSS REFERENCED.

Catalysts and chemicals

Catalysts for the equipment will be important. We will use the catalyst and chemical suppliers to give us the best product for the material and specifications that we require.

We have detailed lists of brands and amounts used for all these catalysts and chemicals.

Utilities

- Water
- Power Fuel gas requirements over and above the amount that is produced in the plant.
- Nitrogen
- Hydrogen

All the utilities will have to be connected: steam, sewer system, fire water hydrant system, DCS system, flare.

Tankage. Detailed Autocad tank configuration available.
Laboratory equipment will be needed for testing: Octane testing equipment, distillation machine, sulphur indication, cloud and pour cooler, flash equipment and may others.

It is standard to have a product release form and retain program.
There are chemicals that can be added to increase the octane such as MTBE, MMT, TAME. Here are may fact's that must be considered as maximum addition rates, government regulations, cost and availability.

Spare Parts

- Spare parts inventory will be very important.
- We have the inventory records that were kept by part number, and this can be referenced to each individual piece of equipment-by-equipment numbers.
- This information also indicates the frequency that they parts were used.

Storage Tanks

A refinery of this size will have about 1.3 million barrels of storage capacity but will depend on many things:

- How is the crude coming in.
- How is the product going out.
- What tanks are needed for normal operations.
- An evaluation should be done when we know all this information.

We are supposed to input a tank monitoring system like Varec or Honeywell.

Buildings

- Office building
- Maintenance building
- Lunchrooms, washrooms.
- Control Building.
- We have the floor plan drawings for these buildings.

Security and people

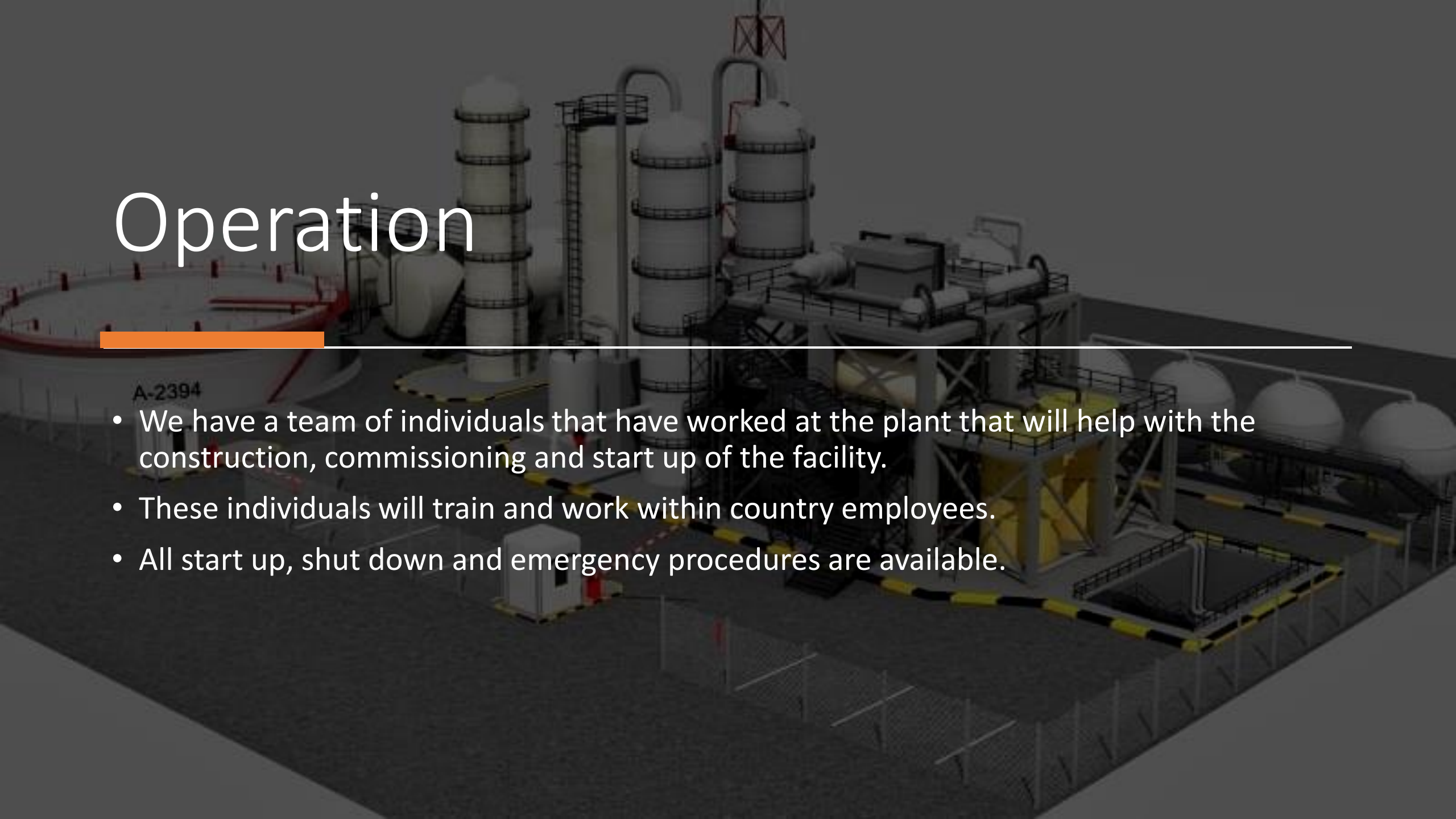
Fence to isolate the facility.

plants require trained experienced personal

How do handle fire protection and what is required.

Foam systems deluge systems.

Operation



- We have a team of individuals that have worked at the plant that will help with the construction, commissioning and start up of the facility.
- These individuals will train and work within country employees.
- All start up, shut down and emergency procedures are available.

Thank you for your attention