# AN OVERVIEW AND A WBS TEMPLATE FOR CONSTRUCTION PLANNING OF MEDIUM SIZED PETROLEUM REFINERIES

**Kabir Sadeghi[1], Maryam Babolian[2]**

[1]Professor, Faculty of Engineering, Near East University, NORTH CYPRUS, &
[2]Pacer Corporation Group of Companies, CANADA.

kabir.sadeghi@neu.edu.tr[1], mariam.babolian@yahoo.com[2]

## ABSTRACT

*Oil and gas are considered among the world's most important resources. The oil and gas industry plays a critical role in driving the global economy. Petroleum itself is used for numerous products, in addition to serving as the world's primary fuel source. The processes and systems involved in producing and distributing oil and gas are highly complex, capital-intensive and require state-of-the-art technology.*

*The modern petroleum refineries consist of very complex mix of high technology processes which efficiently convert the wide array of petroleum crude oils into the hundreds of specification products used daily by the people. Each refinery has its own unique processing configuration as a result of the logistics and associated economics related to its specific crude oils and products markets.*

*In this paper, an introduction to general items of oil and gas along with a template for scheduling and construction planning of the medium sized oil refineries with capacities around 100,000 barrels per day and even higher capacities is presented. The study evaluated the project life cycle for the construction of a petroleum refinery which comprises of the planning, design, construction, installation and commissioning phases. The project life cycle must be planned in great details for a successful execution. It is therefore necessary to study and gather all necessary information on the construction of a refinery with the objective of creating a client's work breakdown structure (WBS) template in a project planning. The results of this study eventually serve as a guide which can be adjusted to suit the planning and management for the construction of a petroleum refinery depending on the produced products characteristics, environmental and operational parameters. To validate the proposed template, the Tabriz Petroleum Refinery arrangements is considered as case study.*

**Keywords:** WBS, planning, scheduling, construction, petroleum refinery

## INTRODUCTION

The refining industry produces a mix of products making energy, major cost factor and an important opportunity for cost reduction. Energy use in refinery is also a major source of the refinery industry that making energy efficiency improvement an important opportunity to reduce emissions and operating costs. Petroleum refineries are composed of a series of complex units' processes which according to petroleum processing design, the technology that is utilized, and a number of other factors.

Each refinery has its own unique processing configuration as a result of the logistics and associated economics related to its specific crude oils and products markets. The refinery is continuously optimizing the mix of product volumes produced based on current economics. This is accomplished through executing decisions regarding parameters as varied as crude oil feedstock selection, adjustments in product cut-points, and reactor severities in individual processes (Kevin, A., & Giles, P. E., n.d.). A typical large refinery costs billions of dollars to

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build and millions more to run and upgrade. It runs around the clock 365 days a year, employs hundreds of people and occupies as much land as several hundred football fields. The refinery breaks crude oil down into its various components, which then are selectively changed into new products. This process takes place inside a maze of pipes and vessels. The refinery is operated from a highly automated control room. All refineries perform three basic steps:

1- Separation (fractional distillation),
2- Conversion (cracking and rearranging the molecules),
3- Treatment: Crude oil is a complicated mixture of compounds most of them hydrocarbons. This mixture is split up into different fractions in the distillation tower (*Thomko petro chemical*, 2007).

The Tabriz petroleum refinery in Iran is used as case study in this paper. The nominal capacity of this refinery is around 110,000 barrels per day (*Tabriz oil refinery company*, 2008).

This paper focuses on construction planning of a petroleum refinery. In order to have full view of the planning, information about all details of petroleum refinery design, construction and assembling units should be taken into account. The real WBS and scheduling templates for construction planning of a petroleum refinery is created with using the Microsoft Project Software.

## PURPOSE OF STUDY AND STATEMENT OF PROBLEM

Project planners these days are playing a major role to make the project a safe and cost efficient project and to avoid any mistakes leading to insufficient resource being allocated for the project. Designing a detailed construction project planning is vital. This discussion leads us to the following questions: a) Is there any way to identify the frame work needed for all petroleum refineries? b) Is there any way to make the same template work for all petroleum refineries with a capacity of 100,000 bbl/day) Is there any way to integrate this program to assist project planning for larger size of petroleum refineries?

This study mainly aims at designing a project management template for a petroleum refinery which could be used for bigger sizes of projects.

## FUNDAMENTALS OF PETROLEUM REFINERY

### Petroleum

Petroleum is categorized as fossil fuel. Petroleum is often called crude oil, or oil. It is called a fossil fuel because it was formed from the remains of tiny sea plants and animals that died about 300 million years ago (Anonymous, 2008).

### Classification

Oil is not just one single substance - there are many different kinds of oil. Oil from different geographical locations has its own unique properties, and varies in consistency from a light volatile fluid to a semi solid state. The types of oil differ from each other in their **viscosity**, **volatility** and **toxicity. Viscosity** relates to the oil's resistance to flow (*Thomko Petro Chemical*, 2007). “The American Petroleum Institute (API) has developed the term degrees API gravity (°API) which is widely used as another general characterization of the density of crude oils. The relationship is as follows:

$$°API = (141.5/\text{Specific Gravity at 60 degrees Fahrenheit}) - 131.5 \quad (1)$$

Specific gravity at 60 degrees Fahrenheit is the density of the crude oil measured at 60°F divided by the density of water at 60°F. Therefore, when comparing two crude oils, the higher density crude (i.e., the one with the highest specific gravity) has a correspondingly lower °API (Kevin, A., & Giles, P. E., 2008).

## Refineries Industry

In looking at the total number of refineries worldwide, there are around 720 refineries. The U.S. has the largest number of refineries (132) followed by China at 95, and Russia at around 45 refineries. As mentioned previously, the world's total refining production capacity is estimated at 82 million barrels per calendar day. In observing the top four countries in refining capacity, the U.S. has the largest refining capacity totaling 16.7 million barrels per day, Russia's refining capacity is at 5.4 million barrels per day, Japan at 4.7 million, and China at 4.5 million barrels per day. However, refining capacity is not the actual indicator of oil production in the number of barrels produced per day. Saudi Arabia is actually the world's largest oil producer, producing an estimated 8.4 million barrels per day, Russia is second producing 8.2 million barrels per day and the U.S. is third producing 5.7 million barrels per day (Science, technology & business division, 2008).

**Table 1. Global oil demand and refining capacity (in Mbbl/d) (Anonymous, 2005)**

| Year | 1990 | 1995 | 2000 | 2001 | 2002 | 2003 | 2004 | 2010 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Global oil demand | 6,200 | 70,000 | 76,600 | 77,300 | 77,900 | 79,400 | 82,300 | 90,400 | 106,700 |
| World refinery capacity | 4,532 | 76,509 | 81,961 | 82,840 | 83,562 | 83,930 | 84,592 | 98,536 | 116,303 |
| Incoming oil demand | | 3,800 | 6,600 | 700 | 600 | 1,500 | 2,900 | 8,100 | 16,300 |
| Incremental refining capacity | | 1,977 | 5,452 | 879 | 722 | 368 | 662 | 13,944 | 17,767 |
| Refining capacity as % of oil demand | 73% | 109% | 107% | 107% | 107% | 106% | 103% | 109% | 109% |

A comparison of the current and estimated growth in refining capacity are shown in Table 1. During the period from 1990-2000, when the refining margins were less volatile and relatively low as compared to the period after 2000, the global refining capacity was on average 9 percent more than the global oil demand. Since 2000, this percentage has dropped to as low as 3 percent above global oil demand in 2004 (Anonymous, 2005).

**Table 2. Average annual growth rates in world refined product consumption (ex FSU) (Anonymous, 2005)**

| Product | 1981-1985 | 1986-1990 | 1991-1995 | 1996-2000 | 2001-2004 | 1980-2004 |
|---|---|---|---|---|---|---|
| Gasolines | +0.3% | 2.9% | +2.2% | +2.3% | +1.8% | +1.9% |
| Middle distillates | +0.5% | 2.8% | +3.2% | +2.6% | +2.1% | +2.2% |
| Fuel oil | -6.7% | 1.7% | -0.3% | -0.6% | -1.2% | -1.4% |
| Others | +1.5% | 3.0% | +3.3% | +3.0% | +2.7% | +2.7% |
| Total Oil | -1.0% | 2.7% | +2.3% | +2.1% | +1.7% | +1.6% |

Table 2 shows the growth rates in refined product consumption with the final column showing the annualized growth rate over the last 25 years. The growth in demand for light products such as gasoline and diesel has been matched by the growth in concern over mobile

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source emissions and their effects on the environment and public health. The last five years has seen increasingly stringent environmental restrictions on product specifications, particularly the sulfur content (Anonymous, 2005).

Nowadays the refineries are operated by around 60 companies. Although there are a relatively large number of independent companies in the U.S. refining industry, the majority of the refining capacity is operated by a small number of multi-national or national oil processing companies. The largest companies (as of January 2003) are: Conoco Phillips (13% of crude capacity), Exxon Mobil (11%), BP (9%), Valero (8%), Chevron Texaco (6%), Marathon Ashland (6%), and Shell (6%), which combined represent 59% of crude distillation (CDU) capacity (Worrell, E., & Galitsky, C., 2005).

## PROCESS

Adopted from studies of Worrell, E., and Galitsky, C. (2005), A modern refinery is a highly complex and integrated system separating and transforming crude oil into a wide variety of products, including transportation fuels, residual fuel oils, lubricants, and many other products. The simplest refinery type is a facility in which the crude oil is separated into lighter and heavier fractions through the process of distillation. Refinery processes can be characterized by five major operations:

1) Separation,
2) Petroleum conversion,
3) Petroleum treating,
4) Feedstock and product handling,
5) Auxiliary facilities.

Within these operations consist of an integrated system of distillation towers, boilers, process heaters, blow down systems, cooling towers, catalytic crackers, pumps, valves, drains, flanges, storage tanks, and a variety of other equipment and processes.

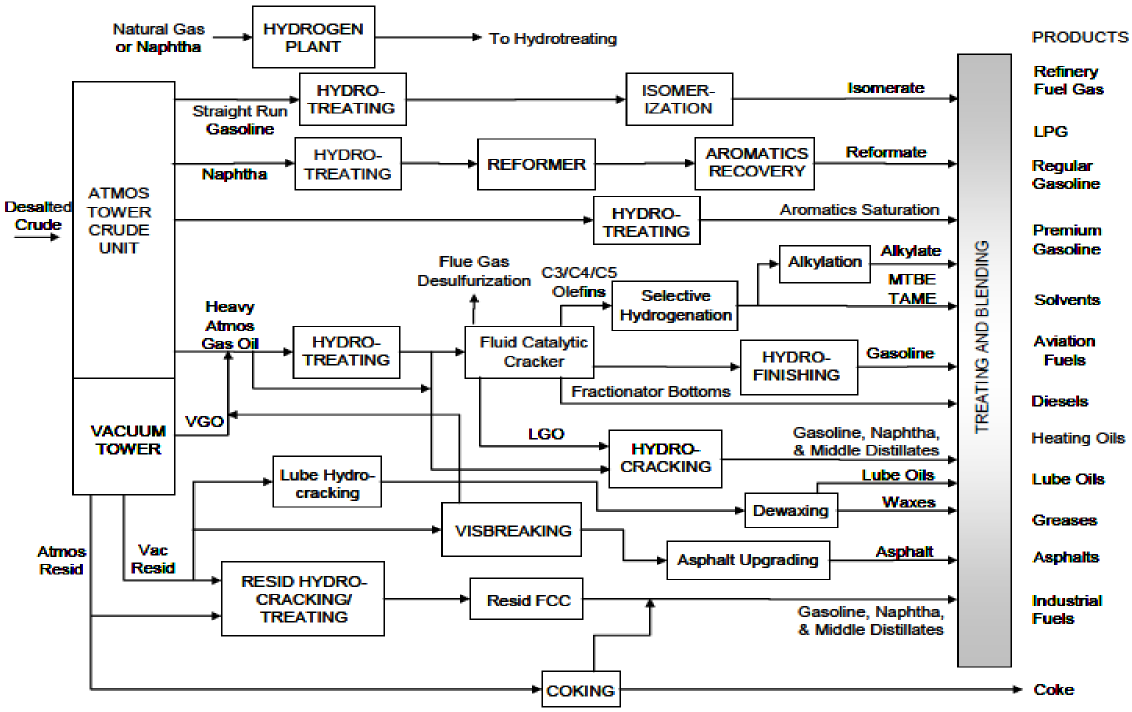


Figure 1. Simplified flowchart of refining processes and product flows (U.S. Department of Energy, 2006)

Number of key processes are the major energy consumers in a typical refinery, i.e., crude distillation, hydro-treating, reforming, vacuum distillation, and catalytic cracking. Hydrocracking and hydrogen production are growing energy consumers in the refining industry. Above figure 1 showed the units required in a petroleum refinery along with production of their units.

**Refinery Process Units**

Most significant processes in petroleum refining include the units mentioned below and these processes account for approximately 70% of the energy consumed by the refining industry and offer significant opportunities for increasing energy efficiency (U.S. Department of Energy, 2006).

**Fractional Distillation Unit**

Fractionation separates the hydrocarbons in the desalted crude oil by boiling point temperature. The oil is fed into a 120-foot vertical steel tower, called a distillation column or fractionating tower, and is heated to 700 degrees Fahrenheit, causing most of the oil to vaporize. The vapor cools as it rises in the tower, condensing on fractionation trays inside the tower along the way.

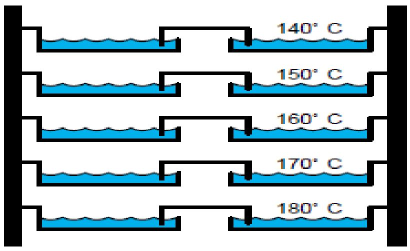


Fig. 2. Fractional distillation unit trays (Anonymous, 2001)

The trays are located at specific condensation temperatures. The heavier hydrocarbons condense at higher temperatures, and lighter hydrocarbons condense at lower temperatures. Two types of fractional distillation are used: 1) Atmospheric distillation, 2) Vacuum distillation. Atmospheric distillation is used first (Anonymous, 2001).

In Fig. 3, the flow diagram of Atmospheric and vacuum crude distillation are shown.

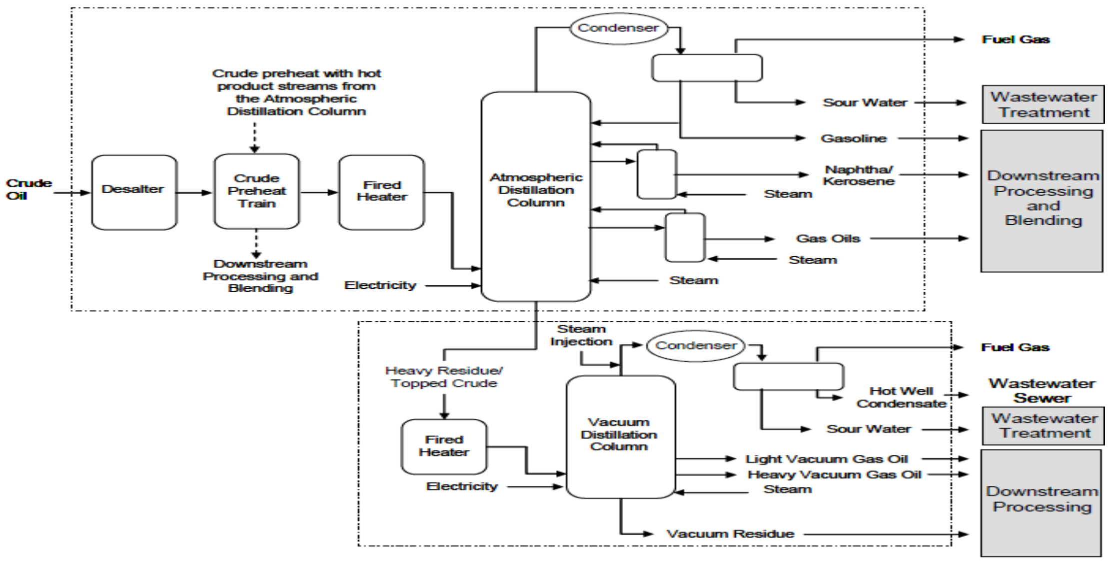


Fig. 3. Atmospheric and vacuum crude distillation flow diagrams and system boundaries for bandwidth energy analyses (U.S. Department of Energy, 2006)

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## Fluid Catalytic Cracker Unit (FCCU)

Adapted from the studies of Wakefield, B. J. (2007), catalytic cracking (commonly called cat cracking) uses heat and pressure to break heavy hydrocarbon molecules into lighter hydrocarbons in order to produce gasoline. However, as the name indicates, catalytic cracking also uses a catalyst (a material that facilitates, but does not participate in, a chemical reaction) to break the hydrocarbons and produces is high-octane gasoline. There are three types of catalytic cracking: fixed-bed catalytic cracking sometimes called Thermoform catalytic cracking (TCC), moving-bed catalytic cracking, and fluidized-bed catalytic cracking (FCC) (sometimes simply called fluid catalytic cracking). FCC reactor are by far the most common type of catalytic crackers, called fluidized-bed catalytic cracking units (FCCUs).

In a fluidized bed reactor filled with particles carrying the hot catalyst and a preheated feed (500-800 °F, 260-425 ºC), at a temperature of 900-1000 °F (480-540 ºC) the feed is cracked to molecules with smaller chains (Worrell, E., & Galitsky, C., 2005). Consequently, the fresh feed enters the process unit at temperatures from 500-1,000 ºF. Circulating catalyst provides heat from the regeneration zone to the oil feed Carbon (coke) is burned off the catalyst in the regenerator, raising the catalyst temperature to 1,150-1,350 ºF, before the catalyst returns to the reactor (U.S. Department of Energy, 2006).

In Fig. 4, the simplified flow diagram of fluidized catalytic cracker process unit is shown.

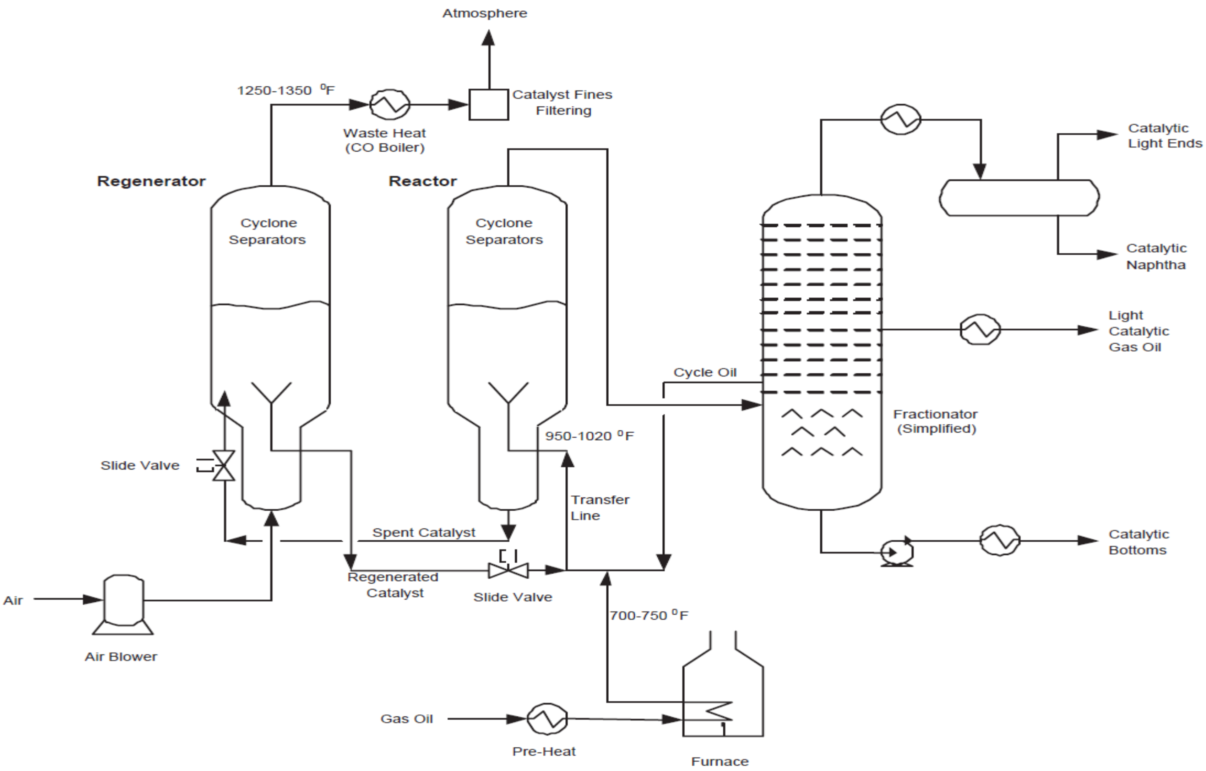


Fig. 4. Fluidized catalytic cracker simplified process flow (Kevin, A. & Giles, P. E., n.d.)

## Catalytic Reformer Unit

According to U. S. Department of Energy (2006), the catalytic reforming process converts naphtha and heavy straight-run gasoline into high-octane gasoline blending components. The feed and product streams to and from the reformer are composed of four major hydrocarbon groups: paraffins, olefins, naphthenes, and aromatics. Also the four major reaction types that take place during reforming include dehydrogenation, dehydrocyclization, isomerization, and hydrocracking. Adapted from the studies of Worrell, E., and Galitsky, C. (2005), the reformer is used to increase the octane level in gasoline. The desulfurized naphtha and gasoline streams are sent to the catalytic reformer. The product, called reformate, is used in blending of different refinery products. The catalytic reformer produces around 30-40% of all the gasoline produced. Because the catalytic reformer uses platinum as catalyst, the feed needs to be desulfurized to reduce the danger of catalyst poisoning. Reforming is undertaken by passing the hot feed stream through a catalytic reactor. In the reactor, various reactions such as dehydrogenation, isomerization, and hydrocracking occur to reformulate the chemicals in the stream. Some of the reactions are endothermic and others exothermic. The types of reactions depend on the temperature, pressure, and velocity in the reactor.

In below the four reaction types are presented in more detail with specific reactions that are typical of each type (U.S. Department of Energy, 2006):

Dehydrogenation of naphthenes to aromatics:

Typical reaction a): highly endothermic, high reaction rate

Dehydrogenation of alkylcyclohexane to aromatic

$$\text{Methylcyclohexane} \rightarrow \text{Toluene} + 3\,H_2 \quad (2)$$

Typical reaction b):

Dehydroisomerization of alkylcyclopentane to aromatic

$$\text{Methylcyclopentane} \rightarrow \text{Cyclohexane} \rightarrow \text{Benzene} + 3H_2 \quad (3)$$

Dehydrocyclization of paraffins to aromatics

Typical reaction:

$$\text{n-Heptane} \rightarrow \text{Toluene} + 4\,H_2 \quad (4)$$

Isomerization (fairly rapid reactions with small heat effects)

Typical reaction a):

Isomerization of n-paraffin to isoparaffin

$$\text{n-Hexane} \rightarrow \text{Isohexane} \quad (5)$$

Typical reaction b):

Isomerization of paraffin to naphthene

$$\text{Methylcyclopentane} \rightarrow \text{Cyclohexane} \quad (6)$$

hydrocracking (exothermic, relatively slow)

Typical reaction:

$$\text{n-Decane} \rightarrow \text{Isohexane} + \text{n-Butane} \quad (7)$$

**Catalytic Hydrotreating Unit**

According to U.S. Department of Energy (2006), Catalytic hydrotreating, also referred to as hydroprocessing or hydrodesulfurization, commonly appears in multiple locations in a refinery. In the hydrotreating process, sulfur and nitrogen are removed and the heavy olefinic feed is upgraded by saturating it with hydrogen to produce paraffins. Hydrotreating catalytically stabilizes petroleum products. In addition, it removes objectionable elements such as sulfur, nitrogen, oxygen, halides, and trace metals from products and feedstocks through a reaction with hydrogen. Most hydrotreating processes have essentially the same process flow.

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In Fig. 5, the flow diagram of catalytic hydro-treating unit is shown.

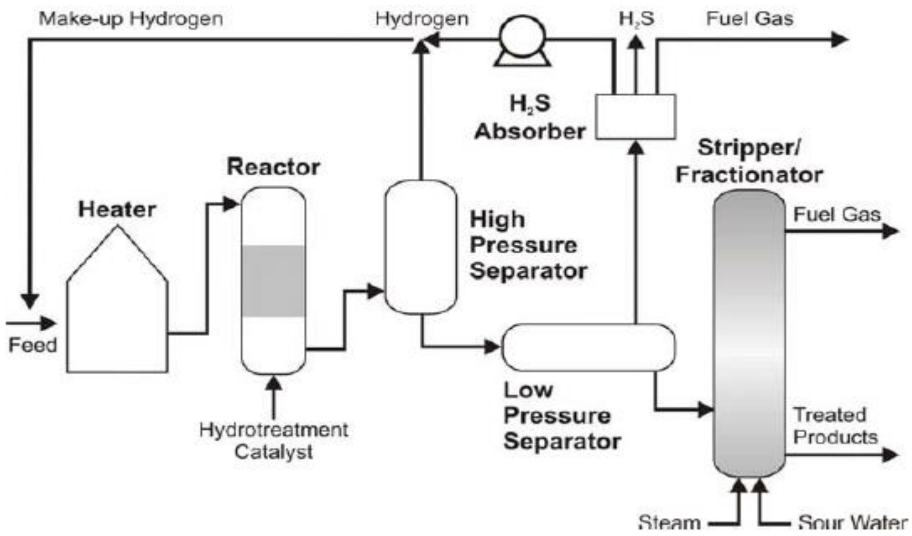


Fig. 5. Catayic hydrotreating flow diagram (U.S. Department of Energy, 2006)

**Alkylation And Polymerization Unit**

According to U.S. Department of Energy (2006), alkylation involves linking two or more hydrocarbon molecules to form a larger molecule. In a standard oil refining process, alkenes (primarily butylenes) are reacted with isobutene to form branched paraffins that are used as blending components in fuels to boost octane levels without increasing the fuel volatility are shown below.

$$C4H8 \quad + \quad C4H10 \quad \rightarrow \quad C8H18 \quad + \quad Heat \qquad (8)$$

There are two alkylation processes: sulfuric acid-based (H2SO4) and hydrofluoric acid-based (HF). Both are low-temperature, low-pressure, liquid-phase catalyst reactions, but the process configurations are quite different. Several companies are also developing advanced HF catalysts to reduce the environmental and health risks of HF alkylation (see Fig. 6 and Fig. 7).

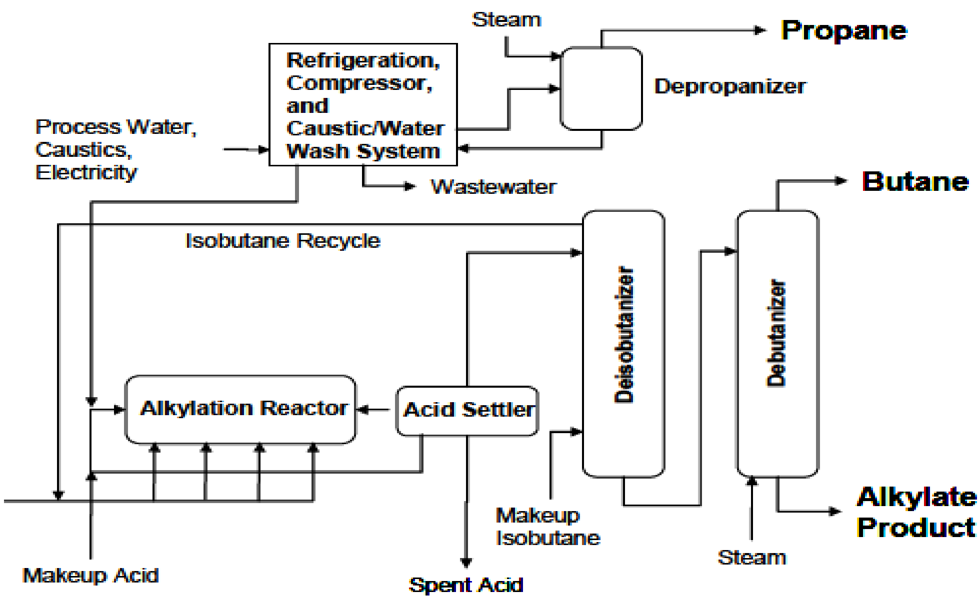


Fig. 6. Sulfuric acid-based alkylation flow diagram (U.S. Department of Energy, 2006)

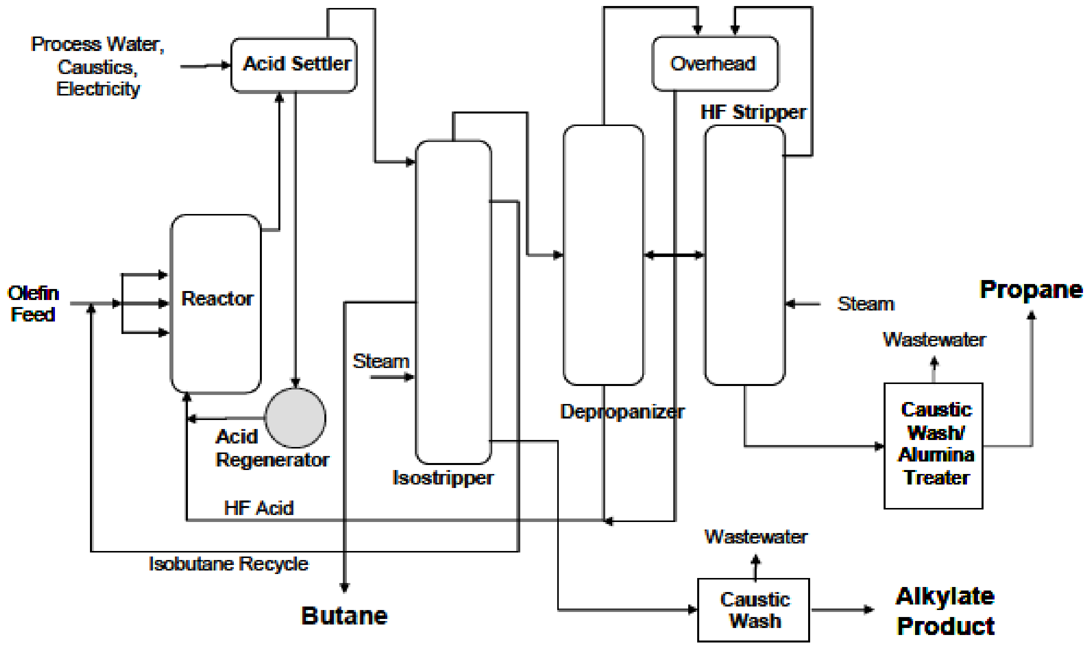


Fig. 7. Hydrofluoric acid- based alkylation flow diagram (U.S. Department of Energy, 2006)

## Storage Tanks

Storage tanks are used throughout refineries for storage of crude oil, intermediate feedstock, and finished products, as well as storage of water, acids, additives, and other chemicals. Also base on the studies of Neiro, S. M. S., and Pinto, J. M. (2003), the petroleum industry can be characterized as a typical supply chain. All levels of decisions arise in such a supply chain, namely, strategic, tactical and operational. In spite of the complexity involved in the decision making process at each level, much of their management is still based on heuristics or on simple linear models. The petroleum supply chain is illustrated in Fig. 8.

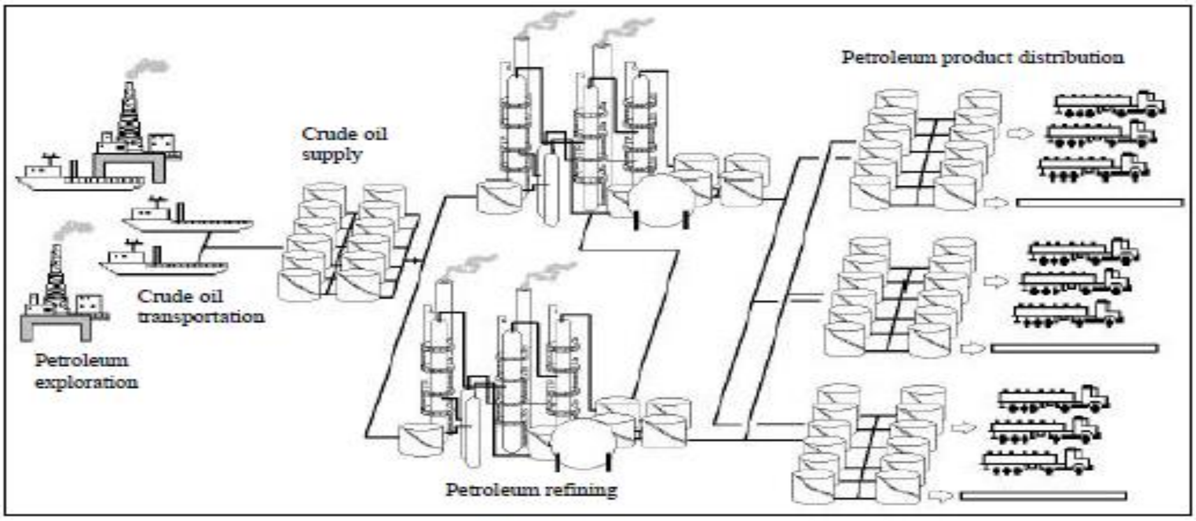


Fig. 8. Petroleum supply chain (Neiro, S. M. S. & Pinto, J. M. 2003)

## PROJECT PLANNING AND MANAGEMENT ASPECT

During project planning of a petroleum refinery with capacity 100,000 bbl per day, the project manager, through regular communication with the customer representatives, refines the project scope to clearly define the content of the deliverables to be produced during project execution. This definition includes a clear description of what will and will not be

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included in each deliverable. The following issues must be included in scope statement of a petroleum refinery:

| | |
|---|---|
| Project description | Site Area |
| Site features | Location of the site or potential sites |
| Summary of environmental impact report | Capacity of the project |
| Type of units | Electrical, mechanical and instrumentation |
| Type of foundation | Operating and maintenance base |
| Total estimated cost of the project | Annual produce output |

**Feasibility Study**

One of the first steps necessary to take for planning a petroleum refinery is feasibility studies. Several potential petroleum refineries are investigated based on construction planning and scheduling of Tabriz petroleum refinery with a capacity of about 110,000 bbl/d and other data conditions. Then it is narrowed down to a few best sites which provide an ideal location and product market demand which require technical study unit conditions. After the raw data are collected from the selected sites and products demand, technical study of process units and related facilities and based on the technical study of electrical, mechanical, instrumentation, civil, architect and healthy safety environment (HSE) are required. Also frequency technology of licensed units is changed based on the flow chart of refinery and land demand for each unit. The main objective of the feasibility study is to ensure that enough market demands for the products will be provided while it is environmentally, legally, socially, technically and economically viable to build petroleum refinery at the selected location or not?

Other site conditions, such as geotechnical and environmental items, which are often applied to petroleum refineries must also be carefully surveyed. The Client must provide a detailed environmental impact assessment report to legal authorities and supervising bodies. Visual impacts and hazard study are also among very important subjects of environmental impact studies. Permits from Ministry of Energy, local municipality, military and Environmental Organization are required.

**Case Study: Description of Tabriz Petroleum Refinery**

The Tabriz Refinery located in North West of Iran was designed in 1974 and after the operations related to the construction, was reached to the exploitation stage on February 1977. On January 1998, on the basis of the instant policies, the handling of Tabriz Refinery was changed to the firm type and has started its new period of activities as "Tabriz Oil Refining Company". The nominal capacity of this company was 80,000 barrels per day that with executing the responsibilities augmenting schemes; nominal capacity has been increased to 115,000 barrels per day (Tabriz oil refinery company, 2008). The Tabriz petroleum refinery consists of 14 refining units and 10 units related to other services (Zadakbar, O. et al, 2008).

## WBS TEMPLATE FOR PETROLEUM REFINERIES WITH CAPACITIES AROUND 100,000 bbl/d

Planning for petroleum refineries with capacities around 100,000 barrels per day have different levels, the main levels being illustrated below. The sequence of requirement and facilities should be completely investigated. Planners should arrange the activities and schedules in order to meet the client objectives. By increasing the levels, actions are divided

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into more actions and tasks. Level one, describes the major titles of the work breakdown structures and each level are divided into detailed sub-levels. It is so important for the project manager to understand the phase of work and critical situation in order to control, plan and schedule the entire project. The levels 1 and 2 of the proposed WBS template for the construction of petroleum refineries with the capacities around 100,000 bbl/d are presented as follows:

**Level 1**

1 Project initiation

2 Key milestones

3 Conceptual design

4 Pre-basic design

5 Basic design

6 Time and cost management

7 Bidding process & selection of successful contractor

8 Award of contract

9 Performing the detailed design

10 Performing the procurement

11 Construction

12 Commissioning

13 Delivery & close out

**Level 2**

1 Project initiation

1.1 Scope of work definition

1.2 Site assessment

1.3 Project definition

2 Key milestones

2.1 Project effectiveness

2.2 Issue of pre-basic & configuration report

2.3 Approval of pre-basic & configuration report (by client)

2.4 Issue of PFDs

2.5 Issue of P&ID

2.6 Issue of major equipment data sheets

2.7 Issue of basic design package

2.8 EPC package completion

2.9 BEDP validation (by client)

2.10 Non-Licensed units basic design

2.11 Licensed nits BD completion

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| | |
|---|---|
| 2.12 | Issue of operating manual |
| 3 | Conceptual design |
| 3.1 | Reviewing the requirements |
| 3.2 | Market evaluation |
| 3.3 | Evaluation long term and short term benefit |
| 3.4 | Technical study |
| 4 | Pre-basic design |
| 4.1 | Process |
| 5 | Basic design |
| 5.1 | Process |
| 5.2 | Piping |
| 5.3 | Electrical |
| 5.4 | Civil & architectural |
| 5.5 | Health & safety & environment |
| 5.6 | Mechanical |
| 5.7 | Instrumentation |
| 6 | Time and cost management |
| 6.1 | Activity definitions |
| 6.2 | Activity sequencing |
| 6.3 | Activity resource estimates |
| 6.4 | Activity duration estimates |
| 6.5 | Develop schedule |
| 6.6 | Risk management |
| 6.7 | Project investment cost estimate |
| 6.8 | Economic considerations |
| 6.9 | Plant costs calculations |
| 6.10 | Project planning |
| 6.11 | Reporting results meeting |
| 7 | Bidding process & selection of successful contractor |
| 7.1 | Announcing the bid |
| 7.2 | Submitting the bid documents to potential contractors |
| 7.3 | Evaluation of the received proposal |
| 7.4 | Selection of successful contractor |
| 8 | Award of contract |
| 8.1 | Review notification of proceed & signing of contract |

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8.2 Planning for the evaluation of actual manpower needed

8.3 Revaluation of needed spaces comparing to actual available

8.4 Submission of bond & insurance certificates

8.5 Preparing and delivery of cost/cash flow estimates

8.6 Obtaining construction permits

8.7 Preparing contract and signing the contract

9 Performing the detailed design

9.1 Preparing and awarding subcontractor (consultant) for detail design

9.2 Endorsement of base design documents

9.3 Process

9.4 Piping

9.5 Electrical

9.6 Civil & architectural

9.7 Health, safety & environment

9.8 Mechanical

9.9 Instrumentation

10 Performing the procurement

10.1 Completing the vendor list for all materials & equipment

10.2 Sending the necessary documents to the suppliers

10.3 Receive proposals of the suppliers

10.4 Selecting of the winning suppliers

10.5 Contracting with the winning suppliers

10.6 Testing the materials during the fabrications

10.7 Shop inspection

10.8 Expediting

10.9 Traffic coordination

10.10 Customs clearance

10.11 Tax duties

10.12 Shipment of materials

10.13 Receiving the materials

10.14 Storing the materials

10.15 Supervision of productions in fabrications

11 Construction

11.1 Construction phases

11.2 Process

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11.3 Installation Piping
11.4 Electrical
11.5 Civil & architectural
11.6 Healthy, safety & environment
11.7 Mechanical
11.8 Instrumentation
11.9 Testing

12 Commissioning

12.1 Pre commissioning of process area
12.2 Modifications
12.3 Safety manuals and safety plans
12.4 Managing deliverables acceptance
12.5 Measure quality levels
12.6 Facilitate continuous improvement
12.7 Hook-up
12.8 Checkout

13 Delivery & close out

13.1 Delivering manuals
13.2 Preparing and delivering as-built drawings
13.3 Delivery of extra material to the client
13.4 Finalizing the financial issues
13.5 Delivering the project to the client
13.6 Close out
13.7 Start-up of operation
13.8 Demobilization

## CONCLUSION

An overview and a WBS template are submitted for planning of construction of petroleum refineries with a capacity of 100,000 barrels per day, considering the Tabriz Refinery as a reference. The construction planning of a petroleum refinery with a capacity of 100,000 barrels/day has at least 13 main major tasks including: project initiation, key milestones, conceptual design, pre-basic design, basic design, time and cost management, bidding process and selection of successful contractor, award of contract, performing the detailed design, performing the procurement, construction, commissioning, delivery and close out. The construction phase takes the most time of the project compared with other main activities of the project. Recycling is a very crucial matter in the environment surrounding the refineries. Since the processes involve the use of toxic chemicals; it is very important that these materials be properly disposed of to avoid health hazards.

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## REFERENCES


[1] Anonymous. (2008). *Intermediate energy info book activities.* Retrieved April 3, 2009, from http://www.need.org/needpdf/Intermediate%20Infobook%20Activities.pdf

[2] Anonymous. (2005). *The emerging oil refinery capacity crunch: A globule clean products outlook.* News of ICF Consulting. pp. 1-9.

[3] Anonymous. (2001). *Oil refineries*. *Chemical Physics.* New York: John Wiley & Sons.

[4] Kevin, A., & Giles, P. E. (n.d.). Fundamentals of petroleum refining. *PDH engineer*. Retrieved April 10, 2009, from http://www.pdhengineer.com/pages/O-3001.htm

[5] Neiro, S. M. S., & Pinto, J. M. (2003). *Supply chain optimization of petroleum refinery complexes.* Paper presented at the *FOCAPO Conference*, Florida, USA.

[6] Science, Technology & Business Division (n.d.). Retrieved August 10, 2009 from http://www.loc.gov/rr/business/BERA/issue5/refining.html

[7] Tabriz Oil Refinery Company, (n.d.). Retrieved March 14, 2009, from http://www.tbzrefinery.co.ir/En/default.aspx

[8] Thomko petro chemical, (2007). Types of Oil. Retrieved February 15, 2009, from http://thomko.squarespace.com/types-of-oil/

[9] U.S. Department of Energy, Office of Energy Efficiency and Renewable, Energy Industrial Technologies Program. (2006, October). *ITP petroleum refining: Energy bandwidth for petroleum refining processes.* Retrieved October 20, 2009, from http://www1.eere.energy.gov/industry/petroleum_refining/pdfs/bandwidth.pdf

[10] Wakefield, B. J. (2007, December). *Oil refinery permits: A handbook for citizen participation in the permitting of oil refineries under the new source review provisions of the clean air act.* Washington: Environmental Integrity Project.

[11] Worrell, E., & Galitsky, C. (2005). Energy efficiency improvement and cost saving opportunities for petroleum refineries. *Journal of Energy Star.*

[12] Zadakbar, O., Vatani, A., & Karimpour, K. (2008). Flare gas recovery in oil and gas refineries. *Journal of Oil & Gas Science and Technology, 63*(6), 705-711


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