CHAPTER - 3

ADEN REFINERY COMPANY (A CASE STUDY)

3.1 Introduction

Aden Refinery Company with its office, located in Little Aden at Alburigah district, Aden governorate, the Republic of Yemen was basically owned by the British Petroleum (BP) who established and constructed it from 1952’s to 1954’s and the production had commenced on July 1954’s (Smitson [135]). In May 1977’s the ownership of this refinery transferred to the Yemen government and thus its name changed to Aden Refinery Company. In 1979’s the same happened with the British oil which changed to Aden oil limited, located at Steamer Point, Aden, which is specialized in supplying fuel to vessels.

It was merged to Aden Refinery Company under new administration for ship chandelling (Annul bulletin [4]).

This refinery is one of those which use Hydrogen to process its products (Hydro Skimming Refinery) and designed to process high Sulfur crude, Kuwaiti crude and Qatar crude, during its refining process. It refines crude from various resources from Middle East, North Africa, Russia and Iran up to the mid-nineties 1990’s, when, Mareb crude had replaced them and became the main crude available for refining.

Geographically, Aden Refinery Company is divided into four locations (Areas) that consist of the following: (Statistics Department Report [138]).
3.1.1 Refinery Area

The refinery area consists of the following:

Processing units, reservoirs field, power station, different systems and service centers.

Picture 3.1 Primary Column of Crude Oil Distillation at ARC

- **Processing Units**
  - Crude Oil Distillation Unit.
  - Catalysis Platformate Unit.
  - Extracting Unit with Sulfur Dioxide.
  - Sulfur Dioxide Production Unit,
  - Auto finer Unit.
  - Four Assisting Processing Units with assistance of solution agent Solutizer.
  - Four Assisting Processing Units with assistance of agent Copper Chloride.
  - Vacuum Distillation Unit.
- Asphalt Unit.
- Ethane Gas Extracting Unit.
- Asphalt Filling Unit.
- Asphalt Barrel Factory.

Reservoirs Field

It contains 101 metal reservoirs of different sizes and kinds for storing crude oil and its derivatives at both areas of refinery and coast. It provides a reserving capacity for Aden Refinery Company estimated with about 200 million imperial gallons. Then, between 1992’s and 2002’s the field is developed by adding 30 new reservoirs and repairing many of the existing once in order to increase capacity of the company and to compensate for out of order reservoirs.

- Pumping Stations and joining pipe lines: Aden’s’ oil pipe line with a length of 35 kilometer approximately from the refinery to Aden administration for ship chandelling.

Picture 3.2 Storage Tanks for Motor Gasoline and Diesel Oils at ARC
Power Station

Furnishes the refinery with the following:

- Generating electricity: three electrical generators works on steam turbines each of a power of 7.5 megawatt.
- Steam production: four boilers each of a power of 160,000 steam pound per hour, with a pressure of 600 pound per square inch and a temperature of 750°F.
- Pumping cooling water to refinery sea water; 3,300,000 gallon per hour approximately.
- Producing distilled water; 7,600 gallon per hour approximately.
- Producing oxygen.
- Producing high pressure air; operating precise equipment’s at the refinery for other type of usage.

Picture 3.3  Service Centers, Workshop and Power Station at ARC
Different Systems and Service Centers

- Treating Service Systems (flame, quick discharging and separators).
- Safety and Fire Fighting Service System.
- Maintenance Workshops.
- Transportation Services, vehicles and heavy equipment’s station.
- Crude Materials Laboratory.
- Training Center.
- Administration buildings.

3.1.2 Coast Area

The coast area consists of the following:

Oil port, reservoir field, different systems and service centers.

Picture 3.4 Aden Refinery Company and the oil port
➢ **Oil Port**

- Four berths for crude oil and its derivatives were repaired and modernized in 1987-1989.
- Three of these can receive vessels with a load of 80,000 tons; the fourth one can receive vessels with a load of 110,000 tons.
- New berth for asphalt and liquid gas erected in 1989 can receive vessels with a load of 22,000 tons.
- Sea anchor for each of spirals, boats, skiffs and materials all of them were maintained in 1987-1989.
- Three Tankers: Qana (3,000 tons), Masealah (13,800 tons) and Bab al Mandab (6,000 tons) of capacity.

➢ **Reservoirs Field**

- Metal reservoirs for crude and its derivatives.
- Spherical shape reservoirs for liquid gas each of a capacity of 250 tons and space for 450 m².
- Three new spherical shape reservoirs for liquid gas each of a capacity of 875 tons and space for 1,700 m² constructed in 1985-1987.
- Ten new cylindrical shape reservoirs for liquid gas each of them for 250 m² (constructed in 2000-2010).
- Pumping stations and joining pipe grid.

➢ **Different Systems and Service Centers**

- Treatment systems and service centers (Al Mafrikat, Al wahl, etc.).
- Safety and firefighting service system.
- Marine stores.
- Administration buildings.
3.1.3 Aden Administration for Ship Chandelling

- Fixed sea berth.
- Floating sea berth.
- Small tankers.
- Spirals.
- Boats.
- Reservoirs fields.
- Control room.
- Pumping station.
- Stores.
- Maintenance workshop.
- Administration buildings.

3.1.4 General Services

- Aden refinery hospital (100 beds).
- Aden refinery club.
- Golf club.
- Tennis club.
- Marine club.
- Celebration hall.
- Squash hall.

- Short historical resume about development plans and modernization of Aden Refinery Company (Statistics Department Report et al. [138] and Statistical Technical Committee [139]).

Since the year of 1983’s Aden Refinery Company sets plans of development programs, modernizing the refinery and searching for means and ways to attain it. Several technical studies were prepared to recognize and specify the required development and modernizing quality
and quantity performed by companies and recognized consulting institutions. Out of these studies few are listed here: U Bank Survey for renewing power station in 1985’s. Star energy survey on developing and modernizing the refinery in 1988’s. Japanese Consulting Institute (JCI) on development and modernizing the refinery in 1989’s. A British Multinational Consultancy Engineering and Project Management Company (AMEC) survey in 1995’s in which it specified the required developing and modernizing quality and quantity. These survey documents in 1996’s are converted to tender deeds for rehabilitation and modernization project of Aden refinery and put for international tender invitation in the same year. Kvaerner John Brown Survey which is an amendment for the prepared tender documents by AMEC for rehabilitation and modernization of Aden refinery to a new tender documents of modernization project for Aden refinery in order to get a large number of participating companies.

But due to various reasons Aden Refinery Company could not execute except the following large projects only:

3) Modernization of reservoirs field by adding new reservoirs for crude oil, derivatives, asphalt, liquid gas and to repair the old reservoirs. (Period: 1992-2002)
4) Purchasing of three tankers:
5) Qana: 1985’s.
7) Bah al Mandab: 2001’s.

Recently the plan of Aden Refinery Company for large project is restricted to the following two projects:

1. Constructing crushing compound with catalysis for atmospheric distillation residual so that the capacity of crushing unit would be: 25,000-30,000 barrel per day.
2. Rehabilitation renewal and modernization of power station.

3.2 The Laboratory of ARC

The laboratory is established with the beginning of the refinery operation (Annul Bulletin [5] and Statistics Department Report et al. [138]). Its consists of the following departments:

1. White Oil Laboratory to test light and heavy naphtha, kerosene aircraft fuel and car’s benzenes.
2. Black Oil Laboratory that includes the test of diesel, mazout and crude oil.
3. Gases Laboratory to test all gases formed from refining process from which the important gas is butane.
4. Inorganic Analyzing Laboratory analyze water included in refining process, power production, mineral testing and in various kinds of fuel through incineration.
5. Machine Testing Laboratory to specify the octane number for the car’s benzene also it includes aircraft fuel testing for oxidation acceptability in heat.
6. Laboratory Maintenance Section that care of all the particles in the laboratory as devices, electricity and pipes etc.
7. Research and Development Section to execute any mission assigned to it especially which concerns to general tests that are not
related directly with the refinery activity or introduced once which requires to performs testing and researched especially as revealing the existed elements in water, oils and fuel specimens etc.

3.2.1 Missions

The laboratory performs the following works:

- Permanent and periodical controlling of production units performance as per as daily schedule so that required specification would be matched.
- Testing products ready for export and assures its compatibility with local and international specifications
- Testing products purchased by refinery and confirms their compatibility with contractual terms.
- Issuing quality certificates for refinery’s exported and internationally approved products.
- Tracing the new issues of international specifications and care to develop facilities that grants listings obligation on them.

3.2.2 Modern Devices in the Laboratory

1) Reformulizer device to specify oxygen, pentane, aphanite aromatic and naphtha. This device will enable to test all kinds of new benzene that is used scientifically and its components are known from various compounds with its extent with specification compatibility in use.

2) Distillation device which consist of three devices in one frame, one of these performs atmospheric distillation, another performs vacuum distillation and the third forms partial distillation for all kind of crude and mazout.

As the atmospheric distillation is separating crude oil to derivatives by using heat and under regular atmospheric pressure, vacuum
distillation is separating Mazout to other derivatives under very less pressure than atmospheric pressure.

3) Inductive couple plasma (ICP) device which explore minerals in mazout and lubricants.

Also some groups of modern devices were introduced such as:

Chromatograph in liquid form which will allow performing many tests on liquid fuel such as testing aromatic items in various sections especially aromatic compounds in diesel fuel and other.

In addition to replacing and modernizing old devices such as:

- Specific dens meter device.
- Bi compound measuring device.
- Automatic distillation.
- Gas analyzing device.

3.3 The Safety in ARC

There are three main goals in ARC (Statistics Department Report et al. [138] and Torosyn [147]).

1) Protect their workers and staff from accident and diseases.
2) Protect properties.
3) Assuring the continuity of refinery activities with high efficiency.

3.3.1 Safety Department Mission

- To issue safety wear and equipment’s to the workers and staffs in the refinery.
- Tract and allocate the violators of safety procedures.
- Issue and follow the work permits with its’ various types and its validity as per the required jobs.
- Daily field visit by safety members at the refinery branches and crude oil derivatives and crude oil port to inspect works and
workers and observes the defaults if existed to correct them on time and to raise a report to the faire and safety manager on all the observation each as per as his duty.

- Conduct training course for all workers, staffs, assistants and supervisors categories in the training building on every Monday of each week and to give lectures on line and safety scopes also to perform a life firefighting training in the training field to know the use of fire extinguishers for various types of fire.

### 3.4 Development and Modernization of ARC (in brief)

The development and modernization for ARC (Mobbs [97], Statistics Department Report et al. [138] and The World Bank Group [145]) as following:

1) Development of production units.
   - Arial distillation unit.
   - Atmospheric distillation unit.
   - Plat former unit.

2) Utilities and off set development and modernization.
   - Oil tanks and petroleum products.
   - Crude oil and petroleum products tanks.
   - Modernization of tank from.
   - Construction of power station.
   - Preparation of the stand by electric power station.
   - Rehabilitation of oily water separators.
   - Maintenance of oil pipeline to the port.

3) Development and modernization of oil harbor:
   - Development of jetties.
   - Rehabilitation of tankers and tags.
• Development of loading arms.

4) Renew oil tank, fuel and gas.

5) Renew tank farm.

6) Construction of two gas tanks.

7) Organize security system.

8) Aden bunkering development.

9) Development and renew the buildings:
   • Administration department.
   • Building of security gate.
   • Maintenance department.

10) Reorganize the company:
   • Head office building and annexes.
   • The hospital first Stage.
   • Training center regional training center.
   • Information center.
   • Security organization.

11) Renewal:
   • Renew the old hospital.
   • Renew administration and service buildings.
   • Sport clubs and filed.

12) Social services projects.

13) Renew roads and bridges.

14) Renew oil pipeline to Aden bunkering department.
Picture 3.5 Crude Oil Distillation Units at ARC

Picture 3.6 Storage Tanks for LPG at ARC
3.5 Conclusions

Aden Refinery Company (ARC) located in the city of Aden on a coastline approximates 350 k.m south of Sana’a capital of Yemen Republic. It was established and constructed by British Petroleum (BP) in 1954’s. In May 1977’s the ownership of this refinery transferred to the republic of Yemen.

The Industrial units in ARC are LPG Production Unit, Fractional Atmospheric Distillation Unit, Vacuum Distillation Unit, Hydrotrating Unit, Gasoline Reforming Unit, Merox Unit (sweeting unit for Gasoline, Kerosene) and De asphalting Unit.

The ARC is one of those which use Hydrogen to process its products like LPG (Liquefied Petroleum Gas,) Motor Gasoline’s (Regular and Premium, Diesel Oils, ATK (Aviation Turbine Kerosene Fuel Oils, Waxy Gas Oils and Asphalt. This refinery is designed to process high Sulfur crude, Kuwaiti crude and Qatar crude. During its refining process, it refines crude from various resources from Middle East, North Africa, Russia and Iran up to the mid-nineties 1990’s, when Marib crude had replaced them and become the main crude available for refinery. The Marib crude, firstly, transferred through a 450 k.m pipeline from the producing fields to Ras-Issa terminal, on the red sea then carried to ARC using tanker trucks like Qana, Al Maseala and Bab Al Mandab.