



إحدى شركات مؤسسة البترول الكويتية  
A Subsidiary of Kuwait Petroleum Corporation

# Progress & Prosperity





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### HISTORICAL INSIGHT



Kuwait Oil Company (KOC) was established in 1934 under joint ownership agreement between the Anglo-Iranian Oil Company, now known as British Petroleum and Gulf Oil Corporation known today as Chevron. The company was given free concession rights to explore and produce oil in state of Kuwait.

Exploration activities began soon after; surface geology studies and gravity surveys were conducted.

In 1936 KOC drilled the first exploratory well in north Bahra area but the results were not encouraging enough to continue.

In 1938 oil was discovered in Burgan well-1. During the following years, eight exploration and appraisal wells were drilled which established "Burgan" as one of the largest producing oil fields in the world. However, drilling and production operations were suspended due to the eruption of World War II. After the end of the war in 1945, operations were resumed and the eight drilled wells produced at a rate of 30,000 bpd. Surface facilities, pipe lines, exporting facilities... etc had been constructed and Kuwait was

ready for new era of prosperity.

In June 30, 1946 His Highness the late Sheikh Ahmad Al-Jaber, then Amir of Kuwait, inaugurated the first shipment of oil when he turned the silver wheeled valve to start loading of the first flow of oil onto the 12,000 tonne "British Fuzilier" tanker.

Following the early success, more appraisals and development well were drilled in Burgan field to increase production. In 1951, explorations operations were extended into Magwa and Ahmadi ridge area, oil was discovered and production began from the Magwa field in 1953.

Exploration activities continued in the following years leading to the discovery of Raudhatain field in north Kuwait and Minagish field in west Kuwait in 1955.

In 1974 a partnership was ratified by Kuwait National Assembly giving 60% control of the operations and facilities of KOC to the State of Kuwait while remaining 40% were divided equally between BP and Gulf.

In 1975 the Kuwait government assumed full ownership of the company.

In 1980, it was about time to organize the oil sector. Kuwait petroleum Corporation (KPC) was established by an Amiri Decree.

KOC was given the responsibility of on-shore off-shore exploration, drilling, development, and production of hydrocarbon in the state of Kuwait.

In 1981 KOC conducted an on-shore off-shore 2D seismic survey for development and exploration objectives. This was followed by successful drilling program to increase production from the discovered fields. In 1983 KOC commenced its first off-shore exploration drilling. Four prospects were drilled using Al-Baz rig with no economical discoveries but oil shows were reported.

Between August 1990 and February 1991, nearly 80% of KOC producing wells, installations and facilities were destroyed in the wake of the Iraqi invasion. Their complete restoration in less than four years was achieved as result of the remarkable level of cooperation between KPC subsidiaries, and in tribute to Kuwaiti National pride.

H.H the Amir Sheikh Jaber Al-Ahmed Al-Jaber Al-Sabah personally capped Burgan 118 on November

6, 1991, 18 months ahead of international forecast. This was the result of more than 700 oil wells set ablaze by the Iraqis. The first post-liberation shipment of 1.64 million barrels of crude oil left Kuwait in July 1991, by September of the same year new wells were under construction and crude oil production once again exceeded the two million barrels per day level by February 1993.

The strategic goals of KOC were to increase oil and gas reserves and production. Plans were established following the liberation. In 1995 extensive exploration and development programs were designed. Thousands of 2D, 3D and 4D Seismic data were acquired over the whole land area, Bubiyan Island and transition zone. In December 30 of the same year the company signed a contract with Chinese Petroleum Corporation to build gathering centers 27 and 28 in west Kuwait. In January 9, 1996 two rotary platforms were constructed.

In March 1997, the Ahmadi Park was renovated, decorated and reopened under the patronage of then Ahmaid governor Sheikh Ali Jaber Al-Ahmad Al-Sabah. In March 1998, Ahmadi sports day was re-celebrated after the company has rebuilt the sporting, entertainment and social facilities.





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In April 1998, the chairman's HSE award was implemented.

The Company's various activities continued at all levels. In March 2000, the 14th Ahmadi Sports Day was held.

In July 2000 gathering center 25 north of Kuwait was commissioned. In January and April 2001 gathering centers (27), (28) in west Kuwait fields were respectively inaugurated and commissioned.

In 2003, KOC jointly with major seismic company tested the use of digital single sensors to acquire high resolution 3D Seismic data in Minagish field.

In 2003/2005 KOC acquired 1650 sq. km of 3D Seismic cover, Ratqa, Mutriba, Ladira, Dhahi and Raudhatain areas.

KOC has launched its ambitious 2020 strategy which calls for increasing oil and gas reserves and increase production.

Exploration activities have been intensified in order to achieve the strategy. Exploration studies and drilling have been focused on the hydrocarbon potentials of the deep Jurassic and Permian reservoirs.

These intense exploration drilling activities have resulted on several significant light oil and gas discov-

eries.

SA-153 (1999-Marrat, 2002-Najmah/Sargelu) Middle Marrat interval was tested and produced 15.7 MMSCFD gas, with condensate @ 4500 BCPD. Najmah/Sargelu interval was tested and produced 14 MMSCFD gas with condensate @ 4510 BCPD.

RA-206 (2002-Marrat) exploratory well Middle Marrat interval was tested and the well produced light crude oil (46o API) @3869 bopd of oil with gas potential of 8.55mmscf/day.

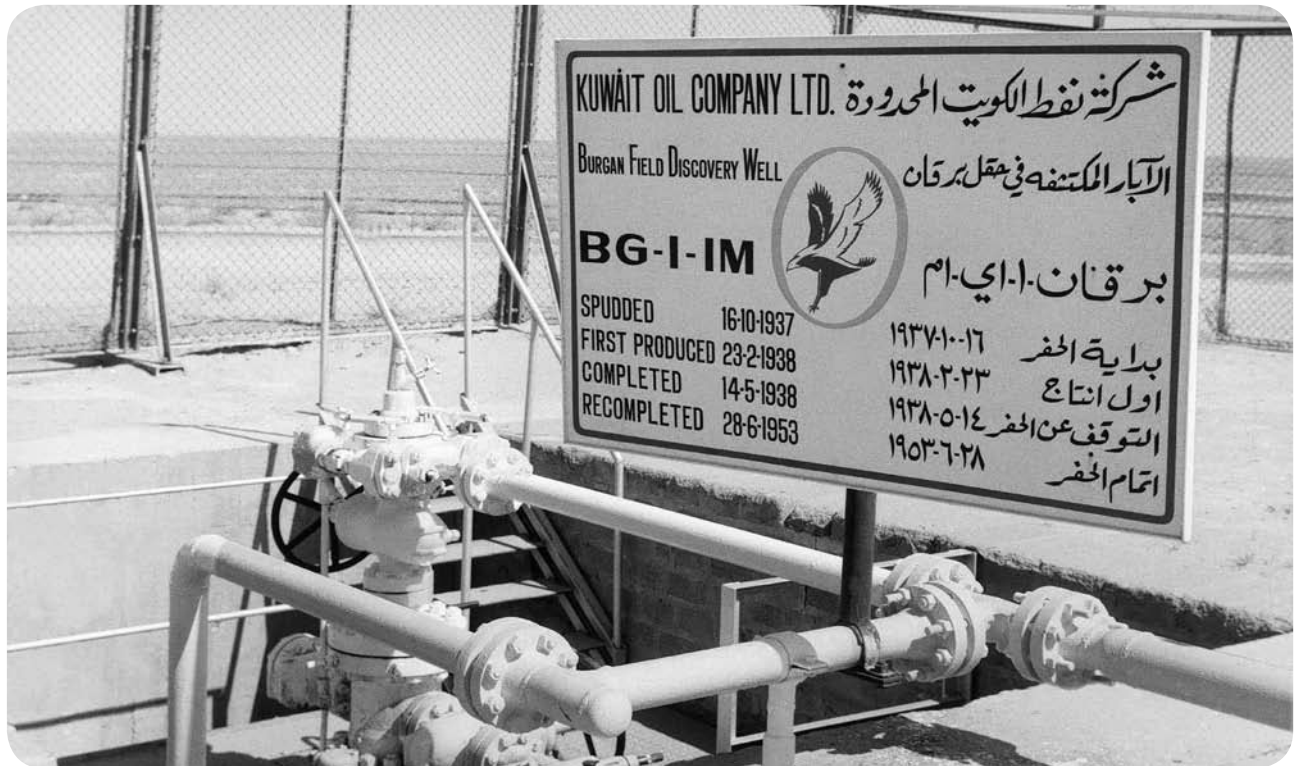
NWRA-01 (2002-Marrat) Middle Marrat interval was tested @ 5189 bopd of (43o API) oil and associated gas 11.5 MMSCFD.

KA-01 (2002-Marrat) discovery of 40 API oil was made in Middle Marrat produced 323 bopd of oil with GOR of 1070scf/bbl.

SA-072 (2003-Marrat) The well has been completed in Middle Marrat and produced 8.2 MMSCFD gas with condensate @ 4532 BCPD.

KA-01 (2004-Najmah/Sargelu) Well KA-01ST(Side Track) has produced from Najmah Sargelu reservoir through 32/64" @ 1876 BOPD, API: 49°, GOR: 1795 SCF/bbl

Bahrah-28 (2004 Middle Marrat) First commercial





quantities of light oil in Bahrah Field in the very first Jurassic well. The post-acidization test results through 32/64" choke @ 4860 BOPD, API: 44°, Gas Rate: 12.670 MMSCFD

RA-230 (2005-Middle Marrat) Oil: 4963 BOPD, Gas: 14.0 MMSCFD, FWHP: 5933 PSI, RA-236 (2006-Middle Marrat) Oil: 5245 BOPD, Gas: 15.2 MMSCFD,

These discoveries (RA-230/236) have confirmed the extent of high quality oil in Raudhatain structure.

RH-02 (2003-Marrat, 2004-Najmah/Sargelu) exploratory well Middle Marrat interval was tested and the well flowed 46 API OIL @ 2352 bopd of oil with GOR of 1627 scf/bbl. Najmah/Sargelu interval was tested and produced light crude (52° API) @ 5702 bopd with GOR of 2582 Scf/bbl and associated gas @ 14.7 MMSCFD.

The highest quality oil in Kuwait and proved oil 1500 feet deeper than the known Minagish field.

UN-01(SA-215)\_2005 Middle Marrat Test-1

Gas rate: 16.8 MMSCFD, Condensate rate: 3052 BCPD

Middle Marrat Test-2

Gas rate: 14 MMSCFD, Condensate rate: 2738 BCPD

Middle Marrat Test-3

Gas rate: 14.4 MMSCFD, Condensate rate: 2455

BCPD,

Upper Marrat Test

Gas rate: 10.206 MMSCFD, Condensate rate: 1879 BCPD

Najmah/Sargelu Test

Gas rate: 27.132 MMSCFD, Condensate rate: 2153 BCPD

NWRA-02 (Najmah/Sargelu)-2005 Has been the second gas condensate discovery in North Kuwait from Najmah/Sargelu. Gas: 19.1 MMSCFD, Condensate rate: 3571 BCPD.

Arifjan-01(Marrat)-2006 Located SE of Burgan Structure this well has produced oil @ rate 5357 BOPD API: 42°, Gas rate: 8.336 MMSCFD

UR-01(Marrat)-2007 Located on Minagish \_ Rahayiah Trend the UR-01 have produced oil @: 679 BOPD, API: 43

UN-02(Marrat)-2007 has produced Gas @ rate: 19 MMSCFD and Condensate @ rate: 2063 BCPD

These major light oil and gas discoveries have established Kuwait on the world map of gas producing countries.

### EXPLORATION & DRILLING OPERATIONS



#### Oil Origin & Formation:

Oil is formed from the remains of numerous animals and plants that lived and died in the sea millions of years ago. Covered beneath hundred of tons of rocks and subject to high pressures and temperatures, bacterial reactions take place in these organic materials to form oil.

#### Locations of Oil:

Oil exists within the porous layers of sedimentary rocks that have been trapped for millions of years by a covering of non-porous "cap" rocks. Sedimentary rocks are formed from silt, sand or the debris of shells precipitated at the bottom of ancient seas and it is these sedimentary rocks that oil explorers search for.

#### Exploration:

Exploration process is divided into several phases. It begins with identifying a specific location in which geologists expect availability of main factors for oil reservoirs formation. At this point, geologists make recommendations to conduct certain geological surveys which are divided into several types according to the type of information needed to be collected. Such surveys are concerned with studying physical properties of earth layers through conducting measurements for physical fields on and near land surveys. The importance of these surveys is that they reduce exploration drilling risks. The types of these surveys are set out below:



#### • Magnetic Surveys:

These are used in the preliminary stages of exploration and can be performed on land, at sea and from the air. Magnetometers are used to measure magnetic anomalies in the subsurface rocks to identify possible sedimentary rock basins and main drifts where oil might be located.

#### • Gravimetric Surveys:

In this method, earth gravity is measured to identify anomalies associated with oil entrapments. These surveys can also be carried out on land, at sea and from the air. The interpretation of this survey provides information on the depth to basement and the subsurface structural configuration.

#### • Aerial Surveys:

Picture and images taken from aircraft or satellites are used to draw maps of geological and topographic features on the earth's surface that indicates where oil may be trapped in the rocks below. The images recorded can be pho-

tographic or radiant, i.e. measuring the reflection, absorption and dispersion of electromagnetic wave spectra emanating from the earth's surface. These methods are additionally used in engineering projects to select locations for pipelines, roads and buildings.

#### • Seismic Surveys:

Using the information provided by the geophysical methods described above, the oil explorations will then carry out seismic surveys over locations that indicate where oil is most likely to be found. Seismic surveys can be performed on land, at sea and provide much more detailed information about the deposition and formation of the subsurface geology. Structural maps and stratigraphic interpretations can be made from 2D seismic data. Advanced three dimensional (3D) seismic surveys provide even more accurate geological images of complex faults and oil traps leading to fewer dry wells being drilled. New techniques make use of seismic data to measure



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rock porosity and permeability within oil reservoirs. The four dimensional (4D) seismic surveys have been recently introduced. This technique provides information on the fluid movements within producing reservoirs.

The accuracy of the results of the seismic surveys greatly enhances the success of exploration drilling.

After obtaining these surveys and analyzing information, geologists team perform the next phase which includes many geological studies using the information gathered through geophysical surveys in addition to information made available from neighboring wells, if any. Some of these studies are mentioned hereunder:

- **Constructive Geological Studies:**

Concerned with the study of the Geology of strata based on the structure and the changes of the appearance of traps and potential for oil entrapment within oil traps in addition to identification of types of folds and drifts that may

exist in the oil field and have positive or negative impact on traps according to type of layers.

- **Sedimentary Geological Studies:**

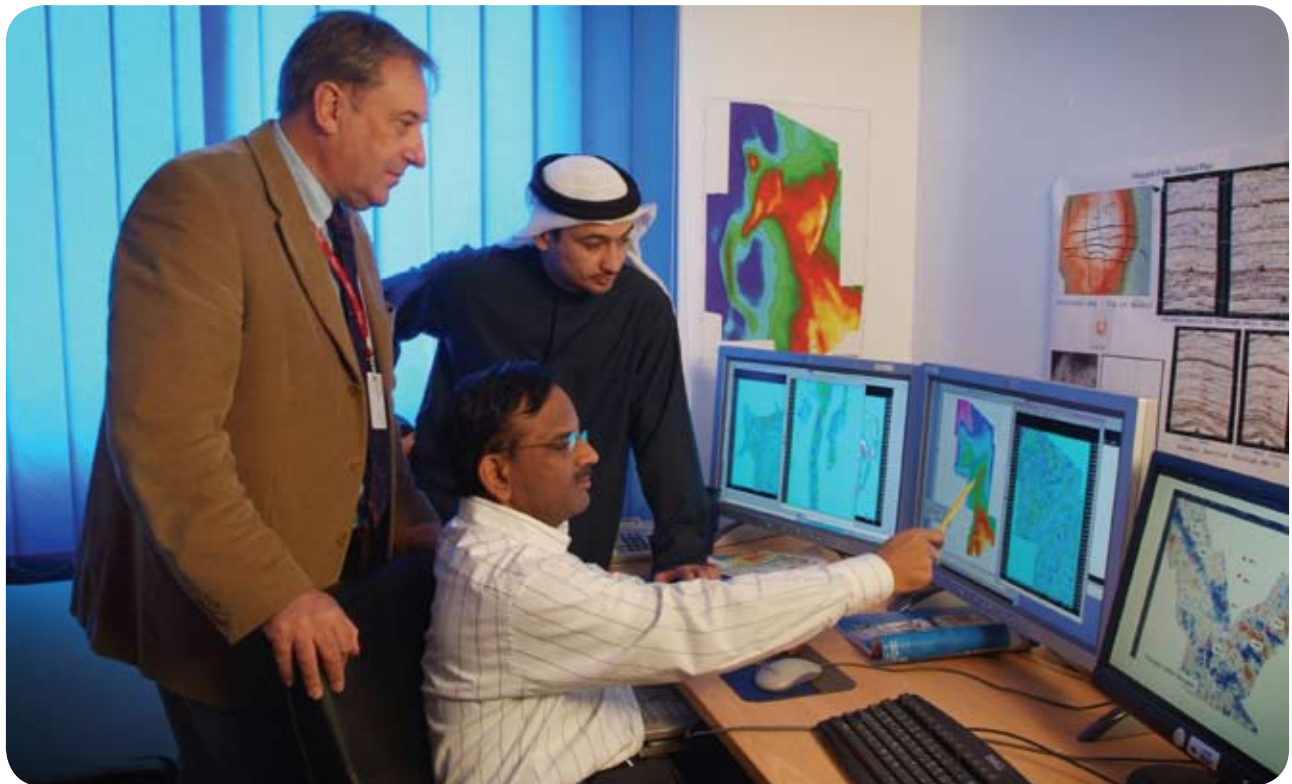
Geological Studies including the study of sedimentary sequences in respect to the type of rocks and entrapment mechanism, migration before or after the trap formation and also the presence of the sealing rocks for hydrocarbon preservation.

- **Basin Analysis:**

Concerned with the general studies of the sedimentary basins and their distribution, the types of the sedimentary rocks, the geologic structures and the potentialities of hydrocarbon occurrences and the optimum location of entrapment and the nature of the reservoir rocks and its extension and geographic distribution.

- **Geochemical Studies:**

Method involves chemical principle to characterize source rock, its thermal maturity for hydro-





carbon generation and migration in basin and to correlate the oil-oil and oil source rock samples. In addition, to identify various reservoir alterations of particular oil occurrence.

#### · Economic Feasibility Prospect Evaluation:

The prospective evaluation is dual with economics of the potential traps after running the technical geological & geophysical studies/surveys for defining the oil entrapment. The assessment of the economical value of these traps is very essential to show the elements of risk analysis, the oil in place and the recoverable reserves, the exploration and development cost estimates for economic feasibilities.

After completion of all required studies and identification of economic feasibility for the reservoir intended for exploration, geologists provide recommendations which include explanation for all previous phases in addition to one or two locations that have been identified through studies to conduct drilling indicating risk rate and the

difference between one site and the other.

All these studies are then highlighted by drilling exploration wells to prove oil presence, where these wells may be drilled to intermediate or deeper depths. After the completion of exploration drilling and oil has been discovered, the prospects are then transferred to the next phase, which is the delineation & appraisal drilling to define the boundaries of the discovered field and to assess the recoverable oil reserves.





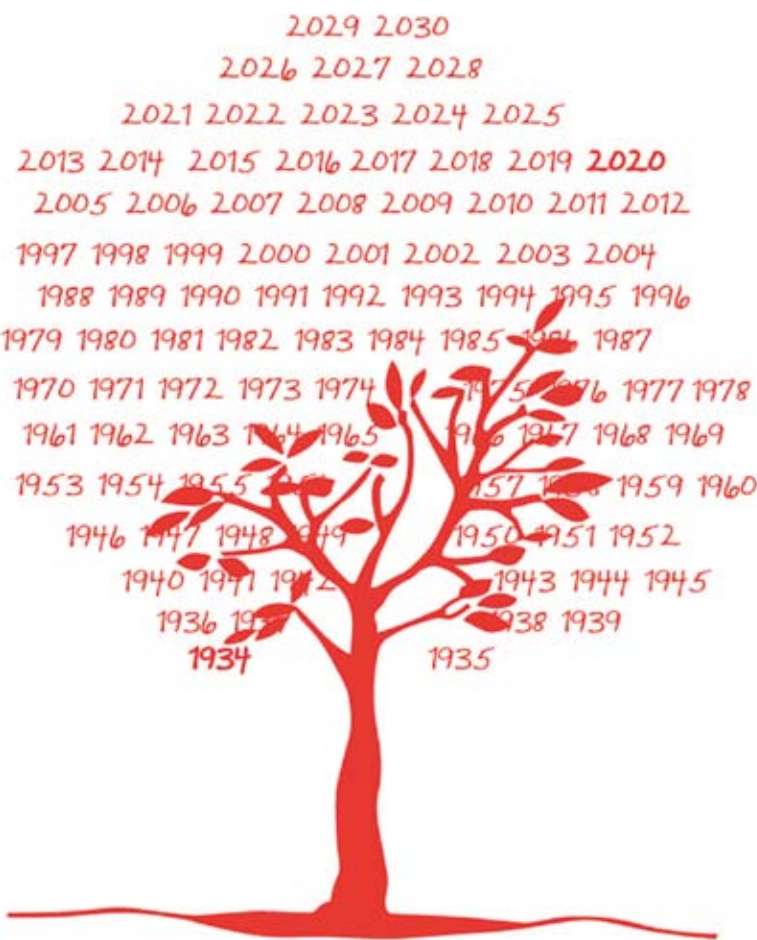
STRATEGY (2020)

In 2005 Kuwait Oil Company launched its ambitious strategy for 2020 which aims to increase production to four million barrels per day, increase oil reserves and explore gas. Appropriate and deliberate plans were developed to achieve these objectives in all fields of exploration, drilling and development. Exploratory drilling operations resulted in many significant explorations of light oil and gas. This gives importance and strategic dimension to exploration operations and achieving the Company ambitious plans as well as es-

tablishing history of Kuwait joining gas producing countries forum.

The strategy is based on the following seven axes:

- 1- Production Capacity
- 2- Increase Reserves
- 3- Gas exploration and Production
- 4- Health, Safety & Environment
- 5- Research & Technology
- 6- Regulatory Culture and the Company Image
- 7- Support Services





## DRILLING OPERATIONS



### Definition:

Drilling is a mechanical process that requires special tools and technology. Equipment is used to penetrate the earth to recover oil and gas found in the subsurface layers.

Once an exact spot on the surface is determined, drilling operations begin. Drilling operations are in accordance with a schedule indicating the depth of the well and the different size casings to be placed in the well at different depths. These casings are used to protect the well from corrosion and to prevent fluids from entering the hole.

### Drilling fluid:

Drilling fluid or mud is basically a mixture of water, clay, minerals and chemicals. Drilling mud is pumped down the hole through the drill pipe and the drill collars and exits at the bit through the nozzle and heads back up the hole to the surface through the annulus, a space between the outside of the drill strings and the wall of the hole.

### Drilling fluids are used to:

- Flush cuttings from the hole.
- Cool and lubricate the bit and ease the rotation of its



cones.

- Support the walls of the well from caving in and prevent the flow of gas and oil into the formations during drilling operations.

### Casing and tubing:

Casing and tubing are precision made steel pipes of various sizes and specification. At intervals a drill hole is lined with "casing" which is inserted from top to bottom and cemented into position.

### Main uses of casing are:

- To control high and low pressure formations.
- To prevent the hole from caving in.
- To replace the flow of oil "production from casing".
- To produce oil from different formations, "dual producer".

### Drilling Techniques:

Wildcat drilling is considered one of the most expensive and difficult drilling of all. This type is carried out to determine whether gas or oil accumulations exist in the explored area. Another drilling technique is developmental drilling.

Work-over operations are carried out by work-over rigs.

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When the rig moves over a well, first the well has to be stopped flowing or "killed". This is usually done by forcing the oil back into the formation with pumping suitable saline fluid to overcome the production pressure. When the well is killed, the Christmas tree can then be removed and blowout prevents are fitted, after which the tubing can be pulled out of the hole and work-over is carried out. Since the first well was drilled in search for oil at mid 19th century, there have been massive developments in the tools, technology and methods of drilling. The rotary drilling technique allows us drill to greater depth in shorter periods of time. This was followed by turbine drilling which used the turbines inside the well to directly rotate the drilling bit.

Due to the awkward location of some drilling sites in residential, archeological and offshore areas, directional drilling was developed. Also in line with these developments is the horizontal drilling which became another method used in production. It is also one of the methods used in supported recovery. In comparison with other production methods, horizontal drilling increases production rates, as well as the percentage of oil recovered from the reservoir.

### Offshore Drilling:

Offshore Drilling is very similar to onshore, the chief different being the rigs used to drill offshore wells.

The rigs used to drill offshore wells are installed on mobile platforms pinned to the seabed by means of piles driven into the sea-floor. They can be moved easily from one location to another. The platform is designed to hold the equipment, drilling materials and small facilities. Offshore drilling cost is higher than terrestrial drilling.

### Drilling wells in Kuwait:

The wells in Kuwait are drilled vertically. Within these

wells are wells of lesser depths, beginning at a depth of about 850-7000 feet and averaging to about 7000-12000 feet. There are much deeper wells of about 20,000 feet.

Recently, Kuwait Oil Company has introduced a number of modern techniques, the most notable of which is horizontal drilling. This type of drilling method is carried out drilling a vertical hole to the producing zone, then followed by horizontal drilling. The advantages of this type of drilling are that it increases production from certain formations and reduces the cost over the long-term.

The Company is currently carrying out deep exploratory drilling to search for new formations and to prospect for gas.

### Drilling Workshops:

Workshops and Stores carry out the following:

- The storage of equipment and materials required for drilling operations.
- Coordinate between the concerned parties and the Drilling Dept.
- Planning and scheduling of drilling rig movement.
- Supply and provide materials and equipment to the drilling sites.

### Drilling Water Wells:

In addition to the drilling of oil wells, there are also water well drilling operations. These wells are drilled in order to supply rigs and Gathering Centers with water. Also, wells are drilled to protect oil wells from corrosion, referred to as cathodic protection.



## FIELDS DEVELOPMENT



### 1- RESERVOIR GEOLOGY

Oil is usually found in pores and vugs of reservoir rocks. These rocks are in most of the cases of sandstone, limestone or dolomite and found underground at different depths. Some reservoir rocks in Kuwait are at more than 7 kilometers depth.

The amount of oil or gas in the reservoir rock depends on many rock physical properties out of which porosity (percentage of rock pores to the rock and total volume), permeability (how easy fluids can pass through rock pores), oil saturation, net pay thickness

and reservoir geometry (Geological structure) are part of it. By determination of all these reservoir physical parameters, strategic oil reserves can be calculated and economically evaluated.

Identification of type of structural traps is considered as the main part in setting the proper Geological Model for each reservoir, which in return facilitates setting the optimum Field Development Plan for the reservoir.

Kuwait Oil Company is currently utilizing what is considered as top of the art in hard-



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ware and software technology in oil industry in order to calculate accurate reservoir rock physical properties and set a most accurate Geological Model for Kuwaiti oil fields. This goes side by side with the huge measurements and studies in lots of directions where the following are to be mentioned.

### Seismic Survey:

The surface and well seismic survey is considered as the first step in exploration and development of oil fields. It helps to identify the structural and stratigraphic traps that can be considered as promising in hydrocarbon content. Therefore, Kuwait Oil Company has performed what is considered as vast 2D and 3D surface seismic survey on all onshore and offshore land of Kuwait state. Extensive processing and interpretation of

the seismic data have followed this survey in order to improve the geological model of all reservoirs.

### Wire-Line Well Logging:

International logging contractors working in Kuwait are providing wide range of logging service, processing and interpretation of logging data in oil wells on daily basis. These log data are the only way to predict the physical properties of the reservoir rock. Each logging tool works on a specific technique to measure one of the natural responses of the reservoir rock. These responses are interpreted later to calculate the physical properties of the reservoir. Logging technology is subject to daily development and lots of high tech tools are introduced to the market from time to time. Kuwait Oil Company





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is considered one of the leaders in the area in utilizing all the new in this career for the benefit of Kuwait oil industry.

#### Core Sample Analysis:

As wire-line logging process does not measure direct and absolute rock properties but depends on interpretation of nature of rock character to predict rock physical parameters, the need for direct measurements of rock properties is raised to calibrate log measurements. This is being achieved now by collecting either a full diameter core or side wall core plugs from the reservoir rock. These rock samples are sent to Kuwait Institute for Scientific Research or any other spe-

cialized contractors working in Kuwait for different and detailed type of measurements to identify the absolute rock properties of the reservoir which facilitates development and production process.

This type of study is considered one of the latest technologies used to get more knowledge about the reservoir and detailed study thereof through incorporating all information made available from seismic and wire line well log measurements and analysis of core samples. They assist to build a comprehensive structure model to interpret and evaluate the reservoir internal structure leading to distribution and classification of information within it in 3D vision.





### 2- Development of Oil Production Reservoirs:

The primary objective of reservoir engineering is to cost effectively optimize the hydrocarbon recovery through efficient strategic planning and reservoir management.

The Company therefore, has undertaken a long-term study of the condition and behavior of the oil reservoirs.

These studies have become more complicated with time. The utilization of new technologies and industry modern techniques is very essential in order to efficiently construct development plans and production strategy. The studies identify the point of force and the attributes of a reservoir that control the flow of liquids and gases within the reservoir rock and into production wells.

#### Reservoir Definition:

Reservoir is a subsurface layer having sufficient porosity and permeability to store and transmit economic quantities of hydrocarbon fluids. Oil, gas and water contained in this layer are usually sealed by a relatively imper-

meable formation through which hydrocarbons will not flow. Reservoir rock could be either sandstone or carbonates.

Areas contribute to enhance Reservoir Development:

- 1- Reservoir rock type (sandstone or carbonate) and its properties (porosity and permeability).
- 2- Fluid properties (viscosity, associated gas, API density...).
- 3- Reservoir geological model showing rock and properties distribution.
- 4- Production mechanism (solution gas drive, gas cap drive, water drive).
- 5- Tracking water encroachment.
- 6- Reservoir simulation models.

#### Modern Studies in production Development:

In general, the abovementioned studies are applied to different fields in Kuwait such as the Greater Burgan Field, which contains the largest Sandstone reservoir in the world. In order to manage such reservoir, state of the art technology needs to be utilized in the Company's researches and studies. The following are some of the major studies conducted in the area of reservoir development:

- 1- Post-Blowout status of the reservoir.
- 2- Geological and simulation models.
- 3- Water encroachment studies.
- 4- Reserves evaluation studies.
- 5- Production history and predicted reservoirs behavior.



6- Evaluating different production scenarios and determining the feasibility of each scenario.

7- Analyzing 2D and 3D seismic studies.

These studies were carried out for the following fields in Kuwait:

Fields		Reservoirs		
Greater Burgan Field		Burgan Wara Marrat Minagish		
Umm Gudair Field		Marrat Minagish		
Minagish Field		East Minagish Marrat		
Raudhatain Field	Maudoud	Upper Burgan	Down Burgan	Zubair
Sabriyah Field	Maudoud	Upper Burgan	Down Burgan	

### 3- Petroleum Engineering:

Petroleum Engineering is the backbone to all oilfield operations. Hydrocarbon reservoirs need wells to be completed and produced in an appropriate manner to get the best out of this Mother nature's treasure. Petroleum engineering usually associated with completion, monitoring, evaluation and optimization of well performance. With increasing complexity of reservoirs and the need to enhance production through secondary and tertiary enhanced recovery process, artificial lift etc., the role of petroleum engineers is becoming ever important to ensure desired results.

Some major petroleum engineering areas that are efficiently being dealt with in KOC

are outlined below:

### Well planning, design and equipment selection:

Each well is planned to meet specified requirements and completion designed to meet required rate conditions. Appropriate completion equipment is thus selected keeping in view HSE compliance.

### Well Engineering:

Tubing stress calculations are done for each well and appropriate completion equipment is selected to ensure well integrity.

Injection well monitoring and use of performance improvement techniques.

Injection well rates & quality are constantly monitored and evaluated. Acid stimulation and flow back techniques are being utilized to improve well performance where appropriate.

### Balance injection and off-take rates for water flood management:

Production and injection rates for each waterflood pattern are assessed and adjusted to maintain optimum sweep.

### Inhibition of asphaltene/scale/bacterial, etc. deposition:

Asphaltene deposition is a problem in some of our oil fields. Many studies have been conducted to identify the causes of the problem and to devise remedial measures. Chemical squeezes are currently being tried to control/mitigate this problem. Also with



onset of water cut in wells scale deposition is a potential problem and measures are available to deal with this through appropriate chemical squeeze treatments.

Corrosion monitoring and control:

Full scale corrosion monitoring and control processes are implemented to ensure risk free operations.

### Water production control:

Water cut is a major problem in wells producing from natural/artificial water influx reservoirs. Water production is reduced with cement squeeze jobs where appropriate.



### Artificial lift design, implementation, monitoring and optimization:

Many type of artificial lift methods such as electrical submersible pumps, gas lift etc. are already designed and in use in many wells. The performance of these lift mechanism is being continuously evaluated.

Production well performance monitoring and evaluation:

All producers are constantly monitored and performance is optimized through vertical lift performance software.

### Well integrity assurance:

Each well integrity is analyzed through suitable logs/well performance and all remedial

measures are being taken to ensure well integrity.

### Surveillance data acquisition and evaluation:

Surveillance strategy based on prudent reservoir management practices is formulated and implemented to acquire required surveillance data. This is key input for reservoir management and highlighting well intervention opportunities.

### Well Surveillance Division:

The division consists of three sections and major functions of each section are given below:



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### First: Contract Section:

The section is responsible for administration of various contracts like:

- 1- Electrical submersible pumping lease contracts.
- 2- Gas lift contracts.
- 3- Coiled tubing contracts.
- 4- Well testing contracts.
- 5- Hydrochloric acid supply contracts.
- 6- Preparation of Capital and Expense budgets.
- 7- Budget control and monthly status reports.
- 8- Processing of contractor's invoices.

### Second: Artificial Lift Operation Section:

This section is responsible for all field operations related to artificial lifts modes such as submersible pumping and gas lift, etc. Main functions of this section are:

- 1- Supervision of work/overs for installations of ESPs and Gas lift.
- 2- Monitoring and trouble shooting of artificial lift installations.
- 3- Verifying contractors service tickets for the services provided.
- 4- Weekly and monthly status reports.

### Third: Rigless Operations Section:

This section is responsible for all wire line activities and rigless operations as detailed below:

- 1- Follow up well measurement activities.
- 2- Well renovation through cleaning operations.



- 3- Slick line works, enlivening wells by swabbing, PLTs, TDTs, pressure/temperature surveys and tubing corrosion logs.
- 4- Well productivity measurement processes.
- 5- PVT sampling, production-GOR testing of wells.
- 6- Rigless perforations.
- 7- Well stimulation and coiled tubing jobs.
- 8- Increase production through changing production layer.
- 9- Reduce water production.
- 10- Treat production deposits
- 11- Treat pipelines from asphaltine and lime deposits.
- 12- Well depth control.
- 13- Lift and remove equipment and wires dropped into the well.
- 14- Services tickets/invoices verification and budget control for related jobs.
- 15- Preparation of monthly status reports.
- 16- Train and develop the Company petroleum engineers in addition to the students of Faculty of Engineering & Petroleum in Kuwait University and PAAET.

## PRODUCTION (EXPORT & MARINE) OPERATIONS



### 1- Production Operations:

Production Operations manage the process of producing crude from all of Kuwaiti oil fields. The fields are connected to Gathering Centers where gas is separated from oil.

Oil is then pumped along to the main manifold in Ahmadi where the oil produced is combined. The oil is temporarily stored in the North and South Tank Farms, and is then transferred and loaded in vessels at sea. The oil is also transferred to the refineries in Mina Al-Ahmadi, Al-Shuaiba and Mina Abdulla and occasionally to Kuwait's power generating stations.

The gas separated from oil is also transferred to gas booster stations and, from there, to the gas refinery station in Ahmadi. The gas, referred to as "rich" gas contains hydrocarbons and other chemicals that are later separated at the refinery. The gas is fed back to the distribution network as "lean" fuel gas and is then distributed to power stations and other industries.

### Production facilities include:

#### The Wellheads:

The Wellhead is the equipment used to confine and control the flow of oil from the well



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to Gathering Centers. The wellhead is made up of an assembly of valves and fittings that can control the amount of crude oil that is produced from the well. Wellheads are made of a special type of metal. They are heavy and high-pressured to support the weight of the tubing in the well.

### Pipeline and Manifolds for oil and gas:

A manifold is an accessory system of pipes and lines that extend along an area to carry gas, liquefied gas and crude oil to the various facilities and installations in the Company. A manifold is a center for a number of pipelines that control the flow of oil and gas with the ability to separate them during maintenance.

### Oil Gathering Centers:

Gathering Centers are installations where oil is

separated from high and low pressure gases. The two types of gases are then transferred to gas booster stations. Each Gathering Center receives oil from a number of wells, determined according to the size and production capacity of the Center. Most Gathering Centers accommodate 30 wells at least. Each one of the wells is distinguished from one another in terms of pressure, amount of salt found, production method used and depth.

### Gas Booster Stations:

The gas which is separated in Gathering Centers is sent to these stations, then it is compressed and transmitted to the petroleum condensation plant. Before gas is transferred to the refineries it passes through a water removal system.

Under high and low pressure, liquefied petroleum gas is produced. The gas passes





through the water removal plant a second time and is transferred to refineries in Shuaiba.

#### Water Injection:

A method of re-injecting effluent or surplus water into the earth's high-pressure reservoirs. The internal pressure of the well can be maintained or dispose of produced water into reservoirs allocated for this purpose by using this method.

#### Gas Injection:

A method of re-injecting surplus gas into the earth's high-pressure reservoirs. The internal pressure of the well can be maintained by using this method.

#### Steam Injection:

Similar to the method used in gas injection and is used to maintain production.

Manifold where oil from Gathering Centers is combined:

Gathering Centers pipeline converge at the main manifold. A manifold connects between the crude oil system and the oil tank farms.

#### Tank Farms:

A group of tanks to collect and store the crude before the transfer to the loading facilities for export. There are a total of 56 tanks, 24 in the North Tank Farm and 22 in the South Tank Farm with a total storage capacity of about 16 million barrels.

#### 2- Export Pipelines:

Oil is exported from the South Tank Farm through pipelines. It flows through a grav-





ity manifold connected to the South Tank Farm.

These pipelines extended to the South Pier and single point mooring and supply the refineries and power stations.

Oil is exported from the North Tank Farm through four pipelines which are connected to gravity manifolds of North Tank Farm. Three of the pipelines extend to the North Pier and to the SPM pump house at Mina Al-Ahmadi.

### · Pump House (gravity line):

Oil is exported through use of gravity flow lines. The pumping units located in Mina Al-Ahmadi are used when high export flow rate is needed.

### · Crude Oil Control Room:

All operations including mixing, storing and exporting of crude oil are controlled in this room using sophisticated and advanced equipment. Construction of this Center was completed in 1994.

### · Old South Pier:

It was constructed in Mina Al-Ahmadi in 1949 and it includes 7 berths in 40-49ft. in depth.

Due to old construction of this pier, a new pier was constructed near thereto including 7 berths in 40-49 ft. in depth, out of which 3 berths are equipped with facilities for loading crude oil tankers. This pier includes facilities for exporting gas, light distilled products, heavy and light fuel oil and diesel oil including shipments limited to one item only or in shipments in which one of these prod-



ucts is mixed with other products. The pier is equipped with two berths that include special facilities for LPG.

Although ownership of this pier was transferred to Kuwait National Petroleum Company, however, marine operations are managed by Kuwaiti Oil Company through Export and Marine Operations Group.

#### • North Pier:

The North Pier was constructed in order to accommodate the increase in oil exports. It was commissioned in June 1959. The pier includes four berths with 55-60ft. in depth.

#### • Sea Island:

The increase in size and number of tank-

ers (reaching a loading capacity of 320,000 d.w.t.) prompted the idea of constructing a two-berth sea island 10 miles offshore in 95 feet of depth.

A ceremony was held under the auspicious of the late Sheikh Sabah Al-Salem Al-Sabah to announce the flow of oil through the world's longest marine pipeline extending to the Sea Island and loading on the VLCC "Universe Kuwait" with a capacity in excess of 326,000 tons (the island was destroyed due to invasion of vanished Iraqi regime in August 1990).

#### • Mooring Berths:

In 1994 to new mooring berths were built instead of the sea island which was destroyed

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by vicious invasion to Kuwait. These two mooring berths are operated alternatively and their export capacity is 14500 m/tons per hour.

### · Single Point Mooring:

The SPM is a loading facility. Carriers are secured by means of a single rope tied to the front of the ship. Floating hoses are placed along the side of the ship while it rotates freely around the SPM. The exporting capacity from this facility is about 7,500 ton/h by gravity lines and 12,500 ton/h by pumping.

### · New Production Operation Projects:

Upgrading Gathering Centers and gas boost stations through mega projects whereby oil and gas flow pipelines are changed and lifted as well as increasing their oil capacity by pro-

viding them with new equipment such as isolation units, dewatering and desalting units, pumps and liquefied gas intensification units.

### · Export operations Projects:

- Project for upgrading export facilities including construction of 19 tanks with operating capacity of 11,500 million barrels and adding 5 gravity 48" dia. pipelines and setting up post pumps, modern gauges and two new mooring berths.
- Increase export capacity through constructing 8 additional tanks with operating capacity of 5 million barrels.
- Replace filling pipelines for south and north tanks and replacing central mixing manifold.
- There are projects under study to accommodate future increase in production as per 2020 strategy for attaining production rate of 4 million barrels per day.





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## HEALTH, SAFETY & ENVIRONMENT



Health, Safety and Environment Group monitors and directs the Company's performance for applying HSE schemes and projects through the adoption of many sensitive programs, including:

- Project for limiting emission of gas contaminants associated with production as the most important source of air pollution in most oil production operation is the flaring of associated gas and its effect on the surrounding residential areas according to weather conditions at the time of emission and spread. Reducing these pollutants is considered as one of the most important environmental achievements in the Company's activities that started a short time ago, owing to their negative impact on the Company's environmental health reputation locally, regionally and internationally on one hand and on the credibility of performance in programs made within the Company's strategic plans at a healthy environment clear of pollutants and diseases on the other hand.
- The project of monitoring the quality of ambient air in oil operations area and identifying all sources causing air pollution resulting in emission of air contaminants, then, finding the best solutions to put a limit to this problem which is harmful to the health of employees, society and environment.
- Improving the quality of effluent water as-

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sociated with exploration and production operations with view of injecting such water into underground after processing and clearing it of the associated oil within the expansion and development programs in oil production operations.

- The Company is seeking to establish an optimal HSE program, through technology transfer programs and contracts with world major oil firms to identify the measure and methods special for realizing that program. Kuwait Oil Company is participating in organizing HSE seminar for oil sectors in the Middle East in cooperation with each of Exploration & Production Forum and International Petroleum Engineers Association.

- The Company carried out a pioneering experiment in waste recycling through actual participation by Ahmadi inhabitants for separating household wastes and redirecting the same to proper locations.

- The Company enclosed operations area with a security fence for protecting it, thus adding a new block to the project of land greenery and expanding the area of reserves which play a noticeable positive role in:

- Reducing the sand advancement phenomenon. This further helps expand the beautiful green plant area and contributes to promoting the biological diversification in the area.

- Among the vital projects, there is the annual gardening competition which encourages society to contribute to developing the agriculture and expanding the greenery in Ahmadi city. This had a remarkable effect in landscaping the area and developing it environmentally.

- Under its strategic plan, the Company developed a public project represented in project for keeping all gaseous, liquid and solid emissions and further all chemical waste in an accurate database for benefiting from them in decision-





making and facilitating the performance in applying HSE scheme.

- The Company is currently entering all file rules in the Geographical Information System (GIS) for facilitating the process of dealing with diversified and various information with the aim of developing, improving and speeding up its use in service of information management and implementation in a proper way in due time at the least cost. The system will serve as a specialized data-bank that provides the information to all Company employees. This will positively help in management of oil exploration and production operations within the framework of HSE policy.
- Water injection project at Wafra Field-Ratawi Reservoir has been commissioned in full for completely disposing large quantities of effluent water through pumping it in wells instated of draining it in water gathering pools in the desert.

- Coordination with the Public Authority for Industry and the National Cleaning Company for transporting inactive and dangerous waste from the Company's operations facilities to Shuaiba Waste Plant according to Cabinet's Resolution No. 1002 dated 20/12/1998.
- The Company has adopted HSE Benchmarking pioneering project within its strategic plan. This enhances its status and places it in the forefront of the region states in the field of HSE. The project aims at comparing the Company's performance at all levels with that of similar oil companies in the GCC countries for giving prominence to distinctive points and adjusting the standard of performance through implementing Gap Analysis in applications of HSE management program wherever development and change are needed in comparison with advanced international measures and systems as



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regards HSE program.

- Project for identifying the measures and regulations for assessing the health environmental hazards of projects presented by financiers for preserving the health and safety of the atmosphere of work environment and its surroundings.
- For limiting smoking phenomenon at work sites in order to reduce the direct effects on the health of smokers and indirect effects of passive smoking within a special awareness program for activating the law which undoubtedly helps achieve the goal.
- In addition, the Company participate in national plan for combating oil pollution in marine environment which was represented as distinct emergency plan for combating oil contamination in territorial waters which made it the leading local and regional company in this field.
- Implement a program for removal of all sources of asbestos used for a long time over many years in the Company and its houses. This program is within a deliberate plan that ensures all means of safety and health during the removal and disposal these wastes.
- The Company is devising a clear-cut program for measuring and assessing the environmental output of the projects it will carry out within the implementation of its independent or joint development plans. The Company is conducting environmental output studies of construction and industrial projects in coordination with the Environment Public Authority under Law No. 9/90.
- Project for monitoring the quality of underground water located beneath the pools used for gathering effluent water associated with production operations. This water is often mixed with varied quantities of crude oil.
- Continuing the process of clearing the Com-

pany fields of ordnance and explosives.

- Cooperation with KISR in the program of remediation of the soil oil lake polluted and building the treated soil park in Ahmadi town.
- Participation in various HSE activities, exhibitions and workshops and local, regional and international conferences.





## • GAS MANAGEMENT GROUP



- To keep up with today: World developments and changes and entering gas era, Kuwait Oil Company adopted the concept of being a leader in penetrating this industry in order to keep pace with challenges and new conditions taking place in oil and gas sectors worldwide, Gulf region and Arab world.
- From this point, Gas Management was created in July 2004 under Circular No. 19/2004.
- Kuwait Oil Company did not hesitate in joining advanced countries and breaking into gas era in the course of utilizing this natural fortune in addition to shortage in gas quantity faced by State of Kuwait and hence there is a pressing need for increasing such quantities, in particular fuel gas in order to operate electricity power stations and dispense with combusting heavy fuel due to air pollution resulting from this process. Therefore, to protect environment, there is no solution but using gas because it is very

clean upon combustion and free from contamination.

- Kuwait Oil Company, under its strategy, is looking forward to achieving high quality production of gas in the required quantities in lieu of importing gas from neighboring countries to fill up the shortage. In this regard, Kuwait Petroleum Corporation, in conjunction with Kuwait Oil Company, works on developing plans and strategies for exploring free gas to be separate from associated gas in oil production.
- Kuwait Oil Company adopts the concept and goal set for reaching 1% in gas flaring due to very significant environmental and economical return in addition to the benefit of energy savings and all of these have positive reflections on Kuwaiti economy.
- Keep ambitions and ideas aim at attaining sound clean environment using best practices and methods in gas flaring processes. If natu-



ral gas becomes available in State of Kuwait, it will provide the opportunity to transmit gas to houses through various distribution networks following the example of advanced countries in addition to using such gas in various industrial sectors in order to maintain clean environment free from pollution.

- Security and safety processes are the top priorities in relation to dealing with highly hazardous materials. In this regard, an action plan was developed to maintain security and safety of personnel and facilities; get knowledge of gas hazards and different methods for dealing with it and staff's good knowledge of ideal operations to avoid sudden shutdown events and work-related accidents.
- Kuwait Oil Company strives and plans for providing and preparing technical cadres required for keeping up with rapid development in gas industry and follow up in addition to supervising

huge projects approved by top management. Accordingly, a comprehensive training plan was designed for staff of Gas Management Group where technical cadres began to participate in preparing work papers and workshops in international organizations in addition to providing engineers and personnel with special experience through contribution by global companies and international organizations specialized in reducing flaring rates, increasing production and improving its quality.

- Gas Management Group aims on the short term to attain full development in terms of production, operations, transport and marketing gas to cover entire needs for energy in State of Kuwait.

## • TRAINING & DEVELOPMENT



The Company's role and interest are obvious in qualifying national manpower since it opened the first center for technical training Magwa in 1951. A large number of Kuwaitis began training at this center and were acknowledged as the first craftsmen in Kuwait.

Training and development continued through opening in 1960 a training center equipped with the latest facilities and workshops.

In the mid-sixties and seventies, the Company presented many training, services, secretariat and administration program to qualify the Kuwaiti youth for running oil production, exporting and refining operations.

At present, the Company is greatly interested in qualifying and developing the employees at all levels to upgrade their efficiency and prepare them for managing the company operations proficiently. To achieve this, the Career Development Department prepares the plans for iden-

tifying the training needs through the most up-to-date international methods, devises training policies and implements them by using all available channels, e.g. preparing and implementing technical programs, managerial, secretariat and English language program in cooperation with KPC, all consultancy houses and institutions and Kuwait University. It also sends the employees abroad for courses, programs, conferences and work with international oil companies for acquiring further advanced expertise. Training and development targets concentrate on preparing and qualifying new recruits, including university graduates and diploma holders, through specialized programs in line with the requirements and goals of the Company's strategic plan.

The Company does not neglect its national role in training through giving opportunities of field training to college, institute and university students within its various operations.



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### General Objectives:

- The Company gives significant interest to human capital due to its important and effective role in achieving strategic objectives and optimal utilization of human resources through provision of training and development opportunities.
- Job Training & Development Group endeavors to support 2020 strategy to achieve the Company future objectives.
- Transfer working environment in the Company to a learning environment to motivate personnel and urge them for continuous self-development through in-house programs and online learning programs provided by the Company to its staff.
- Enhance organization and performance level in developing awareness, qualifying and development programs to personnel with high quality.
- Work on providing the Company key functionaries with most significant administration and leadership skills through holding development programs by many international experts specialized in management and leadership.
- Continuous upgrade of training and develop-

ment programs for the Company personnel in line with pace of oil industry development worldwide and give them the opportunity for training and promotion of their capabilities to match those of international companies' personnel.

- Strategic thought for concepts related to training and development was updated to keep pace with the Company 2020 strategy as well as human development plans associated therewith which focuses on capitalization on national manpower as a primary source for accelerating development in all other activities and programs.

### Strategic Objectives:

- Design Strategic Objectives for training and development based on requirements of earning phase in line with the Company 2020 strategy.
- Support and promote Kuwaitization plans through development of national manpower according to international standards.
- Facilitate technology transmission through co-ordination with international companies.





## • MEDICAL SERVICES



In 1947 the Company relied on medical services from Kuwait City. In July 1948, the Company established a hospital due to the expansion of the Burgan Field. It held 130 beds and employed a large number of doctors, nurses and other personnel, and provided services to the Company for over 12 years. Medical care was provided patients at the Ahmadi clinic 24 hours a day. Other smaller clinics were established in Ahmadi, Shuwaikh, Wara, Mina Al-Ahmadi and Raudhatain. At that time patient care was concentrated at Ahmadi Clinic where medical services were provided around the clock. On 27th of April 1960, Ahmadi Hospital was opened to provide medical and treatment services for the company personnel following issuance of Amiri Decree for establishing Kuwait Petroleum Corporation in January

1980, it was decided to expand medical services provided by Ahmadi hospital to cover all personnel of the Corporation and its subsidiaries as well as staff families. Therefore, Ahmadi hospital is the main institution responsible for providing comprehensive medical services for oil sector employees. Moreover specialist physicians were recruited to work in various medical fields. In addition, the hospital could attract specialized efficient Kuwaiti cadres to work in medicine field including:

- Medical records
- Health information system management
- Diagnostic scans
- Medical labs industry

The hospital works on provision of best medical services in terms of sufficient experiences

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and advanced medical equipments through several departments including emergency, general medicine, internal medicine, protective medicine, surgery, Obs & Gyn, ophthalmology, ENT, dentistry, radiology, anesthesia, intensive care unit, physical therapy, laboratory, catering and ambulance services. There are also consultancy clinics operated by specialists seconded by Ministry of Health, Faculty of Medicine in the State of Kuwait to provide emergency and normal medical services for the Corporation staff.

In general, the hospital services are categorized into four types, i.e. diagnosis services, treatment services, protective services and cultivating services. These four service categories constitute the hospital strategy.

The hospital also plays a prominent awareness role through delivery of lectures and holding medical conferences that benefit the community. In addition, the hospital issues many medical awareness manuals and brochures and distribute the same to patients and clients as the hospital management believes in importance of nursing

profession as a humane profession in the first place, the company holds an annual celebration for Internal Nursing Day besides celebration for diabetes day and other diseases. Several institutions related to medicine profession participate in this occasion to provide guidelines and advice through lectures and responding to enquiries which held patients to follow the right treatment system and overcome illness difficulties.

The hospital keeps up with the latest international medical developments on a continuous basis in order to promote its desired medical role in all specializations.





Kuwait Oil Company Main Office

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