A Summer Internship Report

OVERVIEW OF DRILLING SERVICES IN ONGC MEHSANA ASSET

A report submitted in partial fulfilment for the award of degree of

Bachelor of Technology in Petroleum Engineering

By

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DECLARATION

I, **KATTA SRIDHAR**, hereby declare that this summer internship report entitled "OVERVIEW OF DRILLING SERVICES IN ONGC MEHSANA ASSET" is original and has not previously formed the basis for the award of any degree to similar work.

Place: KAKINADA Signature

DATE: 13-12-2018 Katta Sridhar

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ABSTRACT

The abstract is to be in fully-justified italicized text, at the top of the left-hand column as it is here, below the author information. Use the word “Abstract” as the title, in 12-point Times, boldface type, centered relative to the column, initially capitalized.

An Abstract is required for every paper; it should succinctly summarize the reason for the work, the main findings, and the conclusions of the study. The abstract should be no longer than 250 words. Do not include artwork, tables, elaborate equations or references to other parts of the paper or to the reference listing at the end. The reason is that the Abstract should be understandable in itself to be suitable for storage in textual information retrieval systems.

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Chapter 1

About ONGC

Oil and Natural Gas Corporation Limited (ONGC) is an Indian multinational oil and gas company earlier headquartered in Dehradun, Uttarakhand, India. As a Corporation, its registered office is now at Deendayal Uurja Bhavan, Vasant Kunj, New Delhi (110070) India. It is a Public Sector Undertaking (PSU) of the Government of India, under the administrative control of the Ministry of Petroleum and Natural Gas. It is India's largest oil and gas exploration and production company. It produces around 70% of India's crude oil (equivalent to around 30% of the country's total demand) and around 62% of its natural gas.

1.1 History of ONGC

1. Foundation to 1961

a) Before the independence of India in 1947, the Assam Oil Company in the north-eastern and Attock Oil Company in north-western part of the undivided India were the only oil producing companies, with minimal exploration input. The major part of Indian sedimentary basins was deemed to be unfit for development of oil and gas resources.

b) After independence, the Central Government of India realized the importance of oil and gas for rapidindustrial development and its strategic role in defense. Consequently, while framing the Industrial Policy Statement of 1948, the development of petroleum industry in the country was considered to be of utmost necessity.

c) In 1955, Government of India decided to develop the oil and natural gas resources in the various regions of the country as part of the Public Sector development. With this objective, an Oil and Natural Gas Directorate was set up towards the end of 1955, as a subordinate office under the then Ministry of Natural Resources and Scientific Research. The department was constituted with a nucleus of geoscientists from the Geological Survey of India.

d) Soon, after the formation of the Oil and Natural Gas Directorate, it became apparent that it would not be possible for the Directorate with its limited financial and administrative powers as subordinate office of the Government, to function efficiently. So in August, 1956, the Directorate was raised to the status of a commission with enhanced powers, although it continued to be under the government. In October 1959, the Commission was converted into a statutory body by an act of the Indian Parliament, which enhanced powers of the commission further. The main functions of the Oil and Natural Gas Commission subject to the provisions of the Act, were ”to plan, promote, organize and implement programs for development of Petroleum Resources and the production and sale of petroleum and petroleum products produced by it, and to perform such other functions as the Central Government may, from time to time, assign to it ”.

The act further outlined the activities and steps to be taken by ONGC in fulfilling its mandate.

2. From 1961 to present

a) Since its inception, ONGC has been instrumental in transforming the country's limited upstream sector into a large viable playing field, with its activities spread throughout India and significantly in overseas territories. In the inland areas, ONGC not only found new resources in Assam but also established new oil province in Cambay basin (Gujarat), while adding new petroliferous areas in the Assam-Arakan Fold Belt and East coast basins (both onshore and offshore).

b) ONGC became a publicly held company in February 1994, with 20% of its equity were sold to the public and eighty percent retained by the Indian government. At the time, ONGC employed 48,000 people and had reserves and surpluses worth □104.34 billion, in addition to its intangible assets. The corporation's net worth of □107.77 billion was the largest of any Indian company .

c) In 2003, ONGC Videsh Limited (OVL), the division of ONGC concerned with its foreign assets, acquired Talisman Energy's 25% stake in the Greater Nile Oil project.

d) In 2006, a commemorative coin set was issued to mark the 50th anniversary of the founding of ONGC, making it only the second Indian company (State Bank of India being the first) to have such a coin issued in its honor.

e) In 2011, ONGC applied to purchase 2000 acres of land at Dahanu to process offshore gas. ONGC Videsh, along with Statoil ASA (Norway) and Repsol SA (Spain), has been engaged in deep-water drilling off the northern coast of Cuba in 2012. On 11 August 2012, ONGC announced that it had made a large oil discovery in the D1 oilfield off the west coast of India, which will help it to raise the output of the field from around 12,500 barrels per day (bpd) to a peak output of 60,000 bpd.

f) In November 2012, OVL agreed to acquire ConocoPhillips' 8.4% stake in the Kashagan oilfield in Kazakhstan for around US$5 billion, in ONGC's largest acquisition to date. The acquisition is subject to the approval of the governments of Kazakhstan and India and also to other partners in the Caspian Sea field waiving their pre-emption rights.

g) In January 2014, OVL and Oil India completed the acquisition of Videocon Group's ten percent stake in a Mozambican gas field for a total of $2.47 billion.

h) In June 2015, Oil and Natural Gas Corporation (ONGC) gave a Rs27bn ($427m) offshore contract for the Bassein development project to Larsen & Toubro (L&T).

i) In February 2016, the board of ONGC approved an investment of Rs. 5,050 crores in Tripura for drilling of wells and creation of surface facilities to produce 5.1 million standard cubic feet per day gas from the state's fields.

j) On 19 July 2017, the Government of India approved the acquisition of Hindustan Petroleum Corporation by ONGC.

Product	Revenue
Crude Oil	526.38
Gas	168.88
LPG	31.48
Naptha	36.80
C2-C3	13.44
Others	1.59
Adjustments	-32.74
Total	825.52
Rs.825.52 billion	

Table 1.1: P
roduct-wise revenue breakup for FY 2016–17 (□ billion)

Chapter 2

About Mehsana Asset

The Mehsana Tectonic Block is a fairly well explored, productive hydrocarbon block of North Cambay Basin. Exploration activity for hydrocarbons by ONGC in the Mehsana Asset commenced in the 1960s and discovered fields are in an advanced stage of exploitation. The Asset has been endowed with a number of oil fields with multilayered pays belonging to Paleocene to middle Miocene age.More than 26 small to medium size oil and gas fields have been established in the Mehsana area of Mehsana-Ahmedabad Tectonic Block.Operational areas for the Mehsana Asset include a Mining Lease(ML) area of 942 Km 2 . In this Asset, 2324 wells have been already drilled. Further, 35 production installations have already been established to complete the hydrocarbon production, storage and delivery cycle. The Asset currently produces 6100 TPD of crude oil and 5 Lakh m 3 of natural gas on a daily basis.

Major oil fields within the Asset have been clubbed under six different areas:

1. Becharaji & Lanwa (Area-I)
2. Sathal & Balol (Area-II)
3. Jotana (Area-III)
4. Sobhasan Complex (Area- IV)
5. Nandasan, Linch, Langhnaj, Mansa & other satellite structures (Area-V), and
6. North Kadi (Area-VI)

Area I & II constitute the heavy oil fields of the Mehsana Asset.

The Asset, spread over four districts in North Gujarat, covers:

Two talukas of Patan and Ahmedabad Districts Six talukas in Mehsana District,and One taluka in Gandhinagar District

2.1 The Drilling Process

Drilling operations shall be conducted round-the-clock for 24 hrs. The time taken to drill a well depends on the depth of the hydrocarbon bearing formation and the geological conditions.ONGC intends to drill wells to a depth range from 1200 to 2000 m. This would typically take 30 - 35 days for each well – however drilling period may increase depending on well depth.In general, a 17 1⁄2” hole is drilled from the surface up to a predetermined depth and 13 3/8” surface casing is done to cover fresh water sands, prevent caving, to cover weak zones & to provide means for attaching well head & the blowout preventer(BOP).This is followed by drilling of 12 1⁄4” hole and lowering of 9 5/8” intermediate casing depending upon the depth of the well and anticipated problems in drilling the well. The 8 1⁄2” holes is drilled up to the target depth of the well cased with 5 1⁄2” or 7” production casing to isolate the producing zone from the other formations.

In the process of drilling, drilling fluid is used to lift the cutting from the hole to the surface. Drilling fluid is formulated by earth clay and barites. Various types of bio-degradable polymers are also added to maintain the specific parameters of the mud. After completion of production casing the well is tested to determine & analyze various parameters of producing fluid.

Water based mud, that is ecologically sensitive, will be used and all drilling activities will be conducted as per the requirements of the Oilfield and Mineral Development Rules, 1984 as amended till date. Guidelines issued by the Oil Mines Regulation (OMR) will be followed throughout the drilling process.

The power required for driving the drilling rig, circulation system and for providing lighting shall be generated by DG sets attached with the rig deployed by ONGC from various rigs available with ONGC mentioned in the table.. Fuel used in DG sets shall conform to Bharat Stage IV norms including a sulphur content of <50 mg/kg.

Table 2.1: Table -Power Requirement of Various Rigs of ONGC

Serial no	Rig	packager	KVA
1.	IPS-700-V (Mechanical rig)	Sudhir DG	500
		Caterpillar	438
2.	IPS-700-VI (Mechanical rig)	Jackson	500
		Kirloskar	380
3.	IPS-700-VII (Mechanical rig)	Jackson	500
		Jeevan DG	380
4.	M-900-I (Mechanical rig)	Sudhir DG	500
		Kirloskar	355
5.	M-750-II (Mechanical rig)	Sudhir DG	500
		Sudhir DG	380
6.	E-760-XI (Electrial rig)	BHEL	1430
		BHEL	1430
7.	CH Rig,John-10 (Mechanical rig)	Caterpillar	500
		Caterpillar	500
8.	CH Rig,John-19 (Mechanical rig)	Caterpillar	500
		caterpillar	500
9..	CH Rig,John-23 (Mechanical rig)	Caterpillar	500
		Caterpillar	500

2.2 Water Requirement

The drilling operation and maintenance of the drill site facilities have various water requirements. The most significant of these requirements in terms of quantity is that for mud preparation. The other requirements would be for engine cooling, floor / equipment / string washing, sanitation, fire-fighting storage / make-up and drinking. Water for emergency fire fighting would be stored in a pit of 200 m 3 capacity and make-up of the same will have to be made on a regular basis.The requirement of water expected for sanitation and drinking purposes of the workers shall be insignificantly low in terms of quantity. ONGC has planned to meet the requirement of water at the drilling site through water supplied by tankers and sourced from nearest ONGC installation. Since, there is no quality criterion for usage of raw water for the various uses mentioned above (other than drinking), the tanker water shall be directly used without any treatment.The potable water requirement shall be met by procuring adequately treated water from off-site locations.

2.3 Waste Water Generation

The drilling operation would generate waste water in the form of wash water due to washing of equipment, string etc. This waste water along with spill over mud will be diverted to waste water mud pit whose bottom would be lined with HDPE sheet so as to avoid percolation of water contaminants in the soil. Approximately 25 m 3 per day of waste water will be discharged in HDPE lined evaporation pit. The domestic sewage generated from the drill site operations will be treated in a septic tank–soak pit system. The septic tank is adequately sized to cater to a volumetric capacity of 4–5 m 3 per day.

2.4 Air Emissions

The emissions to the atmosphere from the drilling operations shall be from the diesel engines and flaring of associated gas during testing operation in case of hydrocarbon is discovered. In accordance with the Oil Mines Regulations Rules, a flare stack of 9m height will be provided.

2.5 Solid and Hazardous Waste Management

The drilling rig system to be employed for drilling will be equipped for the separation of drill cuttings and solid materials from the drilling fluid. The drill cuttings, cut by the drill bit, will be removed from the fluid by the shale shakers (vibrating screens) and centrifuges and transferred to the cuttings containment area.Once the drilling fluid / mud have been cleaned it will be returned to the fluid tank and pumped down the drill string again.It is estimated that 104 MT of formation cuttings and 650 m 3 of drilling mud will be generated in the form of solid waste, during the drilling operation.

Drill cuttings and drilling mud will be disposed off in accordance with the Gazette Notification dated 30th August 2005 - G.S.R 546(E), Section C 'Guidelines for Disposal of Solid Waste, Drill Cuttings and Drilling Fluids for Offshore and Onshore Drilling Operation'.

Under these guidelines:

Drill cuttings separated from Water Based Mud (WBM) will be properly washed and unusable drilling fluids will be allowed toevaporate in a HDPE lined pit. In case the drill cuttings have oil and grease level in.

Chapter 3

Drilling

Once the geoscientists analyze a prospective oil field and the land is leased, a well is drilled to obtain more information about the reservoir. Not all wells are straight and vertical. Horizontal drilling has become a very profitable way to increase production by having the wellbore contacting more of the formation.

3.1 Drilling Rig

A drilling rig is a device used to drill, case and cement oil and gas wells. In drilling an oil well different types of rigs are used. The type used will depend on whether the drilling is being done in sea or on land and also on depth.

3.2 Rig Components

The most important rig components include: rig engines, derrick and substructure, hoisting equipment, rotary equipment, mud pumps and BOPs.

Rig Engines:

Rigs suitable for shallow drilling use two engines and deep drilling is achieved by three to four engines.

Derrick and Substructure:

A derrick is a four sided structure of sufficient height and strength. The substructure provides support for the derrick, draw-works and drill string.

3.3 Hoisting Equipment

The main function of hoisting equipment is to get the drill string and other necessary equipment in and out of the hole safely and efficiently. The main components of hoisting system include draw-works, crown and travelling block, hooks, drilling line.

Drawworks:

This is an assembly of a rotating drum, a series of shafts, clutches, chains and gears for changing speed and for reversing. It also contains the main brake for stopping the drilling line. The drilling line is wound a number of times around the drum, the end of the line then passes on the crown and travelling block.

Crown block:

A block located at the top of the derrick and is stationary. The crown block provides ameans of taking the drilling line from the hoisting drum to the travelling block.

Travelling block:

It is a diamond shaped block. The drilling line is wound continuously on the crown and travelling blocks, with the two outside ends being wound on the hoisting drum.

Hook:

It connects the Kelly or topdrive with the travelling block. The hook carries the entire drilling load.

3.4 Rotary Equipment

The main components of Rotary equipment are: Rotary table, Kelly, Swivel.

Rotary table:

The main function of the rotary table is to transfer the rotary motion through a master bushing to the Kelly, to drill pipe, and eventually to the drill bit.

Kelly:

The Kelly is the rotating link between the rotary table and the drill string. Its main functions are transmits rotation and weight-on-bit to the drillbit, supports the weight of the drill string and conveys the drilling fluid from the swivel into the drill string. The Kelly has a hexagonal or square shape cross section. The Kelly is usually provided with two safety valves, one at the top and one at the bottom, called upper and lowerKelly cocks, respectively. The Kelly cock is used to close the inside of the drill string in the event of a kick.

Swivel:

The swivel is installed above the Kelly and its main function is to prevent the rotary motion of the Kelly from being transferred to the drilling line.

Master bushing:

It serves two purposes:

a) Provides engagement of the Kelly drive bushing with the rotary table.
b) Provides tapered seating for the slips which hold drill pipe in the rotary table.

Kelly drive bushing:

It engages with the master bushing.

3.5 Drill String Components

The main component of the drill string includes drill pipe, drill collars and accessories like stabilizers and reamers.

Drill pipe:

The main function of the drill pipe is to transmit rotary motion and drilling mud under high pressure to the drill bit.

Drill collars:

Drill collars are the predominant component of the bottom hoe assembly (BHA). It is used to provide weight on bit.

Stabilizers:

Stabilizers are tools placed above the drill bit and along the bottom hole assembly (BHA) to control hole deviation, dogleg severity and prevent differential sticking. They achieve these functions by centralizing and providing extra stiffness to the BHA.

Reamers:

Reamers are usually run immediately behind the bit to provide a gauge hole.

3.6 Drilling Bits

Drill bit crushes the rock under combined action of weight on bit and rotary speed.

Roller Cone Bits: These are made up of three equal-sized cones. Each cone is mounted on bearings which run on a pin that forms an integral part of the bit leg. Nozzles are used to provide constriction in order to obtain high jetting velocities necessary for efficient bit and hole cleaning. Mud pumped through the drill string passes through the bit pin bore and through the three nozzles,with each nozzle accommodating one third of the total flow, if all the nozzles were of the same size.

Polycrystalline Diamond Compact Bit: PDC bit employs no moving parts. A PDC bit employs a large number of cutting elements, each called a PDC cutter.The PDC cutter is made by bonding a layer of polycrystalline man-made diamond to a cemented tungsten carbide substrate in a high pressure, high temperature process. The diamond layer is composed of many tiny diamonds which are grown together at random orientation for maximum strength and wear resistance.

Diamond Bit: Diamond is the hardest mineral and also posses the highest thermal conductivity of any other mineral allowing it to dissipate heat very quickly. These bits

Function	Physical/Chemical Property
Transport cuttings from the wellbore	Yield Point,Apparent viscosity, Gel Strength,Velocity
Prevent formation fluids from entering into the wellbore	Density
Maintain wellbore stability	Density,Reactivity with clay
Cool and lubricate the bit	Density ,Velocity
Transmit hydraulic horsepower to the bit	Velocity,density,viscosity

Table 3.1: F
ig 3.1.Functions of the Drilling fluids.

are used for drilling hard and abrasive formations. Diamond bits are manufactured as either drilling or coring bits.

3.7 Drilling Mud

Drilling Mud or drilling fluid is a critical component in the rotary drilling processes.
The primary functions of drilling fluids are:

- Remove cuttings from the wellbore.
- Prevent formation fluids from entering into the wellbore.
- Maintain wellbore stability
- Cool and Lubricate the bit
- Transmit Hydraulic Horsepower to bit

The corresponding properties associated with these functions are:

Types of Drilling fluids

The two major types of mud system used are Oil Based Mud which consists of oil as a continuous phase and other is Water Based mud which consists of water as a continuous phase.Mostly water based mud is used in Mehsana. The following mud systems are in continuous use in Mehsana Asset:

1) SPUD Mud 2) KPPA Mud 3) NDDF Mud

Spud Mud

Mud used to drill a well from the surface to a shallow depth .Onshore spud mud consists of bentonite clay whereas in offshore guar gum and salt gel are used in offshore.

KPPA Mud:

It is an abbreviation of KCL, PHPA, polyol mud.KCL and PHPA in the mud acts as a shale inhibitor and polyol provides lubricity to the mud.

NDDF Mud

It is generally used near pay zone. It is an abbreviation of Non Damaging Destructive Fluid which does not uses barite but polymers as a weighing agent as barite is non biodegradable and damages the pay zone permeability and porosity.

Field Tests on Drilling Mud

The mud properties are regularly monitored by mud engineer. These measurements will be used to determine if the properties of mud have been deteriorated and require treatment or not.

The following tests are used to determine the under mentioned :

- Mud Density

  The density of the drilling mud can be determined with the mud balance shown in Figure. The cup of the balance is completely filled with a sample of the mud and the lid placed firmly on top (some mud should escape through the hole in the lid). The balance arm is placed on the base and the rider adjusted until the arm is level. The density can be read directly off the graduated scale at the left-hand side of the rider.

- Viscosity

  The rheological character of drilling fluids is discussed at length in the chapter on Drilling Hydraulics. In general terms however, viscosity is a measure of a liquids resistance to flow. Two common methods are used on the rig to measure viscosity.

  The marsh funnel viscometer is used to make the quickest analysis of the viscosity of drilling fluid .However this device only gives change in viscosity and does not quantify rheological properties such as yield point and plastic viscosity for which we use rotational viscometer.

  Rotational viscometer: The multi-rate rotational viscometer is used to quantify the rheological properties of the drilling mud. The assessment is made by shearing a sample of the mud, at a series of prescribed rates and measuring the shear stress on the fluid at these different rates.

- Gel Strength

  The gel strength of the drilling mud can be thought of as the strength of any internal structures which are formed in the mud when it is static. The gel strength of the mud will provide an indication of the pressure required to initiate flow after the mud has been static for some time. The gel strength of the mud also provides an indication of the suspension properties of the mud and hence its ability to suspend cuttings when the mud is stationary . It is measured using rotational viscometer by measuring viscosity at 3rpm and after 10 seconds.

- Filtration

  The filter cake building properties of mud can be measured by means of a filter press. The following are measured during this test :

  1. The rate at which fluid from a mud sample is forced through a filter under specified temperature and pressure.

  2. The thickness of the solid residue deposited on the filter paper caused by the loss of fluids.

- pH Determination

  The pH of the mud will influence the reaction of various chemicals and must therefore be closely controlled. The pH test is a measure of the concentration of hydrogen ions in an aqueous solution. This can be done either by pH paper or by a special pH meter.

Chapter 4

Mud Conditioning Equipment

Mud Pump: Sucks mud from the mud pits and pumps it to the drilling apparatus.

Shale shaker: Separates rock cuttings from the mud.

Mud pit: In mud pits drilling mud is mixed and recycled.

Reserve pit: It collects rock cuttings separated from the mud.

Mud-mixing hopper: In this new mud is mixed and then sent to the mud pits.

Desander and Desilter: In desander sand particles are removed while in desilter small silt particles are removed.

Chapter 5

Cementing

Cementing operations consist in placing an appropriate cement slurry in the annulus between the walls of the hole and the casing that has been run in. There are several types of cementing jobs and each one meets a particular need.

PURPOSE:

- Isolating a producing formation from adjacent beds.
- Securing the casing mechanically to the borehole walls.
- Protecting casing from corrosion by fluids contained in the beds that have been drilled.
- Providing a leak-proof base for safety and control equipment that is installed on the wellhead.
- Injecting extra cement through the perforations in the casing to consolidate or repair the primary cementing job.
- Sealing off a depleted productive layer.
- Isolating a bed from adjacent zones to reduce the per cent of water or gas in oil production.
- Seal off water influxes.
- Plug up lost circulation zones.
- Serve as the basis of a side track.

Primary Cementation:
It occurs in 4 stages:

1. The first stage comprises of displacing top plug with pre flush which is water. The bottom plug cleans up the well by displacing mud and water occupies its place.
2. Then cement slurry is followed after pre flush is added.
3. Once the pre calculated slurry volume has been added, top plug is displaced again by spacer (water).
4. Pressure is applied in this process and once the top plug rests upon bottom plug the bottom plug breaks and tremendous increase in pressure is noted which tells us the cement job.

Cementing is performed when the cement slurry is deployed into the well via pumps, displacing the drilling fluids still located within the well, and replacing them with cement. The cement slurry flows to the bottom of the wellbore through the casing, which will eventually be the pipe through which the hydrocarbons flow to the surface. From there it fills in the space between the casing and the actual wellbore, and hardens. This creates a seal so that outside materials cannot enter the well flow, as well as permanently positions the casing in place.

PREPARING THE CEMENT:

In preparing a well for cementing, it is important to establish the amount of cement required for the job. This is done by measuring the diameter of the borehole along its depth, using a caliper log. Utilizing both mechanical and sonic means, multi finger caliper logs measure the diameter of the well at numerous locations simultaneously in order to accommodate for irregularities in the wellbore diameter and determine the volume of the open hole. Additionally, the required physical properties of the cement are essential before commencing cementing operations. The proper set cement is also determined, including the density and viscosity of the material, before actually pumping the cement into the hole.

Special mixers, including hydraulic jet mixers, recirculating mixers or batch mixers, are used to combine dry cement with water to create the wet cement, also known as slurry. The cement used in the well cementing process is Portland cement, and it is calibrated with additives to form one of eight different API classes of cement. Each is employed for various situations. Additives can include accelerators, which shorten the setting time required for the cement, as well as retarders, which do the opposite and make the cement setting time longer. In order to decrease or increase the density of the cement, lightweight and heavyweight additives are added.

Additives can be added to transform the compressive strength of the cement, as well as flow properties and dehydration rates. Extenders can be used to expand the cement in an effort to reduce the cost of cementing, and antifoam additives can be added to prevent foaming within the well. In order to plug lost circulation zones, bridging materials are added, as well.

CEMENTING THE WELL

After casing, or steel pipe, is run into the well, an L-shaped cementing head is fixed to the top of the wellhead to receive the slurry from the pumps. Two wiper plugs, or cementing plugs, that sweep the inside of the casing and prevent mixing: the bottom plug and the top plug. Keeping the drilling fluids from mixing with the cement slurry, the bottom plug is introduced into the well, and cement slurry is pumped into the well behind it. The bottom plug is then caught just above the bottom of the wellbore by the float collar, which functions as a one-way valve allowing the cement slurry to enter the well. Then the pressure on the cement being pumped into the well is increased until a diaphragm is broken within the bottom plug, permitting the slurry to flow through it and up the outside of the casing string.

After the proper volume of cement is pumped into the well, a top plug is pumped into the casing pushing the remaining slurry through the bottom plug. Once the top plug reaches the bottom plug, the pumps are turned off, and the cement is allowed to set. The amount of time it takes cement to harden is called thickening time or pump ability time. For setting wells at deep depths, under high temperature or pressure, as well as in corrosive environments, special cements can be employed.

Chapter 6

Drilling Tool Yard Services (DTYS)

Drill Bits:

A drilling bit is the cutting or boring tool which is made up on the end of the drill string. The bit drills through the rock by scraping, chipping, gouging or grinding the rock at the bottom of the hole. Drilling fluid is circulated through passageways in the bit to remove the drilled cuttings.

There are basically three types of drilling bits: a) Drag bits b) Roller Cone bits c) Diamond bits

Drag bits:

Drag bits were the first bits used in rotary drilling, but are no longer in common use. A drag bit consists of rigid steel blades shaped like a fish-tail which rotate as a single unit. These simple designs were used up to 1900 to successfully drill through soft formations. The introduction of hard facing to the surface of the blades and the design of fluid passageways greatly improved its performance. Due to the dragging/scraping action of this type of bit, high RPM and low WOB are applied.

Roller Cone Bits:

Roller cone bits (or rock bits) are still the most common type of bit used worldwide. The cutting action is provided by cones which have either steel teeth or tungsten carbide inserts. These cones rotate on the bottom of the hole and drill hole predominantly with a grinding and chipping action. Rock bits are classified as milled tooth bits or insert bits depending on the cutting surface on the cones.

Diamond bits:

A new generation of diamond bits known as polycrystalline diamond compact (PDC) bits were introduced in the 1980's. These bits have the same advantages and disadvantages as natural diamond bits but use small discs of synthetic diamond to provide the scraping cutting surface. The small discs may be manufactured in any size and shape and are not sensitive to failure along cleavage planes as with natural diamond. PDC bits have been run very successfully in many areas around the world. They have been particularly successful (long bit runs and high ROP) when run in combination with turbo drills and oil based mud.

Blowout Preventers:

The blowout prevention (BOP) equipment is the equipment which is used to shut-in a well and circulates out an influx if it occurs. The main components of this equipment are the blowout preventers or BOP's. These are valves which can be used to close off the well at surface. In addition to the BOP's the BOP equipment refers to the auxiliary equipment required to control the flow of the formation fluids and circulate the kick out safely .

There are 2 basic types of blowout preventer used for closing in a well: 1.Annular Preventer 2.Ram Type

Annular Preventer:

The main component of the annular BOP is a high tensile strength, circular rubber packing unit. The rubber is molded around a series of metal ribs. The packing unit can be compressed inwards against drill pipe by a piston, operated by hydraulic power. The advantage of such a well control device is that the packing element will close off around any size or shape of pipe. An annular preventer will also allow pipe to be stripped in (run into the well whilst containing annulus pressure) and out and rotated, although its service life is much reduced by these operations. The rubber packing element should be frequently inspected for wear and is easily replaced.

Ram Type Preventers:

Ram type preventers derive their name from the twin ram elements which make up their closing mechanism. Three types of ram preventers are available: Blind rams - which completely close off the wellbore when there is no pipe in the hole.

- Pipe rams - which seal off around a specific size of pipe thus sealing of the annulus. In 1980 variable rams were made available by manufacturers. These rams will close and seal on a range of drill pipe sizes.

- Shear rams which are the same as blind rams except that they can cut through drill pipe for emergency shut-in but should only be used as a last resort. A set of pipe rams may be installed below the shear rams to support the severed drill string.

Chapter 7

Crises Management Team (CMT) Section

Crisis management is the process by which an organization which deals with a disruptive and unexpected action that threatens to harm the organization or its stakeholders. The study of crisis management originated with large scale industrial and environmental disaster in 1980's. It is considered to be the most important process in public relations.

Three elements are common to crises:

1. Threat to the organization
2. The element of surprise
3. Short decision time

In contrast to risk management, which involves assessing the potential threat and finding the best ways to avoid the threats, crisis management involves dealing with threats before, during and after they have occurred. It is a discipline within a broader context of management consisting of skills and techniques required to identify,assess understand and cope with a serious situation especially from the moment it first occurred to the point that recovery procedure start.

Chapter 8

Instrumentation Section

Drillometer:

One of the instruments that the driller uses to monitor and improve the operating efficiencies of the drilling operation. The actual measurement of weight is made with a hydraulic gauge attached to the dead line of the drilling line. As tension increases in the drilling line, more hydraulic fluid is forced through the instrument, turning the hands of the indicator.

The weight that is measured includes everything exerting tension on the wire rope, including the traveling blocks and cable itself. Hence, to have an accurate weight measurement of the drill string, the driller must first make a zero offset adjustment to account for the traveling blocks and items other than the drill string. Then the indicated weight will represent the drill string (drill pipe and bottomhole assembly). However, the driller is only nominally interested in this weight for most operations. The weight of interest is the weight applied to the bit on the bottom of the hole. The driller could simply take the rotating and hanging off bottom weight, say 300,000 pounds [136,200 kg], and subtract from that the amount of rotating on bottom weight, say 250,000 pounds [113,500 kg], to get a bit weight of 50,000 pounds [22,700 kg].

However, most rigs are equipped with a weight indicator that has a second indicator dial that can be set to. read zero (”zeroed”) with the drill string hanging free, and works backwards from the main indicator dial. After proper zeroing, any weight set on bottom (that takes weight away from the main dial), has the effect of adding weight to this secondary dial, so that the driller can read weight on bit directly from the dial.

Chapter 9

Directional Drilling and Fishing Section

Reasons for drilling directional wells are:

1. Multi-well Platform Drilling
2. Fault Drilling
3. Inaccessible Locations
4. Salt domes
5. Relief Wells

1. **Multi-well Platform Drilling:** Multi-well Platform drilling is widely employed in the North Sea. The development of these fields is only economically feasible if it is possible to drill a large number of wells (up to 40 or 60) from one location (platform). The deviated wells are designed to intercept a reservoir over a wide areal extent. Many oilfields (both onshore and offshore) would not be economically feasible if not for this technique.
2. **Fault Drilling:**If a well is drilled across a fault the casing can be damaged by fault slippage. The potential for damaging the casing can be minimized by drilling parallel to a fault and then changing the direction of the well to cross the fault into the target.
3. **Inaccessible Locations:** Vertical access to a producing zone is often obstructed by some obstacle at the surface (eg. Estuary, mountain range etc. In this case the well can be directionally drilled to reach the target from a rig site some distance away from the point vertically above the required point of entry of the reservoir.
4. **Salt domes:** Salt domes (called Diapirs) often form hydrocarbon traps in what were overlying reservoir rocks. In this form of trap the reservoir is located directly beneath the flank of the salt dome. To avoid potential drilling problems in the salt (e.g. severe washouts, moving salt, high pressure blocks of dolomite) a directional well can be used to drill alongside the Diapir (not vertically down through it) and then at an angle below the salt to reach the reservoir.
5. **Relief Wells:** If a blow-out occurs and the rig is damaged, or destroyed, it may be possible to kill the "wild" well by drilling another directionally drilled well (relief well) to intercept or pass to within a few feet of the bottom of the "wild" well. The "wild" well is killed by circulating high density fluid down the relief well, into and up the wild well.

Fishing Tools:

- **Junk Sub:** A down hole tool with a proliferated external surface designed to catch and retrieve junk or debris from the wellbore. The debris is carried up the tool string annulus in the circulation fluid. Anindented profile creating a larger annular area causes the fluid flow rate to drop and allows the debris to drop into a basket or receptacle located at the base of the tool.

- **Reverse Circulation Junk Basket:** The Reverse Circulation Junk basket or RCJB is used to retrieve all types of small junk objects in wellbore. By producing a circulating force with jet nozzles the junk basket is capable of retrieving the most stubborn items in the hole bottom such as bit rollers, bit bearings, tong dies, hand tools.The Assembly consists of top sub, bowl, junk catcher, value assembly and shoe.The reverse circulation is made possible by hollow barrel.

- **Overshot:** Overshot is a positive engagement and disengageable tool. Positive engagement means the overshot is capable of withstanding even jarring impact (F.S. type). Disengageable means, it can be disengaged from the fish at any position/depth.It is designed to catch smooth round tubular o/d fish. The standard overshot is as the equivalent tool joint strength for screw in connection, Excluding slim hole overshot. It can be disengaged from fish on requirement basis.

- **Fishing Magnet:** It is used to retrieve undrillable material having magnetic attraction. Small odd shaped items like bit rollers, dies, tong pins etc. which cannot be retrieve by any outside or inside catching tools. They can be run on wire line or drill string.

- **Die Collar:** Rotary Die Collar are the simplest fishing tool available for engaging a fish externally. This is not a positive engagement tool. It consists of wickers which are non-fluted design if circulation isrequired below the stuck point. Fluted type design also available to flush cutting while engaging fish.