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HYDROCARBON SECTOR
SKILL COUNCIL

Participant Handbook

Sector
Hydrocarbon

Sub-Sector
Upstream

Occupation
Production

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Assistant Technician - Drilling (Oil & Gas)

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"Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission."

Shri Narendra Modi
Prime Minister of India

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Certificate

COMPLIANCE TO
QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

HYDROCARBON SECTOR SKILL COUNCIL

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

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The preparation of this manual would not have been possible without the Hydrocarbon Industry's support. Industry feedback has been extremely encouraging from inception to conclusion and it is with their input that we have tried to bridge the skill gaps existing today in the industry.

This participant manual is dedicated to the aspiring youth who desire to achieve special skills which will be a lifelong asset for their future endeavours.

About this Book

This Participant Handbook is designed for providing skill training and /or upgrading the knowledge level of the Trainees to take up the job of an "Assistant Technician- Drilling (Oil & Gas)" in the Hydrocarbon Sector.

This Participant Handbook is designed based on the Qualification Pack (QP) under the National Skill Qualification framework (NSQF) and it comprises of the following National Occupational Standards (NOS)/topics and additional topics.

- Introduction to Welding
- HYC/N0101 Perform Drilling Operation
- HYC/N0102 Occupational health and safety (OHAS)
- HYC/N0103 Working effectively with colleagues and supervisor
- Employability and Entrepreneurship Skills

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1. Introduction

Unit 1.1 An Introductory Overview

Key Learning Outcomes

After attending the session, you will be able to:

1. Define the Indian Oil & Gas Industry and Assistant Drilling Technician

Unit 1.1 An Introductory Overview

Unit Objectives

At the end of this unit, you will be able to:

- Evaluate the current scenario of the Indian Oil & Gas Industry
- Evaluate the user/individual on the job needs to know and understand
- Evaluate the Personal Attributes of an Assistant Technician - Drilling

1.1.1. Current Scenario of the Indian Oil & Gas Industry

- At present, the Oil and Gas industry in India is one of the 6 prevalent six core industries.
- To fill in the gaps between India's ever-increasing gas demand and its supply NELP (New Exploration Licensing Policy) was envisioned. This proposition took place in the year 1997-1998.
- At the global level, India is on its way on becoming one of the contributors (largest) regarding non-OECD petroleum consumption.
- After the countries like Japan, South Korea and China, India stands as the fourth-largest importer of LNG (Liquefied Natural Gas).
- The total percentage of global trade (Oil and Gas) from India is around 5.8%.
- As per the last report of Ministry of Petroleum and Natural Gas (2016), India holds the 3rd position in the consumption of petroleum and crude oil products on a global level.
- Oil import in India recently (2017) saw a sharp hike of 27.89% (US$ 9.29 billion).
- At present, the gas production in India is 21.3 Billion Cubic Metres. This report was collected from April to November (2017-18).
- It is expected that the gas production in India will touch approximately 90 Billion Cubic Metres in the year 2040.

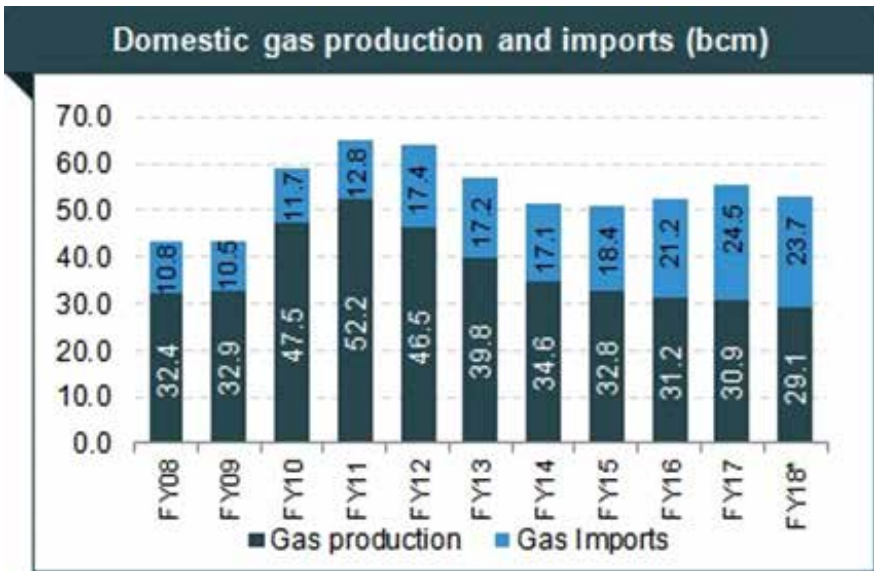

Figure 1.1.1: LNG imports

As per this information, you can see that from the Financial Year 2008 to 2018, the LNG import from India saw a hike of 8.14% (Compound Annual Growth Rate).

1.1.2. The User/Individual on the Job Needs To Know and Understand

Job Description of an Assistant Technician - Drilling

With the increase in Oil and Gas production in India, the market for efficient workers in this sector has also increased. This is especially for technicians and assistant technicians like engineers, roughnecks and drilling.

Amongst the various job roles, the Drilling assistant technicians are responsible for various operations and functions like:

- Rig dismantling
- Drill holes
- Regulating the pressure of various types of tools
- Controlling the rotary tables' speed
- Observe pressure gauges
- Taking the necessary preparations regarding the drilling rig for operations
- Cementation job

Addition to these, the Driller also requires to:

- Constantly keep an eye on the well flow so that there is no overflow
- Check the drilling tools frequently and send for service as per requirement
- Keep a detailed record of the tools required for the drilling process, the location and the depth of the drilled area
- Should be efficient in drilling operations
- Should be able to provide assistance in drilling operations and post analysis process
- Helping the drilling engineers with designing and planning for drilling operations

1.1.3. Personal Attributes of an Assistant Technician - Drilling

The important attributes that an assistant drilling technician requires having are:

- Ability to work under pressure
- Should know how to complete the assigned responsibility with the team
- Should know where to apply practical judgement
- Should be self-motivated
- Should have strong problem-solving skills
- Should know different methods to connect with different types of people
- Can recognise different types of problems arising in this field and solve those
- Have good writing skills
- Have the ability to draft technical memos
- Having sharp eyes regarding detailing
- Have good technical ability
- Possessing excellent coordination skills

Summary

- The proposition regarding NELP took place in the year 1997-1998.
- After the countries like Japan, South Korea and China, India stands as the fourth-largest importer of LNG (Liquefied Natural Gas).
- Amongst the various job roles, the Drilling assistant technicians are responsible for various operations and functions like Cementation job.
- The technicians help the drilling engineers with designing and planning for drilling operations.

Notes

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2. Perform Drilling Operation

Unit 2.1 Understanding the Basics of Oil & Gas

Unit 2.2 Basic Oil & Gas Drilling Process and Operations

Unit 2.3 Basic Maintenance Hand Tools and Measuring and Marking-out Instruments

Unit 2.4 Maintenance

Unit 2.5 Numerical Skills, Physical Science, Basic Properties of Materials

HYC/N0101

Key Learning Outcomes

After attending the session, you will be able to:

1. Comprehend the basics of oil & gas
2. Distinguish basic oil & gas drilling process and operations
3. Define basic maintenance hand tools and measuring and marking-out instruments
4. Define maintenance
5. Define numerical skills, physical science, basic properties of materials

Unit 2.1 Understanding the Basics of Oil & Gas

Unit Objectives

At the end of this unit, you will be able to:

- Evaluate the knowledge of the types of oil & gas wells
- Evaluate the platform types for underwater drilling submersible barges and platforms
- Define knowledge of the wellhead
- Evaluate how to perform abandonment process
- Evaluate about typical drilling program

2.1.1. Understanding and Knowledge of the Types of Oil & Gas Wells

Exploratory well

In order to locate the reserves (proven) of recoverable oil and gas, oil and gas exploration companies drill deep test holes. These holes are on both offshore and onshore sites. These holes are known as an exploratory well. With the help of seismic data, the areas containing gas or oil reserves are identified.

This is done before the utilisation of exploratory wells for gathering detailed geological data. The data are on the basis of:

- Reservoir productivity
- Initial reservoir pressure
- Fluid properties
- Rock properties

In case, it is discovered that an area has gas or oil reserve, the oil extraction process will be started with the drilling of a development well.

- The drilled area where gas or oil hasn't been found previously in the exploratory wells is known as Wildcats.
- The drilled wells where accidentally gas or oil reserves are found are known as "discovery wells."
- To search new gas and oil bearing formations or to determine a field's limits (beneath the earth's surface), exploratory wells are drilled. These wells are known as or "appraisal" wells or "step-out" wells.
- A "dry hole" is a well where no gas or oil can be found.

Figure 2.1.1: Exploratory well

Developmental well

- Once an oil or gas reservoir is discovered, its area is roughly calculated with the help of appraisal wells or series of step-out wells.
- In order to produce oil and gas, Developmental wells are drilled.
- It is important to understand and know how to determine the number of wells that require to be drilled. This can be done by analysing the new fields on the basis of productivity and size.
- In most cases, it is seen that the producing and drilling process takes place simultaneously.

Geopressure/ Geothermal Well

Beneath the Earth's crust, there is abundant natural geothermal energy. The wells that tap into these thermal energy sources are known as Geothermal wells.

In simple words, Geopressure/geothermal wells are those wells that produce water having high temperature and high pressure.

- The high temperature is usually around 149 °C
- The high pressure is usually around 7,000 psi

In most cases, it is seen that this water is rich in hydrocarbons.

For several decades it has been seen that the geothermal wells are in use as an addition to existing cooling and heating systems. Its design is relative to the utility of relatively constant subsurface temperature of the Earth to remove or add heat from a particular dwelling.

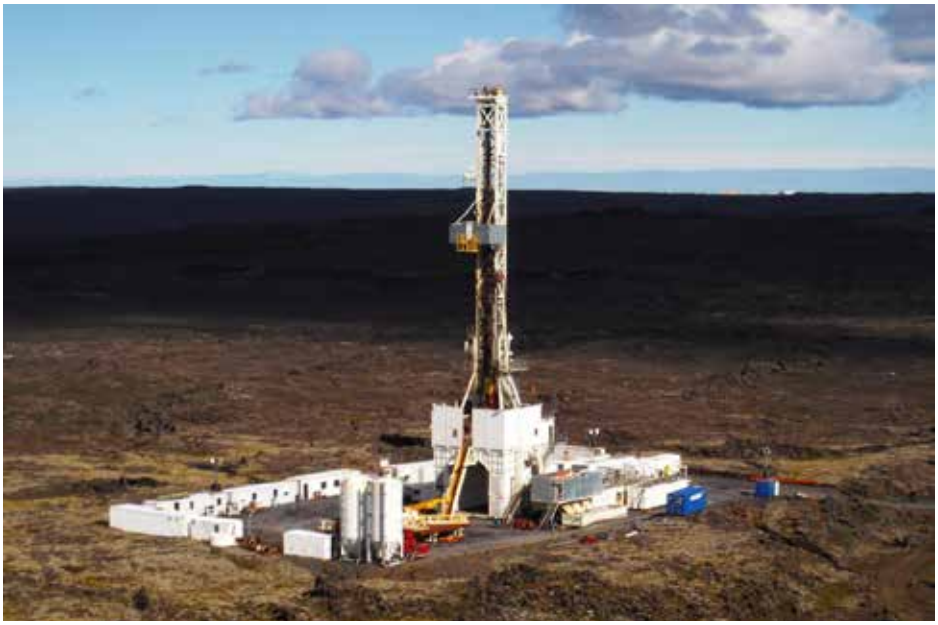


Figure 2.1.2: Geothermal Well

Stripper well

- If considered from the viewpoint of financial aspect, a stripper well is a well that is at its working life's end but still operating.
- A stripper well can produce an average of 10 to 15 barrels of oil in a day (average of yearly or per annum period).
- If you consider about an equivalent gas well, the maximum gas production on per day basis will be around 60 Mcf (thousand cubic feet to 90 Mcf.
- There are chances that aged wells produce less hydrocarbons. However, this variation in flow rate can differ in newer wells too.

Figure 2.1.3: Stripper Well

Multiple Completion Well

During a single well drilling process, multiple producing formations can be discovered. At this time, there may be chances for a separate pipe string to run into singular formation (single wells).

The packers isolate multiple piping and direct to their respected formation (gas and oil). The isolation seals the spaces (annular) between the casing and the piping. This is known as multiple completion wells.

The well completion method has few steps.

- **Casing**

Casing ensures that after the well drilling process is over, the well does not close up after the removal of drilling fluids.

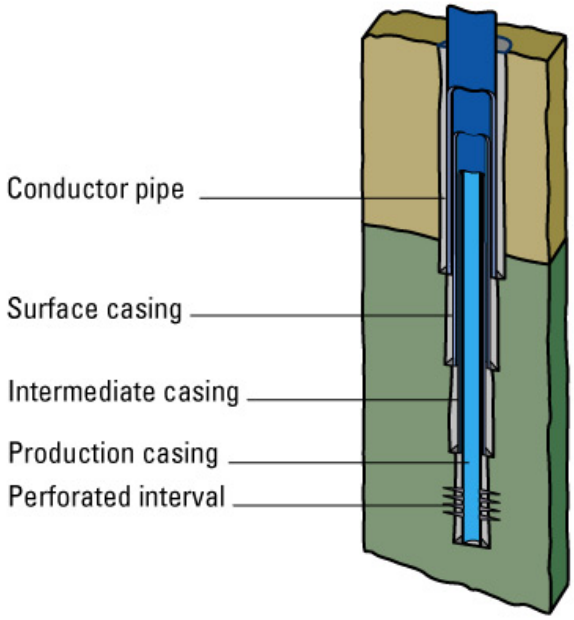


Figure 2.1.4: Casing

- **Cementing**

Cementing is the process where water, cement additives and slurry of cement are mixed together. After mixing these, the mix is pumped down to critical points through casing in the annulus. It is in the open hole or around the casing below the casing string.

There are two principal functions related to the cementing process. They are:

i. Bonding and supporting the casing
ii. Restricting fluid movement that takes place between the formations

In simple words, as the name suggests, it is the closing of the well by cementing it with a special mix of cement and additives known as the pumping cement slurry.

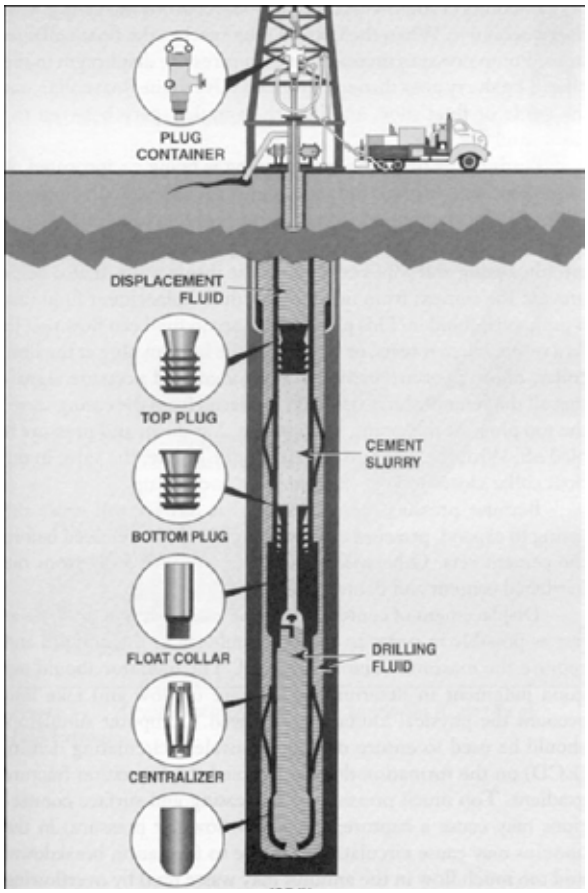


Figure 2.1.5: Cementing

- **Open-hole completions**

This is also known as barefoot completions and top sets that ensure the completion methodologies used on wells.

This refers to a well whose position is on top of the hydrocarbon reservoir. It simply means that on top of a hydrocarbon reservoir the well is drilled. At this level, the well is cased and at the bottom is left open. Open-hole completions, also known as barefoot completions or top sets, are used for casing cost reduction where the reservoir is well-known and solid.

- **Perforation**

If we talk in the context of oil wells, perforation refers to a hole that is punched in the liner or casing of an oil well whose connection is directly to the reservoir. The achievement of this process is by running a perforation gun. It is done on E-line on coiled tubing and in normal wells. The tubing is in highly deviated wells. At present, one can see these on slickline with embedded fiber optic lines for transmitting signals for firing explosions.

In this process, a reservoir locating device and a perforation gun is inserted in the wellbore a number of times with the help of coiled tubing, slick line or a wire line.

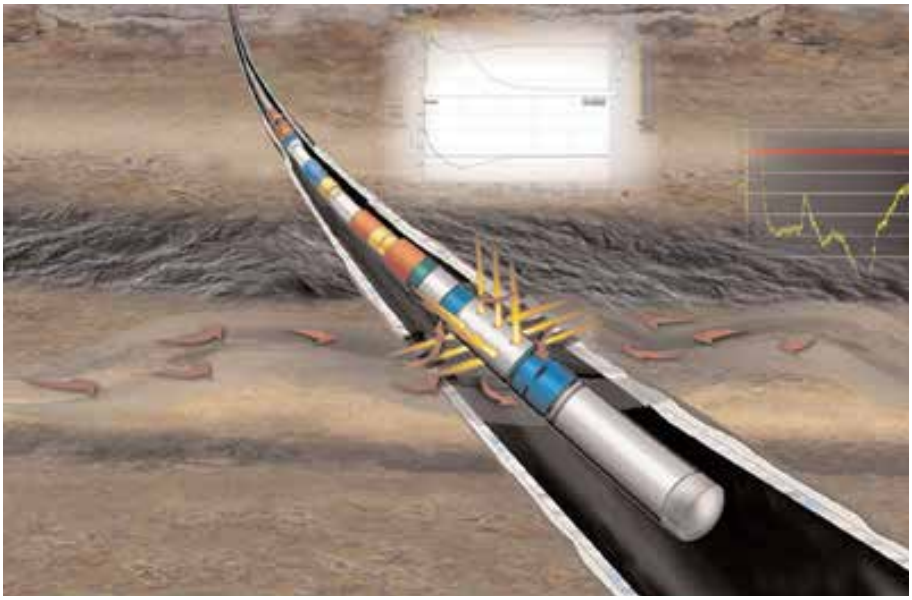


Figure 2.1.6: Perforation

- **Gravel Pack**

A gravel pack refers to a downhole filter which is specially designed for the prevention of unwanted formation sand production. Properly sized gravel pack sand holds the formation sand. Then again, properly-sized screen holds the properly sized gravel pack sand.

In simple words, this pack is an excellent method used for the prevention of sand to enter into the well stream.

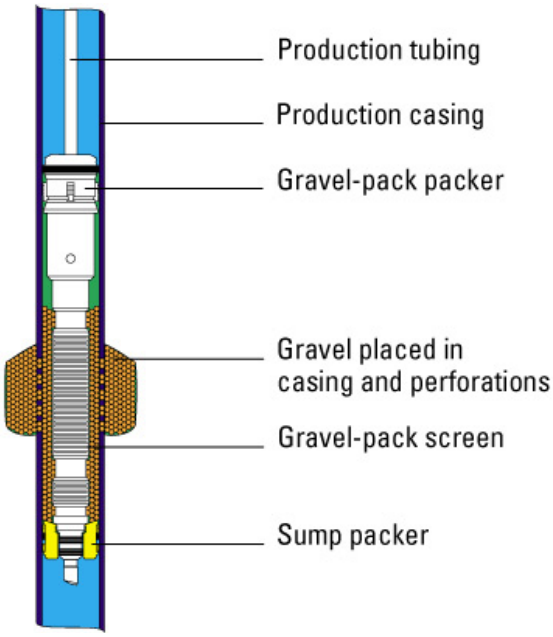


Figure 2.1.7: Gravel Pack

- **Production tree**

This is the completion step which involves the installation of a wellhead at the well's head.

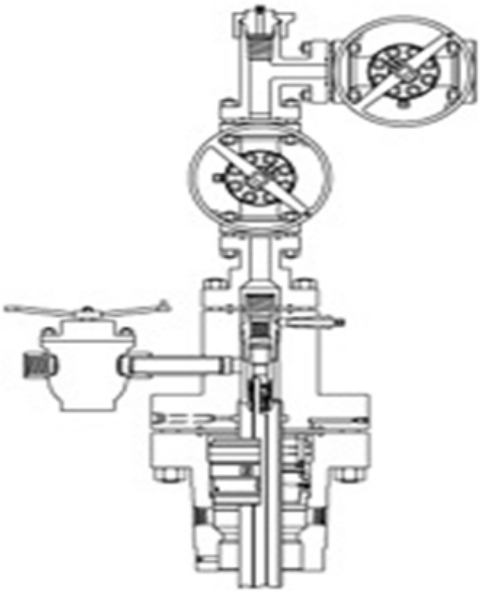


Figure 2.1.8: Christmas Tree Assembly and Coil Tubing Wellhead

Christmas Tree

A Christmas Tree, in this contexts, has a series of connection, a choke, spools, and valves. Its utility can be seen for injection or production wells like water disposal wells, water injection wells, gas wells, oil wells, etc. It offers various means for allowing measurement tools to access the wells, ensure the facilities safety and control effluents.

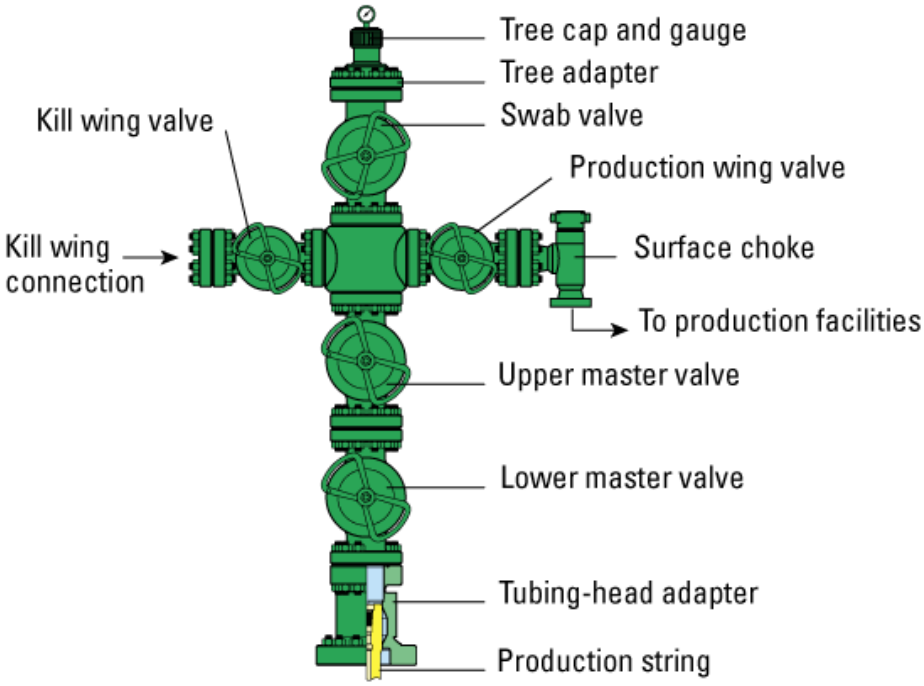


Figure 2.1.9: Christmas Tree

Injection well

The utilisation of an injection well is basically towards porous geologic formations where underground fluid placement is done. The range of these underground formations may be from:

- Shallow soil layer
- Limestone
- Deep sandstone

The fluids that are injected into the porous geologic formations are like:

- Chemically mixed water
- Saltwater or brine
- Wastewater
- Water

The construction of these injection wells depends on the depth and type of the injected fluid. The utility ranges of these wells include:

- Saltwater intrusion prevention
- Mining
- Enhancing oil production
- Disposing of waste
- Storing CO_2

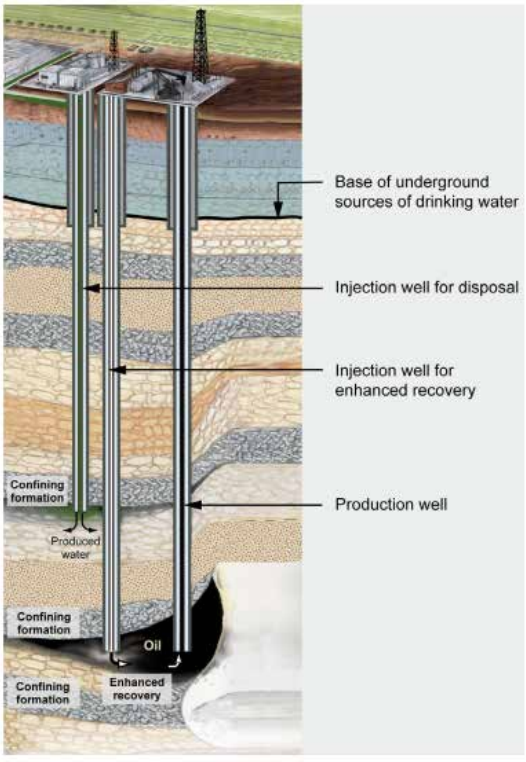


Figure 2.1.10: Injection well

Service well

It is a type of well that is drilled, converted or completed in an existing field to support production. Conversion or drilling of wells of this class is done for the certain purposes like:

- Injection for in-situ combustion
- Water supply for injection
- Salt water disposal
- Air injection
- Steam injection
- Water injection
- Gas injection for natural gasses and other gasses like fuel-gas or butane, propane, etc.

These wells are constructed for various operations like:

- Plug placement
- Packer placement
- Reworking or removal related to plug placement
- Wire-line operations
- Fishing operations

Drilling of these wells for underground areas is mainly for saltwater disposal. This is an impurity which is later separated from gas and crude oil.

2.1.2. Understand Platform Types for Underwater Drilling Submersible Barges and Platforms

Shallow water complex

Shallow water complex is a platform type whose utility can be seen in shallow waters. The depth of these areas is a maximum of 100 meters to 150 meters. The composition of this complex comprises of several independent and individual interconnected platforms. However, all the platforms have different functionalities like refining and extraction.

Figure 2.1.11: Shallow Water Complex

Gravity base

Gravity Base Complex has a base or foundation of concrete pillars. These are huge and are laid at the bottom of the sea. The important aspect of this complex is that its base is not fixed.

The gravity provides the stability of these structures once it finds a suitable surface. This is only possible due to the pillar weights.

Figure 2.1.12: Gravity Base

Compliant Towers

These complexes are a piece of art as they are located atop steel towers. These towers are basically attached to the sea floor. It is to be maintained that the depth of the sea bed can go up to 900 meters.

These towers are names complaint due to one reason – they will sway and follow the ocean's motion. The best aspect of these towers is that they can be erected in areas where hurricane occurrence is frequent.

Figure 2.1.13: Compliant Towers

Floating platforms

These are concrete gravity structures (reinforced) that are multi-levelled, self-contained and large in size. In order to predetermine the depth, these structures have water ballast submerged in the sea. This anchors the columns, thereby stabilising the devices' offset against the wave's motion. Unless the crude is off-loaded, the columns hold it.

Drilling rigs are supported by smaller floating platforms and floating tenders service it. The depth of this platforms ranges from 100 meters and 3000+ meters.

Figure 2.1.14: Floating platforms

FPSO: Floating Production, Storage and Offloading

This is a platform that comprises of different floating platforms and boats. Drilling technicians and assistant technicians use these platforms for storing and producing natural gas and oil. Added to this, FPSO is useful in collecting oil from platforms that are closer to it.

Installation of these platforms is best for those areas where it is inconvenient or difficult to build gas or oil pipelines for the purpose of fuel transportation.

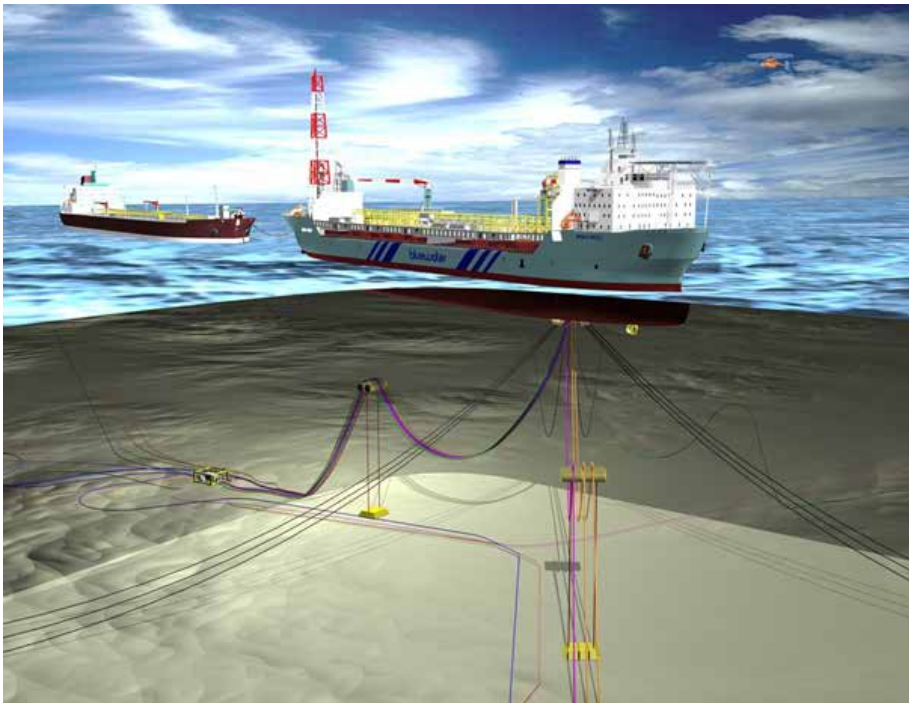


Figure 2.1.15: Floating Production, Storage and Offloading

Jack-ups (on legs)

This is a self-elevating, buoyant mobile platform whose supporting legs are jacked up. This is basically for towing purpose. If you have a look at the site, you will find that the jacks up legs are lowered. This is towards the bottom. After this, the legs are extended above the water level. The depth of the jack-ups is between 30 meters and 100 meters.

Figure 2.1.16: Jackup Rig

Tension Leg Platform (TLP)

This is also known as ETLP or extended tension leg platform. This is a moored floating structure (vertical) whose utility can be seen in offshore gas or oil production. The location of these types of structure is particularly on those areas where the depth is less than 4900 feet or 1500 meters and more than 1000 feet or 300 meters.

The tension legs of the structure are fixed to the seabed. The mooring system allows the tension legs to move horizontally with wave disturbances. However, it does not make any vertical movement or bobbing.

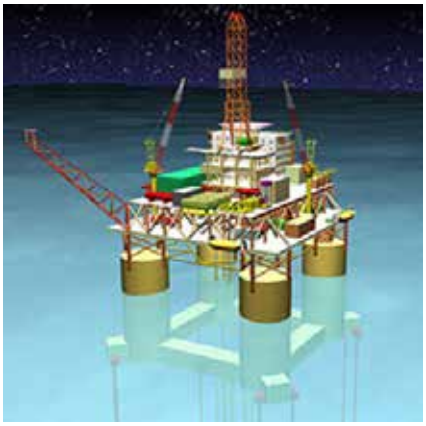


Figure 2.1.17: TLP

Semi-submersible platforms

This is a specialised marine vessel that uses pontoons or legs to float. They are used for certain offshore roles like:

- Lifting heavy cranes
- Oil production platforms
- Safety vessels
- Offshore drilling rigs

The design of this platform is basically dependent on seakeeping characteristics and good stability.

Figure 2.1.18: Semi-submersible platforms

Drilling barges

For the purpose of drilling oil wells in the petroleum industry, drilling barges are used. This is a type of drilling rig whose utility can be seen in the shallow water areas like:

- Canals
- Rivers
- Swamps
- Lakes

The drilling barge has a floating platform, and with the help of a tug boat, the platform is transported. These are semi-submersible and self- propelled barges whose depth range in the seabed ranges from 30 meters to 300 meters.

Figure 2.1.19: Drilling Barge

Drill ships

These are specialised ships that are specially designed for a higher sophisticated look and functionality. These are generally semi-submersible or floating ships.

The purpose of these ships is to drill the ocean beds for extracting oil and natural gas. These vessels have the ability to penetrate greater depths. The depth can be between 600 meters to 3000+ meters.

Figure 2.1.20: Drill Ships

Fixed On Site Platforms

It is an offshore platform that is used for gas or oil platform. The legs of these platforms are made up of steel or concrete so that it can act as an excellent and sturdy anchor to the seabed. It supports a spacious deck that consists of:

- Crew quarters
- Production facilities
- Drilling Rigs

These are economically feasible as these platforms can be installed in water depths that can be as deep as 150 meters or 500 feet.

Figure 2.1.21: Fixed on-site platforms

Sub-sea Templates

It is a huge steel structure whose utility can be seen as a foundation to a number of subsea structures. This includes:

- Manifolds
- Subsea tree
- Wells

A subsea template's size can be determined on the basis of the attached structures. This is a protective structure that provides protection against fishing activities.

Figure 2.1.22: Sub-sea Templates

2.1.3. Knowledge of the Wellhead

Dry or Subsea Completion

When the system of valves, connections and pipes are laid on the ocean bed to gather or collect hydrocarbons from single completed wells is known as a subsea or dry completion. This organised system directs the produced hydrocarbons for offloading and storage facilities that are situated either onshore or offshore.

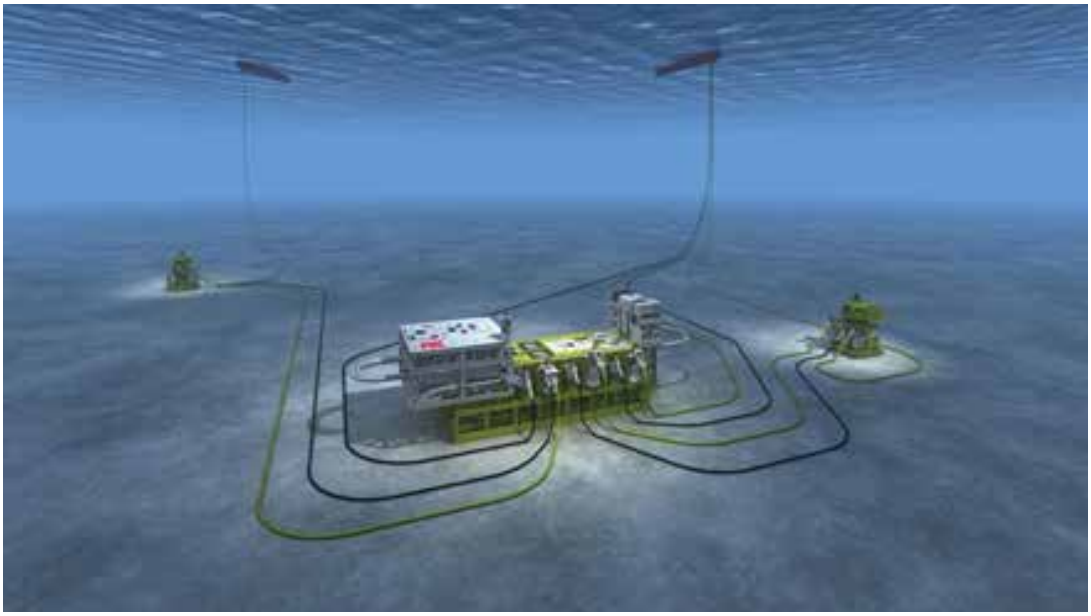


Figure 2.1.23: Dry or Subsea Completion

Casing Head and Casing Hangers

In case of oil drilling process, one can see the presence of drive-pipe or conductor pipe as the part of the drilled well's wellhead system. The casing head is a metal flange that is screwed or welded on the top of the casing or the drive pipe.

To control the surface pressure, the Casing Head acts as the primary interface. Two of the excellent examples to explain this term are:

- In case of well production - Christmas tree (figure 2.1.8)
- In case of well drilling - blowout preventers

The purpose of installation of the casing head is to check the leak-off parameters and pressure parameters. This is mainly done before the installation of any surface equipment to ensure the viability that takes place under the blowout conditions.

Figure 2.1.24: Casing Head

The casing hanger is a supporting element that can be seen as a wellhead assembly's part. This assistance is for the casing string during that period when the string is lowered carefully inside the wellbore. The main purpose of this string is to make sure that the casing in place properly.

The casing string rests inside the casing spool on a landing shoulder. This takes place when the casing string is suspended or hung off by a casing hanger into the wellbore. The design of casing hangers should be made in such a way so that it can carry the weight of the entire casing. Added to it, it should also act as a seal between the spool and the casing hanger.

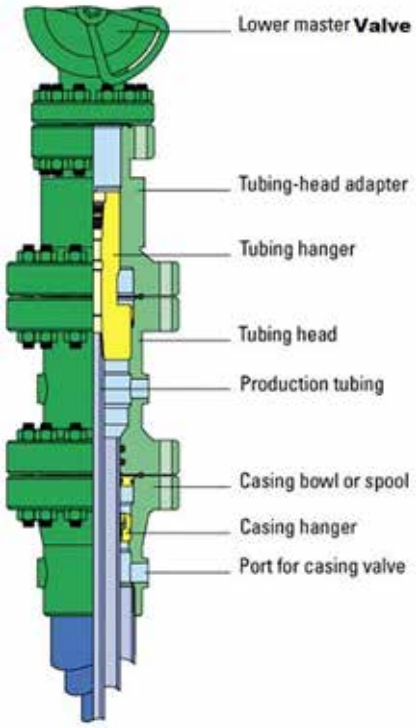


Figure 2.1.25: Casing Hanger

The Tubing Hanger

- This is an important component that is used for the completion purpose of production wells (gas and oil).
- Setting of the tubing hanger can be seen the wellhead or in the Christmas tree.
- The hanger then suspends the casing or the production tubing.
- There are times when this hanger provides the porting facility and permits communication of chemical injection, various downhole functions, electric functions and hydraulic functions.

Figure 2.1.26: Tubing Hangers

Master Gate Valve

A Master Gate Valve controls the flow of gas and oil from the wellbore.

The location of this valve is atop the Christmas tree.

In most of the Christmas trees, 2 master gate valves are fitted.

The lower one provides contingency or backup functions, and the upper one works as the main device that works on a regular basis.

Its working is in the event of normal valve servicing when it is leaking, or the valve requires replacement.

Figure 2.1.27: Master Gate Valve

Pressure Gauge

These are instruments that are found in oil and gas companies to analyse the force of gasses or oil flowing through pipes or n a surface. The utility of these gauges can be seen over a pumping lease. This encompasses ranges of accuracy levels, costs, and sizes.

The gauges that can take maximum abuses have the tendency to be less accurate. Gauges that have a higher level of preciseness need careful treatment.

Figure 2.1.28: Pressure Gauge

Wing Valve

This is a specialised valve that you will find at the side of temporary surface flow equipment or a Christmas tree. The wing valve is mainly utilised for drill stem test. 2 wing valves are fitted to the tree –

- **The kill wing valve**

The fitting of this valve can be seen at the Christmas tree's opposite side. Its main purpose is well control or treatment.

- **The flowing wing valve**

This valve is utilised for isolation and control production.

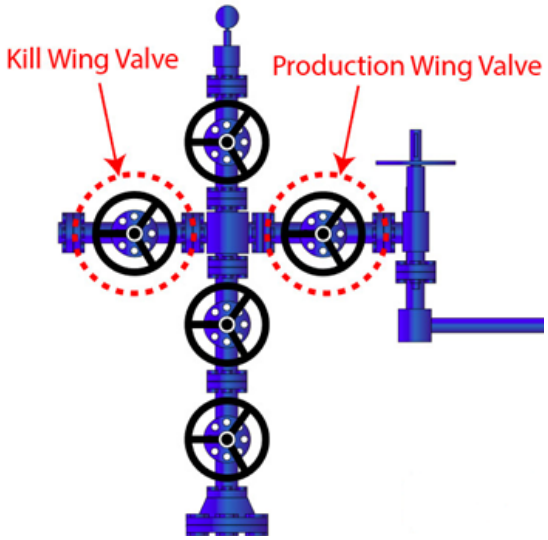


Figure 2.1.29: Wing Valve

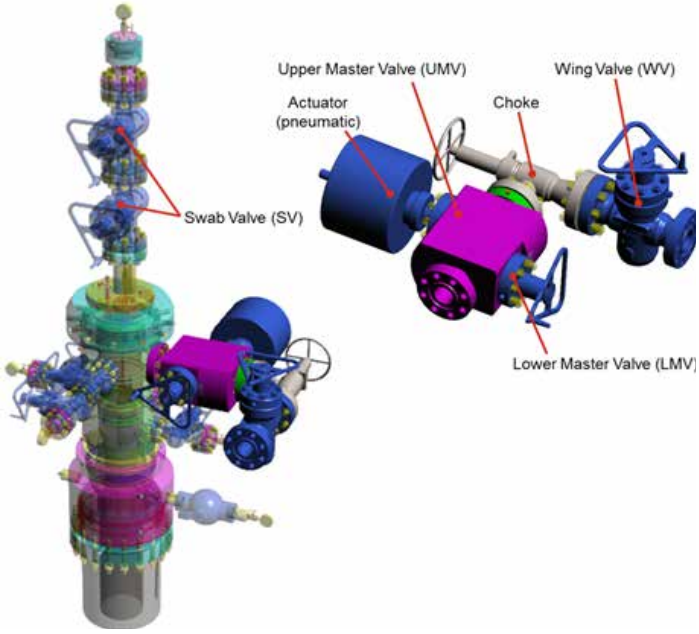


Figure 2.1.30: Wing Valve - Cross-section View

Swab Valve

It is a valve that is located at the topmost part of the Christmas tree and gives direct access to the vertical section of the wellbore.

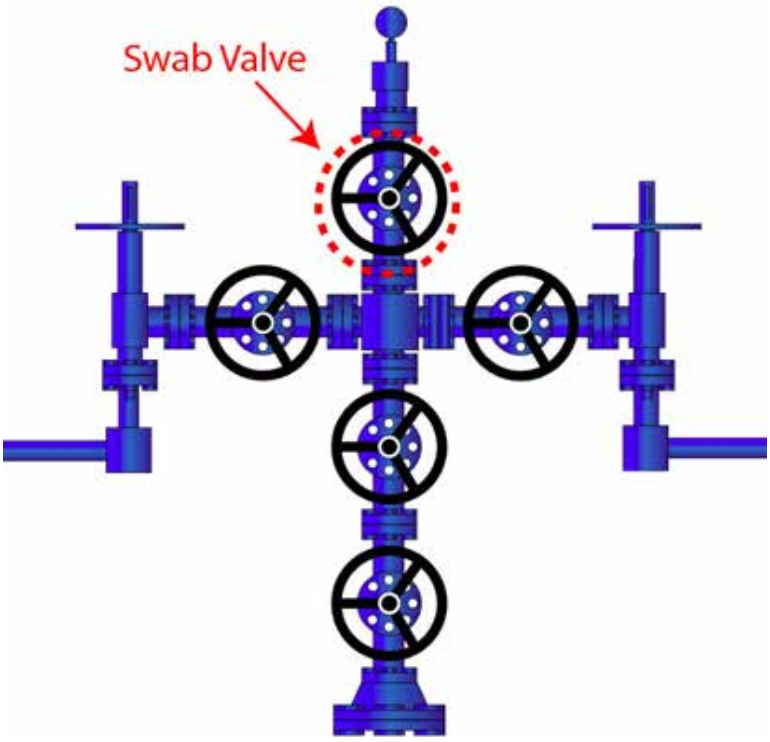


Figure 2.1.31: Swab Valve

Variable Flow Choke Valve

It is one of the control valve types whose utility can be seen in gas and oil production wells. This controls the production of well fluid (flow). This regulates the downstream pressure and kills the pressure that arises from the reservoir.

Figure 2.1.32: Variable Flow Choke Valve

Vertical Tree

Vertical tree is a system of connectors, piping, flow paths, and valves that control and contains the fluid's flow from the surface (by injection) or a reservoir. For well intervention program removal of wireline, plug is not required. If this system is compared to the horizontal tree, this is a cheaper and simpler system.

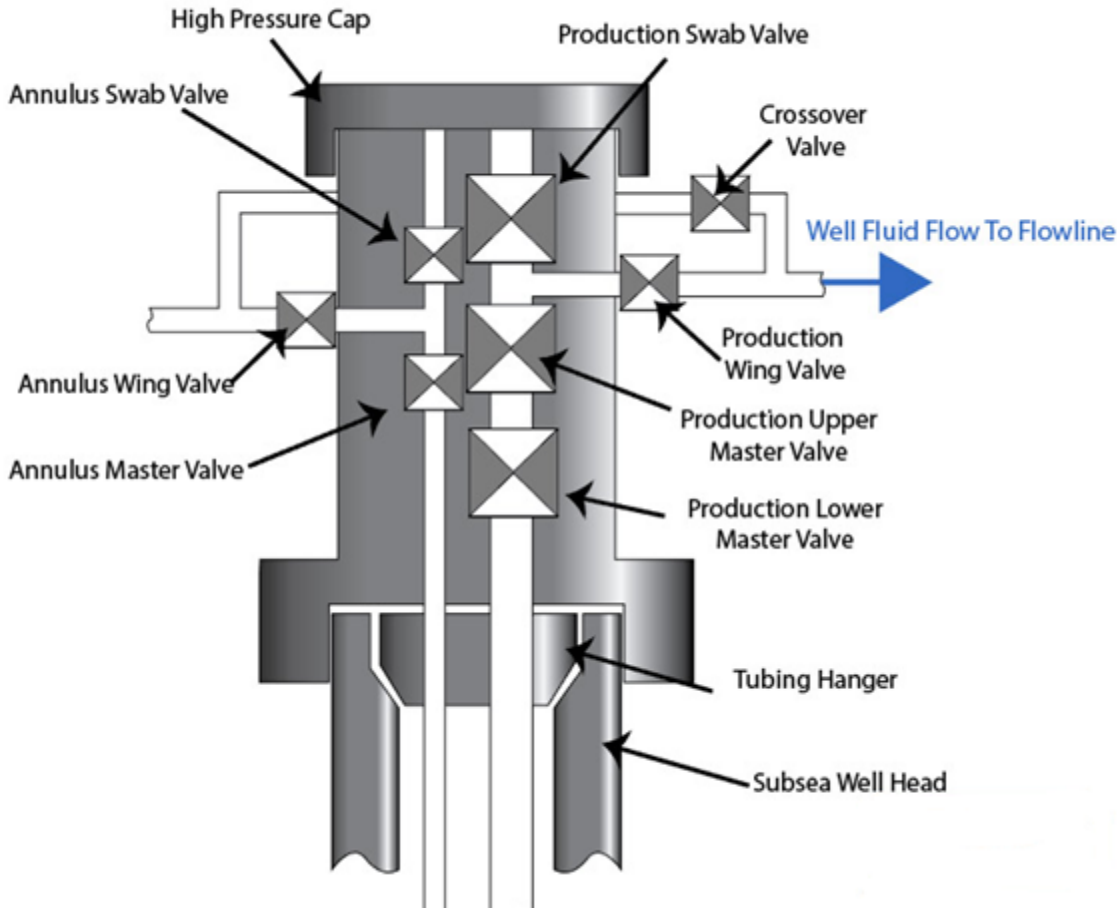


Figure 2.1.33: Vertical Tree

Subsea Wells (Umbilical)

It's a bundle of conduits and cables that transfer electric as well as hydraulic power from topsides to subsea within the field. This is beneficial in carrying gas (in case of artificial lift) and chemicals (in case of subsea injection).

The umbilical consists of:

- Gas supply
- Chemical supply
- Fibre-optic signal
- Electrical signal
- Electrical power supply
- Hydraulic power supply

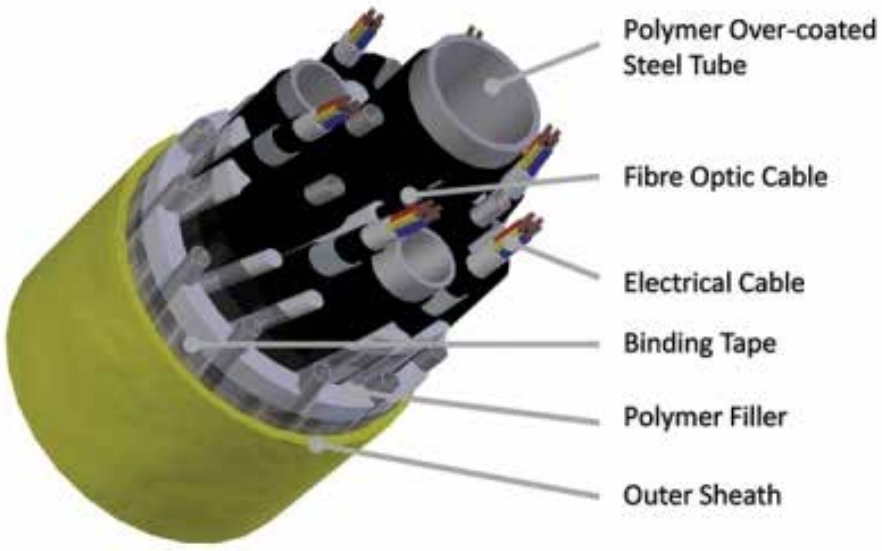


Figure 2.1.34: Subsea Wells (Umbilical)

2.1.4. Perform Abandonment Process

Well Abandonment

By isolating all permeable water zones and hydrocarbon zones from each other of different pressure regimes, well abandonment prevents cross flow and pressure build-up. This process also ensures:

- Prevention of freshwater aquifers contamination
- Blockage of wellbore fluids leakage to the surface
- Decrease the well operations' consequential effects on the environment

As per this section, the application of abandonment procedure to a well implies that:

i. The production of oil and gas ceased or came to an end
ii. Its operation is no longer in progress, especially for the purpose the well was drilled
iii. It is complete and acts as a non-productive well

Before plans are made for well abandonment, production casings, cement bonds behind the intermediate, and cement top are reviewed.

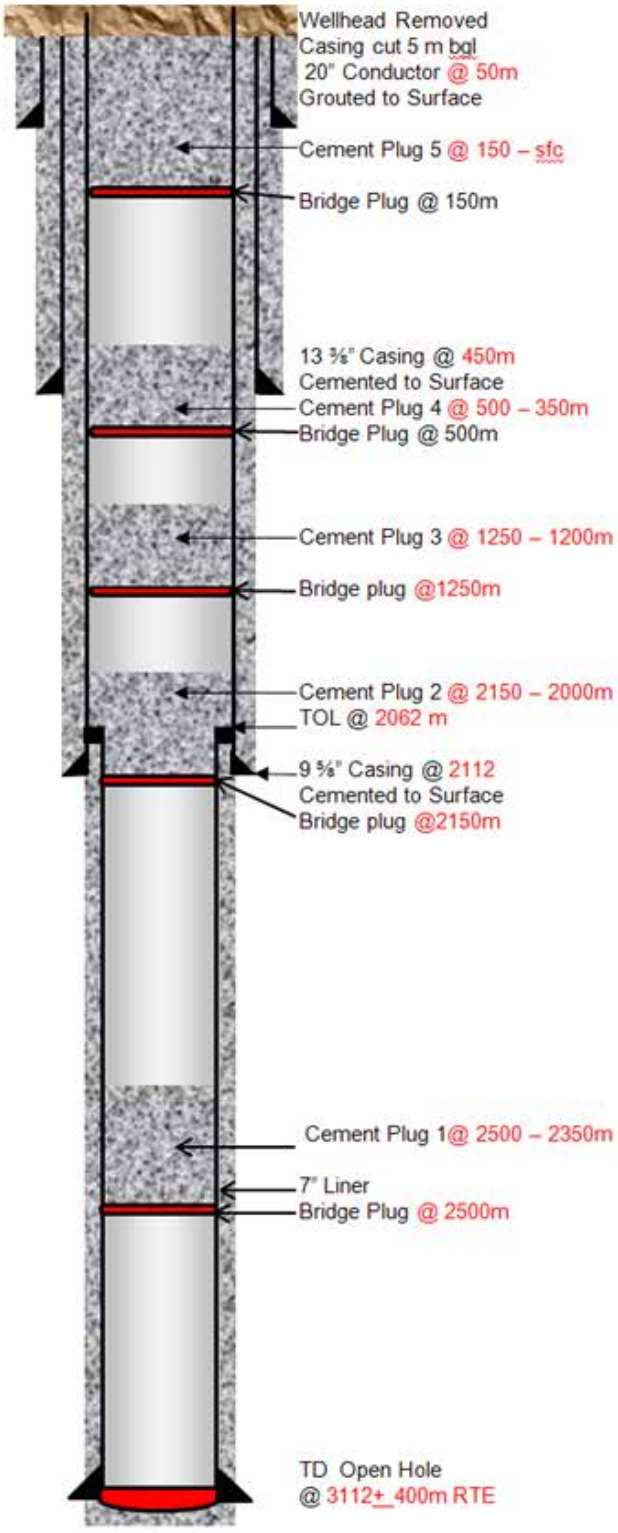
Permanent Abandonment

The abandonment process consists of:

- Surface abandon plug
- Down hole abandon plug(s)

Down Hole Abandon Plug

1. In a well's cased or uncased portion, the setting of cement plug is done in a precise way so that the extension from below is nearly 30 m and from freshwater zones, gas or oil's top section is another 30 m.
2. Added to this, below and above previous casing shoe, the setting of cement shall for a minimum of 30 meters. Placed against the zone bearing hydrocarbon, the cement plug will be considered as the plug's backup.
3. The covering process is difficult with one cement plug for all porous zones. This is especially in connection to multi porous zones and longer drilled intervals in the open hole. For this case, placements of two or more cement plugs are required.
4. After WOC, the plug(s) shall be tagged (in context of in the open). This can be done with the weight application of a minimum of 8 MT on the plug.
5. With the placement of one cement plug, an open hole (where there is no freshwater zone, gas or oil) can be isolated. The length of one cement plug is generally 60 meters (minimum). This means that the plug is 30 m inside and 30 m below the deepest casing shoe.
6. Cement plugs will cover cement squeezed intervals, casing failure point, and casing patch. In this case, the plugs are placed 30 meters below and above the extremities.
7. A mechanical barrier device such as bridge retainer or plug for known lost circulation conditions or expected scenarios. The placement of these plugs is generally above the casing shoe (15 to 30 m above). The minimum distance of the cement is 15 m above the device. As a substitute for adequate compressive strength, lightweight slurry can be used.
8. Until good hard cement plug is within the deep-set target, it is best to drill out high plug(s) and built up low plug(s). When the abandonment plug is placed inside the cased hole surface or open hole, it is to be considered that the length of cement plug that requires to be inserted should be a minimum of 60 m. The Driller should also ensure that the plug's topmost portion should be within 60 m and below the mean ground level. This is in the string's smallest string.
9. For the verification of annulus integrity and isolation above TOC, pressure test should be made for all casing annulus. At the annulus's outer casing shoe, it should be maintained that the test pressure should not go beyond the LOT value.
10. As per the satisfaction of the local authorities, the abandonment well's marking and capping needs to be done.



Picture 2.1.35: Well Abandonment – Schematics

2.1.5. Understand a Typical Drilling Program

A typical drilling program basically refers to the operational aspects that are in relation to the proposed drilling process, its completion and well testing. In simple words, that is an engineering plan that is made before drilling a wellbore.

The drilling program comprises of an elaborated plan that includes important aspects like:

- Special procedures
- Economics
- Estimations regarding pore pressure
- Offset well information
- Initial bit selections
- Well control concerns
- Mud considerations
- Casing programs
- Well geometries

The objective of well planning is to formulate a drilling programme having following characteristics: Safety, minimum cost and usability.

The well planning's objective is the formulation of a specific drilling programme that will have the characteristics like:

- Usability
- Minimum cost
- Safety

Activities before the Beginning of Drilling Operation

i. Location's release
ii. Survey of subsea location or surface location
iii. Foundation and Civil works
iv. GTO (Geo Technical Order) preparation
v. Complete well program or plan preparation
vi. Initiation of purchase procedure and material bill's preparation
vii. Allocation of rigs and shifting those to new location

Input Data regarding Well Planning

i. Objectives in relation to the well
ii. Regarding formation type thickness and top, aspects like information, correlation logs, offset, expected pore pressures, structural map, location map, Seismic data, etc.
iii. Drilled well data and offset
iv. Coring programme, testing and proposed logging

GTO or Geo Technical Order

The preparation of GTO or Geo Technical Order is made in a certain way so that it can provide broad guidelines regarding the well drilling process. It provides details like:

i. Drilling data
ii. Mud parameters
iii. Geological data
iv. A well's general data like well's objective, category, well type, elevation, location water depth, area, well number, well name, etc.

Preparation of Drilling Programme

There are 12 main sections that in combination comprises of a Drilling Programme. They are:

i. Survey requirements
ii. Deviation programme
iii. Hydraulics and Bit programme
iv. Mud programme
v. Estimation of well cost
vi. Evaluation requirements
vii. Well Objectives
viii. Well details
ix. Wellhead selection
x. Casing Policy
xi. Cementing programme
xii. BOP requirements

Unit 2.2 Basic Oil & Gas Drilling Process and Operations

Unit Objectives

At the end of this unit, you will be able to:

- Evaluate Working at Height, Operation at Monkey Board, Top Man Escape Device
- Gain Knowledge about Well Workover, Intervention and Stimulation
- Evaluate about Drilling Methods
- Demonstrate Perform Drilling Operations
- Evaluate Completion, Enhanced Recovery and Workover Operations

2.2.1. Understanding of Working at Height, Operation at Monkey Board, Top Man Escape Device

Working at Height

The working environment is extremely dangerous in oil and gas companies. One of the main risks in this area is working at heights. This is unavoidable as daily activities related to typical offshore rig require the technician to work at heights. This accounts for grave injuries to the workers.

70% of the injuries in the oil production areas, especially on rigs, comprises of:

- Falls
- Trips
- Slips

Falling from one level to the other or into a well opening can not only break the bones of the workers, making them partially or completely paralysed, it can also prove to be fatal.

In case of underground operations, the technicians should be well aware of the constantly changing environment. They should remember the fact that working at heights at an underground area is different from working at the surface. The key barriers in this case are:

- Ventilation issues
- Workspace constraints
- Challenging ground conditions where the ladders are placed
- Limited visibility

Picture 2.2.1: Working at Height

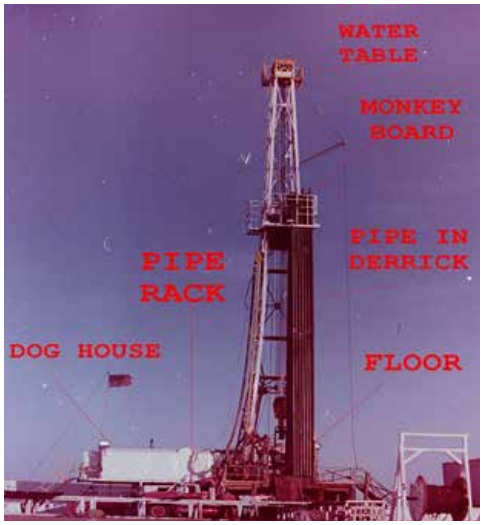
The fall protection system for the workers working at heights is:

- Warming lines system
- Restraint system
- Personal fall arrest system
- Safety net system
- Guard rail system

Picture 2.2.2: Fall Protection System

Operation at Monkey Board

- The Derrickman or the person using the ladder uses a platform to perform drilling operations. This platform is known as Monkey Board.
- The monkey tubing board is one of the typical rig tasks that expose the derrick hand or the operator to higher falling risks.
- With the help of this platform, the operator can reach heights and handle the pipe tops.



Picture 2.2.3: Monkey Board

Top Man Escape Device

- The top man escape device is installed at every rig on the monkey board.
- The make of this device comes with a slide so that the operator or the technician working at heights can come down easily on the ground level.
- The escape line of the device is fastened securely to the girt.
- This girt is located just above the monkey board.
- The line has a safe anchor at a certain distance on the ground.
- The device has track ropes that are used for emergencies.
- It has sufficient sag that does not allow the ropes to strain. The reason for this is pre-tensioning.

Picture 2.2.4: Top Man Escape Devicet

2.2.2. Knowledge of the Well Workover, Intervention and Stimulation

Well Workover

This is a well intervention type whose focus is to enhance a well's performance. In simple words, it basically is a re-completing process of an already completed well so that its performance can be better than before.

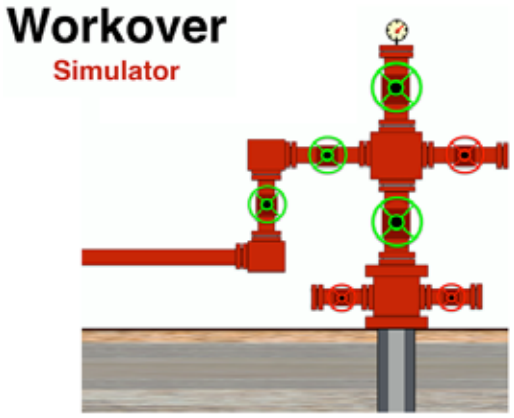
Only after a well is drilled, a proper assessment is conducted to know if the particular area has oil content in commercial quantity. In case, oil is found in the required quantity; the work-over is completed for the well and then it is placed on stream.

There are certain circumstances when during the well's life production process the condition may change. It is during those times one can see a decline in that well's performance level.

8 steps regarding the operation of well work over:

i. Rig down BOP
ii. Rig up of BOP
iii. Final Running in of Tubing
iv. Specified jobs
v. Circulation
vi. Rig down of X-mass tree
vii. Well killing
viii. Rig-up Mast

Picture 2.2.5: Well work-over team performing the task



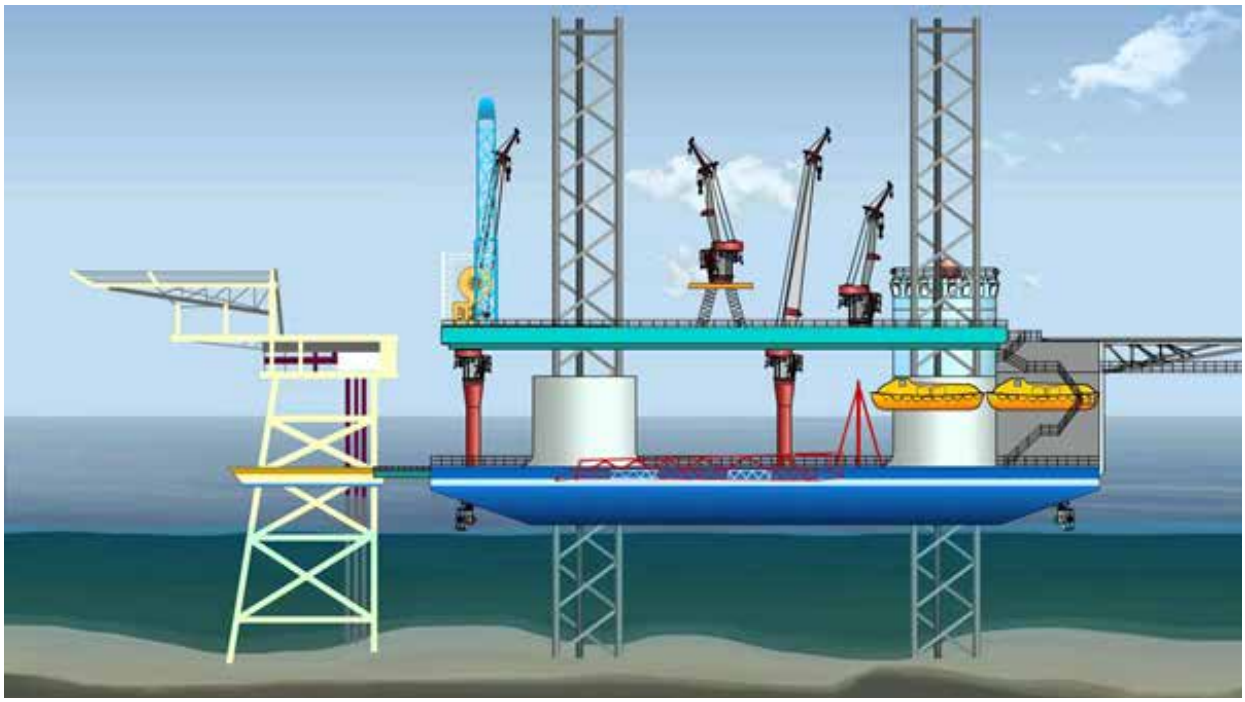
Picture 2.2.6: Work-over Simulator

Well Intervention

Any operation carried out on a well during or at the end of its productive life, which alters the state of the well and/or well geometry, provides well diagnostics or manages the production of the well.

Types of Well Intervention

- Wire line
- Coiled tubing
- Work over
- Snubbing
- Slick line
- Pumping



Picture 2.2.7: Well Intervention

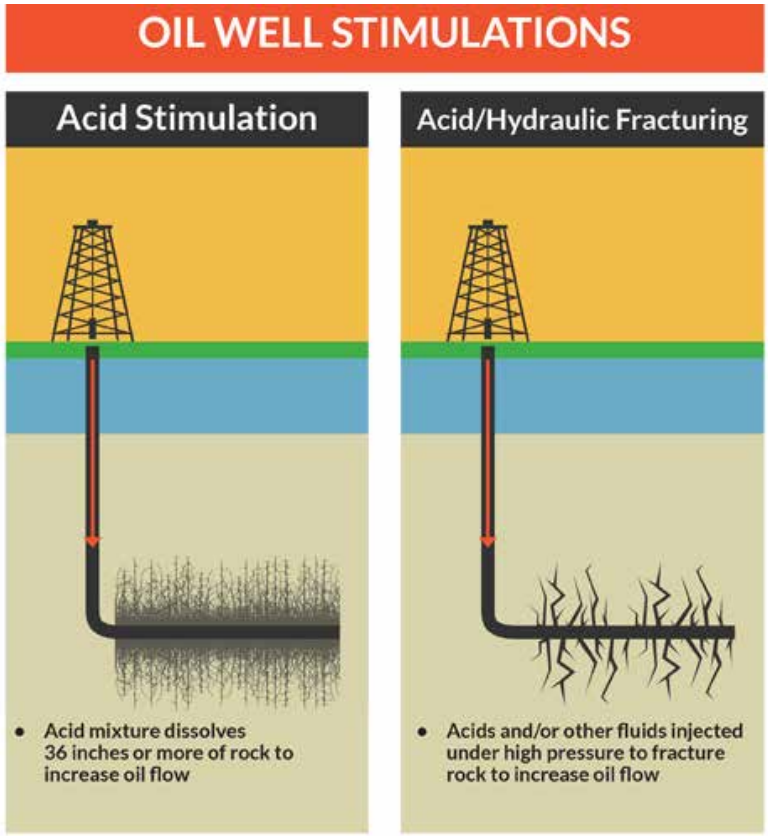
Well Stimulation

To increase the production quantity in a gas or oil well, by enhancing the hydrocarbons flow to the well bore from the drainage area, well intervention or involvement is performed. This process is known as stimulation. The entire process takes place by the utilisation of drilling vessels/ shore ships or well stimulator structure. This is called Well simulation vessels.

There are 2 important Stimulation treatments.

- Matrix treatments
- Hydraulic fracturing

Both these processes are used for improving or restoring well productivity. This productivity is in relation to reservoir environments and all formation types.



Picture 2.2.8: Well Stimulation

2.2.3. Understanding/Knowledge of the Drilling Methods

Drilling Rigs

Drilling rig is a machine that is used for creating holes in the surface of the Earth.

These rigs mainly consist of:

- An engine, pump mud and mixer to drive the winch and table
- Drilling table to rotate the drilling bit and pipe
- Large winch to lift out and lower the drilling pipe
- Drilling pipe
- Tower or derrick

The drilling rigs that are larger in size do have jack knife (hinged) derricks that are portable, or they are erected on site.

The drilling rigs that are used for drilling seismic wells or exploratory wells are smaller in size and can be transported from one site to another site on trucks.

Figure 2.2.9.: Drilling Rigs

Percussion or Cable Drilling

One of the oldest manual drilling techniques is cable or percussion drilling. This involves the use of a heavy hammering or cutting bit that is attached to a cable or rope and then lowered into a temporary casing or an open hole. This process loosens the consolidated rock or the soil inside the borehole. Later with the help of a bailer, the extractant are extracted.

This technique has another name - 'Cable tool'. In order to support the tools, a tripod is used. The utilisation of manual percussion drilling is done for creating holes up to 25 meters (depth).

This is a limited and slow depth method that is rarely used. This process used the technique of raising and dropping heavy chisel stem and bit to crush the rocks. During the interval periods, the cuttings are hung inside the water, and the bits are removed. Later they are removed by pumping or flushing the cutting to the surface.

Steel casings are lined inside the drilled holes as they continue to deepen. This is to protect the hole from groundwater contamination and prevent cave-in.

This drilling technique is one of the best methods as it can break harder formations and remove boulders at a faster pace, that too with higher efficiency. Added to it, this process can be used for drilling at any soil type. However, these machines are expensive and heavy.

Figure 2.2.10: Percussion or Cable Drilling Technique

Rotary Drilling

- This is one of the common methods is used for drilling both production wells and exploratory wells. The maximum depth that can be drilled with this process is around 7000 meters or 5 miles.
- These drills are lightweight and are best for drilling low-depth seismic wells. They can be mounted on trucks and transported to one site from another site.
- The heavy and medium rotary floating and mobile drills are used for drilling production wells and exploratory wells.
- The drilling platform (Derrick) on which the rotary drilling equipment are mounted are usually of a height of 30 meters to 40 meters.

The components of the rotary drilling equipment are:

- Pipes of approximate 27 meters length
- Winch or wire-line drum hoist
- Injector pump
- Mud mixer
- Engine
- Rotary table

The drilling pipe has square Kelly connected that is turned by the rotary table. This Kelly is connected to the blowout preventors' topmost position and has a mud swivel.

The speed of the drill pipe is around 40 to 250 rpm.

The bit having rolling cutters has hardened teeth, and the drag bits have chisel-like cutting edges that are permanently fixed.

Figure 2.2.11.: Rotary Drilling

Rotary Percussion Drilling

This is a special type of drill that is used for actions related to percussive and rotary drilling. Its utility is mainly for producing a hole in the land and chipping away rocks. This drilling technique is excellent for construction and mining applications and used for constructing wells and tunnels.

This is a popular choice for oil well construction. The chipping, grinding, and cutting actions are driven pneumatically and hydraulically. There are 2 types of rotary percussion drills.

- DTH (down-the-hole) hammer drill
- Blast hole drill

Figure 2.2.12.: Rotary Percussion Drilling

Electro and Turbo Drilling

In most cases, electric turbines or motors drive heavy drills (pumps), winches and rotary tables. During operations, it allows increased flexibility as well as remote-controlled drilling.

Turbo drilling and Electro drilling are the latest methods. The drill bits get direct power due to both of these techniques. This is done by connecting the bits to the drilling motor at the drilled hole's bottom.

Directional Drilling

The rotary drilling method that directs the drill string along the path (curved) and continues to do so with the deepening of hole is known as Directional drilling. When the technicians cannot reach the deposits with the assistance of vertical drilling, they do use the directional drilling process.

From a single platform, multiple wells can be drilled. This is an efficient as drilling can be done in different directions, and it reduces the costs related to drilling. With the help of extended-reach drilling, many undersea reservoirs can be tapped from the shore.

It is an advantage for the technicians as they can directly use the coiled tubing or flexible pipe and automatic drilling machines with the help of computers. The best thing about this drilling process is that the pipes can be lowered and raised without disconnecting and connecting sections.

The process of wellbore deviation whose given location is at lateral distance from vertical, along a pre-determined course and to a specific target is known as controlled directional drilling. Here are certain applications that are listed as per their definition.

- **Troublesome Geological Conditions**

With the help of directional drilling method, drillers can avoid drilling through troublesome formations or geological faults such as salt dome, etc. The well planning is done as per practical approach so as to avoid problematic formations or structures that may result from the drilling path.

- **Multiple Targets**

There are instances where during the process of drilling one target, a driller has to change the drilling direction of the well to reach their next target. This is known as multiple targets.

- **Relief Well Drilling**

Relief Well Drilling is directional drilling's important applications. This is near the well's bottom intersect a blowout well so that water and mud can get into it.

- **Side-tracking**

For wellbore deviation away and around the barrier in the original wellbore, directional drilling is used.

- **Drilling Of Multiple Wells from a Single Platform**

Due to land limitations on onshore, drillers apply cluster drilling. As offshore platforms are the highly common and sought application for directional drilling, in the same platform, via various installed slots, multiple wells are drilled.

- **Drilling of Inaccessible Locations**

Suppose there is a target zone whose position is directly below the surface location. The utility of these locations as rig sites is basically impractical. Now, these locations like harbours, river beds, residential locations, etc. can be used by drilling a directional well.

Explosive Drilling and Flame Piercing

Explosive drilling method uses explosives to serve its work purpose. In the same way, flame piercing uses fire for the drilling process.

In these drilling processes, various methodologies are also in use. One of the potent methodologies is gas pressure blasting pyrotechnics. These methods are the economic excavating technique where normal digging process cannot take place.

Well Control Theory

In this theory, primary control is extremely important.

Primary control – With the help of columns and drilling fluid density primary control can provide enough pressure to stop formation fluid's influx into the wellbore. Maintaining primary well control is necessary. The maintenance process includes:

- Any change in the drilling fluid flow rate, volume and density from the wellbore requires to be quickly detected. Added to this, it is also important to take the required actions.
- Mostly during tripping, it is necessary to monitor drilling fluid's active volume.
- When drilling fluid is used, it is important to check if its density is appropriate or not.

Causes of Kick

When primary control is lost over formation pressure, the result can be seen as well kick. There are 5 main causes:

1. Riser Drilling Fluid Column Loss

When hydrostatic pressure reduces in the hole due to mud column loss in riser, there are chances of primary control loss. This occurs on floating rigs. There are 3 reasons for riser hydrostatic column loss.

- With sea water, displacement of riser fluid volume
- Riser damage
- Riser's accidental disconnection

2. Insufficient Drilling Fluid Density

Formation fluid is bound to enter the wellbore when the drilling fluid density is less due to hydrostatic pressure. The density is lower than permeable zone's formation pressure.

The reasons include:

- After kick circulation in the riser, failure to displace the kill mud
- Weighted material settling in mud
- Due to formation fluid's influx (particularly gas), a decrease in drilling fluid density
- Drilling fluid dilution
- Drilling into abnormal pressure zone

3. Lost Circulation

A drop at mud level can be seen when circulation is lost. Added to this, hydrostatic pressure can also be seen as reduced in bore wells. This may be due to primary control loss over formation pressure.

Either due to induced or natural causes, circulation loss can take place.

In case of induced cause:

- When drilling fluid's gel strength is high, it creates excessive pressure. This can lead to breaking circulation
- Annular friction losses at an excess
- Due to shale sloughing or BHA, restricted annulus balling
- Due to the pipe's fast running, development of high surge pressure

In case of natural cause:

- Pressure depleted formations
- Sub-normally pressured zones
- Vugular formations
- Cavernous formations

4. Swabbing

When full gauge tools or when drill string is pulled out in the well bore, the hydrostatic pressure reduces to an extent. This may be one of the chief reasons of primary well control loss. The causes of swabbing are:

- Reduced annular clearance
- Mud with high gels and high viscosity
- Pulling pipe's high speed

5. Failure to Properly Fill the Hole While Tripping Out

When several volumes of steel pipes are removed, and drill string is pulled out, there is a hole drop in the mud level. With this drop, there are chances of sufficient hydrostatic pressure reduction that can cause primary control loss. Hence, formation fluids can easily enter the wellbore.

Secondary Control

This process states about the appropriate blowout prevention equipment use so that a well can be controlled or managed when failure can be seen for primary control over formation pressure. A well can be controlled effectively identifying the early warning signals and ensuring that the well is shut down as seen as possible or as seen as reasonable.

If the shutdown process is quick, the expelled mud amount in the annulus and entered amount in the wellbore gets reduced. Annulus pressure or lower choke is required for smaller kicks, which takes place during circulation of kick via choke and upon initial closure too.

2.2.4. Perform Drilling Operations

Drilling Techniques

- For the uncoupling and coupling of drilling pipes and its various sections, the drilling platform gives the appropriate base to the workers.
- These pipes are used for increasing the drilling depth.
- With the deepening of drilled holes, the technicians add lengths of pipes, and from the derrick, a drilling string is suspended.
- In case the technician requires changing the drilling bit, he or she needs to pull out the drilling string out of the pipe.
- For that, the entire pipe needs to be pulled out of the drilled hole.
- After the detachment of each section, the pipes are vertically stacked and kept inside the derrick.
- The reversed process is utilised once the fitting of new bit is complete.
- After this, the technician returns the inside the hole and continues with the drilling process.

During this process, it is important that the technician takes extra care. He or she should maintain the fact that drilling string pipe shouldn't split apart and falls inside the hole. The main reason behind this care is that if the pipe drops into the drilled hole, the pipe retrieval process can be difficult as well as expensive. Added to it, this can also lead to well loss.

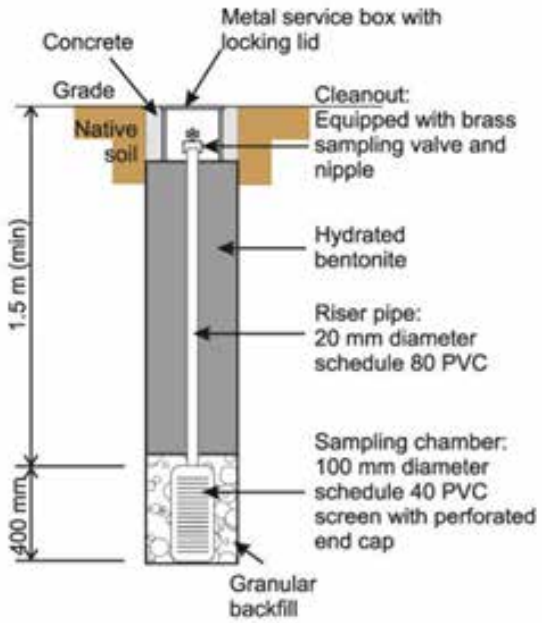


Figure 2.2.13: Drilling Techniques

Drilling Mud

After an area is drilled, fluid comes out of the surface. This fluid comprises clay, oil or water in addition to various chemical additives. The chemical additives can be like:

- Barite
- Sodium hydrazine
- Lime
- Formaldehyde

This fluid is known as drilling mud.

In order to control the drilling mud's pH level (generally it is acidic in nature) and neutralise the potentially hazardous completion fluids and additives inside the mud, caustic soda (Sodium hydroxide) is added.

On the drilling platform, a mixing tank is kept where the drilling mud is pumped (into). This pumping process takes place under high pressure. The mud goes down to the drill bit via the drilling pipe.

After this process is complete, the drilling mud rises out of the drill pipe and moves to the hole's sides. This mud then returns to the earth's surface and where technicians filter the mud and recirculate it.

To flush the rock cuttings, lubricate the pipe and lubricate and cool the drilling bit, technicians use drilling mud. By lining the hole's sides with the drilling mud, technicians can control the fluid flow and resist any liquid's or gases' pressure that is met by the drill bit.

Figure 2.2.14: Horizontal Well Drilling Mud Pit

Casing and Cementation

To line the well holes, specialised heavy pipes are used. These are known as casing. Its utilization is mainly for protecting fresh water strata and drilling hole walls to prevent cave-ins. The protection aspect is mainly in relation to leakage prevention of the fresh water so that during the drilling operations, it does not return to the mud flow.

One of the advantages of casing is it seals the high-pressure gas zones and water-permeated sands. In the first place, this process is utilised near the surface area. Later, this casing is cemented so that the drill pipes can be guided.

Once this process is complete, through the drilling pipe cement slurry is pumped down. Then that same slurry is forced up to the casing via the gap between well hole and the well wall. The drilling procedure continues (smaller diameter bit usage) after the placement of casing and the setting of cement.

Attachment of blowout preventors takes place above the casing aster the placement of surface casing in the well. This is known as stack. Some of the preventor types are like:

- Rams
- Bags
- Large bags

After the discovery of gas or oil in a certain area (well), a casing is set. This is done at the well's bottom so as to prevent contaminants, salt water, rocks, dirt, etc. from the well hole. Added to it, it provides a conduit for gas and crude oil extraction lines.

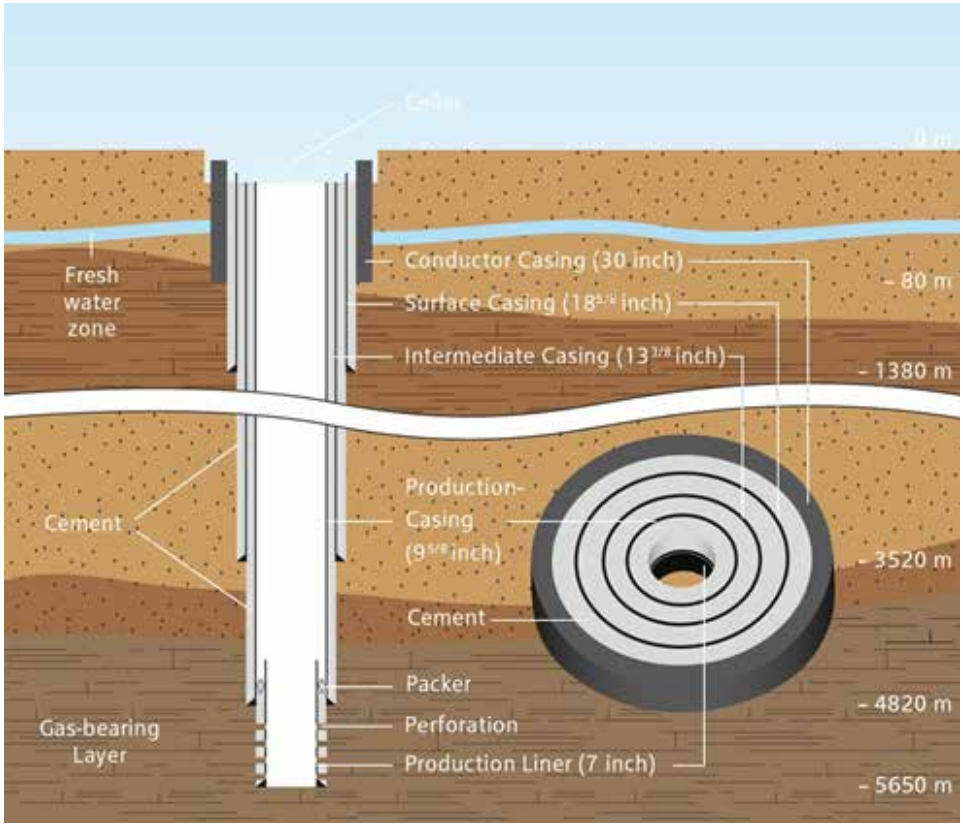


Figure 2.2.15: Gas Well Casing and Cementation

2.2.5. Understanding Completion, Enhanced Recovery and Workover Operations

Completion refers to that procedure of production of a well after the drilling process is complete for the required depth. This requirement is related to the information where the discovery of gas or oil is expected.

There are a number of operations related to this completion process. This includes:

- Cleaning sediment from pipeline for an unobstructed oil or gas flow
- Cleaning out water
- Penetration of casing

To extract and drill the core (till 50 meters) special core bits are utilised. This is done for the evaluation process that takes place during the drilling operation. This is basically to understand the appropriate time for the drilling operation.

i. The foremost thing is to remove the drill bit and pipe and cementing the final string's casing.
ii. The next step is to lower the perforating gun into the well. This gun is basically a metal tube holding shaped explosive charges or bullets. The tube consists of sockets.
iii. Electrical impulses are discharged into reservoir via the casing. This is to create an opening through which gas and oil can flow into the surface and the well.

Recovery Methods for Additional Product

Improvement in the productivity of gas and oil reservoirs can be brought by a number of recovery methods.

The first method is to open the strata's passage physically or chemically so that gas and oil can pass freely to the well through the reservoirs. To maintain the working pressure inside reservoirs, gas and water are injected. This is attained by natural displacement.

The other methods include:

- Restoring and enhancing reservoir pressure
- Artificial flooding and lift
- Displacement by pressure

When we talk about enhanced recovery, we basically are discussing about multiple recovery methods in different combinations. The methodologies under this include:

- Thermal recovery
- Advanced additional product obtaining techniques from depleted reservoirs

Work-over Operations

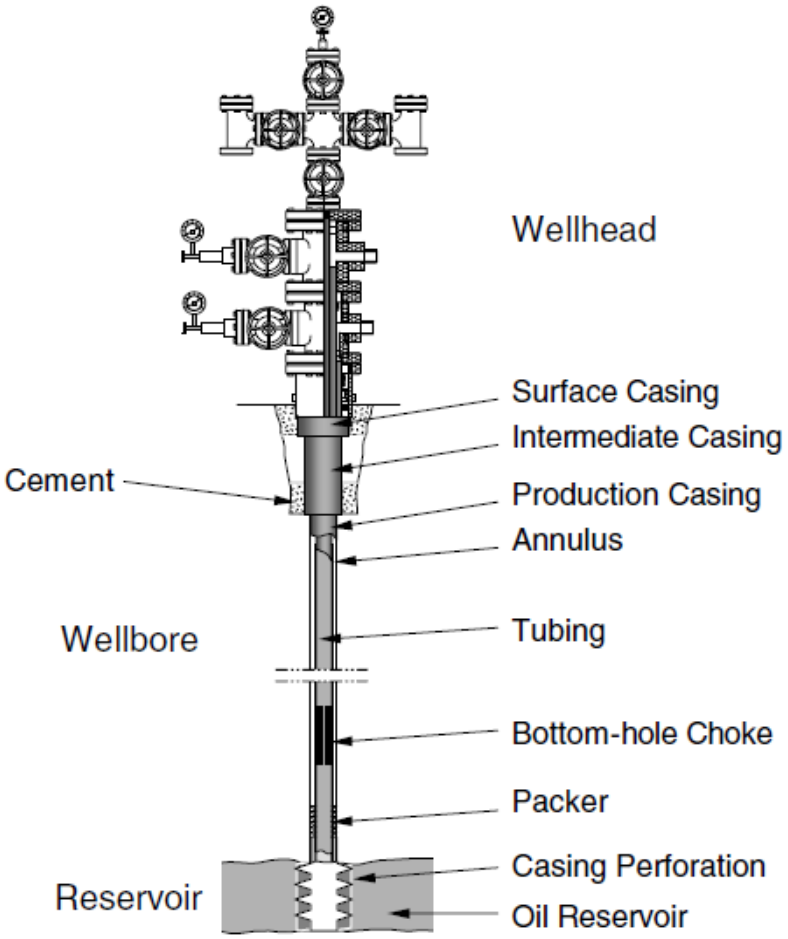


Figure 2.2.16: Well Workover

Acidizing

This is process of enhancing a well's output by directly pumping acid to a reservoir (production). This is to open the flow channels via which minerals and chemical reactions can flow. Initially, for dissolving the limestone formations, regular or hydrochloric acid was used.

It is still the highly preferred option. However, a number of chemicals are added for its reaction control. Basically, this addition is for preventing emulsion formation and corrosion. For cleaning perforation plugged with drilling mud, acid mud is used.

Fracturing

For increasing gas or oil flow, they are forced into wells and reservoirs. This process is known as fracturing. This process is usually used when there is a decrease in production due to impermeability in the reservoir formation. Fracturing basically pumps the fluid through underground channels that is forcibly opened. The treatment of the liquid is done with the help of:

- Shells
- Chemical pellets
- Metal
- Sand

For stimulated expansion in the liquid, nitrogen is added.

Pressure Maintenance

In reservoirs, 2 pressure maintenance methods are used. It comprises of gas (natural gas, carbon dioxide, nitrogen and air) and water that are injected into those reservoirs. These reservoirs are basically those where the natural pressures of production are insufficient or reduced. This pressure injection is known as natural displacement.

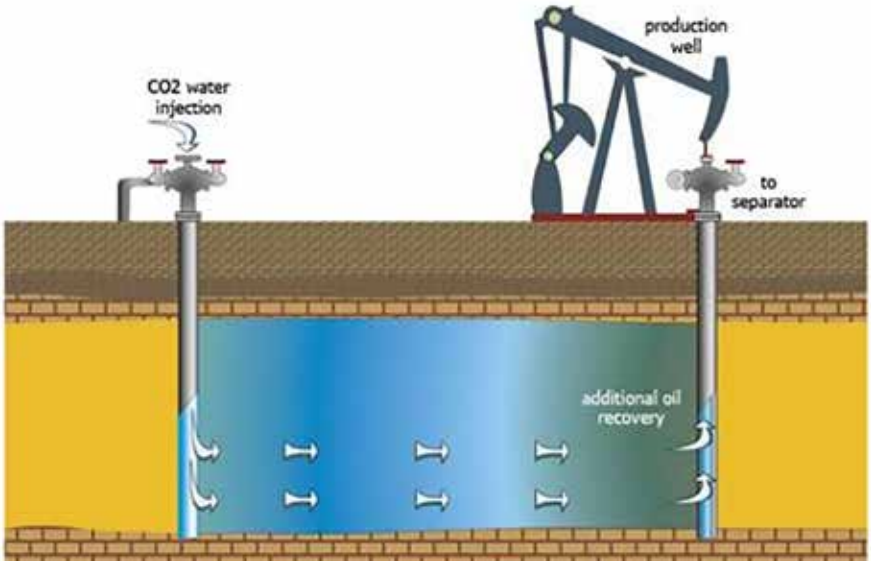


Figure 2.2.17: Pressure Maintenance

Water Flooding

This is one of the common secondary enhanced recovery methods where in the oil reservoir water is pumped. This is to push the product or item towards the producing wells. This injection is for maintaining and controlling the water advancement to producing well from the reservoir. From the crude oil, salt water is obtained. This is often used in the injection process.

Unit 2.3 Basic Maintenance Hand Tools and Measuring and Marking-out Instruments

Unit Objectives

At the end of this unit, you will be able to:

- Define the onshore Well Components
- Identify Upstream Process Sections
- Recognise the Components of Drilling Rig
- Identify the Components of Well
- Perform Artificial Lift Operation

2.3.1. Knowledge of the on shore Well Components

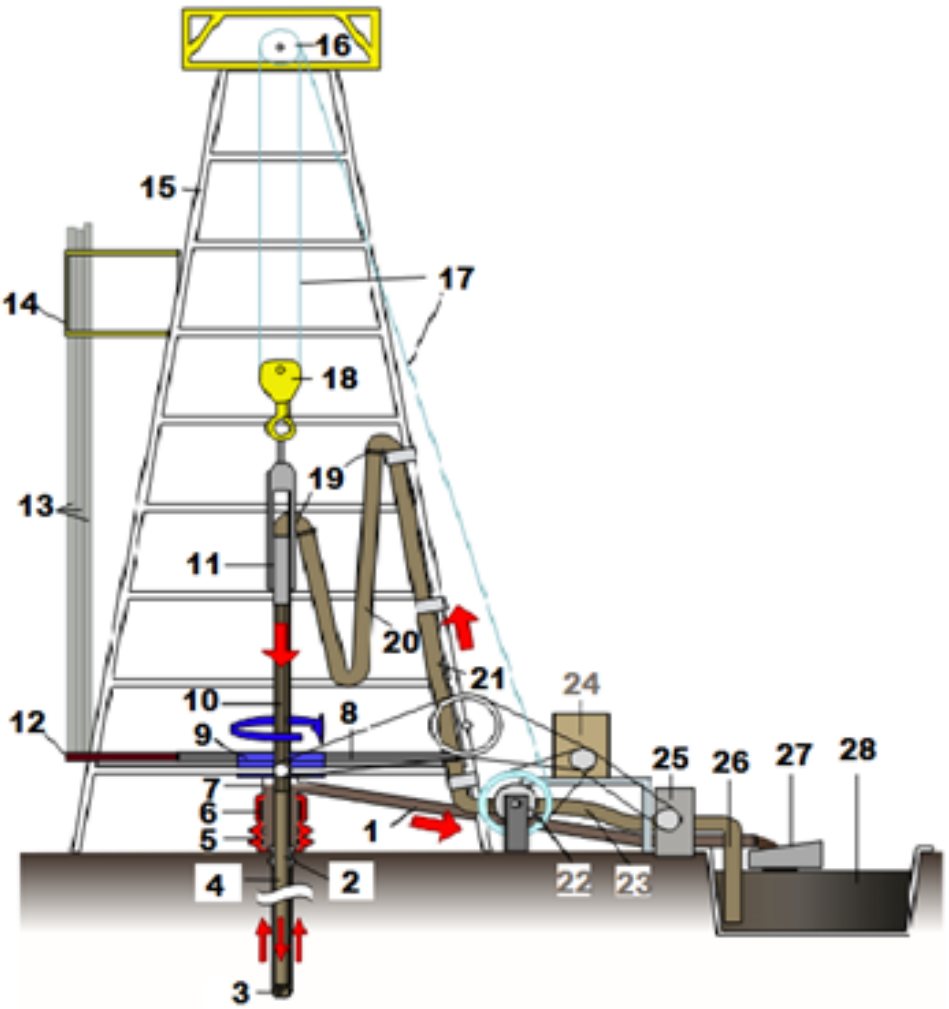


Figure 2.3.1: Drilling rig (Simple diagram) + Basic Operation

1. Flow line
2. Wellhead or Casing head
3. Drill bit
4. Drill string
5. Blind ram and BOP (Blowout preventer) Pipe ram
6. BOP (Blowout preventer) Annular type
7. Bell nipple
8. Drill floor
9. Rotary table
10. Kelly drive
11. Swivel
12. Setback
13. Stand of drill pipe
14. Monkey Board or Racking Board
15. Derrick
16. Crown block
17. Drill line
18. Travelling block
19. Goose-neck
20. Kelly hose
21. Standpipe
22. Draw-works
23. Hose
24. Motor or power source
25. Mud pump
26. Mud pump or Suction line
27. Shale shakers
28. Mud tank

2.3.2. Identify Upstream Process Sections

Wellhead

Wellhead is a machine that is installed at the completed gas or oil well's surface. It terminates the wellbore's surface that includes the installation of casing hangers in the construction phase of the well.

The wellhead also integrates the installation of Christmas tree and hanging the production tubing. The BOP (blowout preventer) controls the surface pressure in the oil well while the drilling process takes place. If the pressure is not controlled the well can blow out.

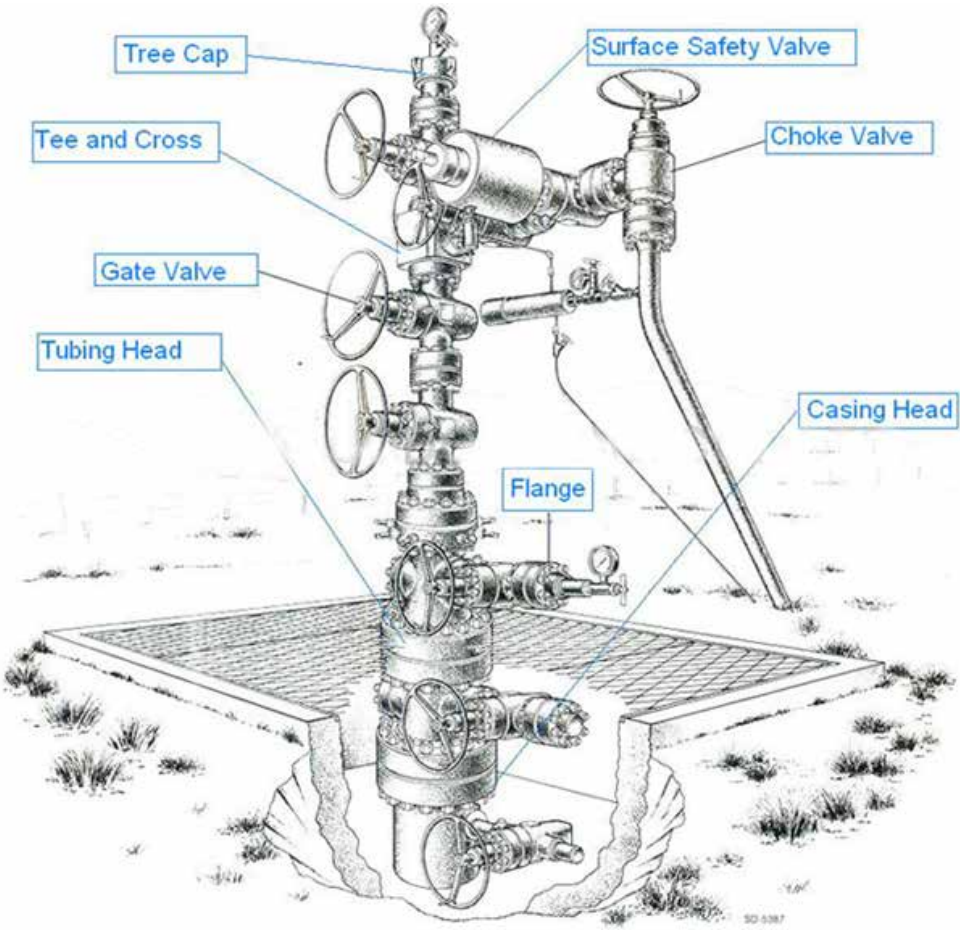


Figure 2.3.2: Wellhead

Manifolds and Gathering

In the main production facilities (Onshore), single well streams are brought over a network of manifold systems and gathering pipelines. For the selection of well flow composition, best reservoir utilisation, and given production level, the manifold or gathering are set up in the production "well sets".

In case of multiphase flows (water, oil and gas combination), software flow rate estimator usage leads to higher multiphase flow meters cost. The production manifolds are directly fed by dry completion wells. This takes place during the installation of subsea and outlying wellhead towers through multiphase pipelines.

Pipelines and Risers

Processed gas and oil is transported via Pipelines. This transported fluid is single phase fluid. This is converted to this state after the conveyed fluid gets separated from other solids, water, oil and gas. The name for this pipeline is an export line. For exporting the fluid to the pre-arranged destination, the pipeline has induced low pressure and ambient or moderately low temperature.

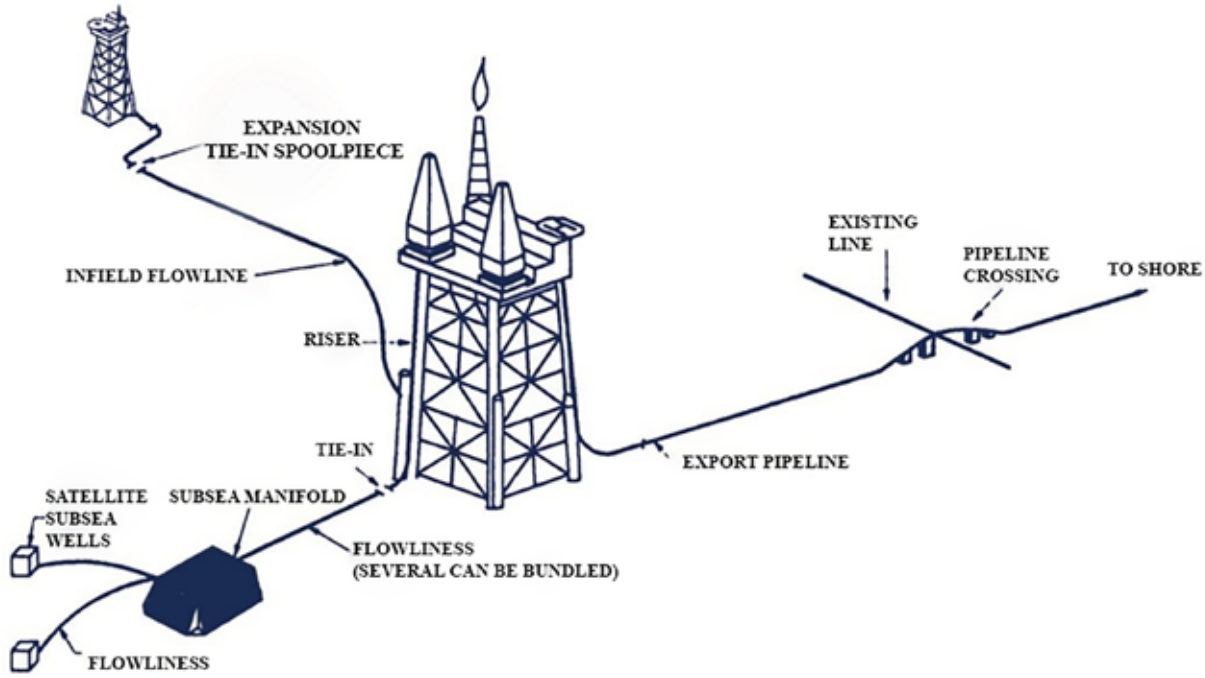


Figure 2.3.3: Pipelines and Risers

Separation

There are few wells that encounter pure gas production. In this case, the gas is directly taken for compression or treatment. Often it is seen that the well produces a combination of contaminants, water, oil and gas. It is important to separate this combination and sent for processing.

The separators for production elements come in various designs and forms. The common variant is the gravity separator.

The well flow is attached to the horizontal vessel in case of gravity separation. The period in which the gas takes time for bubbling out is usually 5 minutes and known as retention period.

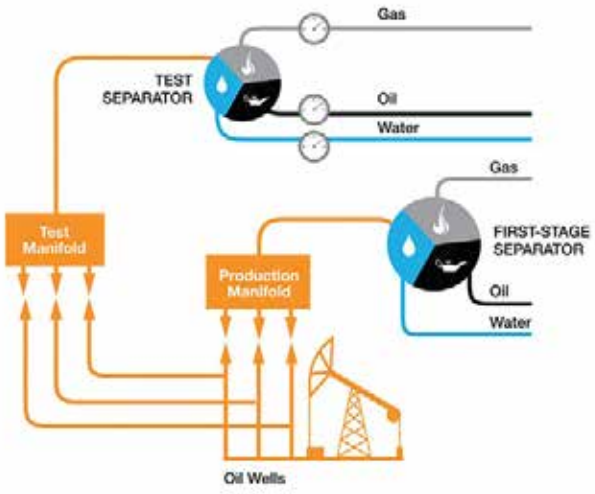


Figure 2.3.4: Work Of Production Separators

Metering, Storage and Export

Local gas storage is generally not allowed in most of the plants. However, before loading oil on a vessel, it is stored in shutter tankers. These tankers take the oil to crude carrier or larger tanker terminals directly. The production facilities in offshore sites rely on crude storage as they do not have a direct pipeline.

This storage unit is in the hull or at the base which allows offloading from the shuttle tanker. This usually takes place once every 7 days. Tank farm terminals are found in larger production complexes which allow storage of crude (different grades) that acts as changes in demand.

For managing and monitoring natural oil and gas which are exported from production installation, the operators take the help of Metering stations. For measuring natural oil and gas flowing unobstructed through the pipelines, these stations use specialised meters. The metering installation has multiple meters so that the full handing capacity range is evenly distributed.

The diameter of these pipelines can be around 6 inches to 48 inches. With the help of sophisticated equipment, the pipelines are inspected (for defect and corrosion). This equipment is known as pig.

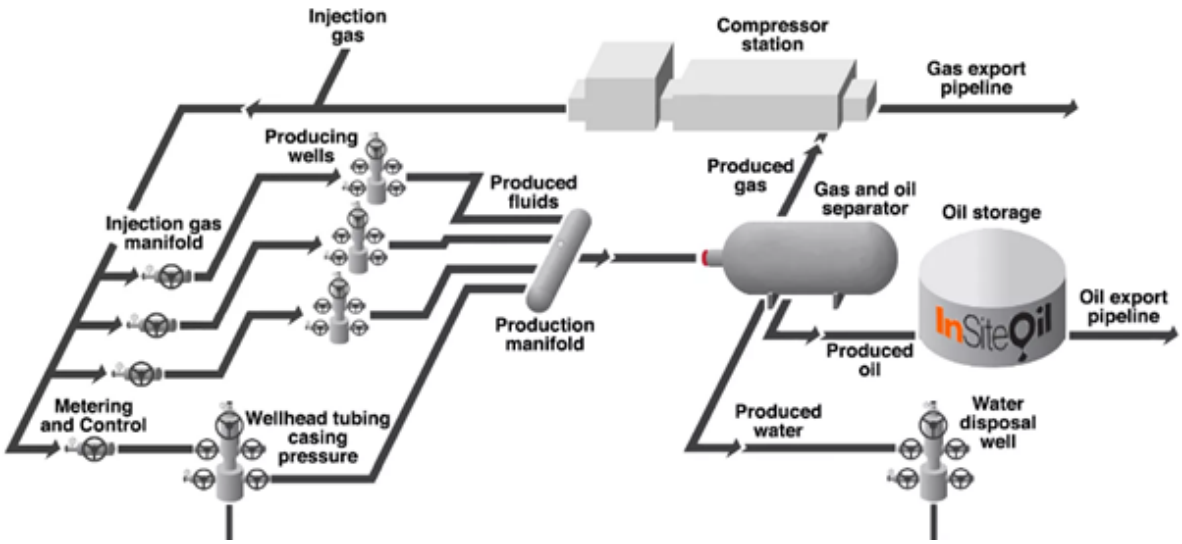


Figure 2.3.5: Metering, Storage and Export

Utility Systems

These are specialised systems that look into the utility of the residents or process safety and are not responsible for the hydrocarbon process flow handling. In case of remote installation, it is a must for these systems to be self-sustainable (water and power generation). Multiple functions are available under this system. However, it is dependent on the installation location.

2.3.3. Understanding the Components of Drilling Rig

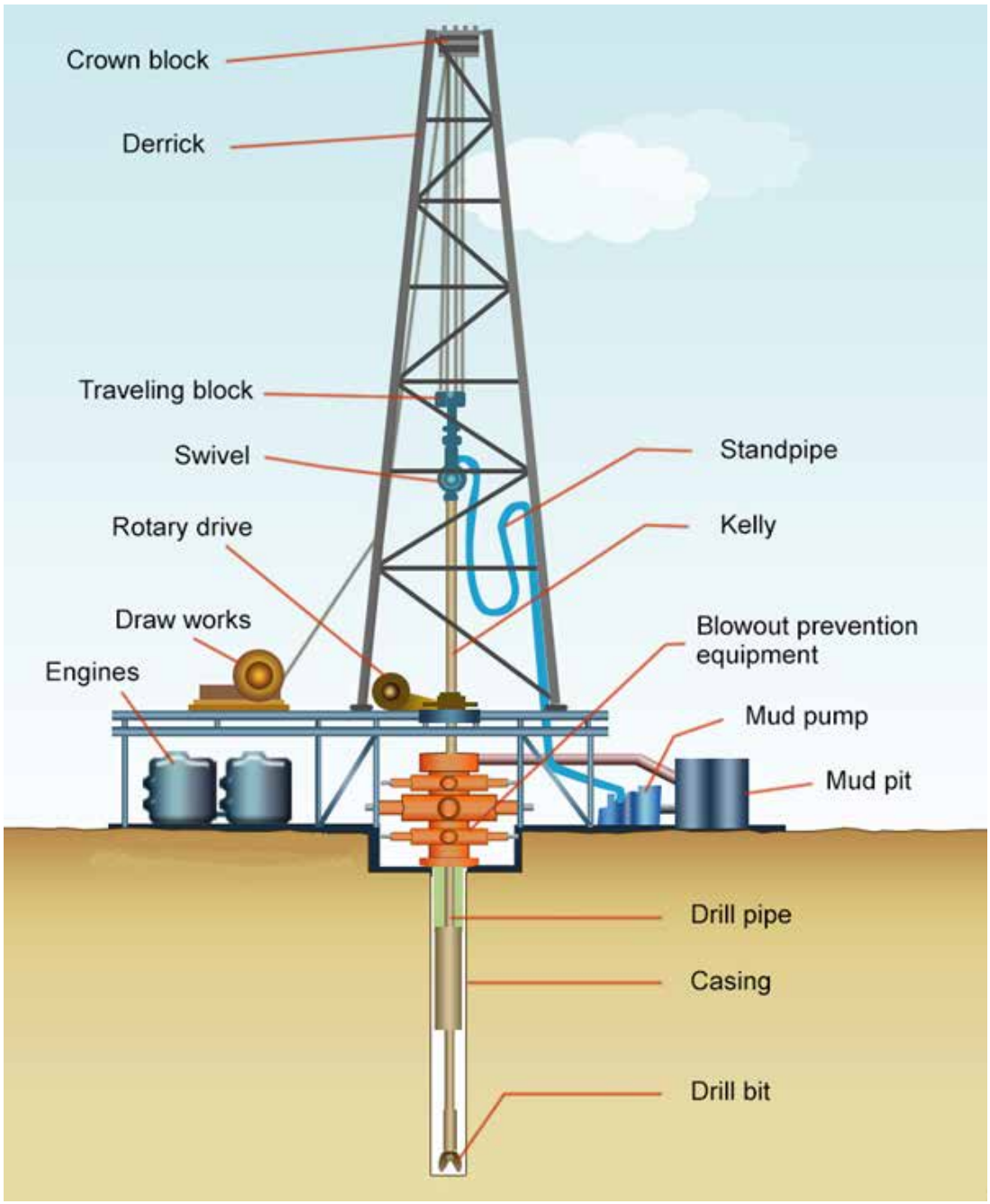


Figure 2.3.6: Components of Drilling Rig

Derrick

- This is a platform or a structure whose utility is towards the drilling rig's drill string and support of crown blocks.
- The shape of derricks is usually pyramidal.
- The derrick is not just a single piece of equipment. Due to this feature, technicians (special ironworkers) can assemble and dismantle the entire equipment and move it from one to another.
- They offer excellent strength-to-weight ratio.

Floor

Floor or rig floor is a small area where the rig operations take place under the supervision of rig crews. Here the crew removes or adds drill pipes from the drill string.

As heavy iron is moved from one place to another above the floor, it makes the area dangerous. It is on the drill floor that the driller breaks or makes the drill string connections. There are certain attaching rooms in the rig floor like:

- Doghouse
- Metal room
- Activity area

Drawworks

This is an equipment present on the rig that has:

- Assorted auxiliary devices
- Power source
- Brakes
- Large-diameter steel spool

Its function is to control the reel in and out process for large diameter wire rope. Over the crown block, reeling over is done for drilling line. This reeling in and out raises or lowers the travelling block out of the wellbore. The reeling in can be performed with the assistance of diesel or motor engine. The reeling out can be performed with the assistance of gravity.

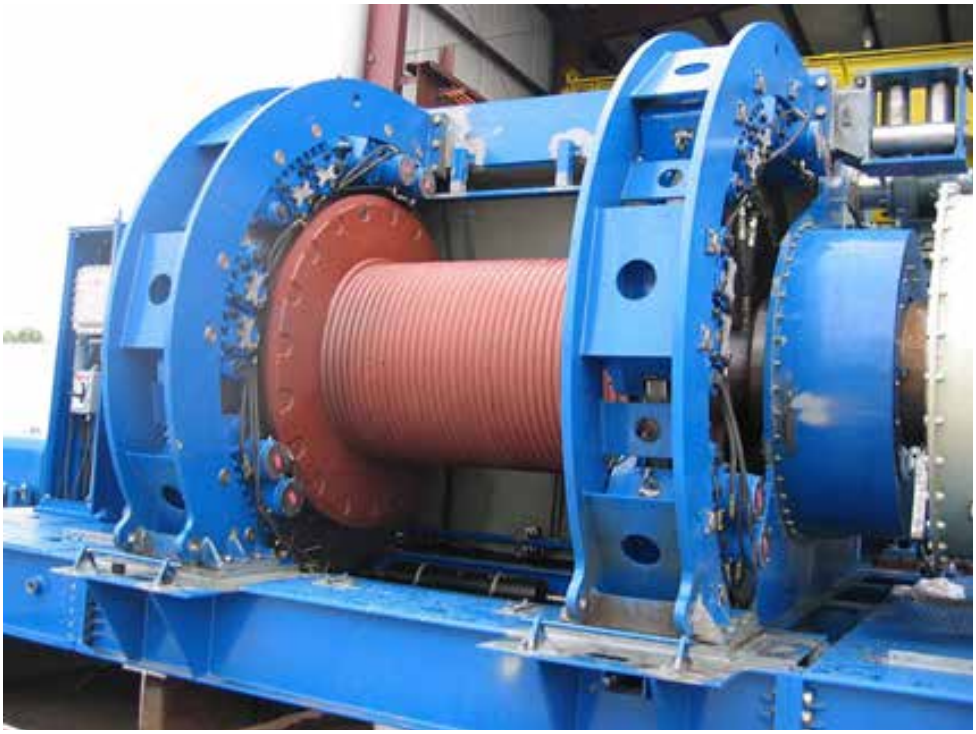


Figure 2.3.7: Components of Drilling Rig

Drill Bits

It is also known as a bit or a rock bit. To produce a wellbore or cylindrical hole, a drill bit is used. It is a specialised tool that digs the earth's crust with the help of rotary drilling method. It is used for the discovery of hydrocarbons like natural gasses and crude oil and extracts them.

The hoes created by the drill bits have a smaller diameter. They can be from 8.9 cm to 76 cm (3.5 inches to 30 inches). This is way less than the hole depths that can range from 300 m to 9,100+ m (1,000 feet to 30,000 feet).

The classification of drill bits is done as per their primary cutting mechanism. They are of 2 types.

- **Fixed Cutter Bits**

They employ blade sets whose cutting elements are extremely hard. Those elements may be like synthetic or natural diamonds. As the bits rotate, they use grinding or scraping action to remove material.

- **Rolling Cutter Bits**

The blades have "tooth"-shaped cutting elements which crush or fractures the formation. The cutting elements are cone-shaped, and they bore holes when he bits rotate.

For containing cutting elements, the commercial rolling cutter bits (modern) employ three cones. In most cases, 4 cones (rarely) and 2 cones are seen. Depending on "teeth" or cutting elements' production ratio, the bits fall into two classes.

i. TCI or Tungsten Carbide Insert Bits

These have sintered tungsten carbide press-fit teeth that are fit into the cone's drilled holes. Certain steel-tooth bits have milled teeth and TCI elements. On journal bearings or rollers the cones do rotate. These bearings with different metal face seals or O-ring arrangements are sealed from hostile down-hole drilling fluid environment. For the bearings, these bits usually have grease lubrication systems (pressure compensated).

ii. Steel-tooth Bits

These have wedge-shaped teeth inside the cones and are directly milled in the cone steel. On the teeth's surface, application of tungsten carbide material (extremely hard material) is seen. For durability improvement, the work is done via welding process.

Figure 2.3.8: Typical tri-cone rock bit

Figure 2.3.9: PDC Bit

Drill String

The drill string is a grouping of various types of tools, bottom hole assembly and drill pipe. It is helpful in turning the drill bit inside the wellbore (bottom).

Drill Stem

In the rotary drilling process, the drill stem acts as an important part. It represents rig's largest investment. When this stem fails, a considerable amount of money and time is lost. When we consider the drill stem, it has a large number of members who are involved in the drilling process. This takes place with the rotary method that swivels to the drill bit.

The members include:

Bottom hole assembly

- Drill pipe
- Kelly

The drill pipes have heavy weight drill pipe and conventional drill pipe. The BHA or Bottom Hole Assembly contains:

- Bit-sub
- Shock sub
- Reamers
- Jars
- Stabilizers
- Drill Collars

The drill stem acts as a fluid passage that begins from the swivel and continues to the bit.

This allows setting of weight and rotary motion to drilling bit. It also ensures that the bit is raised or lowered to the well. Added to this, it ensures that bit bouncing and vibration is minimised by providing stability. Again, through drill stem operations testing formation takes place, and the permission for logs is via pipe evaluation.

Kelly

It is a steel pipe that has a hexagonal or heavy square size. With the help of Kelly drive bushing, it engages the master bushing. Through the drill string, it transmits a rotating force to the bit. The connections of Kelly from the swivel via upper section are all left-hand threads.

When torque is imparted at the Kelly, instead of backing off at each section, it tightens. The usual size of Kelly (hexagonal) is 3 inches whereas size of Kelly (square) is 5 ¼ inches. The range of Kelly length is between 11 and 16.5 metres.

On each end of Kelly, pressure safety valves are placed (2, i.e., 1 in each side).

- The one at the topmost section is known as upper Kelly cock.
- The other one at the bottom section is known as lower Kelly cock.

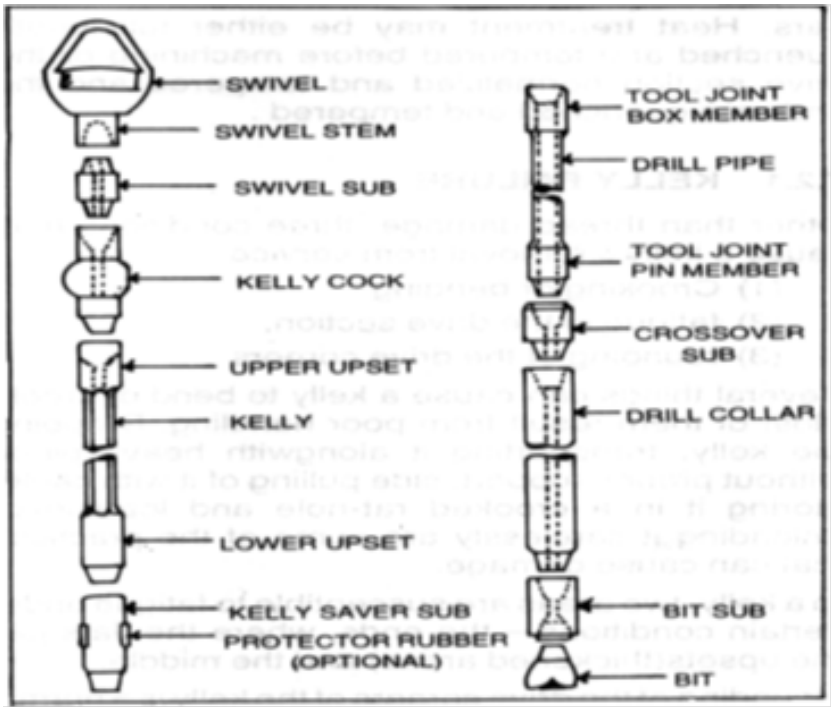


Figure 2.3.10: The Drill Stem Members

Drill Pipes

These are steel tubes that are used for transmitting drilling fluid and rotational power to the bit that is situated at the hole's bottom. The OD or outside diameter of drill pipes ranges between 2 3/8" to 6 5/8". The pipes that are commonly used have the length ranging from 8.5 m to 9.2 m.

Heavy Weight Drill Pipe

When drill pipes that are situated above drill collars have frequent joint failures, it states the fact that these joints are facing abnormally high bending stresses. This is particularly evident when bit is rotated off bottom, and with the depth the hole angle is increasing. With the low change rates of hole angle in combination to deviated holes, the results regarding the drill pipe's first joint may be a sharp bend just above the drill collars. For failure reduction at transition zones, one of the best practices is to enhance the damage control of joints that usually takes place due to heavy wall drill pipes usage. The location of these pipes is just above the drill collars.

The heavy wall drill pipe usage ensures that stress level at the joints is reduced. So it is best to use 12 to 16 heavy wall drill pipe joints for large and rough hole conditions, and 9 or 10 heavy wall drill pipe joints for normal drilling conditions.

Benefits of Heavy Weight Drill Pipe

i. In case of directional drilling costs, lit ensures substantial savings. This is done by replacing drill collar strings (largest part), decreasing the downhole drilling torque, and reducing the tendencies that can be the reason for direction change.
ii. It increases the depth capabilities and performance of small rigs to simplify the replacement and handling of drill collars. The position of rigs, in this case, is in shallow drilling areas.

Drill Collar

This is one of the important parts of the drill string. A drill collar is responsible for the weight on the drill, which is necessary for drilling. The make of the collars comprises of solid steel bars that are tubular and thick-walled. The steel may be plain carbon. However, there are cases where the solid steel is either of nonmagnetic premium alloys or nonmagnetic nickel-copper alloy.

These are thick and heavy walled steel pipes on the ends of which threaded connections are cut. Here are few functions that are performed by a string of drill collars.

i. For pressure reduction at differential hole sticking, spiral drill collars are used. This relieves differential pressure by creating a passage for drilling fluid.
ii. It reduces bit stability problems that occur due to bouncing, wobbling, and vibrations.
iii. It offers stiffness to BHA (bottom hole assembly) and reduces directional control problems.
iv. It maintains weight and tension to the drill pipe to subject the drill stem to buckling forces.
v. For the drilling process, it offers the drill bit its required weight.

There are a number of drill collar sizes whose outside diameter ranges from 3 1/8 inches to 11 inches. The shapes can be the following:

- Spiral grooved
- Triangular
- Square
- Round

The highly used drill collar types are spiral grooved and round(slick).

Blowout Preventer

Blowout Preventer is a special valve that is present at the topmost section of the drill pipe (between drill floor and wellhead system). This valve is responsible for controlling the well. The installation of BOP is in stacks that are redundantly placed.

The blowout preventer is made up of:

- Different Ram types which are efficient in closing the well with the help of drill pipes
- Annular BOP that can close the different services of the well

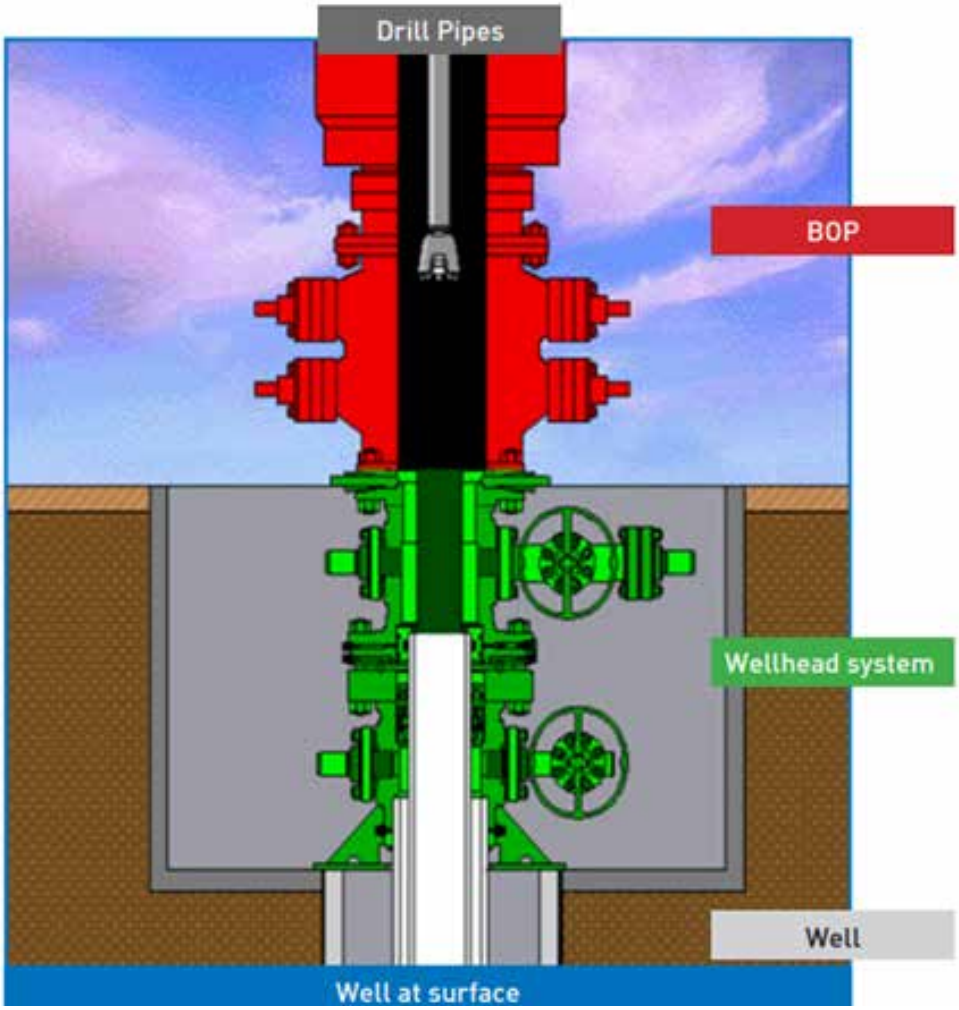


Figure 2.3.11: Blowout Preventer (BOP)

Blow Out Preventer (BOP) Control Unit

The BOP control unit's primary function is to permit the opening and closing of hydraulic valves and individual BOP without external energy usage. 4 important characteristics are associated with this.

- Total active volume
- Minimum residual pressure
- Maximum operating pressure
- Nitrogen charging pressure

BOP Location

- The installation of control unit should be based on the appropriate control panel numbers. This is to make the operation readily accessible to the driller regarding the control of valves and BOPs. It also ensures that the driller is at a safe distance (from rig).
- It is important that the control unit location should be in a specific place so it can be easily approachable and safe during emergency situations. The location should be set keeping in mind that flow back or excessive drainage can be prevented to the fluid reservoir from the operating lines.

Turn Table

The other name of an oil rig turn table is Rotary table. It is the spinning or revolving section that you can see on the drill floor. To turn the drill string in the clockwise direction power is required. This required power is generated by the turn table. The transmission of power and rotary motion takes place via Kelly to drill string and kelly bushing.

Figure 2.3.12: Rotary Table

Crown Block

This is a stationary block section comprising of sheaves and pulleys (sets). The wire rope or drill line is reeved or threaded through the sheaves. It is located above and opposite the travelling block or derrick.

Figure 2.3.13: Crown Block

Top Drive

A top drive is an equipment that helps in turning the drill string. There may be 1 or more hydraulic or electric motor that is directly connected to the quill. This is a short pipe section that is connected to the appropriate gearings. The quill can be screwed into the drill string or a saver sub.

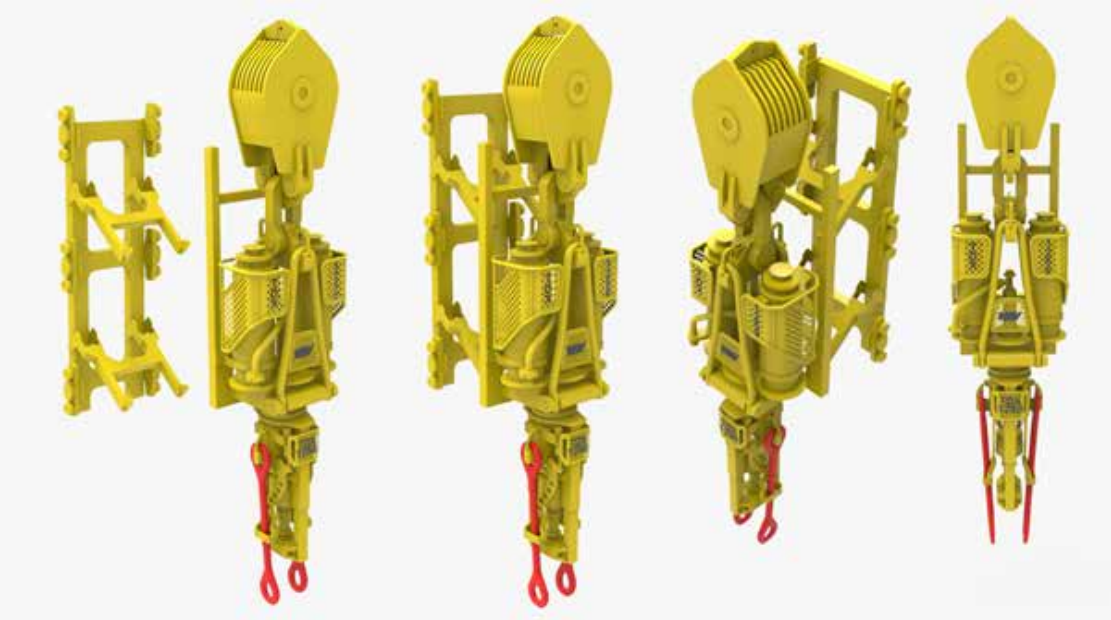


Figure 2.3.14: Top Drive

Iron Roughneck

It is a piece of machine (hydraulic) that disconnects and connects (handles) the pipe segments in the drilling rig. Manipulation of segments is possible as they can be hoisted out and in the borehole. Initially, the work was done with the help of tongs. This was indeed one of the highly dangerous tasks that used to take place amongst the drilling operations. Now, with the introduction of latest technology, the chances of manual work have lessened a lot.

Figure 2.3.15: Iron Roughneck

Mud Pumps

Mud Pumps are plunger or piston pumps that are helpful in circulating drilling fluid down the drill string under high pressure. The pressure can be about 52,000 kPa or 7,500 psi.

Figure 2.3.16: Mud Pumps

Work of Drill Bits in Onshore Drilling

The presence or absence of oil is proved with the help of drill bit. The process of oil drilling is a highly skilled opera¬tion that requires the involvement of various technicians. They are like:

- Tool pushers
- Engine operators
- Derrick operators
- Rotary drillers

In the highly common drilling type, a drill bit with diamond teeth or metal is suspended. This is on a drilling string that is created with the help of joined 30-foot pipes. As the drilling bit goes deeper inside the earth, the addition of string is made. With the help of a downhole motor or rotary mechanism on the drill floor, the bits move or rotate.

With the progress of the drilling process, the drilling bits wore out. This requires replacement. For this, the entire drilling string requires to be hauled out and then section by section to be dismantled. This is a tough process as the average weight of the string can be more than 100 tons. After the replacement of the bits, the string is reassembled and shoved back down.

This process is also called “round trip” as it can take around 12 hours shift for the drilling crew to complete this operation and shift the string deep into the well. Until now, the handling of drill strings was manually done. Currently, for improved efficiency and safety, pipe handling is done automatically, i.e., via mechanised drill rigs.

Operating Sequences and Checklist

Preparations to make before Spudding

These arrangements should be made before spudding the well.

- The installed equipment should be in working condition
- For handling, Slings, Manila rope, and Mud box should be present
- For monitoring, multiple parameters like drillograph, SPM gauge, weight indicator, rotary RPM meter, rotary gauge, tong torque gauge, etc. the installed instruments should be checked regularly
- (G.T.O) Gas to oil system for the well
- Twin stop device and Crown-o-matic valve should be working
- Adequate cement quantity and cementing units (in remote areas) should be present for all exploratory wells
- Kill manifold, choke, BOP stack, and Wellhead
- First aid kit and Safety kits
- Lowering of surface casing and conductor casing
- Cutters and Hole opener
- For drilling rat hole, provision of different bits
- For various bit sizes, the provision of bit breakers
- Lower Kelly cocks, kelly saver sub and upper, kelly top sub, kelly drive bushings, Kelly
- Equipment for making rat hole
- Drill string
- Drilling operations for water supply
- Firefighting equipment
- Casing grease, drill pipe, lubricants, diesel oil
- Chemicals for mud preparation and parameter control

2.3.4. Understanding the Components of Well

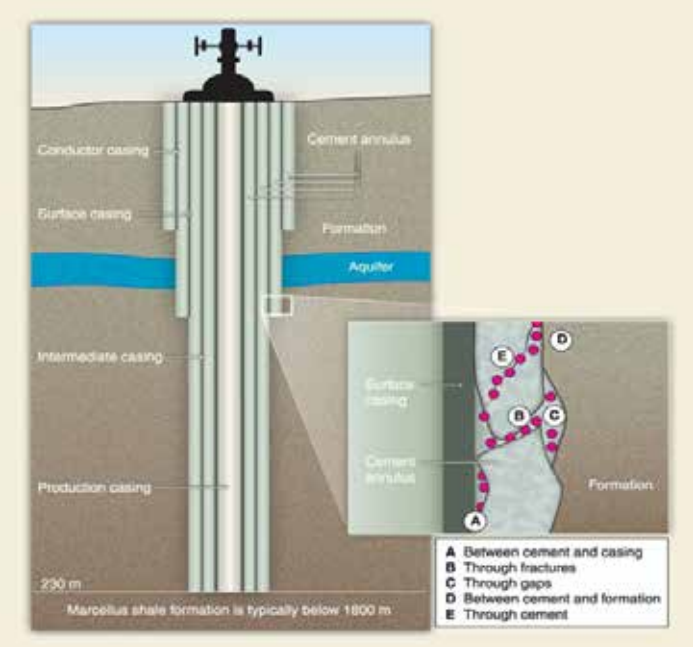


Figure 2.3.17: Components of Well (casings)

Casing head - Conductor Casing

Below the structural casing, it is the first string set. This basically runs the marine conductor to enable drill fluid circulation and protect the loose near-surface formations. For protection against shallow gas, this conductor isolates sand, water and unconsolidated formations. The casing head is installed onto the string. In certain cases, the BOP or blowout preventer is installed onto this string.

Surface Casing

This can be referred as the used casing's largest diameter. Its utility is needed when incompetency is found in soils' surface. This happens due to drilling mud's eroding and washing action. This creates a large cavity at the surface. The surface formations' erosion is controlled by conductor casing.

This is a pipe string set that has relatively low-pressure and large-diameter. This casing is set in competent formations (also shallow) for multiple reasons. The surface casing makes sure about the minimal pressure integrity and protection of onshore fresh-water aquifers.

These are the surface casing's important functions:

- It supports all casing string's weight that runs below the pipe's surface
- It provides a means for blowout preventer and wellhead attachment
- It covers weak zones that are inefficient to control or regulate kick-imposed pressures
- It reduces lost circulation into permeable and shallow zones
- It prevents caving and maintains hole integrity
- It covers freshwater sands

Intermediate Casing

The intermediate casing is set between the production casing and the surface casing. This protects the casing from caving of abnormally pressured formations or weak pressured formations. Added to this, this casing also ensures that the different density drilling fluids are used for controlling the lower formations.

There are scenarios where it becomes important to set multiple casing intermediate strings to seal the troublesome open zone or hole quickly. This depends on the well's depth and various problems associated with well drilling. These issues can be like:

- Lost circulation zones
- Heaving formations
- Abnormal pressure formations

Production Casing

Production casing is a casing string that is installed within the primary completion components and the reservoir interval.

The term that is often stated for production casing is oil string. There are certain purposes for which the production casing is lowered. Some of the relevant ones are:

- Securing the production tubing and other types of equipment related to it
- For the pay zone's known diameter, offering a work shaft
- Ensuring and maintaining the fact that producing zone is isolated from the other formations

Connection Type

API Round Thread Casing

- LTC or Long Thread Coupling
- STC or Short Thread Coupling

There are 8 threads per inch cut on both LTC and STC. LTC couplings' strength is nearly 30% more than the tension in STC.

API Buttress Thread Casing

The capacity of buttress thread regarding the transmission of higher axial load is higher than API 8 round thread. The utility of proper thread compound is for leak resistance creation. In buttress threads, the total number of threads per inch is 5.

API Extreme Line Casing

In these types of casings, we will find a slight upset structure at the pipe ends. This occurs within the box where the pin threads are cut. The box that is provided has a slightly tapered sealing surface at the bottom. This surface is against a mating sealing surface which is extended beyond the threaded pin and has a slight curvature. During makeup, under radial stresses the threaded pin is pressed. For extreme line connection, the thread per inch is 6. This is for the casing size 5 that is ranging from 4 ½ " to 7 5/8". For the casing size 8, the range is from 5/8" to 10 ¾ ".

- The influence of Casing design is directly on:
- The pipe's deterioration degree depends on its subjection of it in a well in the entire life
- Strength formation at casing shoe
- During drilling and production, the loading conditions

Use of tubing and Packer and Completion

- **Open hole Completions**

The completion states about the completion of a well that does not have liner set or casing across the reservoir formation. This allows the direct flows of produced fluids into the wellbore. One of the disadvantages regarding this completion type is the foundationless sandface.

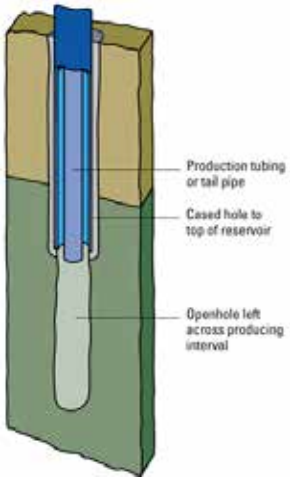


Figure 2.3.18: Open hole Completions

- **Conventional Perforated Completions**

This is one of the common completion techniques used at present. The plus point of this completion type is that the well can be logged and drilled to total depth. This can be done before the cementing production casing.

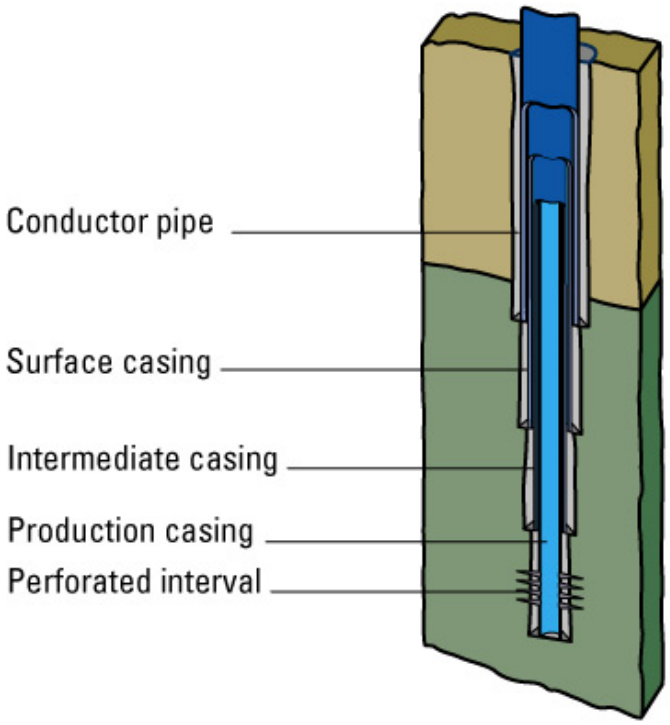


Figure 2.3.19: Conventional Perforated Completions

- **Sand Exclusion Completions**

Sand Exclusion Completions are mainly used in oil wells, gas wells and water wells. This method is used by oil industry engineers. This procedure is helpful in preventing the production of sand in oil wells.

- **Permanent Completions**

The placement or setting of well head and tubing inside the well once in the lifetime are known as permanent completion. The remedial or completion work is done via tubing with the help of various wire-line tools, retrievable tubing extension, and tubing-type perforator.

- **Multiple Zone Completion**

This is a completion type with the help of which the operators can combine reservoir fluid or produce it from various zones into a well. Without the removal of next interval completion, oil well intervention can take place on the completion string's upper part. At the bottom zone, tubing perforation can be performed.

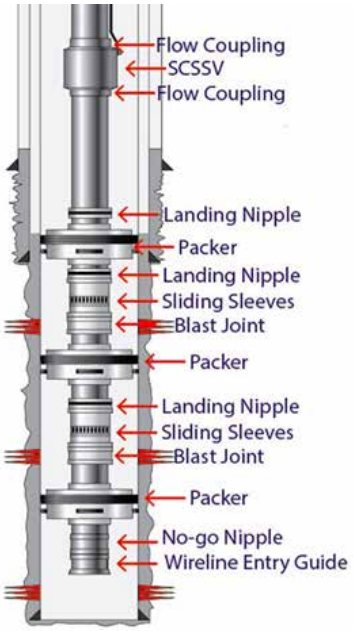


Figure 2.3.20: Multiple Zone Completion

- **Drainhole Completions**

Drainhole well completion talks about flow of fluid via a short conduit. If we consider about equipment applications, the make of drain-hole completion is mostly for evading pressure build-up in non-pressure areas.

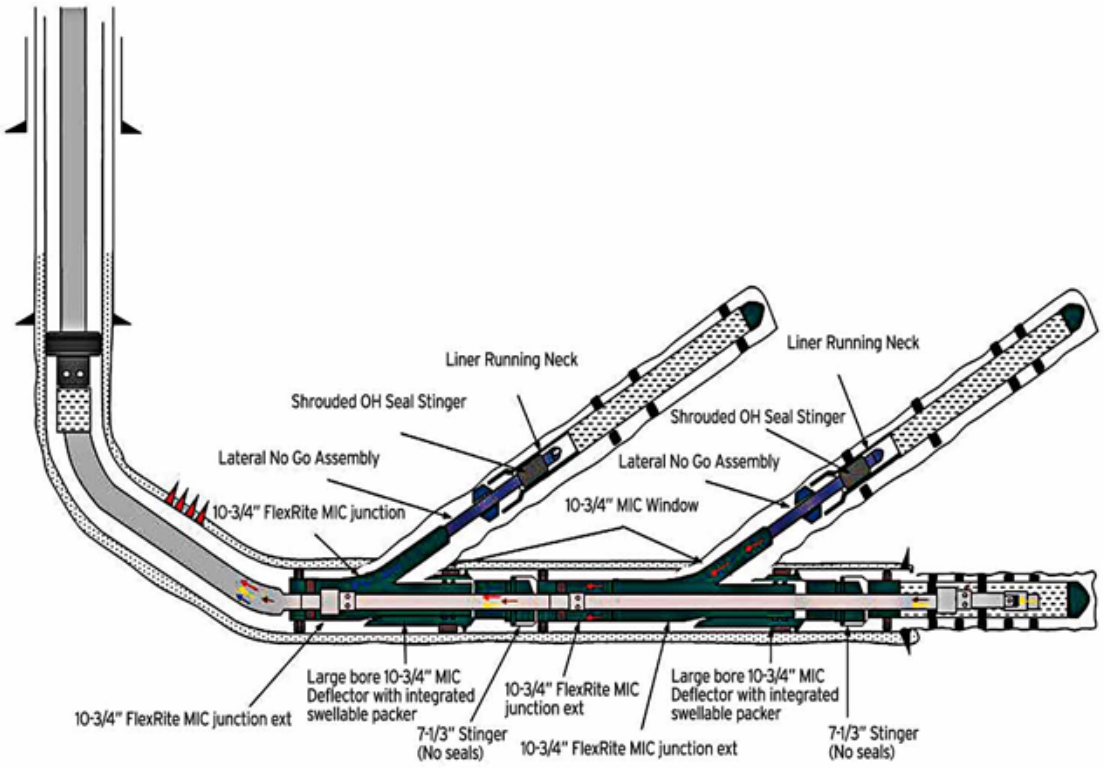


Figure 2.3.21: Drainhole well completion

2.3.5. Perform Artificial Lift Operation

Rod Pumps

It is an lift pumping system (artificial) whose source for driving downhole pump is surface power. The reciprocating motion is created by crank and beam assembly via sucker-rod string. This string is connected to downhole pump assembly. The rod pumps have valve and plunger assembly that helps in the conversion of vertical fluid movement from the reciprocating motion.

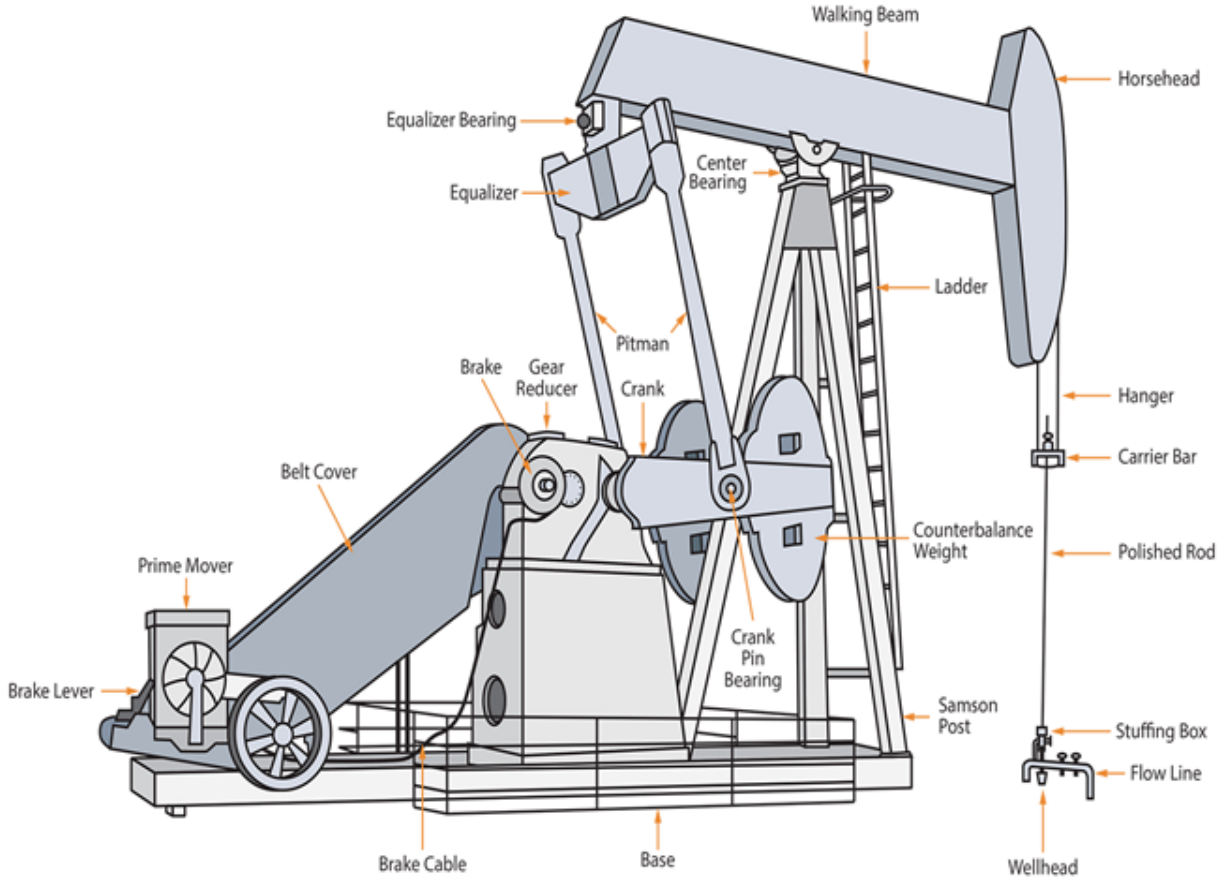


Figure 2.3.22: Artificial lift showing the Work of a Rod Pump

Electrical Submersible Pump (ESP)

These are reliable and efficient artificial-lift techniques that are helpful in lifting fluids from wellbores or high to moderate volume. The range of fluid volume can be as high as 24,600 m3/d (150,000 B/D) or as low as 150 B/D (24 m3/d).

Its components consist of:

- Surface controls
- Power cable
- Seal-chamber section
- Three-phase induction motor
- Multistage centrifugal pump

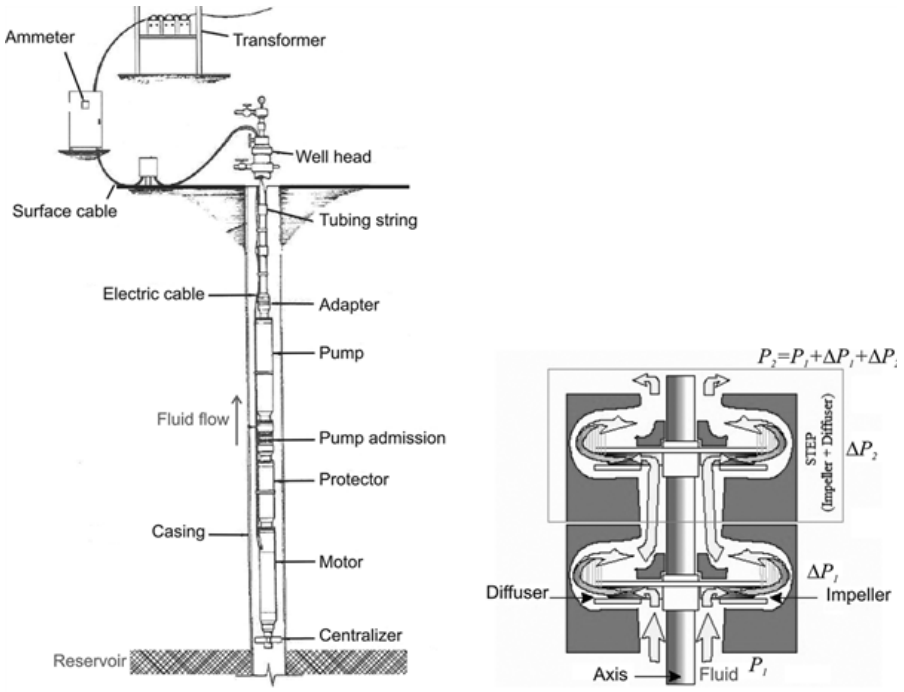


Figure 2.3.23: Electrical Submersible Pump

Gas Lift

This is an artificial lift technique that supplements the formation gas by taking the assistance of high-pressure gas (external source) to lift fluid from the wells. In this case, inside the tubing gas is injected to reduce fluid density.

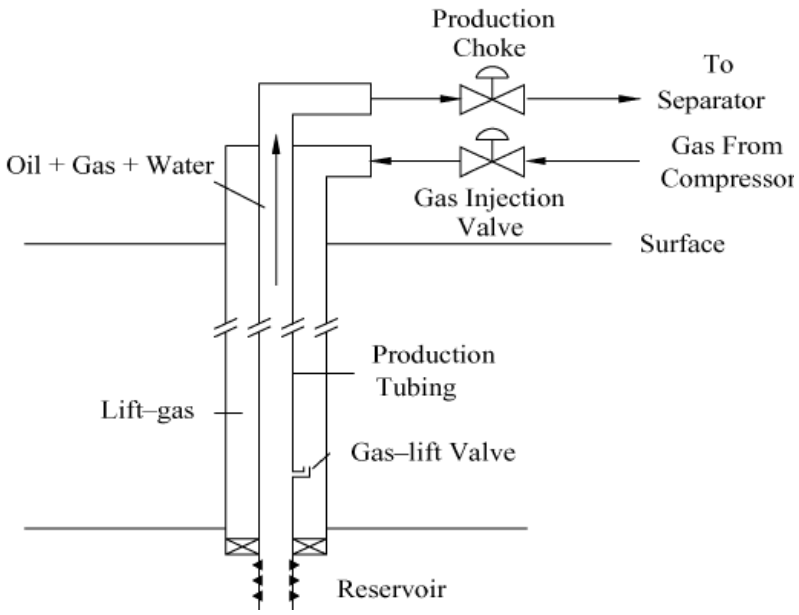


Figure 2.3.24: Scientific diagram of Gas Lift

Plunger Lift

The functionality of plunger lift is similar to hand pumps. It takes the help of free piston that pulls the tubing string inside the well in an up and down direction. It uses the energy of the well and ensures that the liquid fallback level is minimal.

Unit 2.4 Maintenance

Unit Objectives

At the end of this unit, you will be able to:

- Identify the Use of Basic Maintenance of Hand Tools
- Demonstrate the Care of Basic Maintenance of Hand Tools

2.4.1. Identify the Use of Basic Maintenance of Hand Tools

1. Hacksaws

These are used for cutting metals that can't be cut with bolt cutters or snips.

2. Sockets and Ratchets and Wrenches

These are used for tightening the fixtures and joints in the pipe sets.

3. Wire Cutters

As the name suggests, the cutters are useful in cutting wires used inside artificial lifts and other oil and gas equipment.

4. Pillars

It is a type of bench drill that is used for drilling hard metals.

5. Oscillating Multi-Tool

These are used for polishing, grinding, scraping, cutting, sanding and much more. The stroke per minute of oscillating multi-tool is extremely highly (20,000 strokes per minutes).

2.4.2. Demonstrate the Care of Basic Maintenance of Hand Tools

Prepare and Carry out basic Routine Maintenance Tasks and Techniques

Cleaning

- It is best to clean the hand tools as soon as its utility is over.
- With the help of wire brush or hosepipe, the tools should be scrubbed clean.
- Spraying certain parts of the hand tools with light helps in preventing rust formation.
- It is advisable to wash the tools carefully so that pathogens are not easily spread out.

Storage

- One of the best ways to store hand tools is to store them in areas that have sheltered environment. In simple words, the areas should be dry.
- For better safety and better location, it is best to place the hand tools in separate and designated racks.
- Try putting tools under a similar category in one place so that other technicians can locate them easily.

Maintenance

- Try keeping the tools well-oiled and covered which have sharp metal blades.
- The tools consisting of sand wooden parts should be well oiled. The oil combination ratio should be 50% of turps mix and 50% of linseed oil.
- It is better to look for any wear and tear in hand tool components like springs, blades, screws, rivets, bolts, and nuts so that the damaged items can be immediately replaced.
- In case you find certain damaged tools, it is better to remove those from the working hand tools and inform about the damaged tools to the maintenance person or supervisor.

Carry out Basic Inspections

There are certain inspection stages.

- **Visual Inspection**

The main idea regarding this inspection process is to check all the hand tools of any visible chips, cracks, dents, and damages due to production anomalies.

- **Pre-Production Inspection**

With the help of this inspection procedure one can verify if the hand tools have production defects or not. This includes damage due to loose joints, defects, etc. This inspection ensures that before the drilling operations start, all the tools are completely functional.

- **Raw Materials Inspection**

This inspection procedure thoroughly inspects and authenticate that the required materials for hand tools are functional. This inspection is mainly for those tools related to assembling, hardening, cooling, and molding so that the materials are in order and can be used at ease before the production process.

- **Coating Inspection**

This is for the authentication of those hand tools that require metal coating at the surface.

Unit 2.5 Numerical Skills, Physical Science, Basic Properties of Materials

Unit Objectives

At the end of this unit, you will be able to:

- Identify the Basic Numerical Skills
- Interpret Physical Science and Basic Properties of Materials

2.5.1. Basic Numerical Skills

Proportion

For expressing proportions, there are 3 methods.

- The first one comprises of fractions

Example - 50 / 100

- The second one comprises of percentages

Example - 50%

- The third one comprises of decimal

Example - 0.50

FPS system

This is an abbreviated term for foot, pound and second. This system talks about measurement unit for time in seconds, mass in pound and length in foot.

MKS System

This is an abbreviated term for meter, kilogram and second. This system talks about measurement unit for time in seconds, mass in kilogram and length in meter. This is especially good for measuring the length and mass related to pipeline and drilling equipment installation.

Unit	MKS	FPS
Power	1ft lb/s = 1,35582 W	1 ft lb/s = 1,8182 x 10-3 hp = 1,28505 x 10-3 btu/s
Density	1 lb/ft³ = 16,0185 kg/m³ 1 lb/gal = 99,7633 kg/m³	1 lb/ft³ = 5,78704 x 10-4 lb/in³ 1 lb/gal = 6,22882 lb/ft³
Pressure	1 lb/ft² = 47,88 N/m² 1 lb/in² = 6894,76 N/m² 1 atm = 1,01325 bar	1 lb/ft² = 6,9444 x 10-3 lb/in² 1 lb/in² = 0,068046 atm 1 atm = 29,92 in Hg = 33,90 ft water
Force	1 lbf = 4,44822 N 1 pdl = 0,138255 N	1 lbf 1 pdl = 0,031061 lbf
Mass	1lb = 0,453592 kg 1 slug = 14,5939 kg	1 lb = cwt/112; 1 sh tn = 2000 lb 1 slug = 32,174 lb; 1 in tn = 2240 lb
Volume	1ft³ = 0,0283169 m³ 1 bu = 35,2393 l; 1 bbt (US) = 115,627 l	1 foot³ = 1728 inch³ = 6,22882 gallon (UK) 1 gal (US) = 0,83268 gallon (UK)
Length	1 foot = 1/3 yard = 12 inches	1foot = 0,3048 meters 1 mile = 1609,34 meters

Volume Conversion

Volume	cubic foot/feet (ft3)	cubic meter (m3)	litre (L)
1 gallon (gal)	0.13368055555556	0.003785411784	3.785411784
1 cubic foot/feet (ft3)	1	0.028316846592	28.316846592
1 cubic meter (m3)	35.314666721489	1	1000
1 litre (L)	0.035314666721489	0.001	1

2.5.2. Physical Science and Basic Properties of Materials

Oil Processing Gasses

	Type of gas	Pyrolysis	Catalytic cracking	Petroleum- associated gas	Natural gas
Percentage of Gasses by Volume	C5+	2-3	5-12	3	-
	N2+CO2	-	-	10	1.4
	C4H8	-5	5-6	-	-
	C4H10	0.2	42-46	8	0.05
	C3H6	7-8	6-11	-	-
	C3H8	0.5	16-20	17	0.15
	C3H4	16-18	3	20	-
	C2H6	5-7	3-5	42	0.4
	CH4	5-7	10	-	98
	H2	12	5-6	3	-

- **Normally occurring radioactive materials**

The presence of these materials can be seen in drilling mud, drilling deposits, and crude oil. Its radioactive level is low.

- **Naphthenic acids**

These are organic acids whose corrosive nature can be seen when the temperature exceeds 232 °C.

- **Carbon dioxide**

During the distillation process, bicarbonates from a stream or crude get decomposed, finally leading to the emission of carbon dioxide.

- **Inorganic Salts**

Certain crude oils are present in the crude oils. Some of them are:

  - Calcium chloride
  - Magnesium chloride
  - Sodium chloride

- **Trace metals**

In crude oils, small amount of metals like vanadium, arsenic, iron, nickel, and copper are found.

- **Nitrogen compounds**

Nitrogen acts as basic compounds in the crude oil (in lighter fractions). There are instances where trace metals are also found.

- **Oxygen compounds**

In variable amounts in crude oils oxygen compounds are found. Some of them are:

  - Carboxylic acids
  - Ketones
  - Phenols

- **Sulphur and sulphur compounds**

In the form of H2S, sulphur is seen to be present in crude oils and natural gasses. The other compounds consist of:

  - Polysulphides
  - Sulphides
  - Mercaptans
  - Thiols

Hydrocarbons

- **Naphthenes**

Formula: CnH2n

These are hydrocarbon groupings that appear as saturated ring type. In simple words, they are cyclic and have a light structure. The predominating naphthenes with 5 & 6 carbon atoms are mono-cycloparaffins. Those with 2 rings are dicycloparaffins (heavier).

- **Aromatics**

These are hydrocarbon compounds that have unsaturated ring type (cyclic). The aromatic compound that has fused double rings is naphthalenes. The heavier fractions of aromatics that are found in crude oils have 3 or more fused aromatic rings. These are highly complex and are known as polynuclears.

- Paraffins

Formula: CnH2n+2

These have aliphatic molecules (saturated chain type hydrocarbon). The lighter chain paraffin molecules (straight) are found in paraffin waxes and gasses. The chain paraffin molecules that are branched have higher octane numbers.

Summary

- With the help of seismic data, the areas containing gas or oil reserves are identified.
- A “dry hole” is a well where no gas or oil can be found.
- Geopressure/geothermal wells are those wells that produce water having high temperature and high pressure.
- During a single well drilling process, multiple producing formations can be discovered.
- Open-hole completions is also known as barefoot completions and top sets that ensure the completion methodologies used on wells.
- Drilling rigs are supported by smaller floating platforms and floating tenders service it.
- A subsea template’s size can be determined on the basis of the attached structures.
- Vertical tree is a system of connectors, piping, flow paths, and valves that control and contains the fluid’s flow from the surface (by injection) or a reservoir.
- Cable Drilling technique has another name - ‘Cable tool’.
- One of the advantages of casing is it seals the high-pressure gas zones and water-permeated sands.
- Fracturing basically pumps the fluid through underground channels that is forcibly opened.
- From the crude oil, salt water is obtained.
- The wellhead also integrates the installation of Christmas tree and hanging the production tubing.
- For managing and monitoring natural oil and gas which are exported from production installation, the operators take the help of Metering stations.
- The drill string is a grouping of various types of tools, bottom-hole assembly and drill pipe.
- For protection against shallow gas, this conductor isolates sand, water and unconsolidated formations.
- It is advisable to wash the tools carefully so that pathogens are not easily spread out.
- Try putting tools under a similar category in one place so that other technicians can locate them easily.
- The tools consisting of sand wooden parts should be well oiled.
- The oil combination ratio should be 50% of turps mix and 50% of linseed oil.
- MKS System is an abbreviated term for meter, kilogram and second.
- During the distillation process, bicarbonates from stream or crude get decomposed, finally leading to the emission of carbon dioxide.
- Paraffin has aliphatic molecules (saturated chain type hydrocarbon).

Notes

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3. Occupational Health and Safety (OHAS)

Unit 3.1 Health, Safety, Hazards and Its Effects

Unit 3.2 SOP & Safe Working Practices

Unit 3.3 PPE, Fire Fighting Equipment

Unit 3.4 First Aid

Unit 3.5 Risk Management and Reporting

HYC/N0102

Key Learning Outcomes

After attending the session, you will be able to:

1. Discuss Health, Safety, Hazards and Its Effects
2. Relate to SOP & Safe Working Practices
3. Identify PPE, Fire Fighting Equipment
4. Define First Aid
5. Define Risk Management and Reporting

Unit 3.1 Health, Safety, Hazards and Its Effects

Unit Objectives

At the end of this unit, you will be able to:

- Define Occupational Health and Safety
- Evaluate the Job-site hazards and its effects and risk assessment

3.1.1. Occupational Health and Safety

At any workplace, Safety and Health Management System in occupational areas is of prime importance. This came into light when International Labour Conference (2003, 91st session) adopted Global Strategy on Occupational Safety and Health: Conclusions.

As per this strategy, it is important that every occupational system advocates the application of this health and safety management approach which is applied by national OSH systems.

The framework for Occupational Safety and Health Management Systems on organisational or national level abides by the guidelines set by ILO-OSH, 2001 (Occupational Safety and Health Management Systems).

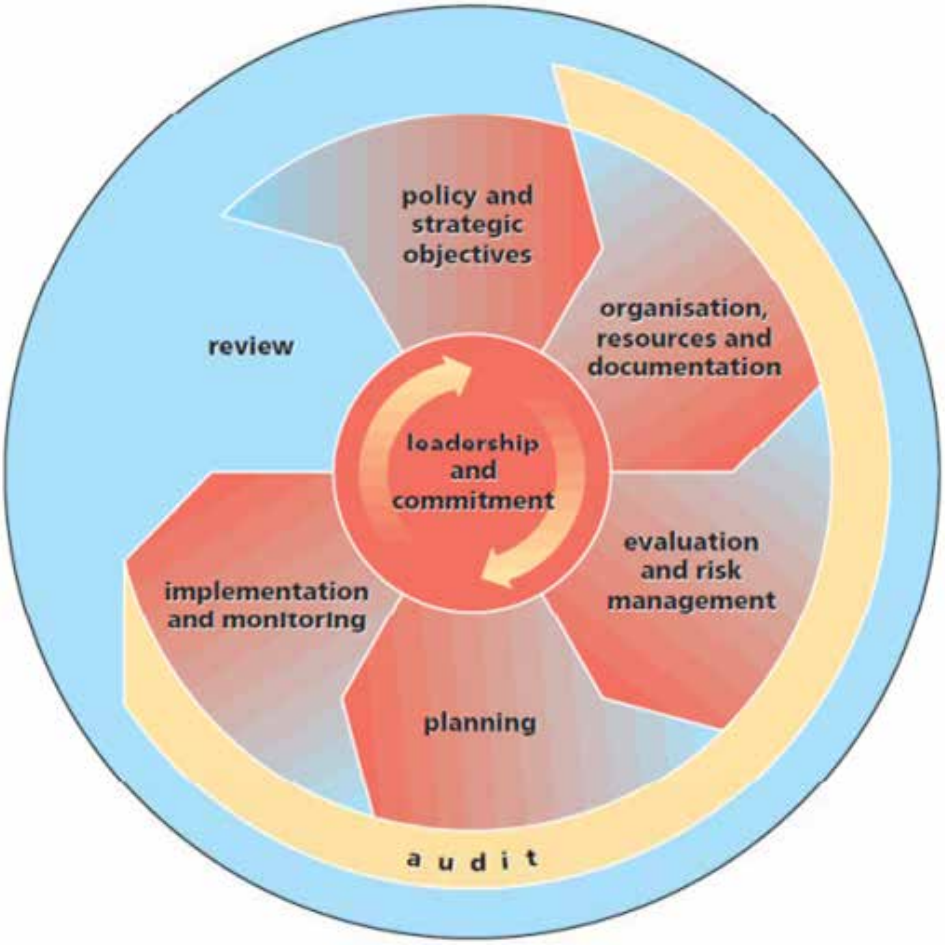


Figure 3.1.1: Model Health, Safety and Environmental Management System

The management system of any oil and gas company should ensure that all the health management related aspects are implemented with respect to the company's:

- Resources
- Procedures
- Practices
- Responsibilities
- Structure

The companies under the oil and gas industry do so to:

- Recognise the reasons for poor performance
- Preventive measures to avoid health and safety issues
- Improve the framework

State Location of General Health and Safety Equipment in the Workplace

In order to save someone's life in the worksite, giving them first aid as soon as possible is important. Whether it is the application of medicine or antibiotics or resuscitation methods, it is necessary that the organisation have an arrangement of general health and safety equipment and specific locations from where those can be easily accessible.

It is imperative that one lit of general health and safety equipment and first aid are kept on the derrick. If the safety and health tools are kept inside cupboards, proper labelling should be made. For example, the section where antiseptics, gauges, band aids, cotton, etc. are kept should be labelled as first aid essentials.

The section where bag valve masks, latex gloves, biohazard bags, antimicrobial wipes, emergency shears, antiseptic towelette, etc. are kept should be labelled as a kit for CPR.

3.1.2. Job-Site Hazards and Its Effects and Risk Assessment

Hazards

Psychosocial hazards

- Substance abuse
- Violence
- Stress
- Fatigue

Manual Handling hazard

- Wrong way of manual lifting
  This includes:
  - Lifting heavier objects like pipes
  - Transporting heavy equipment

Radioactive hazard

- Use of x-ray for welding inspection
- Underwater and water hazards
- Subsea pipeline inspection
- Scaffolding work above sea

Sharp object hazards

Working with:

- Grinding machine
- Drilling machine
- Cranes

Excavation hazards

- Laying in and out buried onshore pipe

Confined space hazards

- Working inside pressure vessel

Hazardous atmosphere

- Sulphide acid in gas
- Gas release from vent

Noise hazards

- Generation of noise (high) at compressor area

Gravity hazards

- Heavy object lifting
- Falling objects
- Slips
- Trips

Electrical hazards

- Electric work
- Lightning

Chemical hazards

- Lube oil
- Corrosion inhibitor
- Silica

- Drilling fluids
- Hydrogen sulphide

Motion hazards

- Swing object during lifting
- Rotating motor shaft
- Rotating drill pipes

Temperature hazards

- Liquid nitrogen tank (low temperature)
- Compressor discharge pipe (high temperature)

Pressure hazards

- High pressure steam from boiler
- High pressure inside vessels and pipes
- High pressure from gas or oil reservoir

Other Job-site Hazards

1. Fire

These are caused due to exposure of guards and the other people in the premises to inflammable/ combustible/ explosive materials or short circuits during security tasks.

The materials responsible for fire hazards are:

- Wood
- Hay and Straw
- Paper
- Combustible Fuel Oil (Gasoline, Kerosene, Diesel, Petrol, etc.)

2. Electric short circuit, Electric Shock and Electrocution

Faulty electrical appliances or contact with an energised source must not be used in the designated premises.

- Worn electric cords, or improperly used or damaged extension cords
- Improperly wired or ungrounded outlets
- Faulty equipment and wiring
- Damaged receptacles and connectors
- Wet clean-up or maintenance processes
- Unsafe work practices

3. Inflammable & Toxic Liquid/ Gases

The general duties and tasks of assistant drilling technician do not involve daily and regular exposure to chemical and biological hazards. But the chances of such exposure may occur in certain situations, specific to the working ambience and client's requirements.

It is best if the guards and the other people on the premises avoid these aspects.

- Poisonous or contaminated chemical spills
- Items causing irritation (Irritants) and allergic reactions (Allergens)
- Corrosive substances, like acids and alkalis, which burn or destroy living tissues
- Poor storage conditions
- Poor inventory control resulting in storing expired products
- Inadequate ventilation and spaces of storage
- Poor and inappropriate waste management in the workplace

4. Accidents

The risks associated with accidents are many. Some of them include:

- Dislocated joints
- Broken bones
- Partial paralysis
- Complete paralysis
- Death

5. Oil and lubricant spills in the premises

Greasy spills on the premises are the major reason for accidental slips, trips and fall. A person falling due to this may suffer from major injuries in the spine or hips. It is because of such careless spilling of liquid; the affected person may lose the ability to walk or sit.

6. Malfunctioning elevators, escalators, staircase and ladders

This is one of the grave consequences where people stuck in malfunctioned elevators can suffer from breathing problems or suffocation. Added to it, malfunctioning elevators can also be fatal to someone if not serviced on time.

In case of malfunctioning escalators or broken ladders and staircases, the person using it can slip and fall. A person with arthritis or rheumatism can face difficulty to climb upstairs or escape during any hazard.

7. Improper use of safety gear and non-adherence to safety norms

The name safety gear means tools that are meant to save the wearer. However, when a person wears a safety gear improperly, he or she is directly calling for a serious situation.

8. Hygiene and sanitation

Risks associated with hygiene and sanitation can not only become an agent of ill health but can also prove to be fatal for the person not following proper hygiene.

Unit 3.2 SOP & Safe Working Practices

Unit Objectives

At the end of this unit, you will be able to:

- Relate the safe working practices
- Demonstrate how to work safely in and around trenches, elevated places and confined areas
- Define the standard operating procedures in oil and gas

3.2.1. Safe Working Practices

Carry Out Safe Working Practices While Dealing With Hazards

On a global level, the jobs in oil and gas industry are considered as highly dangerous tasks. To perform such difficult tasks, various safety measures are applied on a regular basis. Where the number of drilling rig installations have increased to approximately 70%, the size of workforce has also doubled with respect to the increase. Now with the boom in the industry, at present, approximately 27.6% of work related fatalities have been noted. This is a recent statistics (2017).

To prevent site related accidents like trips and falls, exposure to harmful environments, explosions and fire incidents, contact injuries and accidents due to highway vehicles, operators and drilling technicians (including assistants) should follow certain safety instructions. Some of the important ones are as follows:

- Before the work in the worksite starts, it is better to convey all the hazard specifics and work procedures to the crew.
- For better work efficiency and to lessen the chances of incidents, it is better to minimise overall confusions related to the drilling operations.
- It is imperative that the assistant drilling technicians is constantly communicated for the respective equipment and provided guidance for each step.
- For timely completion of the drilling work, it is better to streamline the task.
- First aid kits should be present at the worksite.

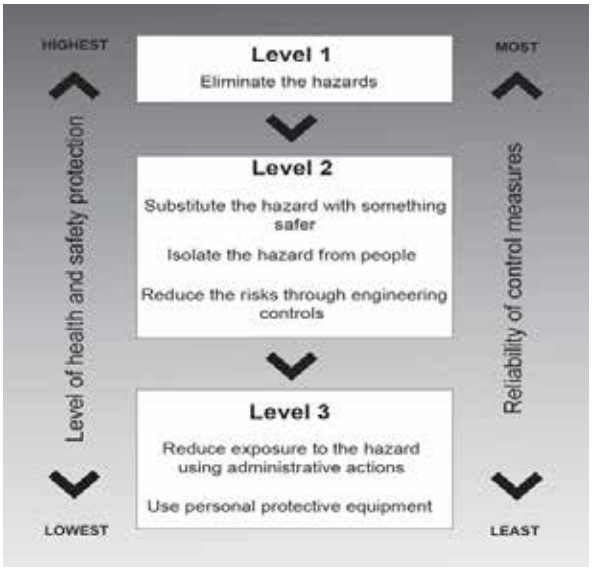


Figure 3.2.1: Safe Working Practices with the help of Risk Controlling Procedure

3.2.2. Work Safely In and Around Trenches, Elevated Places and Confined Areas

There are a number of risks associated with working around confined areas, elevated places and trenches.

Figure 3.2.2: Conditions of technicians working around confined areas

In these areas, the dangers are related to poisonous vapours, fumes, leaks into trenches from old gas works, drowning, etc.

Figure 3.2.3: Conditions of technicians working around elevated areas

In these areas, the dangers are related to rust formation in vessels and steel tanks, lack of oxygen, higher concentrations of dust in the form of flour silos, risk of trip and fall, electric shock, etc.

In order to work in these areas safely, the technicians should follow certain preventive measures.

- It is better to not enter in the confined spaces. However, for work purposes, it becomes mandatory for the assistant drilling technicians to work in such areas.

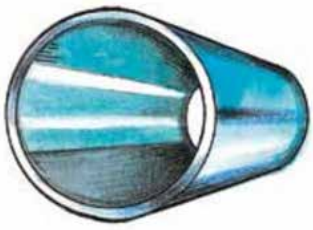


Figure 3.2.4: First example of confined space

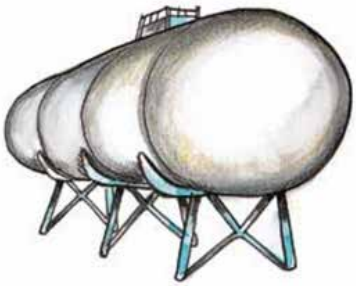


Figure 3.2.5: Second example of confined space

- The technicians should check the depth of the trenches, entrance size of the confined areas and height of the elevated areas.

Figure 3.2.6: Technician in Dilemma – Didn't check the Entrance Size of the Confined Areas before Work

- Before working in such areas, the technicians should modify those spaces.

Figure 3.2.7: Space modification by Assistant Drilling Technician

- For the vessel's internal inspection, they can take the assistance of remote control monitors
- For cleaning operations, sampling and inspection, they can use appropriate tools from outside the space.
- The technician should be a competent person, and he or she should always make a checklist of the tasks that they are planning to do. It helps them to complete the work in a smooth and less exhaustive process.

Figure 3.2.8: Competent Technician

- Testing the air around the work area to see if the enclosed area is free from flammable or toxic gasses. In case of less oxygen in elevated areas, technicians can carry breathing equipment with the help of such air testing method.

Figure 3.2.9: Testing the Air

3.2.3. Standard Operating Procedures in Oil and Gas

Follow SOP in Oil & Gas Drilling Facilities

SOP or Standard Operating Procedures is developed for training operators and drilling technicians. In most cases, integration of Standard Operating Procedures are done through Systems Engineering Team.

Valuable guidance is offered through coordination with control systems. In simple words, SOPs ensures the provision of technical methods and guidance that helps in designing and operating facilities as per the current norms of the oil and gas production facilities.

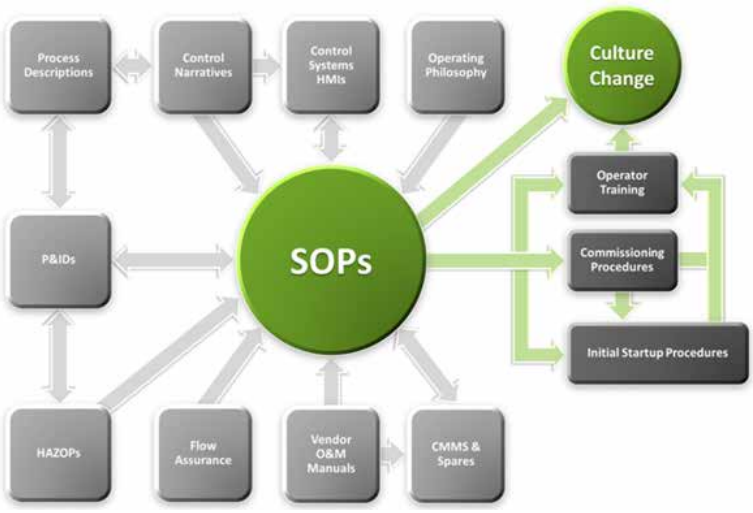
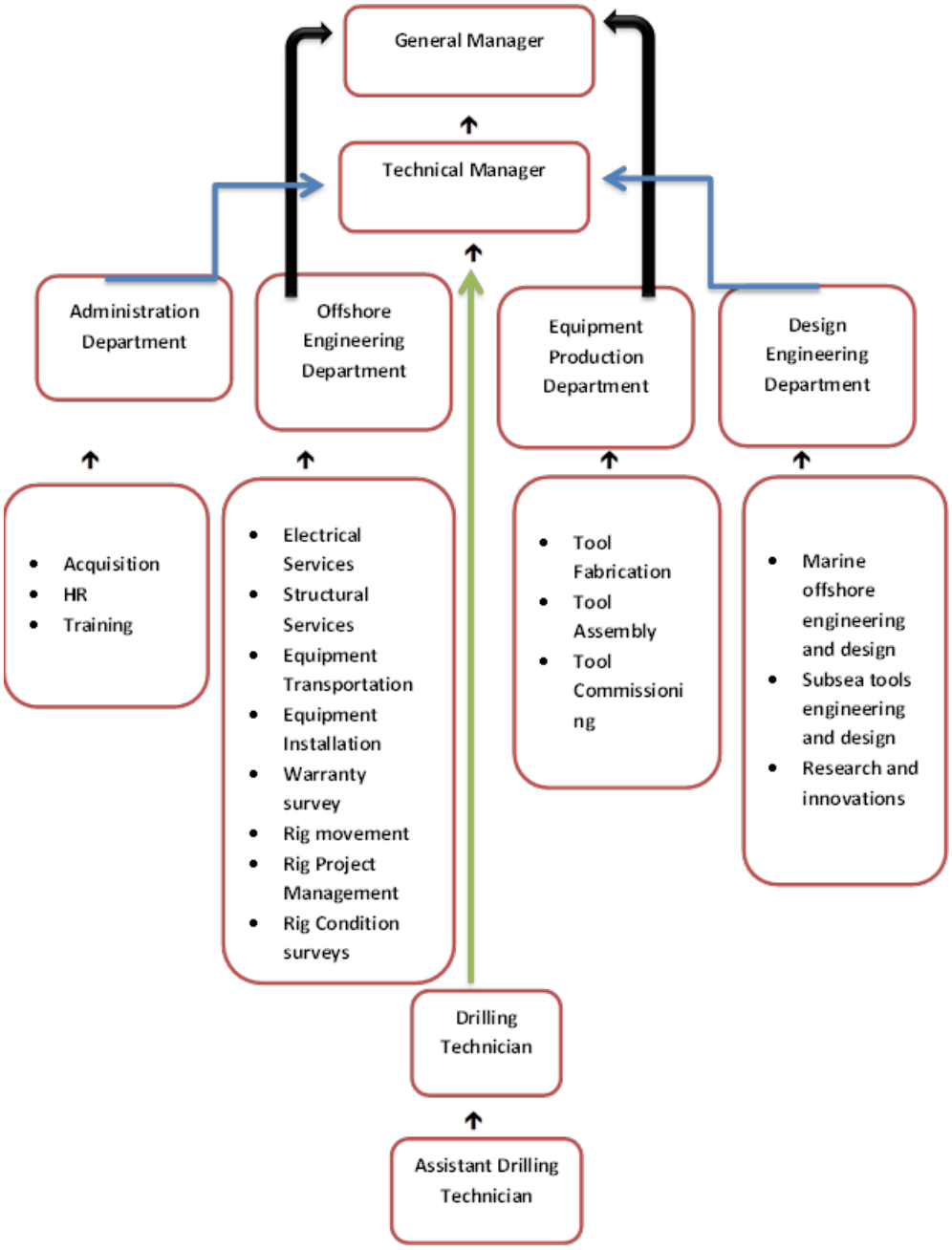


Figure 3.3.1: SOP in Oil & Gas Drilling Facilities

State the name and location of people responsible for health and Safety for the workplace and escalation matrix

These are also the various categories of people that one is required to communicate and coordinate within the organisation.



Unit 3.3 PPE, Fire Fighting Equipment

Unit Objectives

At the end of this unit, you will be able to:

- Evaluate how to use different types of personal protective equipment (PPE)
- Evaluate about various types of fire fighting equipment & its uses in different conditions
- Demonstrate how to perform fire evacuation steps
- Demonstrate how to prepare incident reports

3.3.1. Use of different types of Personal Protective Equipment (PPE)

Protective clothing/equipment for specific tasks

General PPE	
Disposable Mask	
Corded Earplugs	
Grey Durastreme (Eye Protection)	
Peak Hard Hat	

Specialised Gloves	
Redcote Plus	
Oil Grip	
Perfect Cutting Nit	
Skeleton Glove	

Welding and Fabrication	
Welder Gloves	
Supereight Shield	
Tigerhood Classic (fibre metal)	
Fibre-Metal Welding Helmet	

Rigging	
Rigger Boot	
Nitri Task KL	
Optema	
Fibre-Metal Supereight Cap	

Gas Detection	
Sensepoint XCD	
BW Clip	
GasAlert MicroClip XL	
GasAlert Extreme	

Electrical Protection	
Pro-Wear	
Arc Flash Hood	
Insulating Glove	
AS1200 HRC2	

Scaffolding Fall Protection	
Falcon Self Retracting Life line	
Revolution Vinyl Coated Harness	
Air Core Derrick Harness	
Miller H Design Harness	

Specialised Clothing	
Rinba Guardian Plus	
Spacel Comfort Heavy	
Essian Light	

Specialised Footwear	
Oliver Rigger Boot	
Oliver Ankle Boot	
Oliver Lace Up Shoe	
Force(i)Xtrem	

Respiratory Protection	
Survivair Cougar	
Fenzy X-PRO	
Titan SCBA (NFPA)	
Full Face Mask Dual Filter	

Emergency Escape	
SafEscape ELITE	
Opengo	
Evamasque	
BioScape	

Specialised Hearing Protection	
Ear Muff	
Helmet Mount Earmuffs	
Noise Blocking Ear Muffs	
QuietPro	

3.3.2. Various Types of Fire Fighting Equipment & its Uses in Different Conditions

Assistant drilling technicians need to be aware of the different types of fires that can occur and the emergency procedures applicable to their work environment. Especially while working with tools like drilling instruments, pipe fitters, sheet metal fabricators, etc., it becomes important that utmost care is taken for fire safety.

Few important firefighting tools are:

- Sand
- Non-flammable blanket
- Water
- Condensed aerosol fire suppression
- Foam
- Flame inhibitor liquids like Halon
- Fire extinguisher
- Dry powder
- CO2

Figure 3.3.2: Fire Extinguisher

i. Halon 1211 (BCF)

This is helpful in extinguishing fires of Class E, B, and A. this is highly effective as this extinguishant combines with oxygen molecule and makes inert gas. This smothers fire.

ii. Fire Blanket

These are best for extinguishing fire caught on clothes.

iii. Wet Chemical

The Wet Chemicals are helpful in extinguishing fires of Class B and A.

iv. Carbon Dioxide (CO2)

These are specialised extinguishant that are best for extinguishing fires caused due to electrical equipment.

Use the Various Appropriate Fire Extinguishers on Different Types of Fires Correctly

1. There are Various Classes of Fire.

- Class F – fires related to cooking oils
- Class E – fires related to electrical equipment (fuse boxes)
- Class D – fires related to flammable metals (magnesium, titanium)
- Class C – fires related to flammable gases (propane, methane)
- Class B – fires related to flammable liquids (paint, diesel)
- Class A – fires related to solid materials (paper, wood)

2. Different types of Extinguisher

Water fire extinguisher

- Utilisation of these is on Class A fires
- These have RED labels
- Lift the extinguisher, aim it at the fire's base and use it in a sweeping motion

Water mist fire extinguisher (dry water mist)

- Utilisation of these is on Class F, C, B, A fires
- These have RED writing on WHITE labels
- Lift the extinguisher, aim it at the fire's base and use it in a sweeping motion

Figure 3.3.3: Water mist fire extinguisher

Powder Fire Extinguisher

Utilisation of these is on electrical fires as well as classes A, B, C fires.

These have BLUE labels

Lift the extinguisher, aim it at the fire's base and turn it on.

Figure 3.3.4: Fire Extinguisher

Dry powder fire extinguisher

- Utilisation of these is on Class D fires
- These have BLUE labels
- Lift the extinguisher and aim it at the fire's base

Wet chemical fire extinguisher

- Utilisation of these is on Class F fires in addition to class A and B fires
- These have YELLOW labels
- Lift the extinguisher, aim it at the fire's base and use it in slow circular motions

Foam fire extinguisher

- Utilisation of these is on Class A and B fires
- These have CREAM labels
- Lift the extinguisher, aim it at the fire's base and use it in a sweeping motion for class A and at the top of the burning liquid for class B.

Figure 3.3.5: Foam Fire Extinguisher

CO_2 fire extinguisher

- Utilisation of these is on Class B fires
- These have BLACK labels
- Lift the extinguisher, aim it at the fire's base and use it across the area otherwise, your skin can freeze

Identify and Follow Pro Active and Reactive Fire Fighting SOP in Oil & Gas Production Facilities

In oil and gas production facilities, occurrence of fire-related accidents are common. However, such a reactive aspect can be avoided by proactive planning. Such planning can be made with the help of certain pointers.

- Recognise the main reason for the cause and spread of fire

This can be identifies with the help of two questions.

- What was the exact reason for the fire to start?
- Are there any actions that the technicians can apply for the prevention of fire in the production facility?

- **Think and Act**

  It is better not to go with the first solution that comes to your mind. This is because in that state the mind of a person is full of panic. Instead of panicking and taking the decision, the best is to analyse the situation, consider all the aspects and then to take the appropriate actions.

- **Pre-planning is must**

  Instead of advising and encouraging the group of operators and technician to jump and rush to fire-fight, it is better to understand the entire situation and allocate the respective fire fighting task to the other members.

- **Step back when required**

  Fire fighting is not a child's play. Immediately taking certain measure to control fire in oil and gas production facilities can increase the problem instead of solving it. In such cases, it is better to call for professional help.

- **Evaluate properly**

  It is one of the most important aspects that should be followed by every company. Oil and gas production facilities are hazardous places as they have all the elements that can instantly rev up fire incidents. So it is important that after extinguishing the fire, proper inspection arrangements should be made so that there are no chances for the extinguished fire to re-ignite.

3.3.3. Perform Fire Evacuation Steps

Each organisation having fitting, cutting and welding workshop should abide by EHS guidelines. It is especially for those companies that specify the Exit/Escape /Safety Evacuation Points in the workplace. This is important because assistant drilling technicians are exposed to various hazards and health issues in workplace.

EHS stands for Environmental Health and Safety. It is a discipline and department that studies and deploys the practical aspects of environmental protection and safety at work. In simple terms, it is what organisations and workshops must do to ensure that their activities do not cause harm to anyone.

The EHS mandates that there must be specific escape routes or safety evacuation points. This includes highly detailed plans or blueprint of the building which is comprehensible to anyone.

Each floor of the workshop or building must display its own Safety Evacuation Map. These are mainly applicable for cases of Fire outbreaks or natural calamities like Earthquake, Flood, etc.

The sequence of an Evacuation situation is:

- Detection
- Decision
- Alarm
- Reaction
- Movement to an area of refuge or an Assembly station
- Transportation

Figure 3.3.6: Fire Escape Plan

Carry out Evacuation of Casualty and Premises Tasks

Briefing and Guidance for Fire Fighters

There are basically 3 methods with the help of which people can be rescued from a building engulfed in a blazing fire. To ensure on-site reception, here are 2 of the important steps that we will discuss now. These come under the best safe lifting and carrying practices.

Conventional Technique

- This is a good method if there is an open area close by.
- The first rescuers will make the victim sit reach under their armpits and finally, grab their wrist.
- The other rescuer will cross the ankle (victim), pull up that person's legs on his shoulder.
- Finally, on the count of 3, both will lift the person up and move out.

Figure 3.3.7: Fast Strap

Fast Strap

- In case the victim is completely incapable of moving out of the fire zone. The rescuers should follow this method.
- One of the rescuers will place their knee between victim's shoulder and head.
- Pin the loop of webbing to the ground with the help of the knee. This acts as an anchor.
- With the non-dominant hand hold the other end of the webbing and make a loop.
- With steady hands pull the victim's hand in from the loop, tie it securely and finally clip the webbing loops

Figure 3.3.8: Fast Strap

Essentials for Smooth Evacuation

The following are essential to have a smooth evacuation during an outbreak:

- Clear passageways to all escape routes
- Signage indicating escape routes should be clearly marked
- Enough exits and routes should be present to allow a large number of people to be evacuated quickly
- Emergency doors that open easily
- Emergency lighting where needed
- Training for all employees to know and use the escape routes
- A safe meeting point or assembly area for staff
- Instructions on not using the Elevator during a fire

Special Evacuation Requirements For Specially Abled Persons

i. The Visually Impaired

- Announce the type of emergency
- Offer your arm for help

ii. With Impaired Hearing

- Turn lights on/off to gain the person's attention, or indicate directions with gestures, or write a note with evacuation directions

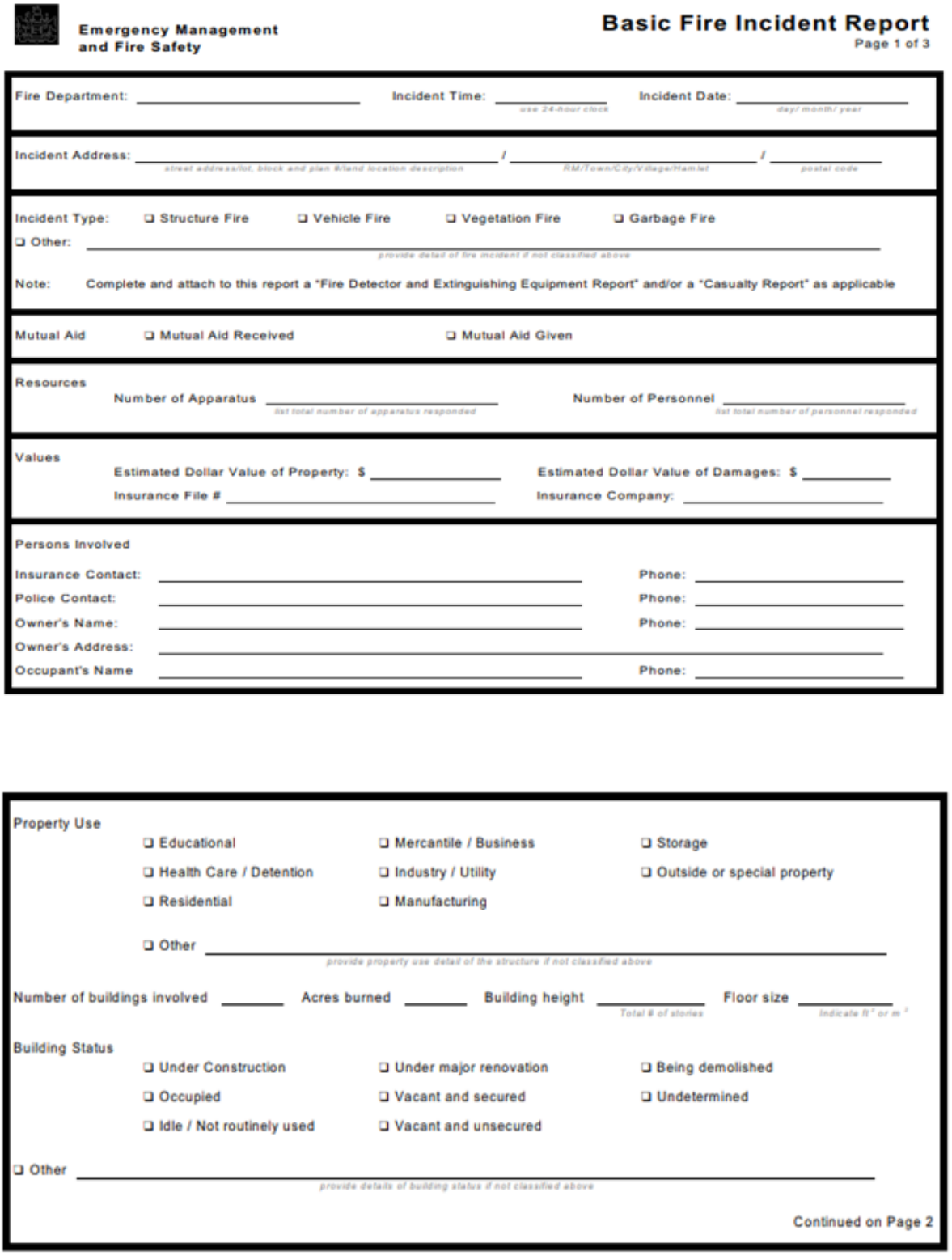
iii. People with Prosthetic Limbs, Crutches, Canes, Walkers

- Evacuate these individuals as injured persons.
- Assist and accompany to evacuation site if possible.
- Use a sturdy chair, or a wheeled one, to move the person to an enclosed stairwell
- Notify emergency crew of their location.

3.3.4. Prepare Incident Reports

In the Oil and Gas companies, fire accidents are a common sight. However, the companies take extra care to prevent the spread of fire. In case any fire accident takes place, it is important that the assistant drilling technician prepares a detailed incident report.

Here is a sample of how an incident report looks like.



Emergency Management and Fire Safety

Basic Fire Incident Report

Page 1 of 3

Fire Department: _____ Incident Time: _____ (use 24-hour clock) Incident Date: _____ (day/ month/ year)

Incident Address: _____ (street address/lot, block and plan #/land location description) / _____ (RM/Town/City/Village/Hamlet) / _____ (postal code)

Incident Type: ❑ Structure Fire ❑ Vehicle Fire ❑ Vegetation Fire ❑ Garbage Fire

❑ Other: _____ (provide detail of fire incident if not classified above)

Note: Complete and attach to this report a "Fire Detector and Extinguishing Equipment Report" and/or a "Casualty Report" as applicable

Mutual Aid ❑ Mutual Aid Received ❑ Mutual Aid Given

Resources

Number of Apparatus _____ (list total number of apparatus responded) Number of Personnel _____ (list total number of personnel responded)

Values

Estimated Dollar Value of Property: $ _____ Estimated Dollar Value of Damages: $ _____

Insurance File # _____ Insurance Company: _____

Persons Involved

Insurance Contact: _____ Phone: _____

Police Contact: _____ Phone: _____

Owner's Name: _____ Phone: _____

Owner's Address: _____

Occupant's Name _____ Phone: _____

Property Use

❑ Educational ❑ Mercantile / Business ❑ Storage

❑ Health Care / Detention ❑ Industry / Utility ❑ Outside or special property

❑ Residential ❑ Manufacturing

❑ Other _____ (provide property use detail of the structure if not classified above)

Number of buildings involved _____ Acres burned _____ Building height _____ (Total # of stories) Floor size _____ (Indicate ft² or m²)

Building Status

❑ Under Construction ❑ Under major renovation ❑ Being demolished

❑ Occupied ❑ Vacant and secured ❑ Undetermined

❑ Idle / Not routinely used ❑ Vacant and unsecured

❑ Other _____ (provide details of building status if not classified above)

Continued on Page 2

Emergency Management and Fire Safety

Basic Fire Incident Report

Fire Spread

- ❑ Confined to room of origin
- ❑ Confined to floor of origin
- ❑ Confined to building of origin
- ❑ Beyond building of origin

Mobile Property Involved

- ❑ None
- ❑ Not involved with ignition, but burned
- ❑ Involved with ignition, but did not burn
- ❑ Involved with ignition and burned

Mobile Property Type

- ❑ Passenger or road transport
- ❑ Freight road vehicle
- ❑ Transport vehicle
- ❑ Water vessel
- ❑ Aircraft
- ❑ Industrial, agriculture, construction
- ❑ Miscellaneous
- ❑ Unknown

Mobile Property Details

Make _____

Model _____

Licence number _____ Province _____ VIN _____

Ignition Factors

Area of Origin _____

provide detailed description of the primary use of the area where the fire started - also check below as applicable

- ❑ Means of egress — >hallways, entrance areas, fire exits
- ❑ Assembly areas — >theaters, community halls, living rooms
- ❑ Function area — >bedroom, kitchen, office, dining room
- ❑ Technical processing area — >laboratories, operating rooms, stages
- ❑ Storage areas — >store rooms, closets, garages
- ❑ Service areas — >conduit, pipes, elevator shaft
- ❑ Service or equipment areas — >mechanical rooms, cells
- ❑ Structural areas — >attics, crawl spaces, exterior of walls
- ❑ Transportation vehicle areas — >passenger area, trunk, engine
- ❑ Outside areas — >streets, parking lots, railway tracks
- ❑ Other areas — >areas not otherwise listed
- ❑ Undetermined — >area or origin cannot be determined

Heat Source _____

provide detailed description of the heat source which ignited the first object to burn - also check below as applicable

- ❑ Operating equipment — >spark, ember, electrical arc, radiant heat
- ❑ Hot smouldering object — >heat of friction, molten material, welding
- ❑ Explosives, fireworks — >blasting agent, munitions, fireworks
- ❑ Other open flame, smoker's materials — >cigarettes, candles, match, lighter
- ❑ Chemical, Natural heat sources — >sunlight, spontaneous combustion
- ❑ Heat spread from another fire — >flame contact, radiant heat, embers
- ❑ Other heat sources — >multiple heat sources
- ❑ Undetermined — >heat source cannot be determined

Item First Ignited _____

provide detailed description of the item first ignited - also check below as applicable

- ❑ Structural component — >wall coverings, framing, floor coverings
- ❑ Furniture, utensils — >upholstery, cabinets, appliances
- ❑ Soft goods, wearing apparel — >mattresses, linen, clothing, drapes
- ❑ Adornment, recreational items, signs — >Christmas trees, awnings, tents, toys
- ❑ Storage supplies — >boxes, packing materials, pallets
- ❑ Liquids, piping, filters — >flammable gases / liquids, pipes, ducts
- ❑ Organic materials — >agricultural crops, humans, animals
- ❑ General materials — >books, trash, dust, lint, tires, fertilizer
- ❑ Undetermined — >item first ignited cannot be determined

Cause of Ignition _____

provide detailed description of the cause of ignition - also check below as applicable

- ❑ Intentional — >misuse of heat source, incendiary fire
- ❑ Unintentional — >careless, reckless, accidental acts
- ❑ Failure of equipment — >equipment not functioning properly
- ❑ Act of nature — >weather, floods, animal behaviour
- ❑ Cause under investigation — >origin and cause not yet determined
- ❑ Cause undetermined — >cause undetermined after investigation

Emergency Management and Fire Safety

Basic Fire Incident Report

Page 3 of 3

Factors Contributing to Ignition

_____
provide detailed description of the factors that allowed heat source and combustible materials to come into contact/combine

- ❑ Misuse of materials — *>unsafe use or placement of heat source*
- ❑ Design, Installation Deficiency — *>design, construction, installation faults*
- ❑ Fire spread or control — *>exposure, rekindle, controlled burns*
- ❑ Mechanical failure, malfunction — *>worn components, control failure, leak*
- ❑ Operational Deficiency — *>collisions, unattended equipment*
- ❑ Undetermined — *>ignition factors cannot be determined*
- ❑ Electrical failure, malfunction — *>short circuit, arcing, equipment failure*
- ❑ Natural condition — *>wind, flood, animal behaviour*

Human Factors

_____
provide detailed description of the human factors related to the fire - also check below as applicable

- ❑ Asleep — *>occupant(s) asleep at time of fire*
- ❑ Possible mentally disabled — *>persons with permanent disabilities*
- ❑ None — *>no persons involved*
- ❑ Impaired by alcohol or drugs — *>impaired occupant(s) asleep or awake*
- ❑ Physically disabled — *>permanent or temporary disabilities*
- ❑ Unattended — *>persons requiring care left unattended*
- ❑ Multiple persons — *>note number of persons above*

Equipment Involved in Ignition

_____
provide detailed description of equipment involved in ignition - also check below as applicable

- ❑ Heating, ventilation, air conditioning — *>furnace, fire place, stove, water heater*
- ❑ Commercial and medical equipment — *>vending machines, O2 equipment*
- ❑ Electronic, other electrical equipment — *>computers, TVs, stereos, cash register*
- ❑ Electrical distribution, lighting, power — *>distribution panels, outlet, lights*
- ❑ Garden tools, agricultural equipment — *>combine, chain saw, milking machine*
- ❑ Personal and household equipment — *>clothes dryer, curling iron, powered toys*
- ❑ Shop tools and industrial equipment — *>power saw, welding torch, compressor*
- ❑ Kitchen and Cooking Equipment — *>Coffee maker, microwave, dishwasher*
- ❑ Other equipment involved in ignition — *>other equipment not listed, none*

Brand or Make _____ Serial Number or other identification _____

Model _____ Year of manufacture _____

Remarks

_____

_____

_____

_____

Person Completing This Report

Name _____ Rank/Title _____

Phone
Work _____ Home _____ Cell _____

Representing _____
government agency, firm or corporation - provide address

Other Forms filed with this Report: ❑ Casualty Report ❑ Fire Detector and Extinguishing Equipment Report

Figure 3.3.9: Fire Incident Report

If such forms are not available, one should remember to include this information as the content.

- In the 1st section, you need to record the basic things related to the accident like:
  - Date of accident
  - Time
  - Specific location
  - Accounts of witnesses
  - Their names
  - Event that caused that accident
  - What other electricians were doing at that moment
  - Circumstances like PPE, materials, equipment, tool
  - Environmental conditions
  - Specific injuries
  - Person(s) who gave first aid

- In the 2nd section, it is mandatory to give a complete description including necessary details and relevant facts. The use of language should be formal.
- In the 3rd section, the person writing the content requires signing it with the current date.

P.S. It is essential that a photocopy of the written accident report be made before submission.

Unit 3.4 First Aidt

Unit Objectives

At the end of this unit, you will be able to:

- Describe rescue activity during an accident in real or simulated environments
- Define how to administer appropriate first aid to victims where required
- Define how to administer appropriate first aid in chemical hazard
- Sort the availability of first aid box & accessories

3.4.1. Perform and Organize Loss Minimization or Rescue Activity during an Accident in Real or Simulated Environments

Demonstrate How to Free a Person from Electrocution

Oil and gas companies are power with high voltage electricity. In addition to it, the drilling technician use tools that work on electricity. In such cases, there are chances that the individuals may receive an electric shock in these circumstances, it is important that another person free the electrocuted person on time.

Here the steps to free a person from electrocution.

1. **Switch off the main power.**

2. **Don't touch the person who is electrocuted.**

3. **Try to remove the person from the electrical source with the help of non-conducting objects like stick, cardboard, bamboo, etc.**

4. **Lay the person in this position.**

3.4.2. Administer Appropriate First Aid to Victims Where Required

Importance of First Aid in emergency management can be elaborated through the following points:

For heavy bleeding

i. **Stop bleeding**
   - Direct pressure must be applied to the cut or wound with a clean cloth, tissue, or piece of gauze, until bleeding stops.
   - If blood soaks through the material, it is highly recommended not to remove it.
   - More cloth or gauze must be put on top of it, and pressure must be continued.
   - If the wound is on the arm or leg, the limb must be raised above the heart to help slow the bleeding.
   - Hands must be washed again after giving first aid and before cleaning and dressing the wound.

- A tourniquet must not be applied unless the bleeding is severe and not stopped with direct pressure.

Figure 3.4.1: Pressure application to stop bleeding

ii. Clean cut or wound

- The wound must be cleaned with soap and lukewarm water.
- To prevent irritation and burning sensation, the soap solution must be rinsed out of the wound.
- Hydrogen peroxide or iodine must not be used to clean or treat the wound since they are corrosive and can damage live tissues.

Figure 3.4.2: Clean cut or wound

iii. Protect the wound

- Antiseptic cream or solution must be applied to the wound to reduce the risk of infection.
- Then, the wound must be gently covered with a sterile bandage.
- Till the wound heals, the bandage must be changed (dressed) daily to keep the wound clean and dry.

Figure 3.4.3: Protect the wound

iv. Call the Emergency Helpline if:
- The bleeding is severe and deep
- You suspect Internal Bleeding
- Abdominal or Chest wound exists
- Bleeding continues even after 10 minutes of firm and steady pressure

For Burns

Immediately put the burnt area under cold water for a minimum of 10 minutes

If the burned area is covered, take clean scissors, cut and remove the fabric covering the area

- In case clothing is stuck to the burned area, leave it as it is
- Before sterile dressing application, remove jewellery (if any)
- It is better to leave the burned area open

Do not apply any medication or ointment

Breaking a blister – it is an absolute no-no!

Figure 3.4.4: Put Burnt Area under Water

For Broken Bones and Fractures

i. Protruding bone must be left alone
- If a bone has broken through the skin, it must not be pushed back into place.
- The area must be covered with a clean bandage and immediate medical attention must be sought.

ii. Bleeding must be stopped
- Steady and direct pressure must be applied with a clean piece of cloth for 15 minutes, and the wound must be elevated.
- If blood soaks through, one must apply another cloth over the first and seek immediate medical attention.

iii. Swelling must be controlled

- The RICE therapy must be applied to control and reduce swelling.
- Rest the injured part by having the person stay off of it.
- Ice must be applied on the area with the help of an ice pack or by wrapping the ice in a clean cloth. Ice must not be directly placed against the skin.
- Compress by wrapping the ankle lightly (not tightly) with an "ace" bandage or elastic ankle brace. Do not try to align the bones forcefully.
- Elevate the injured area above heart level.

iv. Pain and inflammation must be mitigated

- One must have pain medication like Aspirin.
- Aspirin must not be given to anyone aged 18 years or younger.

v. Encourage the person to support the injury with their hand, or use a cushion or items of clothing to prevent unnecessary movement

vi. Continue supporting the injury until help arrives

vii. A physician must be summoned at the earliest

- Call the doctor at the earliest. It is recommended not to take treatment in one's own hands if the fracture is severe.

viii. Follow up

- The doctor will examine and X-ray different parts of the leg.
- The doctor may do a CT or CAT scan, or an MRI to determine if surgery is needed.
- The doctor may align and set the broken bone back into place and immobilise the ankle with a splint, cast, or other device.
- Surgery may be necessary to repair the break.

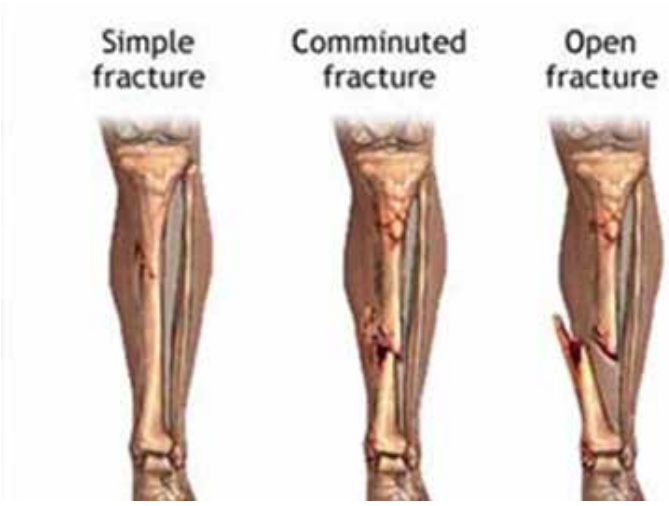


Figure 3.4.5: Broken Bones and Fractures

For Heart Attack/ Stroke

- Think FAST. Face: is there weakness on one side of the face? Arms: can they raise both arms? Speech: is their speech easily understood? Time: to call Emergency helpline
- Immediately call medical/ambulance helpline or get someone else to do it

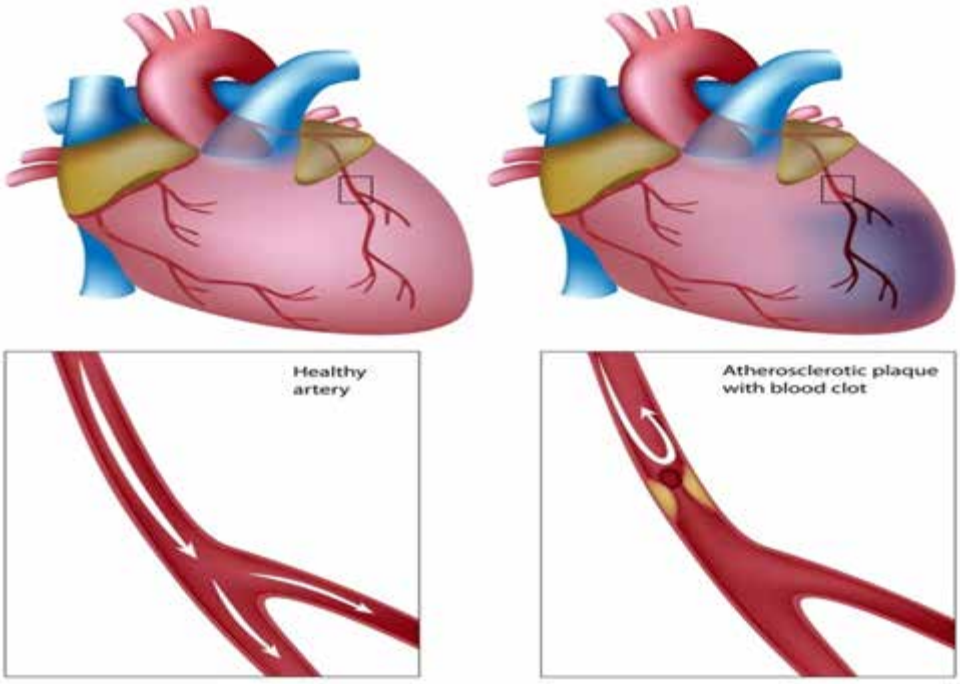


Figure 3.4.6: Anatomy of Heart Attack

For Head Injury

- Ask the victim to rest and apply a cold compress to the injury (e.g. ice bag)
- If the victim becomes drowsy or vomits, call Medical helpline or get someone else to do it

For Electric Shocks

- Switch Off the Main Power Supply immediately
- Free the victim of his clothes
- Give artificial respiration and oxygen if needed
- In case of Burns, apply ice and burn cream and rush him/her to the hospital depending on the severity of the burn

3.4.3. Administer Appropriate First Aid in Chemical Hazard

Chemical hazards are caused by toxic materials, which are poisonous. And being poisonous in nature, they can either be fatal or cause serious damages in case the preventive actions are not taken on time. Now, the exposure to chemicals can be in 3 forms.

They can be:

i. Inhaled (entering the body through nose)
ii. Directly in contact with skin
iii. Ingested (consumed)

The symptoms, in this case, will be:

- Seizures
- Partial or complete loss of responsiveness
- Burning sensation
- Stomach Cramping with bouts of excruciating pain
- Nausea
- Vomiting (and in times with blood-stains)

Now, where there are problem, their solutions come side by side. In such situations, the person giving first aid requires to be calm and take certain preventative actions.

Some of the essential actions are:

- Using insulated equipment
- Wearing protective clothing, goggles, masks, shoes and gloves
- Ensuring the place has enough ample ventilation

Remedial action

- The foremost thing that one should do is to provide immediate first aid. However, it is to be remembered that the victim should not be given any kind of fluid (water, milk) until doctors from Poison control unit gives a green signal.
- Aside from this, there are a few things a person can perform to the victim of toxic material exposure.
- Remove the victim from the toxic zone or vicinity
- Call for an ambulance
- Remove contaminated clothing
- Splash water in the eyes
- If ingested, do not try to make the victim puke (vomit)
- Wash their mouth with water
- In case the victim's breathing has stopped, give CPR (Cardiopulmonary resuscitation)
- In case of burning due to toxic material, apply burn gel or water gel on that area.
- Avoid any cream based or oil based lotion or ointment

Even though giving first aid is the right thing to do in the first place, it is also important that another of the electrician should report the incident to their supervisor

Figure 3.4.8: CPR

3.4.4. Availability of First Aid Box & Accessories

Every company has the provision of first aid box. As you have already read about the types of injuries that technicians can receive in their field of work, it is imperative for the companies to have appropriate first aid accessories.

The basic first aid supplies and accessories that a first aid box should have are:

Supplies and Accessories in the First Aid Box

Splint

Elastic wraps

Latex gloves

Adhesive tape

Tweezers

Blanket

Scissors

Wound cleaning agent

Triangular bandages

Gauze roller bandage

Adhesive bandages

Gauze pads

Antiseptic cleansing wipes

Burn cream or gel

Eyewash liquid

CPR Kit

Unit 3.5 Risk Management and Reporting

Unit Objectives

At the end of this unit, you will be able to:

- Discuss about Risk Management
- Demonstrate how to inspect for faults, set up and safely use steps and ladders in general use
- State the proper utilisation of breathing apparatus
- Define emergency preparation and response

3.5.1. Risk Management

In the Gas and Oil Industry, the general risk management process involves these important steps.

1. **Planning**
   - Recognise the individuals participating in the process of risk management
   - Collecting all the relevant Oil and Gas Industry related safety and health information
   - As per the requirements in legal or business, understanding and defining the workflows and strategies

2. **Identifying the Risks**
   - Recognise issues and hazards related to health and safety within workplace. This can be done via thorough inspection of the work area and going through the ill-health records, previous accidents, and much more.

3. **Evaluating the Risk**
   - Ranking the different types of risks on the grounds of severity
   - Establishing the types of injuries that one may receive at the workplace
   - Recognising the different precautionary measures that are taken place at the workplace and which of the aspects went wrong
   - Assessing the different types of hazards that one can identify from the identified hazards or issues

4. **Recording the Risks**
   - To define various controlling measures related to regulatory purposes, internal review, audit, etc. and recording all the findings related to risk assessment.

5. **Controlling the Risks**
   - Out the various preventive measures and implement those to minimise or eliminate accident or incident related risks.

6. **Assessment Follow On**
   - Re-evaluate the control measures or preventive measures' efficiency
   - Make sure that all the control measures that are implemented are in use and all of them are effective.

7. **Review and Monitor**
   - Monitor carefully, keep an eye on all the risks and update the assessments for those risks.

3.5.2. Inspect For Faults, Set Up and Safely Use Steps and Ladders in General Use

Inspect For Faults

It is important to inspect every safety device and elevating device. The inspection and testing process requires to be determined by the prescribed standards and via a qualified person.

- The prescribed standards state that the inspection criteria are met:
- Once every year
- After any changes are made to any safety devices or elevating devices
- Before the attachment of thereto to the elevating devices

Set Up and Safely Use Steps and Ladders in General Use

- Trestles and steps ladders are the common equipment that is seen in work sites in oil and gas companies.
- It is important that technicians do not use metal ladders.
- It is to be maintained that when using ladders to reach higher areas for installation or storing equipment, the loading should be at zero degrees (straight).
- One should avoid side loading when standing on a step ladder
- Overreaching should be strictly avoided while standing on the ladder
- Light tools and materials should be carried
- Here are few images to show the correct way to use ladders.

Figure 3.5.1: Tying the extension ladder and ensuring that it at least 3 feet higher than the supporting point

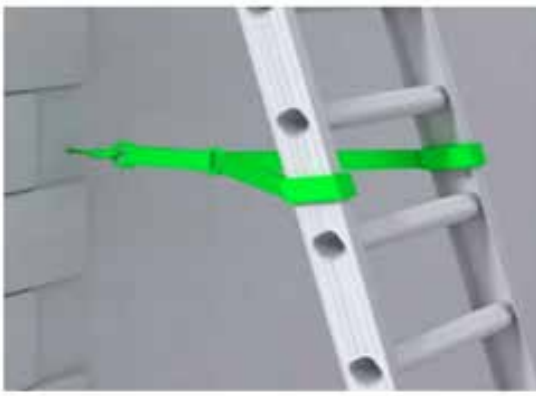


Figure 3.5.2: Tying the ladder near the base

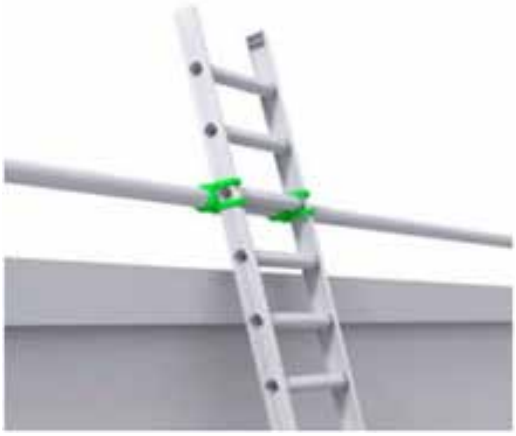


Figure 3.5.3: Tying the ladder above the stiles to work on and not gaining access

Figure 3.5.4: Ensuring that both the legs are on the same platform (step) with the knees supported to the stepladder and availability of handhold

Figure 3.5.5: Taking the help of stand-off devices to get a strong resting point.

Figure 3.5.6: Not following 3 point contact and overreaching an area

Figure 3.5.7: Following 3 point contact and not overreaching the work area

Figure 3.5.8: Right 1 in 4 angle shown with the help of a ladder

3.5.3. Use/Proper Utilization of Breathing Apparatus

- Check the parts of the breathing apparatus thoroughly.

- Check the bypass knob (red). Close it if you see it open. after this, press the reset button (area above bypass nob - black)

- Inspect the face mask to see that it is undamaged.

- Lift the cylinder ensuring that on the top the cylinder valve should be present.
- The backplate of the cylinder should face the wearer.
- Wear the breathing apparatus on the shoulder like a bag pack, and by the neck strap, hang the facemask

- After wearing the breathing apparatus tighten shoulder straps and fasten the waist belt.

- The cylinder valve should be opened slowly to inspect the pressure gauge.

- Make sure that 80% of the cylinder is full.

- Wear the mask slowly by resting your chin in the resting cusp and pull the head strap slowly over your head.
- Pull the head straps for a snug but comfortable fit.

- Breath in and normally to see if you can breathe normally or not.

- Now insert a finger sidewise of the face mask for easy outward airflow.

- Slowly close the cylinder valve without leaving the knob.
- Be steady for 10 minutes and hold your breath or extremely slow to listen to any wheezing sound.

- Also, check the pressure gauge for any dip in the pressure.
- Normally Breathe to vent system
- Listen for a whistle alarm while observing the pressure gauge at 55 bar (+/- 5 bar)

3.5.4. Ensure Emergency Preparation and Response

In oil and natural gas production companies, prior planning is an important aspect. In order to prevent emergencies, offshore operators take various precautions. It is the work of technicians and assistant technicians to analyse potential risks that can harm the work environment and the people working in that area.

When we talk about emergency response plan, we are basically talking about a detailed plan which helps the contractors and the workers during the time of emergencies. These plans provide training to the technicians how to react and take action regarding various emergencies.

Assistant drilling technicians require to be well prepared for emergencies like:

- Helicopter incidents
- Extreme weather
- Presence of icebergs or heavy sea ice
- Vessel collisions
- Aircraft damage
- Support vessel damages
- Offshore infrastructure damage
- Hazardous material spills
- Oil material spills
- Explosions
- Accidental fire
- Any well's control loss
- Diving emergencies
- Missing people or person
- Medical emergencies
- Serious injuries
- Fatalities

For an appropriate response, the assistant technicians should know how to tackle different types of offshore emergency situations.

Figure 3.5.9: Hazardous material spills

In addition to this, oil and gas companies should create separate and interlinked teams. These are:

- Crisis Management Team that Crisis Manager leads
- Emergency Coordination Team that Emergency Coordinator leads
- Site Control Team that Site Controller leads

Summary

- Safety and Health Management System in occupational areas
- Came into light when International Labour Conference (2003, 91st session) adopted Global Strategy on Occupational Safety and Health: Conclusions.
- Faulty electrical appliances or contact with an energised source must not be used in the designated premises.
- Greasy spills on the premises are the major reason for accidental slips, trips and fall.
- With the boom in the industry, at present, approximately 27.6% of work related fatalities have been noted. This is a recent statistics (2017).
- In elevated areas, the dangers are related to rust formation in vessels and steel tanks, lack of oxygen, higher concentrations of dust in the form of flour silos, risk of trip and fall, electric shock, etc.
- SOPs ensure the provision of technical methods and guidance that helps in designing and operating facilities as per the current norms of the oil and gas production facilities.
- While working with tools like drilling instruments, pipe fitters, sheet metal fabricators, etc., it becomes important that utmost care is taken for fire safety.
- The EHS mandates that there must be specific escape routes or safety evacuation points.
- Hydrogen peroxide or iodine must not be used on cuts since they are corrosive and can damage live tissues.
- Aspirin must not be given to anyone aged 18 years or younger.

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

HSSC
HYDROCARBON SECTOR
SKILL COUNCIL

4. Working Effectively with Colleagues and Supervisor

Unit 4.1 Understanding Regarding the Job Profile

Unit 4.2 Communication and its Various Aspects

Unit 4.3 Ethics and Discipline

HYC/N0103

Key Learning Outcomes 

After attending the session, you will be able to:

1. Define the job profile
2. Identify communication and its various aspects
3. Define ethics and discipline

Unit 4.1 Understanding Regarding the Job Profile

Unit Objectives

At the end of this unit, you will be able to:

- Define the job profile
- Identify communication and its various aspects
- Define ethics and discipline

4.1.1. Accurately Receive Information and Instructions from the Supervisor and Fellow Workers

I. **Listening to the information attentively that you receive from your fellow workers and supervisor**
II. **Grasping the content well**
III. **Analysing the instructions that you are given**
IV. **Putting forth the queries regarding the provided information**
V. **Clearing the doubts regarding the given task or instruction**

4.1.2. Give Information to Others Clearly, At a Pace and In a Manner That Helps Them to Understand

The foremost thing regarding giving clear information is respecting the audience. When you communicate and put forth the information to the listener, you should be clear about the message that you would be giving to them.

The next aspect is to stick to the instruction that you want to give to the workers working in the oil and gas facility.

Information exchange makes the process of imparting information smoothly. If the speaker knows what they want to convey, they should also know what the audience is grasping. This decreases the chance of confusion as the listener gets the opportunity to ask about the instruction or about correct selection of tools and clearing their doubts then and there.

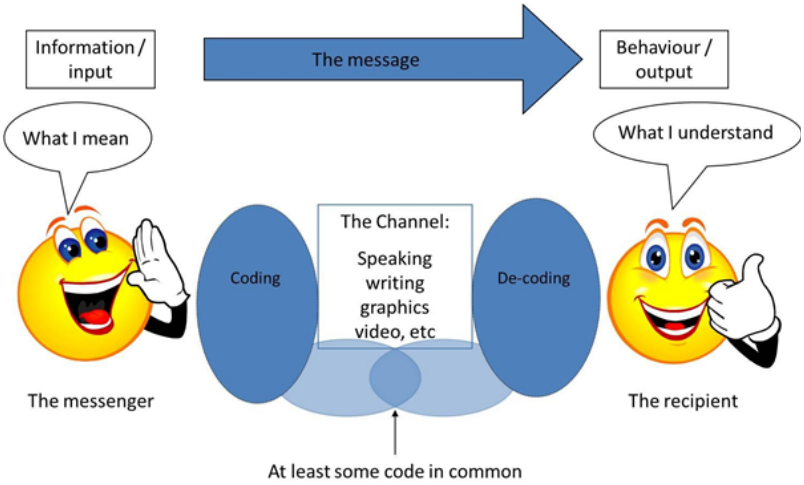


Figure 4.1.1: Clear information Exchange

Unit 4.2 Communication and its Various Aspects

Unit Objectives

At the end of this unit, you will be able to:

- Define the importance of teamwork in organizational and individual success
- Define the importance of effective communication in the workplace
- List the value and importance of active listening and assertive communication
- Demonstrate how poor communication practices can disturb people, environment and cause problems for the employee
- Defien the importance of avoiding casual expletives and unpleasant terms while communicating professional circles
- Demonstrate the appropriate communication etiquette while working
- Define basic engineering communications

4.2.1. Importance of Teamwork in Organizational and Individual Success

T.E.A.M - Together Everyone Achieves More……

Team work is the actions of individuals, brought together for a common purpose or goal, which subordinate the needs of the individual to the needs of the group. In essence, each person on the team puts aside his or her individual needs to work towards the larger group objective. The interaction among the members and the work they complete is called teamwork. Team work is extremely important for the assistant drilling technician to accomplish his or her job responsibilities efficiently.

- The sum of the efforts undertaken by each team member for the achievement of the team's objective is called team work.
- Every member of a team has to perform and contribute in his best possible way to achieve a common predefined goal.
- Individual performances do not count in a team, and it is the collective performance of the team workers which matters the most.

Figure 4.2.1: Benefits of Team Work

The essential components of Team work are:

1. **Communication.** This is the essence of effective Teamwork. Effective communication provides understanding, interpretation and action. Ineffective communication leads to misunderstanding, misinterpretation, and either inaction or inappropriate action.
2. **Active Listening.** There are two responsibilities here: That of the sender and that of the receiver. The sender must ensure that the message is clear and understood and the receiver must ensure that if the message is not clear that they ask for clarification.
3. **Resolving Conflict.** People are different, and inevitably clashes of personality or other conflicts may arise. The conflict must be resolved, and people should use an effective, consistent approach to resolve it.
4. **Team Diversity.** People come from different backgrounds, and this can present challenges and opportunities. People have to recognise and understand their own uniqueness and that of others and make allowances.
5. **Team Motivation.** Motivation inspires commitment, innovation and teamwork. Team leaders and members need to be aware of the factors affecting motivation and techniques they can use to enhance and maintain motivation levels.

4.2.2. Importance of Effective Communication in the Workplace

A workplace is an area where people from different backgrounds and perspective come to work together. An individual working at a work place or work site doesn't work alone. He or she works with a team – colleagues, supervisor, trainer and others (as per requirement). In this case, good communication and mutual bonding make the workflow smooth and uninhibited. In fact, effective communication allows us to understand the problems that our colleagues are facing, and them to portray it clearly.

Effective communication

i. **Ensures a positive attitude**
   - Communication amongst employees with a positive attitude ensures that change or the development is towards a prospective change (positive).
   - It also motivates the employees, thereby ensuring that they provide cost-effective, productive, and valuable services.

ii. **Ensures proper comprehension regarding strategy and goal accomplishment**
   - It gives the employees the correct perception regarding their work.
   - It also makes sure that the employees know how their work is directly influencing the profitability of the company
   - It gives employees the true impression of working as a team

iii. **Ascertain that everybody complies with the company's regulatory bodies**
   - Talking with colleagues and sharing information on any new updates on company policy or project ensures that everyone stays on the same page.
   - Added to this, this makes the team more responsive and positively engaged in the work.

Various Components of Effective Communication

There are basically 5 components of effective communication.

i. Active listening

Active listening is the process by which an individual secures information from another individual or group.

ii. Soothing

When a person is angry, he or she will not listen to anything you say, even if you have logical points. During this time, the people just want others to hear them out.

iii. Clarity

Until and unless you communicate with clear words, there are chances that the listener may misunderstand the information. So it is advisable that you economise your point without muddling the information.

iv. Personal responsibility and empathy

Showing empathy shows your humane side and ensures others that you can understand their situation. This also makes the other person feel not threatened when they share any information with you. Personal responsibility and empathy ensure that colleagues have a better understanding amongst themselves.

v. Body language

Positive body language indicates receptiveness and presents a welcoming image to others. This welcoming image or cordial approach ensures effective communication.

Figure 4.2.2: Components of Effective Communication

Barriers to Effective Communication

An assistant drilling technician must acquire excellent and active listening skills so that he or she can communicate with the customer better and understand his / her problems easily. Understanding the problem implies that the job is half done. Below are the factors that hinder Effective and Active Listening.

Various types of Barriers are:

- Distractions
- Interruptions
- Lack of interest
- Noise
- Prejudice

The Potential barriers that hinder effective communication are:

- Use of Jargon and Technical terms
- Lack of attention, interest, distractions, or irrelevance to the receiver
- Differences in Perception
- Physical disabilities like Hearing Ailments or Impaired Speech
- Cultural and Language Differences and Unfamiliar accents

Figure 4.2.3: Barriers to Effective Communication

Expectations and Prejudices Leading To False Assumptions or Stereotyping

This is a common phenomenon that one can often observe at workplaces. This is not about language differences. This is more about the difference in understanding and what a person wants to understand.

In most cases, it has been seen that people will not hear what is being said to them at that time. Rather, they often hear what they wish to hear. This leads to conflicts.

When a conflict arises, this gives birth to 3 factors.

- Prejudice
- Bias
- Stereotyping

If the conflict is greater at workplace, the stereotyping will be bound to be complex and distorted.

This again ensures that the prejudice and bias become deep-rooted in the minds of the workers.

The main role of prejudice, bias and stereotyping is:

- Make another person feel bad so that they lose their perspective, leading to the loss of patience and power
- Reinforce loyalty, disrespect and punish the person or people as opposition
- Discouraging others from empathising or supporting others and making the situation more complex

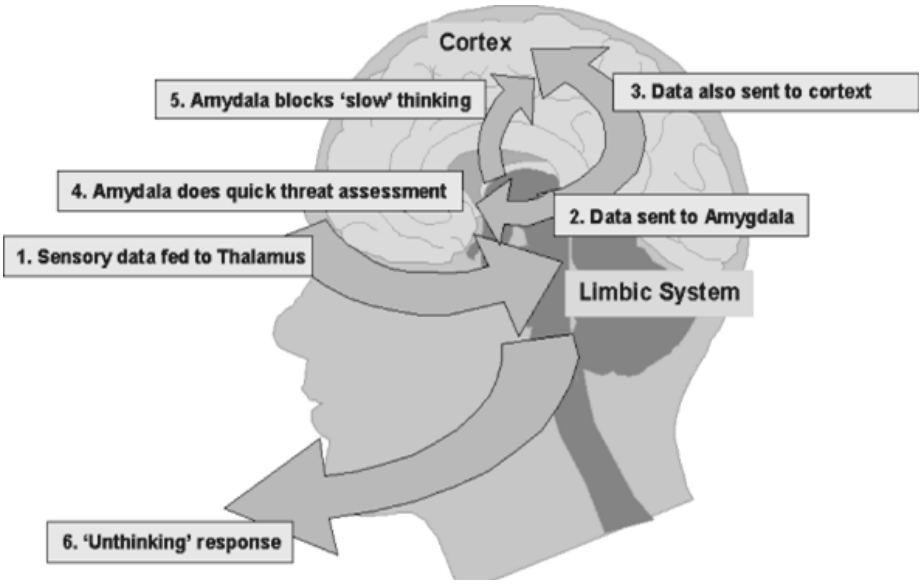


Figure 4.2.4: The Conflict Response

As the work of assistant drilling technician is purely technical, it is necessary for them not to conceive any pre-conceived notion. The technician needs to understand the fact that they being the assistants will have to work on specific work sites or projects which they may find uncomfortable. However, they need to understand the fact that many minor aspects of drilling in oil and gas industry are highly important.

Importance of Tone and Pitch in Effective Communication

Tone and pitch are two of the main aspects of effective communication. The response of people depends on the tone and pitch of the person whom they are listening to.

As per the Department of Psychology, USA, a person having a deep voice is generally associated with dominant nature, leadership quality and higher. Such types of people are good communicators and show qualities like dynamism.

People who know where to use appropriate tone and pitch can manage the work easily without offending others.

For example:

- I didn't say that you removed my pen.

Meaning: I was implying that you took the pen of someone else.

- I didn't say that you removed my pen.

Meaning: The accusation was directed at someone else and not you.

This explains the intonation of the person who is communicating with others.

4.2.3. Value and Importance of Active Listening and Assertive Communication

Importance of Active Listening

- Reduces negative assumptions
- Innovative solutions
- Enhances Confidence
- Ensures better Learning
- Does not allow any conflicting issue to develop amongst colleagues
- Enhances Relationships
- Accuracy
- Better Productivity
- Trust formation
- Building respect amongst colleagues

Importance of Assertive Communication

- The job satisfaction level of an assertive person is higher
- With this form of communication, people can create honest relationships
- People can easily see better decision-making skills
- They can create win-win situations
- The communication amongst colleagues enhances or improves
- People using assertive communication can easily earn respect
- They can understand the feelings and problems of others
- They gain self-esteem and self-confidence

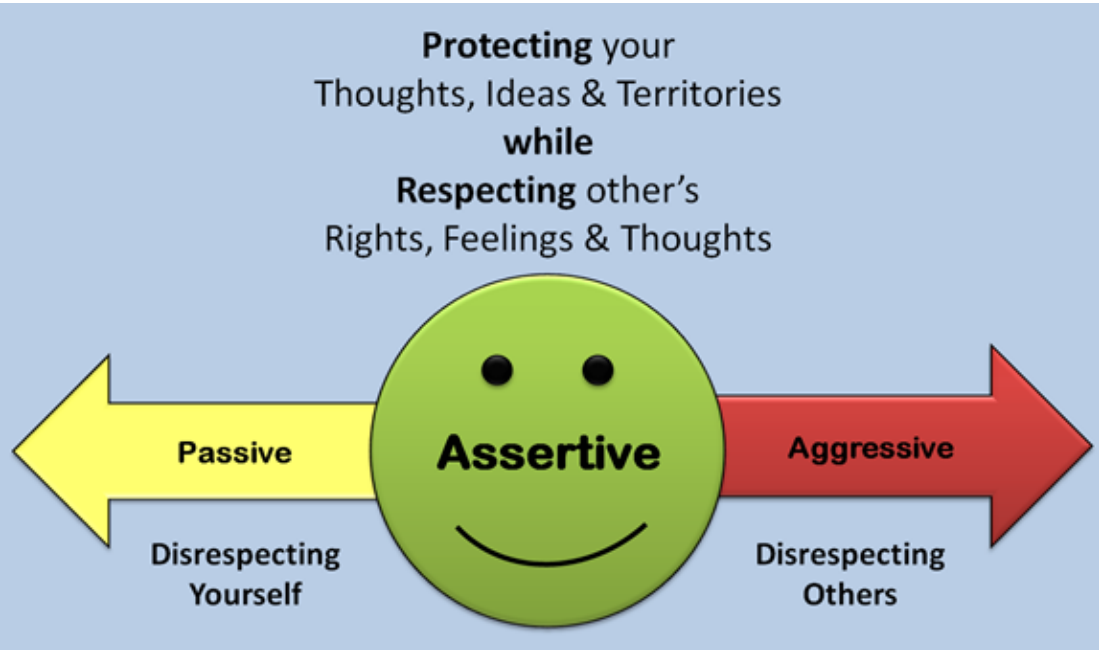


Figure 4.2.5: Assertive Communication

Key Elements of Active Listening

The various elements of active listening include:

1. Paying attention

When your senior technician shares important information with you, he or she is basically asking for your undivided attention. Listening to a piece of information ensures that you can complete your work without any mistakes.

2. Body language shows that you are listening

One of the best ways to show that you are paying attention to the speaker is by using certain gestures. Some of the gestures include:

- Using certain verbal comments like “un huh”, “yes”, “ok” etc.
- Facial expressions like a smile or seeing directly towards the speaker
- Occasionally nodding to the sentences that the speaker is stating

Picture 4.2.6: Body language showing that you are listening

3. Offering feedbacks

The main aspect of active listening is to understand what is being told to you and that you understand what you are being told. The understanding process includes thinking about what you are being told and reflecting on that information. In case there are confusions regarding the provided information, it is better to ask about it. Before going to the site, it is better to summarise the information and tell that to your senior or supervisor.

4. Deferring judgement

When a person talks, interrupting that person several times can make him or her frustrated, and there are chances that he or she can miss a few important pointers. So it is better to allow the speaker to finish what he or she is speaking.

Display Active Listening Skills While Interacting With Others at Work

When displaying active listening skills while interacting with others at work, the technician requires following these points.

- The technician should face the speaker and maintain eye contact.
- The person should be attentive. However, they should be relaxed.
- The technician should keep an open mind.
- They should listen to the words and try to picture what the speaker is saying
- They should not interrupt nor impose their "solutions"
- They should wait for the speaker to pause to ask clarifying questions
- They should ask questions only to ensure understanding
- They should try to feel what the speaker is feeling
- They should give the speaker regular feedbacks

Figure 4.2.7: Active Listening Skills While Interaction

4.2.4. How poor communication practices can disturb people, environment and cause problems for the employee, the employer and the customer

Interpersonal conflicts amongst the employees are one of the major concerns that lead to:

- Litigation
- Grievances
- Strained relationships
- Productivity loss
- Wasted employee time

To resolve personnel issues, it is important that one knows the correct method of interacting with colleagues, seniors and customers.

The essential components to communicate with **Colleagues are:**

- Effectively Communicating with Co-workers begins with Active Listening
- Build trust, but do not get too casual
- Be aware of your tone
- Watch your body language
- Participate and coordinate

- The essential components to communicate with **Seniors** are:
- The tone of the communication
- Amicable but professional approach
- Knowing what you speak
- Thinking before you speak
- Building rapport, based on mutual trust and respect

A successful relationship can be built with **customers** in the following ways:

- Communicating clearly, precisely and politely
- Value the customer and his / her views; the customer is the 'King.'
- Learning thoroughly about the customer
- Resolve service issues and concerns promptly
- Exceed customer's expectations through impeccable deals and service
- Stay in touch and update the customer on existing and upcoming deals and offers
- Empathize
- Stay honest in dealing with customer
- Negotiate fairly, politely but firmly

4.2.5. Importance of avoiding casual expletives and unpleasant terms while communicating professional circles

Every workplace has a number of rules and regulations and certain frameworks that are made to protect the employees from abuse. This abuse can also be in the form of unpleasant terms or casual expletives.

In most cases, employees think that swearing at the workplace does not matter as it only happens when they are stressed. In some other cases employees think that as the colleagues are not complaining about it, the management body does not know about and hence they can continue using expletives. However, organisational norms don't work like that.

There are a number of reasons that can answer why employees need to watch their tongue.

- **People feel bad and offended**

The person listening to the expletives not only feels bad but it also generates negative feeling against the speaker.

- **Showcasing self-centeredness**
- Using unpleasant terns and cursing others definitely proves the fact that the speaker is not concerned what others think about him or her.

- **Lazy and ignorant**

Using profanity can make the user think himself or herself cool. However, it makes the person look ignorant, uneducated and uncivilised.

- **Creating a negative image**

Casual expletives create a negative image in the minds of other workers as well as the management.

Figure 4.2.8: Casual Expletives and Unpleasant Terms

4.2.6. Display Appropriate Communication Etiquette While Working

Effective Communication is a two-way information sharing process, which involves one party sending a message that is easily understood by the receiving party. An assistant drilling technician with effective communication skills can work more efficiently and earn customer appreciation more commonly.

Nowadays, Effective Communication is also possible via Smartphone and Computer, thanks to the advent of e-Mail, Chat and Social Media applications like Twitter, Facebook, and LinkedIn etc.

The essential components of building Effective Communication are:

- Oral / Verbal Communication
- Clarity & Concision
- Confidence
- Respect
- Right Medium
- Empathy
- Politeness
- Delivering precise information
- Non-verbal Communication
- Active Listening
- Open to Feedback

Below are the guidelines on appropriate communication etiquette:

- Listen actively
- Modify tone according to the receiver
- Watch the body language
- Think before speaking
- Take notes
- Act politely but firmly
- Maintain a positive attitude and smile

4.2.7. Basic Engineering Communications

Engineering communication revolves around various aspects.

- Strategies related to effective communication
- Creating persuasive yet clear content (instructions) so that workers of any rank can understand it easily
- Methods of putting forward the information in a short and crisp way
- Creating presentation related to data and organisational information in an effective manner via:
  - Written work
  - Oral work
  - Incorporate graphics
  - Oral presentations
- Providing and managing online presentation
- Speaking to workers and co-workers in a positive manner
- Presenting specialised information to various categories of audiences like:
  - Government agencies
  - In-house departments
  - Supervisors
  - Peers
  - Clients
  - Colleagues
  - Nontechnical people
- Communicating with the help of various document types like
  - Progress reports
  - Proposals
  - Problem analyses
  - Executive summaries
  - Memos
  - Letters

Unit 4.3 Ethics and Discipline

Unit Objectives

At the end of this unit, you will be able to:

- Analyze the importance of ethics for professional success
- Analyze the importance of discipline for professional success

4.3.1. Importance of Ethics for Professional Success

- Codification of professional ethics can stem from the profession or organisation.
- Following ethics in professional areas grounds the person. It makes the person more responsible and instils the sense of what is wrong and right.
- This also builds integrity and strengthens the trust of people on you.
- When a professional person shows the traits of strict ethics maintenance, they are indirectly advertising truthfulness and client confidentiality maintenance.
- People obeying ethical standards rarely come to the troublesome situation with the law, colleagues, employers and customers.
- Strict ethics maintenance ensures that people trust you, give you ample leadership opportunities, cooperation at work and support for your ideas.
- An organisation that can sacrifice their profit in place of their ethics and values tends to attract goodwill, more clients and finally success.

Figure 4.3.1: Ethical Elements following which brings Professional Success

Demonstrate Time Management Skills

There is a common saying, "Time is Money". Not only are there an abundance of reasons as to why time management is important, but there is a multiplicative benefit of time management.

- Implementing good time management methods allows you to accomplish more in a shorter period.
- This leads to more free time, which leads to lower stress.
- This again is helpful as it stretches your attention span, thereby helping you with increased work quality.
- The result – Higher success ratio!

Each benefit of time management improves another aspect of your life, and it keeps going in a constant cycle.

Aspects of time management skills

- A person should set his or her goals beforehand. The person should have a prior idea regarding:
  - What do they want to achieve in their life?
  - Where would they want to see themselves 5 years down the line?
  - What do they see about themselves?

- As per the words of Ryan Deiss, a business can't be killed by a bad idea. But too many good ideas can easily kill businesses. People should know what is important for them at that point in time. Can their work wait for some time or is it important and urgent?

The others aspects are:

- Forgiveness
- Patience
- Record keeping
- Coordination and effective working style
- Stress management
- Coping skills
- Outsourcing
- Communication skills
- Proper planning
- Quick and correct decision making
- Self-motivation
- Self-awareness

Understand Expectation Management

The management ability of an organisation to sustain a rewarding and long-term relationship with the stakeholders and clients after understanding the requirements and also analysing what they are expecting is known as Expectation Management.

Types of Clients under the sales process

- Amateur
- Complex
- Simple

I. Functional risk - Between Amateur and Complex Clients
II. Financial risk - Between Complex and Simple Clients

Expectation Management Matrix

Expectation Factor	Expect to Give	Expect to Receive	Frustration Factor
Change	Observing and Responsiveness	Agreement or Renegotiation	Allowance for Change
Uncertainty	Resource Flexibility	Unspoken Assumption	Open Communication
Risk	Consequences	Agenda	Trust Index
Option	Value-Added	Premium	Value and Compound Cost
Bonus	Low Cost	Delight	Potential Cost of Exchange
Basic Deals	Value	Price	Terms of Exchange

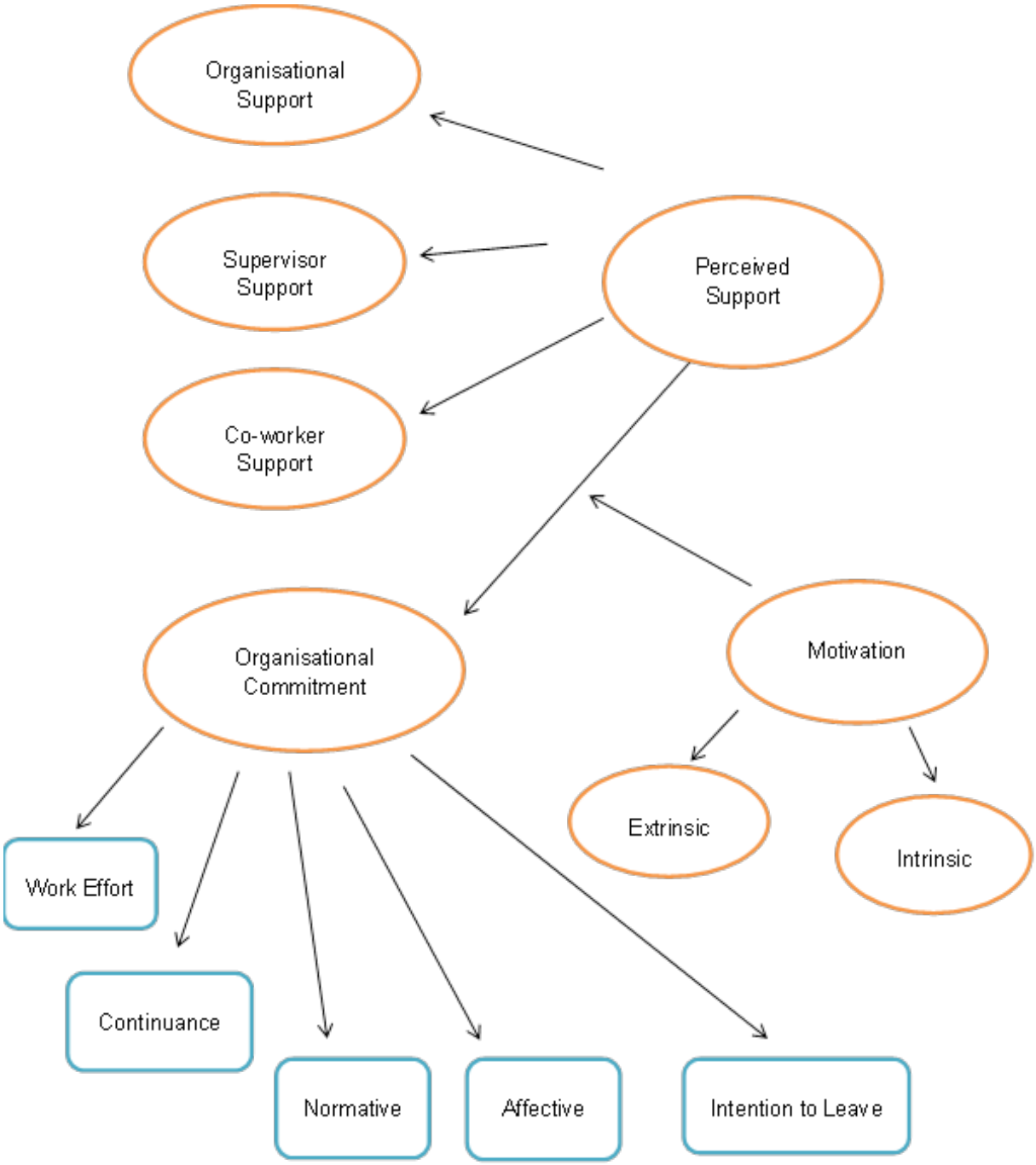
Demonstrate Commitment to work, Adhering to SOPs, Honesty

Commitment to work

This is a sense of responsibility that a professional person has towards the organisational goals, missions and the given task. It is a multi-faceted and complex construct whose formations can be varied (diverse).

Commitment to work can be gained after crossing a number of stages.

Relationship of Perceived Work Outcome, Organizational Commitment, Motivation and Support



Adhering to SOPs

It is a quality that workers follow while carrying out complex operations within the organisation.

Abiding by the Organisational SOPs ensures multiple beneficial aspects.

- It helps the employees replicate their work processes easily and also keep track of each site regarding the productivity level.
- It helps the organisation to conduct appraisals on the basis of employee performance.
- When workers or employees abide by organisational SOPs, the chances of errors decreases in mass product production. In simple words, organisations can keep tabs on quality.

4.3.2. Importance of Discipline for Professional Success

Discipline is not a technique or method but a way of life that teaches a person to live systematically and do everything on time. To attain success, it is important that people adopt and adapt to this style of living.

Here are some of the factors that states why it is important to lead a disciplined live for success.

- It helps a person to always stay focused towards his or her goals, activities and designated work.
- A disciplined life not only lessens the struggles of life but also attracts the admiration of others. This can be from their co-workers or stakeholder or clients.
- It makes the person look at the positive aspects of life. Instead of lazing around, discipline continues to build up the sense of enthusiasm and motivates the person to stretch their boundaries to attain success.

Consult With and Assist Others to Maximize Effectiveness and Efficiency in Carrying Out Tasks

To enhance the efficiency and effectiveness in carrying out tasks, it is better to follow and avoid certain pointers.

	Not Urgent	Urgent
Not Important	Quadrant 1 Focus Quadrant of Quality Empowerment Building a relationship via Re-creation Clarifying the Values Prevention Preparation	Quadrant 2 Manage Quadrant of Necessity Preparation Meetings or projects driven by deadlines Pressing problems crisist
Important	Quadrant 3 Avoid Quadrant of waste Multiple popular activities Pressing matters Meetings (few) Certain types of reports and emails Interruptions due to phone calls	Quadrant 4 Avoid Quadrant of Deception Escape Activities Time Wasters Unimportant Phone Calls Junk mails Busy work, Trivia

What Constitutes Disciplined Behavior for A Working Professional?

It is important that a working professional leads a disciplined personal and professional life. Here are some of the important aspects that will demonstrate responsible and disciplined behaviors at the workplace that every professional should abide by.

- The workers should abide by the company rules, policies and regulations
- They should be compliant to the contract terms related to employment
- The professionals should be punctual to work
- In case the workers take leaves, it should be after taking permission
- Adherence to safety instructions that are set by the organisation
- Fulfilling the given task effectively
- Ensuring that the company property is well maintained

Display Helpful Behavior by Assisting Others in Performing Tasks in a Positive Manner

- Ensuring that during recruitment process, correct factual personal data and correct information is provided to the candidates
- Helping co-workers or colleagues to understand the work in a better way so that they can complete their given work on time
- Discussing the adverse effects of sharing or stealing confidential company intellectual property or data unauthorised personnel
- Explaining the given task starting from the basics and then instructing them whenever they need it
- Ensuring a safe working environment for everyone regarding sexual harassment and taking quick actions if anybody is found guilty for the same
- Teaching the value of subordination, obedience and cooperation at work
- Helping people to work efficiently without idling at workplace
- Encouraging others to participate in training programs
- Ensuring that co-workers are focused towards their work
- Adhering to a disciplinary measure and not allowing the use of strong words, expletives (use of foul words), etc.

Summary

- The foremost thing regarding giving clear information is respecting the audience.
- The interaction among the members and the work they complete is called teamwork.
- Team leaders and members need to be aware of the factors affecting motivation and techniques they can use to enhance and maintain motivation levels.
- Ascertain that everybody complies with company's regulatory bodies
- It is advisable that you economise your point without muddling the information.
- When a person is angry, he or she will not listen to anything you say, even if you have logical points.
- If the conflict is greater at workplace, the stereotyping will be bound to be complex and distorted.
- As per the Department of Psychology, USA, a person having a deep voice is generally associated with dominant nature, leadership quality and higher.
- Before going to the site, it is better to summarise the information and tell that to your senior or supervisor.
- People obeying ethical standards rarely come to troublesome situation with the law, colleagues, employers and customers.
- Implementing good time management methods allows you to accomplish more in a shorter period
- As per the words of Ryan Deiss, a business can't be killed by a bad idea. But too many good ideas can easily kill businesses.
- When workers or employees abide by organisational SOPs, the chances of errors decreases in mass product production.

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

HSSC
HYDROCARBON SECTOR
SKILL COUNCIL

5. Employability & Entrepreneurship Skills

Unit 5.1 Market Study / The 4 Ps of Marketing / Importance of an IDEA

Unit 5.2 Business Entity Concepts: Basic Business Terminology

Unit 5.3 Basic Accounting Formulas

Unit 5.4 CRM & Networking

Unit 5.5 Business Plan: Why Set Goals

Unit 5.6 Procedure and Formalities for Bank Finance

Unit 5.7 Enterprise Management - An Overview

Key Learning Outcomes

At the end of this module , you will be able to:

1. Define market study, the 4ps of marketing, the importance of an idea
2. Define business entity concepts
3. Define basic accounting formulas
4. Evaluate CRM and networking
5. Evaluate business plan
6. Define procedure and formalities for bank finance
7. Define enterprise management

Unit 5.1 Market Study / The 4 Ps of Marketing / Importance of an IDEA

Unit Objectives

At the end of this unit, you will be able to:

- Define terminations and splices
- Evaluate about tightening torques and right splice

Understanding Market Research

Market research is the process of gathering, analysing and interpreting market information on a product or service that are sold in that market. It also includes information on:

- Past, present and prospective customers
- Customer characteristics and spending habits
- The location and needs of the target market
- The overall industry
- Relevant competitors

Market research involves two types of data:

- Primary information - This is research collected by yourself or by someone hired by you.
- Secondary information - This is research that already exists and is out there for you to find and use.

Primary research

Primary research can be of two types:

- **Exploratory:** This is open-ended and usually involves detailed, unstructured interviews.
- **Specific:** This is precise and involves structured, formal interviews. Conducting specific research is more expensive than conducting exploratory research.

Secondary research

Secondary research uses outside information. Some common secondary sources are:

- **Public sources:** These are usually free and have a lot of good information. Examples are government departments, business departments of public libraries etc.
- **Commercial sources:** These offer valuable information but usually requires a fee. Examples of these are research and trade associations, banks and other financial institutions etc.
- **Educational institutions:** These offer a wealth of information. Examples are colleges, universities, technical institutes etc.

5.1.1 The 4Ps of Marketing

The 4Ps of marketing is:

- Product
- Price
- Promotion
- Place

Let's look at each of these 4 Ps in detail.

Product

A product can be:

- A tangible good
- An intangible service

Whatever your product is, it is important that we have a clear understanding of what we are offering. We should also know what its unique characteristics are before we begin the marketing process.

Some questions to ask:

- What does the customer want from the product/service?
- What needs does it satisfy?
- Are there any more features that we can add?
- Does it have any expensive and unnecessary features?
- How will customers use it?
- What should we call it?
- How is it different from similar products?
- How much will it cost to produce?
- Can it be sold at a profit?

Price

Once all the elements of product are established, the Price factor needs to be in consideration. The price of a product will depend on several factors such as profit margins, supply, demand and the marketing strategy.

Some questions to ask:

- What is the value of the product/service to customers?
- Do local products/services have established price points?
- Is the customer price sensitive?
- Should discounts be offered?
- How is your price compared to that of your competitors?

Promotion

Once you are certain about your product and your price, the next step is to look at ways to promote it. Some key elements of promotion are advertising, public relations, social media marketing, email marketing, search engine marketing, video marketing and more.

Some questions to ask:

- Where should you promote your product or service?
- What is the best medium to use to reach your target audience?
- When would be the best time to promote your product?
- How are your competitors promoting their products?

Place

According to most marketers, the basis of marketing is about offering the right product, at the right price, at the right place, and at the right time. For this reason, selecting the best possible location is critical for converting prospective clients into actual clients.

Some questions to ask:

- Will your product or service be looked in a store, online or both?
- What should you do to access the best distribution channels?
- Will you require a sales force?
- Which areas or niche are your competitors offering their products or services?
- Should you follow in your competitors' footsteps?
- Should you do something different from your competitors?

Importance of an IDEA

Ideas are the foundation of progress. An idea can be small or ground-breaking, easy to accomplish or extremely complicated to implement. Whatever be the case, the fact is that idea gives merit. Without ideas, nothing is possible. Most people are afraid to speak out their ideas, out for fear of being ridiculed. However, if you are an entrepreneur and want to remain competitive and innovative, you need to bring your ideas out into the light.

Some ways to do this are by:

- Establishing a culture of brainstorming where you invite all interested parties to contribute
- Discussing ideas out loud so that people can add their ideas, views, opinions to them
- Being open-minded and not limiting your ideas, even if the idea who have seems ridiculous
- Not discarding ideas that you don't work on immediately, but instead making a note of them and shelving them so you can revisit those later.

5.1.2 Tips

- Keep in mind that good ideas do not always have to be unique.
- Remember that timing plays a huge role in determining the success of your idea.
- Situations and circumstances will always change, so be flexible and adapt your idea accordingly.

Unit 5.2 Business Entity Concepts: Basic Business Terminology

Unit Objectives

At the end of this unit, you will be able to:

- Evaluate basic Business Terminologies
- Definitions of those terminologies

If you aim to start and run a business, it is crucial that you have a good understanding of basic business terms. Every entrepreneur should be well versed in the following terms:

- **Accounting:** A systematic method of recording and reporting financial transactions.
- **Accounts payable:** Money owed by a company to its creditors.
- **Accounts Receivable:** The amount a company is owned by its clients.
- **Assets:** The value of everything a company owns and uses to conduct its business.
- **Balance Sheet:** A snapshot of a company's assets, liabilities and owner's equity at a given moment.
- **Bottom Line:** The total amount a business has earned or lost at the end of a month.
- **Business:** An organisation that operates with the aim of making a profit.
- **Business to Business (B2B):** A business that sells goods or services to another business.
- **Business to Consumer (B2C):** A business that sells goods or services directly to the end user.
- **Capital:** The money a business has in its accounts, assets and investments. The two main types of capital are debt and equity.
- **Cash Flow:** The overall movement of funds through a business each month, including income and expenses.
- **Cash Flow Statement:** A statement that shows money entering and exiting a business during a specific period.
- **Contract:** A formal agreement to do work for pay.
- **Depreciation:** The degrading value of an asset over time.
- **Expense:** The costs that a business incurs through its operations.
- **Finance:** The management and allocation of money and other assets.
- **Financial Report:** A comprehensive account of a business' transactions and expenses.
- **Fixed Cost:** A one-time expense.
- **Income Statement (Profit and Loss Statement):** Shows the profitability of a business during a period.
- **Liabilities:** The value of what a business owes to someone else.
- **Marketing:** The process of promoting, selling and distributing a product or service.
- **Net Income/Profit:** Revenues minus expenses.
- **Net Worth:** The total value of a business.
- **Payback Period:** The amount of time it takes to recover the initial investment of a business.
- **Profit Margin:** The ratio of profit, divided by revenue, displayed as a percentage.
- **Return on Investment (ROI):** The amount of money that a business gets as a return from an investment.
- **Revenue:** The total amount of income before expenses are subtracted.
- **Sales Prospect:** A potential customer.
- **Supplier:** A provider of supplies to a business.

- **Target Market:** A specific group of customers at which a company's products and services are aimed.
- **Valuation:** An estimate of the overall worth of the business.
- **Variable Cost:** Expenses that change in proportion to the activity of a business.
- **Working Capital:** Calculated as current assets minus current liabilities.
- **Business Transactions:** There are three types of business transactions. These are:
  - **Simple Transactions –** These usually are single transactions that take place between a vendor and a customer. For example: Buying a cup of coffee.
  - **Complex Transactions –** These transactions go through some events before they can be completed. For example: Buying a house.
  - **On-going transactions –** These transactions usually require a contract. For example - Contract with a vendor.

Unit 5.3 Basic Accounting Formulas

Unit Objectives

At the end of this unit, you will be able to:

- Define basic accounting terminologies
- Evaluate the formulas of those accounting terminologies

Take a look some important accounting formulas that every entrepreneur needs to know.

1. **The Accounting Equation:** This is the value of everything a company owns and uses to conduct its business.

   Formula: Assets = Liability + Owner's Equity

2. **Net Income:** This is the profit of the company.

   Formula: Net Income = Revenues – Expenses

3. **Break-Even Point:** This is the point at which the company will not make a profit or a loss. The total cost and total revenues are equal.

   Formula: Break-Even = Fixed Costs/Sales Price – Variable Cost per Unit

4. **Cash Ratio:** This tells us about the liquidity of a company.

   Formula: Cash Ratio = Cash/Current Liabilities

5. **Profit Margin:** This is shown as a percentage. It shows what percentage of sales is left over after the business pays all the expenses.

   Formula: Profit Margin = Net Income/Sales

6. **Debt-to-Equity Ratio:** This ratio shows how much equity and debt a company is using to finance its assets, and whether the shareholder equity can fulfil obligations to creditors if the business starts making a loss.

   Formula: Debt-to-Equity Ratio = Total Liabilities/Total Equity

7. **Cost of Goods Sold:** This is the total of all costs used to create a product or service, which are sold.

Formula: Cost of Goods Sold = Cost of Materials/Inventory – Cost of Outputs

8. **Return on Investment (ROI):** This is usually seen as a percentage. It calculates the profits of an investment as a percentage of the original cost.

Formula: ROI = Net Profit/Total Investment * 100

Simple Interest: This is money you can earn by initially investing some money (the principal).

Formula: A = P (1 + rt); R = r * 100

Where:

A = Total Accrued Amount (principal + interest) P = Principal Amount

I = Interest Amount

r = Rate of Interest per year in decimal;

r = R/100 t = Time Period involved in months or years

9. **Annual Compound Interest:** It calculates the addition of interest to the principal sum of a loan or deposit.

Formula: A = P (1 + r/n) ^ nt

Where, A = the future value of the investment/loan, including interest

P = the principal investment amount (the initial deposit or loan amount)

r = the annual interest rate (decimal)

n = the number of times that interest is compounded per year

t = the number of years the money is invested or borrowed.

Notes

Unit 5.4 CRM & Networking

Unit Objectives

At the end of this unit, you will be able to:

- Define the aspects related to CRM
- Defibe ideas related to Networking

What is CRM?

CRM stands for Customer Relationship Management. Originally the expression Customer Relationship Management meant managing one's relationship with customers. However, today it refers to IT systems and software designed to help companies manage their relationships.

The Need for CRM

The better a company can manage its relationships with its customers, the higher the chances of the company's success. For any entrepreneur, the ability to successfully retain existing customers and expand the enterprise is paramount. This is why IT systems that focus on addressing the problems of dealing with customers on a daily basis are becoming more and more in demand.

Customer needs change over time, and technology can make it easier to understand what customers want. This insight helps companies to be more responsive to the needs of their customers. It enables them to modify their business operations when required so that their customers get what they desire. Simply put, CRM helps companies recognise the value of their clients and enables them to capitalise on improved customer relations.

Benefits of CRM

CRM has some important benefits:

- It helps improve relations with existing customers, which can lead to:
  - Increased sales
  - Identification of customer needs
  - Cross-selling of products
- It results in better marketing of one's products or services
- It enhances customer satisfaction and retention
- It improves profitability by identifying and focusing on the most profitable customers

5.4.1 What is Networking?

In business, networking means leveraging business and personal connections. It is to bring a regular supply of new business. This marketing method is effective as well as low cost. It is a great way to develop sales opportunities and contacts.

Networking can be based on referrals and introductions or can take place via phone, email, and social and business networking websites.

The Need for Networking

Networking is an essential personal skill for business people, but it is even more important for entrepreneurs. The process of networking has its roots in relationship building. Networking results in greater communication and a stronger presence in the entrepreneurial ecosystem. This helps build strong relationships with other entrepreneurs.

Business networking events held across the globe play a huge role in connecting like-minded entrepreneurs who share the same fundamental beliefs in communication, exchanging ideas and converting ideas into realities. Such networking events also play a crucial role in connecting entrepreneurs with potential investors.

Entrepreneurs may have vastly different experiences and background. However, they all have a common goal in mind – they all seek connection, inspiration, advice, opportunities and mentors. Networking offers them a platform to do just that.

Benefits of Networking

Networking offers numerous benefits for entrepreneurs. Some of the major benefits are:

- Getting high-quality leads
- Increased business opportunities
- Good source of relevant connections
- Advice from like-minded entrepreneurs
- Gaining visibility and raising your profile
- Meeting positive and enthusiastic people
- Increased self-confidence
- Satisfaction from helping others
- Building strong and lasting friendships

5.4.2 Tips

- Use social media interactions to identify needs and gather feedback.
- When networking, ask open-ended questions rather than yes/no type questions.

Unit 5.5 Business Plan: Why Set Goals

Unit Objectives

At the end of this unit, you will be able to:

- Analyze the reasons why to set goals
- Evaluate why to create a business plan

Setting goals are important because it gives you long-term vision and short-term motivation. Goals can be short term, medium term and long term.

- **Short-Term Goals**
  - These are specific goals for the immediate future. Example: Repairing a machine that has failed. Medium-Term Goals
  - These goals are built on short-term goals.
  - They do not need to be as specific as short-term goals.

  Example: Arranging for a service contract to ensure that your machines don't fail again.

- **Long-Term Goals**

  These goals require time and planning. They usually take a year or more to achieve.

  Example: Planning your expenses so you can buy new machinery

Why Create a Business Plan?

A business plan is a tool for understanding how your business is put together. It can be used to monitor progress, foster accountable and control the fate of the business. It usually offers a 3-5 year projection and outlines the plan that the company intends to follow to grow its revenues. A business plan is also a very important tool for getting the interest of key employees or future investors.

A business plan typically comprises of eight elements.

5.5.1 Elements of a Business Plan

Executive Summary

The executive summary follows the title page. The summary should state your desires as the business owner in a short and businesslike way. It is an overview of your business and your plans. Ideally, this should not be more than 1-2 pages.

Your Executive Summary should include:

- **The Mission Statement:** Explain what your business is all about.

  Example: Nike's Mission Statement

Nike's mission statement is "To bring inspiration and innovation to every athlete in the world."

- **Company Information:** Provide information like- when your business was formed, the names and roles of the founders, the number of employees, your business location(s) etc.
- **Growth Highlights:** Mention examples of company growth. Use graphs and charts where possible.
- **Your Products/Services:** Describe the products or services provided.
- **Financial Information:** Provide details on current bank and investors.
- **Summarize plans:** Describe where you see your business in the future.

Business Description

The second section of your business plan needs to provide a detailed review of the different elements of your business. This will help potential investors to correctly understand your business goal and the uniqueness of your offering.

Your Business Description should include:

- A description of the nature of your business
- The market needs that you are aiming to satisfy
- The ways in which your products and services meet these needs
- The specific consumers and organisations that you intend to serve
- Your specific competitive advantages

Market Analysis

The market analysis section usually follows the business description. The aim of this section is to showcase your industry and market knowledge. This is also the section where you should lay down your research findings and conclusions.

Your Market Analysis should include:

- Your industry description and outlook
- Information on your target market
- The needs and demographics of your target audience
- The size of your target market
- The amount of market share you want to capture

- Your pricing structure
- Your competitive analysis
- Any regulatory requirements

Organization & Management

This section should come immediately after the Market Analysis. Your Organization & Management section should include:

- Your company's organisational structure
- Details of your company's ownership
- Details of your management team
- Qualifications of your board of directors
- Detailed descriptions of each division/department and its function
- The salary and benefits package that you offer your people
- The incentives that you offer

Service or Product Line

The next section is the service or product line section. This is where you describe your service or product, and stress on their benefits to potential and current customers. You also explain in detail why your product of choice will fulfil the needs of your target audience.

Your Service or Product Line section should include:

- A description of your product/service
- A description of your product or service's life cycle
- A list of any copyright or patent filings
- A description of any R&D activities that you are involved in or planning

Marketing & Sales

Once the Service or Product Line section of your plan is complete, you should start with the description of the marketing and sales management strategy for your business.

Your Marketing section should include the following strategies:

- **Market penetration strategy:** This strategy focuses on selling your existing products or services in existing markets, to increase your market share.
- **Growth strategy:** This strategy focuses on increasing the amount of market share, even if it reduces earnings in the short-term.
- **Channels of distribution strategy:** These can be wholesalers, retailers, distributors and even the internet.
- **Communication strategy:** These can be written strategies (e-mail, text, chat), oral strategies (phone calls, video chats, face-to-face conversations), non-verbal strategies (body language, facial expressions, the tone of voice) and visual strategies (signs, web pages, illustrations).

Your Sales section should include the following information:

- **A salesforce strategy:** This strategy focuses on increasing the revenue of the enterprise.
- **A breakdown of your sales activities:** This means detailing out how you intend to sell your products or services – will you sell it offline or online, how many units do you intend to sell, what price do you plan to sell each unit at, etc.

Funding Request

This section is specifically for those who require funding for their venture. The Funding Request section should include the following information:

- How much funding you currently require.
- How much funding you will require over the next five years. This will depend on your long-term goals.
- The type of funding you want and how you plan to use it. Do you want to fund that can be used only for a specific purpose, or funding that can be used for any requirement?

Strategic plans for the future

This will involve detailing out your long-term plans – what these plans are and how much money you will require putting these plans in motions.

Historical and prospective financial information

This can be done by creating and maintaining all your financial records, right from the moment your enterprise started to the present day. Documents required for this are:

- your balance sheet which contains details of your company's assets and liabilities
- your income statement which lists your company's revenues
- expenses and net income for the year
- your tax returns (usually for the last three years)
- your cash flow budget which lists the cash that came in
- the cash that went out and states whether you had a cash deficit (negative balance) or surplus (positive balance) at the end of each month

Financial Planning

Before you begin building your enterprise, you need to plan your finances. Take a look at the steps for financial planning:

Step 1: Create a financial plan. This should include your goals, strategies and timelines for accomplishing these goals.

Step 2: Organize all your important financial documents. Maintain a file to hold your investment details, bank statements, tax papers, credit card bills, insurance papers and any other financial records.

Step 3: Calculate your net worth. This means to figure out what you own (assets like your house, bank accounts, investments etc.), and then subtract what you owe (liabilities like loans, pending credit card amounts etc.) the amount you are left with is your net worth.

Step 4: Make a spending plan. This means to write down in detail where your money will come from, and where it will go.

Step 5: Build an emergency fund. A good emergency fund contains enough money to cover at least 6 months' worth of expenses.

Step 6: Set up your insurance. Insurance provides long-term financial security and protects you against risk.

Risk Management

As an entrepreneur, it is critical that you evaluate the risks involved with the type of enterprise that you want to start before you begin setting up your company. Once you have identified potential risks, you can take steps to reduce them. Some ways to manage risks are:

- Research similar business and find out about their risks and how they were minimised.
- Evaluate current market trends and find out if the public is well receiving similar products or services that launched a while ago.
- Think about whether you really have the required expertise to launch your product or service.
- Examine your finances and see if you have enough income to start your enterprise.
- Be aware of the current state of the economy. Consider how the economy may change over time, and think about how your enterprise will be affected by any of those changes.
- Create a detailed business plan.

5.5.2 Tips

- Ensure all the important elements are covered in your plan.
- Scrutinize the numbers thoroughly.
- Be concise and realistic.
- Be conservative in your approach and your projections.
- Use visuals like charts, graphs and images wherever possible.

Unit 5.6 Procedure and Formalities for Bank Finance

Unit Objectives

At the end of this unit, you will be able to:

- Define the Information should Entrepreneurs offer Banks for Funding
- Define the Lending Criteria of Banks

The Need for Bank Finance

For entrepreneurs, one of the most difficult challenges faced involves securing funds for start-ups. With numerous funding options available, entrepreneurs need to take a close look at which funding methodology works best for them. In India, banks are one of the largest funders of start-ups, offering to fund to thousands of start-ups every year.

5.6.1 What Information Should Entrepreneurs Offer Banks for Funding

When approaching a bank, entrepreneurs must have a clear idea of the different criteria that banks use to screen, rate and process loan applications. Entrepreneurs must also be aware of the importance of providing banks with accurate and correct information. It is now easier than ever for financial institutions to track any default behaviour of loan applicants. Entrepreneurs looking for funding from banks must provide banks with information relating to their general credentials, financial situation and guarantees or collaterals that can be offered.

General Credentials

This is where you, as an entrepreneur, provide the bank with background information on yourself. Such information includes:

- **Letter(s) of Introduction:** This letter should be written by a respected business person who knows you well enough to introduce you. The aim of this letter is set across your achievements and vouches for your character and integrity.
- **Your Profile:** This is your resume. You need to give the bank a good idea of your educational achievements, professional training, qualifications, employment record and achievements.
- **Business Brochure:** A business brochure typically provides information on company products, clients, how long the business has been running for etc.
- **Bank and Other References:** If you have an account with another bank, providing those bank references is a good idea.
- **Proof of Company Ownership or Registration:** In some cases, you may need to provide the bank with proof

of company ownership and registration. A list of assets and liabilities may also be required.

Financial Situation

Banks will expect current financial information on your enterprise. The standard financial reports you should be prepared with are:

- Balance Sheet
- Profit-and-Loss Account
- Cash-Flow Statement
- Projected Sales and Revenues
- Business Plan
- Feasibility Study

Guarantees or Collaterals

Usually, banks will refuse to grant you a loan without security. You can offer assets which the bank can seize and sell off if you do not repay the loan. Fixed assets like machinery, equipment, vehicles etc. are also considered to be security for loans.

5.6.2 The Lending Criteria of Banks

Your request for funding will have a higher chance of success if you can satisfy the following lending criteria:

- Good cash flow
- Adequate shareholders' funds
- Adequate security
- Experience in business
- Good reputation

The Procedure

To apply for funding the following procedure will need to be followed:

- Submit your application form and all other required documents to the bank.
- The bank will carefully assess your creditworthiness and assign ratings by analysing your business information concerning parameters like management, financial, operational and industry information as well as past loan performance.
- The bank will decide as to whether or not you should be given funding.

5.6.3 Tips

- Get advice on funding options from experienced bankers.
- Be cautious and avoid borrowing more than you need. This is especially for longer than you need, at an interest rate that is higher than you are comfortable with.

Unit 5.7 Enterprise Management - An Overview

Unit Objectives

At the end of this unit, you will be able to:

- Define the steps to manage a company
- Analyze the questions that a person requires asking before considering entrepreneurship

To manage your enterprise effectively, you need to look at many different aspects; right from managing the day-to-day activities to figuring out how to handle a large scale event. Let's take a look at some simple steps to manage your company effectively.

Step 1: Use your leadership skills and ask for advice when required.

Let's take the example of Ramu, an entrepreneur who has recently started his own enterprise. Ramu has good leadership skills – he is honest, communicates well, knows how to delegate work etc.

These leadership skills definitely help Ramu in the management of his enterprise. However, sometimes Ramu comes across situations that he is unsure how to handle.

What should Ramu do in this case?

- One of the solutions is to find a more experienced manager who is willing to mentor him.
- Another solution is for Ramu to use his networking skills so that he can connect with managers from other organisations, who can give him advice on how to handle such situations.

Step 2: Divide your work amongst others – Realise that you cannot handle everything yourself.

Even the most skilled manager in the world will not be able to manage every single task that an enterprise will demand of him. A smart manager needs to realise that the key to managing his enterprise lies in his dividing all his work between those around him. This is known as delegation.

However, delegating is not enough. A manager must delegate effectively if he wants to see results. This is important because delegating, when done incorrectly, can result in you creating even more work for yourself.

To delegate effectively, you can start by making two lists.

- One list should contain the things that you know you need to handle yourself.
- The second list should contain the things that you are confident can be given to others to manage and handle.

Besides incorrect delegation, another issue that may arise is over-delegation. This means giving away too many of your tasks to others.

The problem with this is - the more tasks you delegate, the more time you will spend tracking and monitoring the work progress of those you have handed the tasks to. This will leave you with very little time to finish your own work.

Step 3: Hire the right people for the job.

Hiring the right people goes a long way towards effectively managing your enterprise. To hire the best people suited for the job, you need to be very careful with your interview process.

You should ask potential candidates the right questions and evaluate their answers carefully. Carrying out background checks is always a good practice. Running a credit check is also a good idea, especially if the people you are planning to hire will be handling your money.

- Create a detailed job description for each role that you want to be filled and ensure that all candidates have a clear and correct understanding of the job description.
- You should also have an employee manual in place, where you put down every expectation that you have from your employees.
- All these actions will help ensure that the right people are approached for running your enterprise.

Step 4: Motivate your employees and train them well.

Your enterprise can only be managed effectively if your employees are motivated to work hard for your enterprise. Part of being motivated involves your employees believing in the vision and mission of your enterprise and genuinely wanting to make efforts towards pursuing the same.

- You can motivate your employees with recognition, bonuses and rewards for achievements.
- You can also motivate them by telling them about how their efforts have led to the company's success.
- This will help them feel pride and give them a sense of responsibility that will increase their motivation.
- Besides motivating your people, your employees should constantly be trained in new practices and technologies. Remember, training is not a one-time effort. It is a consistent effort that needs to be carried out regularly.

Step 5: Train your people to handle your customers well.

Your employees need to be well-versed in the art of customer management. This means they should be able to understand what their customers want, and also know how to satisfy their needs. For them to truly understand this, they need to see how you deal effectively with customers. This is called leading by example.

Show them how you sincerely listen to your clients and the efforts that you put in to understand their requirements. Let them listen to the type of questions that you ask your clients, so they understand which questions are appropriate.

Step 6: Market your enterprise effectively.

Use all your skills and the skills of your employees to market your enterprise in an effective manner. You can also hire a marketing agency if you feel you need help in this area.

Now that you know what is required to run your enterprise effectively, put these steps into play to see how easier managing your enterprise becomes!

5.7.1 Tips

- Get advice on funding options from experienced bankers.
- Be cautious and avoid borrowing more than you need, for longer than you need, at an interest rate that is higher than you are comfortable with.

5.7.2 Considering Entrepreneurship

Questions to ask yourself before considering entrepreneurship

- Why am I starting a business?
- What problem am I solving?
- Have others attempted to solve this problem before? Did they succeed or fail?
- Do I have a mentor or industry expert that I can call on?
- Who is my ideal customer2?
- Who are my competitors3?
- What makes my business idea different from other business ideas?
- What are the key features of my product or service?
- Have I done a SWOT4 analysis?
- What is the size of the market that will buy my product or service?
- What would it take to build a minimum viable product5 to test the market?
- How much money do I need to get started?
- Will I need to get a loan?
- How soon will my products or services be available?
- When will I break even6 or make a profit?
- How will those who invest in my idea make a profit?
- How should I set up the legal structure of my business?
- What taxes will I need to pay?
- What kind of insurance will I need?
- Have I reached out to potential customers for feedback

5.7.3 Tips

- It is important to validate your business ideas before you invest significant time, money and resources into it.
- The more questions you ask yourself, the more prepared you will be to handle to highs and lows of starting an enterprise.

Footnotes:

1. A mentor is a trusted and experienced person who is willing to coach and guide you.
2. A customer is someone who buys goods and services.
3. A competitor is a person or company that sells products and services similar to your products and services.
4. SWOT stands for Strengths, Weaknesses, Opportunities and Threats.

   To conduct a SWOT analysis of your company, you need to list down all the strengths and weaknesses of your company, the opportunities that are present for your company and the threats faced by your company.
5. A minimum, viable product is a product that has the fewest possible features, that can be sold to customers to get feedback from customers on the product.
6. A company is said to break even when the profits of the company are equal to the costs.
7. The legal structure could be a sole proprietorship, partnership or limited liability partnership.
8. There are two types of taxes – direct taxes payable by a person or a company, or indirect taxes charged on goods and services.
9. There are two types of insurance – life insurance and general insurance. Life insurance covers human life while general insurance covers assets like animals, goods, cars etc.

Summary

- Primary information is research collected by yourself or by someone hired by you.
- The price of a product will depend on several factors such as profit margins, supply, demand and the marketing strategy.
- Money owed by a company to its creditors is Accounts payable.
- Break-Even Point is the point at which the company will not make a profit or a loss.
- In business, networking means leveraging business and personal connections.
- A business plan is a tool for understanding how your business is put together.
- Banks will expect current financial information on your enterprise.
- Besides motivating your people, your employees should constantly be trained in new practices and technologies.
- SWOT stands for Strengths, Weaknesses, Opportunities and Threats.

Notes

Skill India
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