Part one:

Introduction

A well intervention, or well work, is any operation carried out on an oil or gas 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.

1- Well Equipment

The well equipment section outlines the regulatory requirements for well equipment in the Drilling and Production Regulation**.**

1-1 Wellhead

A **wellhead** is the component at the surface of an oil or gas well that provides the structural and pressure-containing interface for the drilling and production equipment.

The primary purpose of a wellhead is to provide the suspension point and pressure seals for the casing strings that run from the bottom of the hole sections to the surface pressure control equipment.

a) Components

The primary components of a wellhead system are:

- casing head
- casing spools
- casing hangers
- packoffs (isolation) seals
- bowl protectors / wear bushings
- test plugs
- mudline suspension systems
- tubing heads
- tubing hangers
- tubing head adapter

b) Functions

A wellhead serves numerous functions, some of which are:

1. Provide a means of casing suspension. (Casing is the permanently installed pipe used to line the well hole for pressure containment and collapse prevention during the drilling phase).
2. Provides a means of tubing suspension. (Tubing is removable pipe installed in the well through which well fluids pass).
3. Provides a means of pressure sealing and isolation between casing at surface when many casing strings are used.
4. Provides pressure monitoring and pumping access to annuli between the different casing/tubing strings.
5. Provides a means of attaching a blowout preventer during drilling.
6. Provides a means of attaching a Christmas tree for production operations.
7. Provides a reliable means of well access.
8. Provides a means of attaching a well pump.

1-2Tubing

Tubing is required for the production of gas containing ≥ 5% hydrogen sulphide (H_2S) and for all injection and disposal except for the injection of fresh water.

1-3Packers

A production packer must be used for:

- All injection and disposal except for the injection of fresh water and

- Wells containing gas with > 5% H_2S, or if a numbered highway or populated area is located within the emergency planning zone for the well.

"Populated area" means a dwelling, school, picnic ground or other place of public concourse.

Annual packer isolation testing is required for all wells where installation of a production packer is required. If a packer test fails, the permit holder must complete repairs without unreasonable delay.

1-4 Subsurface Safety Valves

Subsurface safety valves are required for wells containing gas with > 5% H_2S if:

- A major highway or populated area is located within the emergency planning zone for the well

- The well is located within 800 m of a populated area or 8 km of a town, city or village and

- The well could produce > 30 000 m^3 of gas per day

In general, the distance from a city, town or village should be measured from the corporate limits. In cases where the corporate limits do not reasonably correspond with the boundaries of the community, the permit holder may take a functional approach such as delineation of the extent of developed areas.

1-5 Fencing

Permit holders of completed wells that:

- Are located within 800 m of a populated area or
- Have a populated area within the emergency planning zone for the well

Fencing or other measures to prevent unauthorized access to the well must be installed in these circumstances.

Fencing or other forms of access control must be proportional to the potential for unauthorized access to the wellsite. Access control may include fencing of the wellsite, or gating the access road. If the well is located in an access-controlled area, no additional measures may be required. For wells that are located on private land, the method of access control should be developed in consultation with the landowner.

1-6 Leak Detection

All completed wells must be equipped with a system to detect and control leaks as quickly as practicable.

The Commission expects that leak detection systems will be proportional to the consequences that may result from a leak. Leak detection may range from fully automated shutdown systems to periodic inspections.

If an uncontrolled flow from a completed well could produce a hydrogen sulphide concentration in atmosphere greater than 100 ppm at a distance of 50 metres from the well, the permit holder must install and maintain:

- An automated shutdown system and.
- A hydrogen sulphide detection, alarm and automated shutdown system if the well is located within 1600 metres of a populated area.

For wells completed prior to October 4, 2010, H2S detection and automated shutdown systems are not required until.

January 1, 2012 and the permit holder may apply for an exemption to the requirement.

The following formula may be used to calculate the absolute open flow rate of a well that will result in an H_2S concentration in atmosphere of 100 ppm at a point 50 metres from the well:

Wellhead AOF (103m3/day) = 147 000 / H2S (ppm)

or

Wellhead AOF (103m3/day) = 14.7 / H2S (mol %)

2- Type of accident in well

2-1 During drilling operations

Incidents requiring a fishing job can be classified in four categories.

a) Loss of all or part of the bit

The size of a fish can vary. Although certain elements are small (teeth, inserts, balls, rollers), it will be necessary to get rid of them to avoid damaging the next bit to be run in.

Figure 44: Bit Parts lossed in well

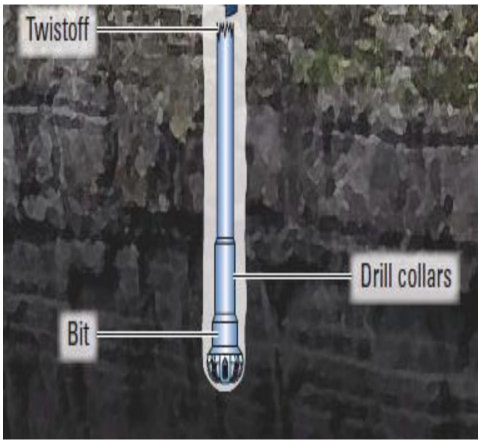

figure 45: Bit lossed in well

b) Metal objects dropped in the well

The most frequently dropped objects are tongs dies, slips elements and tools. A dropped object can cause drill string sticking.

This is a situation that can be avoided by having strict discipline on the rig floor and by regular checking and maintenance of the equipment.

c) Rupture

It is possible that the drill string may break at a connection (especially when the connection is working under alternate bending conditions) at the level of a drill string component body (failure at the point where the slips are placed on the drill pipe, etc.) and thread disconnection (especially casings).

A drill string element may break for reasons related to wear of the equipment, to utilization or drilling conditions.

The condition of the drilling equipment must be checked by periodical inspections, the frequency of which will depend on the type of material and on drilling conditions. Such inspections usually should detect any worn elements in time. The inspections are done using magna flux, sonoscope and dimension controls.

It is important to know the traction, torque or pressure that may be applied to each element of the drill string when it is downhole. Care must be taken regarding combined drill strings, as the various elements usually have widely differing mechanical strengths.

Rupture of an element of the drill string may be caused by fatigue induced by vibratory or cyclical phenomena unrelated to the apparent state of wear. There are rotation speeds for which the vibrations induced in the drill string become critical.

Sharp changes in the well path (dog legs) can also induce rupture. They make the tubular equipment work under alternate bending conditions. Such conditions, which are all the more frequent when penetration is slow and the rotation speed high, can cause fatigue failure. The sharper the angle of a dog leg and the higher the tensile load on the drill pipes, the more dangerous it will be.

Finally, the risk of accidental unscrewing should be considered, especially when under-reaming or drilling out (kickback or unscrewing through inertia).

d) Sticking

Sticking is the most frequent cause and corresponds to the heaviest fishing jobs. In most cases, the long it lasts, the more complicated it becomes.

Sticking costs the oil industry dear every year and occurs in about 20 to 25% of all wells.

There are three categories of sticking :

- sticking due to excessive differential pressure opposite porous and permeable zones,
- sticking due to the formation (crumbly, under-compacted, sloughing, non-consolidated, swelling formations, etc.),
- mechanical sticking (key seat, dropped metal objects, dropped cement, collapse of casing, accumulation of cuttings due to poor borehole cleaning, under-calibrated borehole caused by abrasive formation, etc.).

Often sticking due to the formation is associated with mechanical sticking, and it is considered that any sticking that is not due to differential pressure is mechanical sticking.

Sticking, except for that caused by dropped objects, is generally a gradual phenomenon. The borehole gives warning signs that a problem is likely to occur. It is therefore important to know how to identify these signs and to react correctly as soon as they appear.

2-2 Incidents during casing operations

In addition to the risks of sticking, casing operations have a certain number of weak points related to the geometrical characteristics and mechanical properties. These weak points mostly concern large diameters where burst, disconnection, collapse and ovalization are fairly frequent. Tubes located immediately above the shoe are particularly likely to disconnect during subsequent operations.

2-3 Incidents during logging operations

Possible incidents are the breaking of a wireline cable or of a tool, or more frequently, sticking. In principle, logging tools are run into a well if the borehole has been controlled and considered sound. However, risks of sticking are inherent in certain types of tool and operation ; this is the case for the RFT (Repeat Formation Tester).

Also, under certain conditions (directional wells, high density muds), the weight of the tools is insufficient for it to run in under its own weight : when the rate of the descending tool is reduced, if is being unwound too fast the wireline may stick through the formation of loops.

2-4 Well problems during production

1- low of production :

the low of production it can be because of :

- weak permeability of oilfield

-weak pressure

-layer problem

- Filling (block) of tubing or in well bottom

- artificial production system not comfortable

-high against presser on layer

2- Problem of Water and gas coning

Coning is a production problem in which gas cap gas or bottom water infiltrates the perforation zone in the near-wellbore area and reduces oil production. Gas coning is distinctly different from, and should not be confused with, free-gas production caused by a naturally expanding gas cap. Likewise, water coning should not be confused with water production caused by a rising water/oil contact (WOC) from water influx. Coning is a rate-sensitive phenomenon generally associated with high producing rates. Strictly a near-wellbore phenomenon, it only develops once the pressure forces drawing fluids toward the wellbore overcome the natural buoyancy forces that segregate gas and water from oil.

The term coning is used because, in a vertical well, the shape of the interface when a well is producing the second fluid resembles an upright or inverted cone. Important examples of coning include:

- Production of water in an oil well with bottom water drive
- Production of gas in an oil well overlain by a gas cap
- Production of bottom water in a gas well

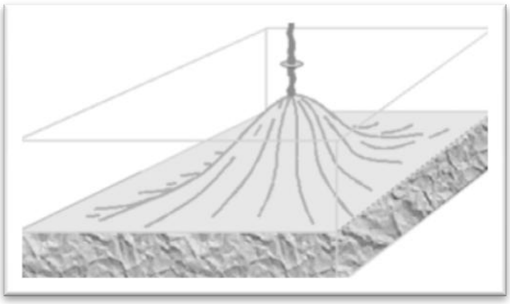

Figure 46 : design present the water coning

Coning is a problem because the second phase must be handled at the surface in addition to the desired hydrocarbon phase, and the production rate of the hydrocarbon flow is usually dramatically reduced after the cone breaks through into the producing well. Produced water must also be disposed of. Gas produced from coning in an oil well may have a market, but also may not. In any event, production of gas in an oil well after the cone breaks through can rapidly deplete reservoir pressure and, for that reason, may force shut in of the oil well.

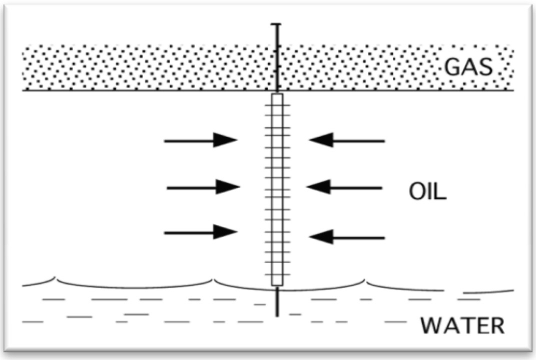

Figure 47:reservoir in normal situation

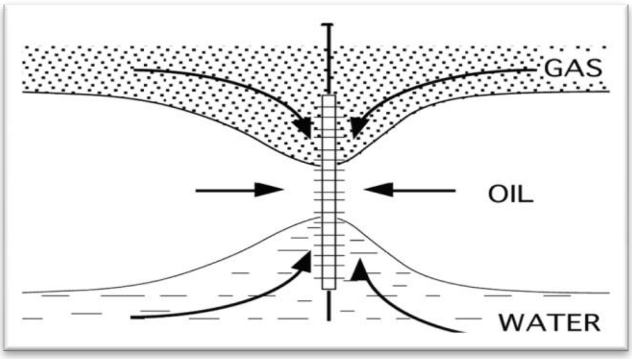

figure 48: problem of water and gaz coning

3- mechanical problem in a well

Types of Mechanical Barriere

- Down hole Plugs
- Surface plugs Sub Surface Safety Valve
- Kill strings suspended from test packer c/w storm valve Cement
- plugs, tagged and tested.
- Annular side outlet valves or VR plugs in side outlet bore.
- BOPs
- Christmas trees
- Tubing hanger seals

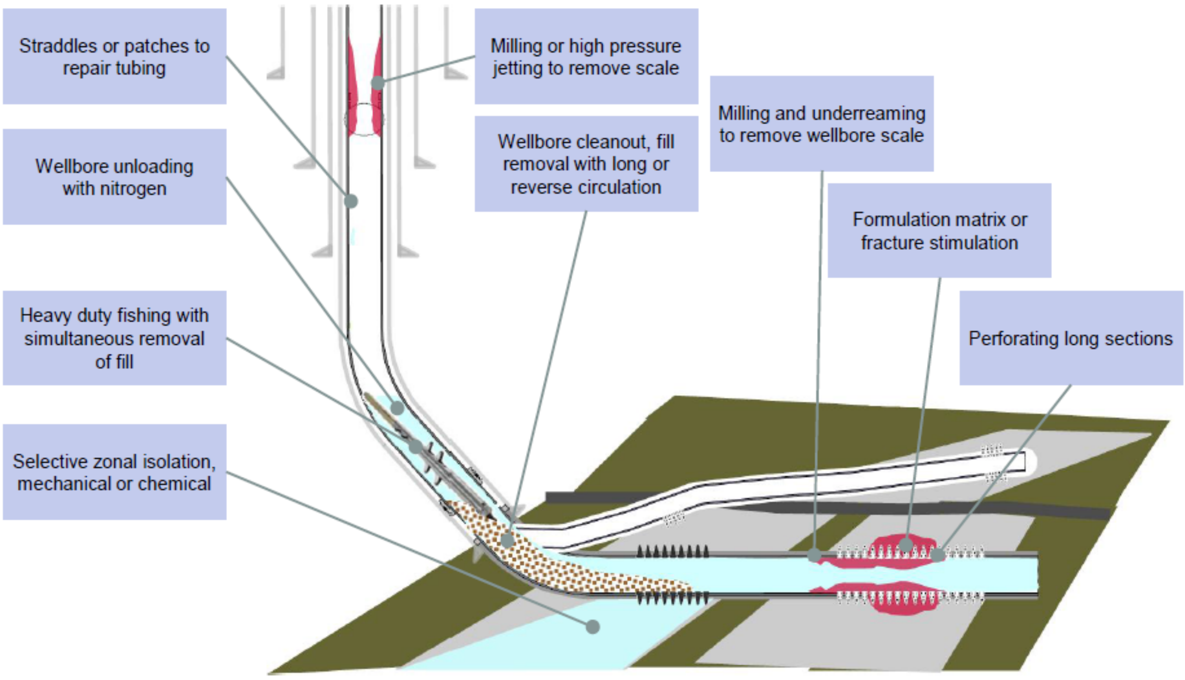

Figure 49: Problems possible in well

<u>3-Cause of accidents</u>

The causes are many and complex. Apart from unforeseeable circumstances (breakdown at the surface : equipment, power supply, etc.), they can be classified in three major categories.

3-1 Causes linked to the state of the equipment used

Rupture of the drill string at the level of the bit can occur when the equipment used is poor quality (steel, poor manufacturing processes, etc.) or when there are defects (badly cut threads, incorrect surface finish, etc.).

The use of inappropriate equipment for the drilling phase underway (use of fatigued equipment, class II drill pipes, etc.) or inadequate upkeep and monitoring of the equipment (drill string, surface equipment) can cause ruptures.

If the equipment for solids treatment is not operating properly, this too can cause sticking.

3-2 Causes related to the personnel

Among these causes, the following can be noted:

- Lack of knowledge regarding the limits of use for the equipment (exceeding allowable stresses on the drill string, drilling line, etc.).
- Non-compliance with good oil field practices (drill string immobilized for too long, etc.).
- Non-compliance with drilling instructions or unsuitable instructions (application of inappropriate drilling parameters to the bit used, critical speed of rotation producing vibrations, etc.).
- The rheological characteristics of the drilling fluid are not respected (due to improper use of the solids treatment equipment, poor control of the rheology, etc.) or to the use of an excessively high density fluid.
- Lack of concentration of the personnel during working hours is also a cause of problems. Statistics indicate that sticking occurs most during shift changes and relief days.
- Clumsiness of personnel on the rig floor can cause dropped objects.

In general, any lack of competence, inattention or lack of experience among the personnel will cause many problems. These points can easily be rectified by **proper training**.

3-3 Causes related to difficult drilling conditions

Highly directional wells, long offsets and horizontal wells often make it necessary to use equipment in uncustomary conditions (drill pipes under compression, connections working under alternate bending, buckling, drill pipes working over their bending strength limits, etc.). Moreover, it is difficult to clean such wells correctly, cuttings accumulate in the annulus and generate sticking.

Well paths with a high buildup also increase the risk of a key seat forming and tubular fatigue.

A change in the drill string or bit may be the cause of mechanical sticking (running in a stiffer drill string in a twisting borehole without taking the necessary precautions, or running in a bit after a coring operation, or after a bit that has reduced diameter).

The nature of the formation (crumbling, under-compact, swelling, flowing or fractured formations), the dip, poor cleaning of the borehole or a badly calibrated borehole can all cause sticking. In principle, the use of suitable drilling mud and hydraulic parameters can reduce these risks.

The collapse of a casing occurs when the outside stresses exceed the collapse pressure limit. This situation can exist opposite saline formations with worn pipes or when the setting tension is too high, in which case the inside diameter will be reduced.

Bits of cement that come off the borehole wall or the setting of the cement too fast can cause sticking.

Different formation pressure regimes in the same open hole (depleted reservoir, high pressure injection zones, thick reservoirs) can cause problems. The density of the mud must make it possible to hold the fluids and formations in place. Certain permeable and porous formations may be under a very high differential pressure, which is inclined to cause drill string sticking.

Environmental constraints (prohibition of using oil base muds, etc.) can seriously complicate drilling.

Drilling conditions can be complicated if the drilling program (position of shoes, well paths, fluids used) is not suitable.

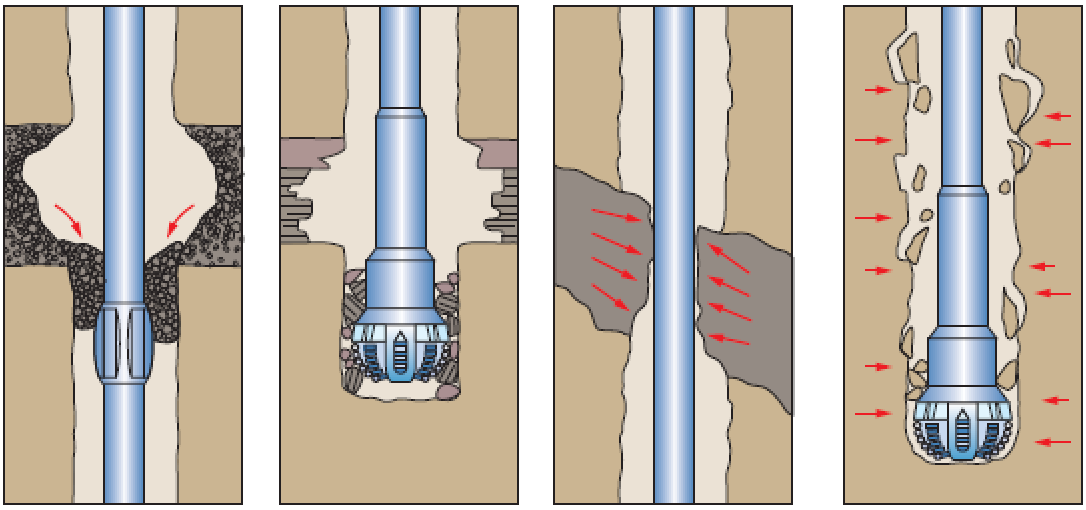

Fig50 :Unconsolidated zone   fig51 : fractured zone   fig52 : mobile formation   fig53 : geopressured zone

4-Types of well work

a) Slickline

Slickline operations may be used for fishing, gauge cutting, setting or removing plugs, deploying or removing wireline retrievable valves, and memory logging.

b) Braided line

Braided line is more complex than slickline due to the need for a grease injection system in the rigup to ensure the BOP can seal around the braided contours of the wire. It also requires an additional shear-seal BOP as a tertiary barrier as the upper master valve on the Christmas tree can only cut slickline. Braided line includes both the core-less variety used for heaving fishing and electric-line used for logging and perforating.

c) Coiled tubing

Coiled tubing is used when it is desired to pump chemicals directly to the bottom of the well, such as in a circulating operation or a chemical wash. It can also be used for tasks normally done by wireline if the deviation in the well is too severe for gravity to lower the toolstring and circumstances prevent the use of a wireline tractor.

d) Snubbing

Snubbing, also known as hydraulic workover, involves forcing a string of pipe into the well against wellbore pressure to perform the required tasks. The rigup is larger than forcoiled tubing and the pipe more rigid.

e) Work-over

In some older wells, changing reservoir conditions or deteriorating condition of the completion may necessitate pulling it out to replace it with a fresh completion.

f) Subsea well Intervention

Subsea well intervention offers many challenges and requires much advance planning. The cost of subsea intervention has in the past inhibited the intervention but in the current climate is much more viable. These interventions are commonly executed from light/medium intervention vessels or mobile offshore drilling units (MODU) for the heavier interventions such as snubbing and workover drilling rigs

Part two:

Work-over

Introduction

Once a well has been completed and has produced for some time, it must be monitored, maintained and, in many cases, mechanically altered in response to changing conditions. Well work-overs, or interventions, are performed by inserting tools in wellbores to conduct maintenance or remedial actions. This discipline covers various technologies that range in complexity from running basic slickline-conveyed rate or pressure control equipment to replacing completion equipment. Important terms include acidizing, fishing, pulling tool, squeeze, stripping and well servicing. All definitions within this discipline have been written and reviewed by intervention and work-over experts, and many are supplemented by high-quality illustrations.

1- Definition of work-over

The term work-over is used to refer to any kind of oil well intervention involving invasive techniques, such as wireline, coiled tubing or snubbing. More specifically though, it will refer to the expensive process of pulling and replacing a completion.

2-Applications

- Through tubing intervention – washing, unloading, stimulation etc.
- Milling inside tubing or casing
- Running or pulling production strings
- Through tubing drilling (over or under balanced)
- Abandonment
- Deploying perforating guns under pressure
- Blowout recovery operations

3- Types of work-over:

There are many types of work-over

a) Work-Over of maintenance : Reparation or prevention the mechanical damage and others.

b) Work-Over of Security : an oil well in production imposes a high level of protection, and the safety operations are:

- Squeezing Cement
- Acidizing
- Casing Running or Pulling

c) Work-Over of Re-entry: it is to Increase the capacity of drainage bay drilling the horizontal section in the reservoir.

*We can classify the categories of work-over in tow:

A- Work-over corrective

Once a well has been completed and has produced for some time, it must be monitored, maintained and, in many cases, mechanically altered in response to changing conditions. Well work-overs, or interventions, are performed by inserting tools in wellbores to conduct maintenance or remedial actions. This discipline covers various technologies that range in complexity from running basic slickline-conveyed rate or pressure control equipment to replacing completion equipment. Important terms include acidizing, fishing, pulling tool, squeeze, stripping and well servicing.

B- Work-over preventive

Preventive work-over is the maintenance performed on a routine basis or as
sensed by observing, listening, feeling or smelling at or near the equipment. This type maintenance is performed to circumvent equipment failure or malfunction.

4-Reasons of work-over

- Prevent water coning
- Prevent excessive gas production in an oil well
- Enhance production
- Control sand problems
- Re-completing a new zone / reservoir
- Completing in multiple reservoir
- Down hole equipment and cement repair
- Eliminate excessive water or gas production
- repair mechanical failure down hole equipments
- Gain additional production through re-completion

- Evaluate potentially productive zones
- Clean scaling of tubing and casing
- Clean perforation plugging
- Replace production string
- Control sand entering well bore from formation
- Increase formation permeability
- Install artificial lift system, bottom hole pump etc.
- Repair or replace well head
- Conversion of well

5-Work-over Operations

- Re-perforation or extention of perforation
- Plug back and perforation higher up
- Isolation Repair
- Acidization
- Cleaning of production string
- Gravel pack
- Casing repair and recovery
- Milling Bridge Plug, Drilling Cement Plug
- Fishing
- Sand cleaning
- Well head repair or replacement
- Installation of artificial lift system, bottom hole heater etc.
- Cleaning of perforation, scaling in casing and tubing

- Conversion of low producing well to water injection for increasing reservoir pressure.
- Conversion of dead well to water disposal well for pumping back formation water producing along with oil

6-Steps in Work-over Operation

- Well Selection
- Work-over Policy Preparation
- Site Preparation
- Security Deployment
- Static and Outfit mobilization and placement
- Work-over fluid preparation or collection
- Well killing
- Operations as per well plan
- Rig-up Mast
- Rig down of X-mass tree and rig up of BOP
- Circulation
- Tripping of Tubing
- Specified jobs
- Final Running in of Tubing
- Rig down BOP
- Rig up X-mass tree
- Enliven the well and hand over to Production Department.
- Rig down Mast
- Mobilize the Rig to new location as per plan

7- Tools of work over

a) External Catch Tools

1-Die collar

Die Collars are simple, rugged, dependable external catch fishing tools.

Operation: Run the Die Collar in the hole to the top of the stuck fish.

Applying less than one point of weight, rotate the die collar until the tapered threads have engaged the fish. Stop rotation and pull the fish from the hole.

Figure54: Die collar type A

figure 55:Die collar type B

2- Overshot with basket grapple: Overshot is the strongest tool available to externally engage, pack off, and pull a fish. The basic simplicity and rugged construction with which it is designed have made it the standard of all external catch fishing tools.

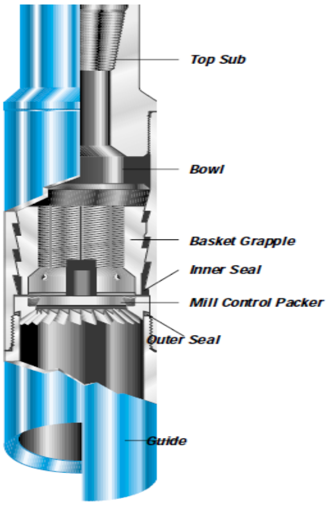

Figure 56: overshot

Construction

The Series 150 Releasing and Circulating Overshot is composed of three outside parts: the Top Sub, Bowl, and Guide. The Basic Overshot may be dressed with either of two sets of internal parts, depending on whether the fish to be caught is near maximum size for the particular overshot.

If the fish diameter is near the maximum catch of the Overshot, a Spiral Grapple, Spiral Grapple Control, and Type “A” Packer are used.

If the fish diameter is considerably below maximum catch size (usually a 1⁄2") a Basket Grapple and a Mill Control Packer are used.

3-Overshot with spiral grapple

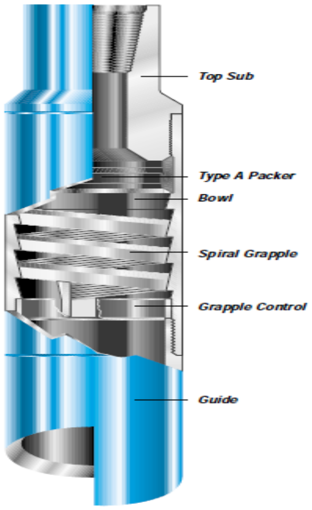

Figure 57: overshot(grapple)

b) Internal Catch Tools

1-Releasing spear

Releasing Spears provide a dependable, inexpensive, and simple means of engaging a fish internally. These Spears assure positive engagement, easy release from the fish when desired, and easy re-engagement after the Spear has been released.

Construction

The Releasing Spear consists of a Mandrel, Grapple, Release Ring, and Nut. The Mandrel may be obtained in either a Flush Type or a Shoulder Type.

Mandrel top connections are furnished to order. The Nut can be obtained as a plain bullnose guide or with a pin connection for the attachment of other tools below the Spear.

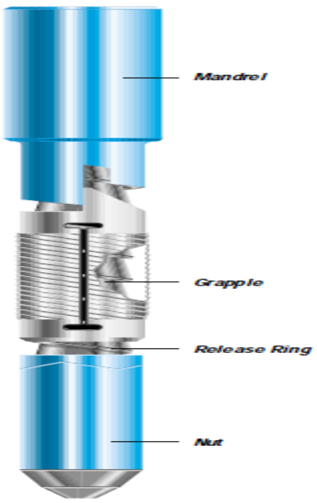

Figure 58: releasing spear

2-Taper tap

Rotary Taper Taps are simple, rugged, dependable internal catch fishing tools.

Operation: Run the taper tap in the hole to the top of the stuck fish, Applying less than one point of weight, rotate the tap until the tapered threads have engaged the fish. Stop rotation and pull the fish from the hole.

Rotary Taper Taps are furnished in two types: Plain or Skirt type. Plain Taper Taps do not have a skirt thread provided on the shoulder. Skirt Type Taper Taps are threaded for a skirt.

A skirt is used when the hole size is drastically different from the fish size. The taper tap can be dressed with a skirt or a skirt and oversize guide. This will allow for the taper tap to be guided into the fish more easily during the fishing operation.

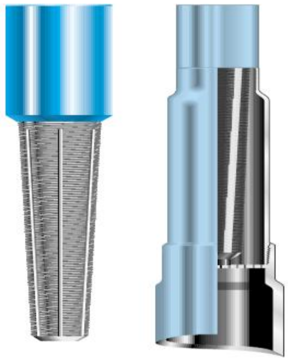

Figure 59 : taper taps

3-Packer Retrievers

Packer Retrievers are internal engaging fishing tools designed to retrieve all types of “drillable” production packers in a single run. They are used in an assembly which consists of a retriever, stinger, mill shoe and bushing.

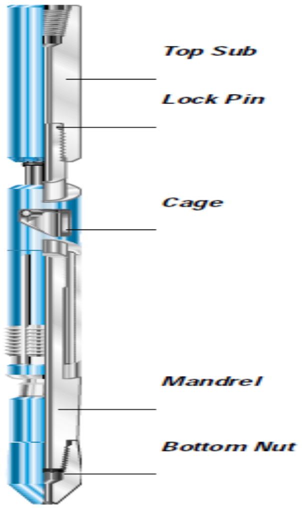

Figure 60:racker retriever

c) Tools of bit and detachments

1-Fishing bumper sub

In all properly made-up fishing strings, it is mandatory to include a dependable Fishing Bumper Sub. The Fishing Bumper Sub is designed to meet this requirement. These Bumper Subs may also be used as a feed-off tool when using the “predetermined weight” method to cut tubing or casing. The Fishing Bumper Sub is simple yet rugged. It is composed of only five primary parts and a double seal assembly. The hexagon-shaped mandrel slides in a similar shaped mandrel body to provide continuous torque capability. The standard 20" stroke of these tools is optimum for most purposes, but longer strokes will be furnished as required, on special order. Full circulation may be maintained through the bores of the tools at all times.

2-Hydraulical jar

The hydraulic Jar is used for fishing, testing, coring, reaming, light drilling, slide tracking, and washover operations.

Each blow can be controlled positively by the operator to deliver a very light blow or a blow of very heavy impact. Full circulation may be maintained throughout the tool for effective flushing. Full torque may be utilized in either direction and are at all times by means of heavy duty spines which are continuously in engagement.

Only straight pull is required to operate the hydraulic Jar, and successive blows can be struck as often as the operator can slack off and raise the running string.

3-Accelerators : to accelerate and raise the choc on the garniture of fishing, combined with oil jar.

4-Safety joint

The newly designed Safety Joint allows quick release from drilling, fishing, testing, washover, or tubing strings should they become stuck, leaving a minimum of pipe in the hole, thereby reducing the problems of fishing or sidetracking. The new design is simple, eliminating the need of a release ring mechanism and lengthy disengagement procedures.

The Safety Joint has a rugged coarse thread design which will not loosen or wedge during operation. Once in the string the Safety Joint is resistant to vibration, heavy loads, and left- or right-hand torque. The tool will disengage by simple left hand rotation at approximately 40% of the tool’s right-hand make-up torque.

d) Tools of cut tubing materiel

1-Internal cutter

The Internal Pressure Pipe Cutter is a simple hydraulic actuated pipe cutter, consisting of a Body, with multiple Knives and Knife Pins: actuated by a Piston with a Pressure Relief Valve System consisting of a Flow Bushing, Valve Stem, Flow Bean Retainer, Valve Stop Spider, Flow Bean, and Set Screws.

2-External cutter

External Cutters are automatic spring-fed cutters that provide fast, efficient, external cutting and recovery of long sections of tubing, drill pipe or casing. The spring-fed feature prevents excessive strain from being applied from the rig floor, which could cause the knives to burn or break before the cut is made.

e) Tools to repair casing

1-Casing scraper

The Casing Scraper is ideal for the removal of mud, cement, bullets, rust, scale, paraffin, perforation burrs and other obstructions from the inside walls of casing.

Maintaining a clean casing I.D. is important when operating drilling, fishing, or wireline tools. Likewise, packers, patches, spears, and similar tools require clean surfaces to grip. Obstructions on casing walls will frequently cause these tools to fail or become difficult to operate.

2-Casing roller

Tubing and Casing Rollers are simple, rugged tools for restoring buckled, collapsed, or dented casing to its normal diameter and roundness. There are no pins, springs or other small parts to break or lose in the hole, making it safer to use and easier to maintain than other rollers. Operation is very simple requiring only ample fluid circulation and slow rotary speeds.

3- Casing patch

Casing Patches are particularly well suited for service in wells which contain fluids and gases which are harmful to synthetic rubber packers. The seals used are compression type, multiple lead rings.

f) Milling Tools

Milling Tools, are designed to mill away stuck fish that cannot be retrieved by conventional fishing methods. Their super penetration rates results in fewer round trips. They are highly resistant to impact loads and their self-sharpening feature results in maximum useful life.

The Milling Tool selected should provide a maximum of milling edges to the material to be milled, maximum replacement of the milling edges as wear occurs, and maximum circulation to remove the cuttings.

1-Junk mill

Figure 61:junk mill

2-Pilot mill

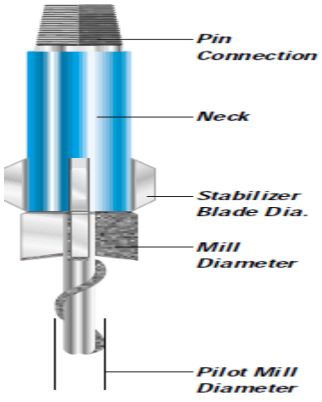

Figure 62:pilot mill

3-Reamer mill

4-Taper mill

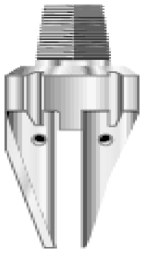

Figure 63: taper mill

5-Round nose mill

Figure 64:round nose mill

6-Value mill

g) Tools to recuperate rubble and scrap

1-Junk basket

The Junk Basket is a rugged junk fishing device, using either a Mill Shoe or Flat Bottom Type Shoe in conjunction with two sets of free revolving finger type Catchers.

The catchers are of rivet less construction. They may be easily redressed on the job, eliminating the necessity of returning them to the shop for replacement.

The upper catcher is designed to effectively break the core which is cut by the shoe. The fingers extend only halfway to the center.

The lower catcher has alternately short and long fingers which extend almost to the center of the tool to effectively collect and retain odd pieces of junk or cores.

2- The Reverse Circulation Junk Basket

The Reverse Circulation Junk Basket is used to retrieve all types of small junk objects in well bores. This tool's unique principle of reverse circulation insures complete recovery of all junk and eliminates misruns. A drain through the tool also eliminates the possibility of pulling a wet string even though the inner barrel is plugged by the core. In addition, it may be converted into an effective fishing magnet and still retain the reverse circulation feature.

3-Junk sub

is used to form the cutting or milling surfaces on milling shoes, rotary shoes, junk mills, section mills, milling stabilizers, piloted liner mills, etc.

4-Fishing magnet

Fishing Magnets are used to retrieve all types of small objects having magnetic attraction from bore hole bottoms. Such unreliable objects as bit cones, bearings, slips, tong pins, and milling cuttings can often be retrieved only by magnetic attraction.

These Fishing Magnets are particularly valuable for use prior to diamond coring. In a single trip, the Fishing Magnet will completely clean the hole of these damaging junk items, insuring good performance and safeguarding the valuable bit.

h) Tools divers

1-tool to close

Retrievable Bridge Plug (RBP)

Back preacher valve (BPV)

2-Test tools

Tester cup

Tester plug

Retrievable packer

3-packer milling tool

4-impression

Part III case study

1) Objective

- Return the well to production

2) Essential points

- Pull the 2" 3/8 suspended tubing (parted)

- Clean of well to original TD

- Run a USIT log to evaluate the integrity of the 5” casing and cement

- Determine the current GOC

- Reduce GOR by cement squeeze isolation of the gas production zone

- If the 5” casing is pulled, run a USIT log to evaluate the integrity of 7” casing and cement.

- Recomplete with a 2”7/8 or 3”1/2 anchored completion..

3) Potential problems

- 5” casing may be extremely corroded.

- Potential for loss of work-over fluid to the formation..

- Tubing is parted at 611m (2005')

- The fish may be broken in several pieces.

- Pulling the 5" casing

4) Economic parametres

- present rate	= 0 BBLS/D (sees Attachment 1)
- expected rate after WO	= 600 BBLS/D

See Attachment 2 for current reservoir penetration details & zonation.

5) Well technical details

a) Coordinates: WGS

- X: 304948m

- Y: 3474712m

- Zs: 154.7m (507')

- Zt: 158.8m (521')

b) Drilling

Spud date	15 November 1961
Completion date	15 March 1962

c) Tubulars

- Casing 13" 3/ 8, shoe@ 238,9m (784') Cemented to surface

- Casing 9" 5/ 8, shoe@ 1749m (5738') Cemented to surface

- Casing 7"

  * 32#, N80, 12m (39')

  * 29#, N80, 1211m (3974')

  * 32#, N80, 1859m (6099')

  * 29#, P110, 2468m (8097'), shoe@ 2468m (8097'). Top cement@ 1700m (5578')

- Casing 5," 18#, N80

  * Class A, 1 joint, 4,5m (15')

  * Class A, 324 joints, 3217,6m (10557')

  * Class B, 3 joints, 3255,3m (10681')

  * Float collar+ 2 sub 3257,0m (10686')

* Class B, 3 joints, 3292,2m (10802')

* Shoe+ Sub, 3283m (10771'), shoe@ 3283m (10771'). Top cement@ Uncertain

All depths are referenced from the rotary table

d) Top of the reservoirs

Original Zonation	New Zonation
- Ri 2610m (8563')	- Zone 6 2610m (8563')
- Ra 2658m (8721')	- Zone 5 2674m (8772')
- R2 2779m (9118')	- Zone 4 2719m (8920')
- R3 2879m (9446')	- Zone 3 2733m (8966')
- INFRACAMBRIEN 3156m (10355')	- Zone 2 2762m (9061')
	- Zone 1 2782m (9127')

e) Perforations

Ri:	None	R3:	2868 - 2880
			2885 - 2890
Ra:	2700 - 2730		2910 - 2925
	2735 - 2755		2935 - 2950
	2760 - 2780		2960 - 2975
			2985 - 3025
R2:	2785 - 2800		3038 - 3051
	2805 - 2820		3055 - 3077
	2825 - 2840		3083 - 3098
	2845 - 2860		3155 - 3130
			3138 - 3153

Infracambrien: 3158 - 3173

3192 - 3207

6) Well history

Initially the well was completed with a 3" 1/ 2 x 2" 3/ 8 anchored completion. The reservoir was left open hole. The initial TD was @ 2774.4 m (9102')

a) Work-over: 6 November, 1962 to 14 January, 1964

Objective:

- Pull the existing completion, deepen the well and re-complete

Results

- Original completion pulled

- Well deepened in 6” hole from 2777.4 (9102') to 3289,4m (10793')

- Hole cased with 5”, 18#, N80 from surface to TD.

- Well perforated

- Recompleted with suspended 2" 3/8 tubing

b) Work- Over 13 May to May 26, 1969

Objective:

- pull corroded 2" 3/8 tubing and recomplete

Results

- pulled tubing

- Cleaned out well but could not reach original TD. Max depth achieved 2915m (9564'))

- Ran 2" 3/8 suspended completion with shoe at 2773 m (9100')

7) Present well conditions

- Currently the well is completed with 2" 3/ 8, EU, N80, 4.7#, suspended tubing , shoe@ 2773m (9100')

- The Tubing is parted at 591m (1939')

- A camera was run in the well on August 23 1996. The tubing was observed parted at 591 m with the top of fish at 608 m The exposed 5" casing was severely corroded.

- See Attachment 3 for current Fiche Technique.

- Well Head Pressurs (well shut-in)

- 13" 3/ 8- 9" 5/ 8 Cannot be measured - corroded valve

- 9" 5/ 8- 7" 0 psi

- 7"- 5" 1200 psi

- 2 '3/ 8 1200 psi

- Reservoir pressure 2000 psi

8) Procedure

01- Prepare the platform to receive the work over rig.

02- Kill the well with work-over fluid.

03- Make a drift run with gauge cutter to 200m (656').

04- Place a Collar Stop with Wireline at 100m (328') and run a plug into the collar.

05- Move in and rig up workover rig.

06- Remove tree.

07- Change the Tubing Hanger.

08- Rig up & test BOPs

09- Pull plug with wireline

10- Pull 2"3/8 tubing.

11- Fish as necessary to clean out hole. If fishing problems are encountered in removing the 2-3/8" tbg, consider running USIT tool above the reservoir to determine the condition of casing. After the USIT has been run and confirms the condition of the casing, proceed with the fishing operation.

12- Run in hole with bit & scraper to TD.

13- Run USIT log in 5" casing from top reservoir to surface.

14- Run TDT log through reservoir to determine GOC.

Further work dependent on the results of the USIT log.

Possible Outcomes:

I) The Csg 5" is free in the 7":

01-Cut and pull the 5" casing

02-Run bit & scraper in 7" casing

03-Run a USIT log in the 7" casing

- If the remainder of Csg 5" (between the 7" shoe and the top of the reservoir) and the 7" Csg is in good condition:

04- Isolate the gas producing zone by squeeze cementing, or other method as deemed appropriate

05- Install a new tubing head spool. (See Attachment 5 for final wellhead orientation)

06- Run bit & scraper to TD.

07- Complete the well with an anchored 3" 1/2 x 2" 7/8 completion (See Attachment 6).

Proceed to operations in step A1.

- If the remainder of 5" casing (between the 7" shoe the top reservoir) is in good condition and the 7" casing is in a bad condition:

04- Run new 5" casing string and cement back to surface.

05- Isolate the gas producing zone by squeeze cementing, or other method as deemed appropriate.

06- Install a new tubing head spool. (See Attachment 5 for final wellhead orientation)

07- Run bit & scraper to TD.

08- Complete the well with an anchored 2”7/8 completion. (See Attachment 7).

Proceed to operations in step A1.

- If the remainder of 5" casing (between the 7” shoe the top reservoir) is in bad condition and the 7" casing is in a good condition:

04- Repair the 5” casing between the 7” shoe to the top of the reservoir. If it is not possible to repair this, abandon the well.

05- Isolate the gas producing zone by squeeze cementing, or other method as deemed appropriate.

06- Install a new tubing head spool.

07- Run bit & scraper to TD.

08- Complete the well with an anchored 3" 1/2 x 2" 7/8 completion

- If the 5" and 7” casing are in bad condition:

04- Repair the 5” casing between the 7” shoe to the top of the reservoir. If it is not possible to repair this, abandon the well.

05- Run new 5” casing string and cement back to surface.

06- Run bit and scraper to TD.

07- Complete the well with an anchored 2”7/8 completion.

II) If the 5” casing is not free and its condition is acceptable:

04- Clean well out to TD.

05- Isolate the gas producing zone by squeeze cementing, or other method as deemed appropriate.

08- Install a new tubing head spool .

09- Run bit & scraper to TD.

10- Complete the well with an anchored 2”7/8 completion.

A1- Circulate the annulus to diesel.

A2- Test tubing.

A3- Install and test new 6500 psi wellhead/xmas tree.

A4- Rig down workover rig and move off location.

A5- Hook-up flowline.

A6- Unload the well and clean-up to flare.

A7- Stimulate /clean-up as necessary.

A8- Test the well as necesary.

Possibilities for Abandonment

01- The 5” casing is not free and its condition is bad.

02- It is impossible to clean out the 5” casing in the reservoir to an acceptable depth.

03- It is impossible to repair the 5” casing between the 7” shoe to the top of the reservoir.

9) Equipment

Option A

- 01 wireline entry guide 2-7/8” New VAM
- 01 joint 2-7/8” ”, 6.4#, N80, New VAM
- 01 pup joint 2-7/8”, 6.4#, N80, New VAM
- 01 X-nipple 2-7/8” New VAM
- 01 pup joint 2-7/8”, 6.4#, N80, New VAM
- 01 joint 2-7/8”, 6.4#, N80, New VAM

- 01 pup joint 2-7/8", 6.4#, N80, New VAM

- 01 packer 5" with millout extn & ratch latch. 2-7/8" New VAM top & bottom

- 01 pup joint 2-7/8", 6.4#, N80, New VAM

-310 joints 2-7/8" , 6.4#, N80, New VAM

- 01 pup joint 2-7/8", 6.4#, N80, New VAM

- wellhead/hanger/tree 4''1/16 series 6500 psi

Option B (See Attachment 5)

- 01 wireline entry guide 2-7/8" New VAM

- 01 joint 2-7/8" ", 6.4#, N80, New VAM

- 01 pup joint 2-7/8", 6.4#, N80, New VAM

- 01 X-nipple 2-7/8" New VAM

- 01 pup joint 2-7/8", 6.4#, N80, New VAM

- 01 joint 2-7/8", 6.4#, N80, New VAM

- 01 pup joint 2-7/8", 6.4#, N80, New VAM

- 01 packer 7" with millout extn & ratch latch. 2-7/8" New VAM top & bottom

- 01 pup joint 2-7/8", 6.4#, N80, New VAM

- 01 joint 2-7/8", 6.4#, N80, New VAM

- 01 pup joint 2-7/8", 6.4#, N80, New VAM

- 01 water injection mandrel 2-7/8" New VAM

- 01 3/8" Valve circulante w/ hard faced

- 01 pup joint 2-7/8" , 6.4#, N80, New VAM

- 01 joint 2-7/8", 6.4#, N80, New VAM

- 01 pup joint 2-7/8", 6.4#, N80, New VAM

- 01 gas lift side pocket mandrel 2-7/8" New VAM

- 01 3/8" Valve circulante w/ hard faced

- 01 pup joint 2-7/8" , 6.4#, N80, New VAM

- 01 joint 2-7/8", 6.4#, N80, New VAM

- 01 x/over 2-7/8" New VAM.M x 3-1/2" New VAM.F

- 280 joints 3-1/2", 9.2#, N80, New VAM

- 01 pup joint 3-1/2", 9.2#, N80, New VAM

- wellhead/hanger/tree 4''1/16 series 6500 psi

- water injection line and clamps

Conversions:

For the purposes of this procedure, the following conversions have been utilized:

U.S.	Metric
3.281 ft	1 meter
35.32 ft^3	1 $meter^3$
6.29 bbls	1 $meter^3$
8.33 ppg	1.0 sg
14.5 psi	1 bar
1 inch	25.4 mm

Conclusion

An oil well During drilling or production may have many problems, because of different causes, to make this source of energies in good situation we need to make intervention and correction work, such of the work-over.