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Subsea Well Intervention and ROV Operation

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ABSTRACT: The world has become aware of its reliance on petroleum during the last several decades. It significantly impacts daily actions carried out by humans. Most of the world's untapped oil resources are primarily found offshore. Many industries have expanded their initial Investigation and Extraction activities with Onshore Platforms to include Earth Probe oceanic surface, realizing the direction of oil and gas technology. It had to contend with the deeper difficulties of the sea, one of the "last frontiers" on Earth.

The oil and gas sector has shifted its primary development focus from onshore to offshore in the modern era. Throughout the past century, there has been a transition from land to sea. The following Offshore technology applications have been innovated. Semi-floating and jack up Drilling platforms; offshore platforms; and dynamically stabilized drilling vessels, FSO, FPSO, and FDPSO. Offshore technology developed to overcome progressively harsh and difficult situations. To access a larger portion of the reservoir, wells could be drilled in several directions from one location on a Stationary platform or buoyant rig. Subsea technology has advanced to a depth of 3,000 meters below the sea's surface. The development of these subsea prospects at depths of up to 3,000 meters needed exceptional engineering abilities, qualified equipment, and a laser-like concentration on dependability. The subsea oil and gas industry was facing changes in global markets, with operating in emerging nations such as West Africa becoming crucial for sustained profitability in the long run. Numerous prosperous submarine industries were compelled to move their portion of the billions of year in US dollars allocated to subsea projects. Subsea well intervention is one of these technologies' developments as it moves toward offshore due to the necessity for various sectors to fulfill the pressing need to enhance and boost the productivity of oil well productions.

By definition, subsea intervention is any form of intervention carried out underwater or below the surface. However, the writer discovered that different sources had different definitions of the term. From Wikipedia Instructor Loh Way Lam's Deep-Sea System Design Lecture Notes, the writer learned that Subsea intervention is more closely associated with well maintenance, subsea intervention. Yong Bai defined subsea intervention as all forms of work carried out underwater by utilizing ROV and introduced the term ROV Deployment. In this paper, the writer will discuss the portrayal of subsea intervention from both references. The chart below illustrates the portrayal of subsea intervention from both references falls into to help the reader understand the differences between the two definitions.

CHAPTER 1

ACTIVITIES OF SUBSEA WELL INTERVENTION

- Pumping :

  Because it doesn't need inserting hardware into the well itself, this is the most straightforward type of intervention. Most of the time, all that needs to be done is hook up the Christmas tree's kill wing valve and pump the chemical substances keen on the well.

- Wellhead and Christmas tree maintenance and servicing:

  Depending on the state of the wellheads, this operation may have varying degrees of difficulty. All that has to be done for scheduled yearly maintenance is pressure testing and lubricating the hardware. Pressure testing is occasionally done on the downhole safety valve also as wells.

- Slick line:

  Slick line operation mostly use for Wellbore fishing, production tube gauge cutting, plugging or unplugging wells, implementing or withdrawing wireline retrievable valves, and data recording logging are examples of applications for slick line activities.

- Braided line:

  Because a grease injection (GOR) system must be installed in the setup of rig up to guarantee that the BOPs can close around the wire's woven curves, this process is more complicated than slick line. As a tertiary barrier, an additional shear-seal BOP is necessary because the Christmas tree's higher master valve can only cut slick line. Both core-less braided line for hoisting fishing and electric woven line for logging and perforating are examples of braided line.

- Coiled tubing:

  When it is desirable to pump substances directly to the bottom of the well, as in a chemical wash or circulation procedure, coiled tubing is utilized. If conditions prohibit the use of a wireline tractor and the deflection in the well is excessive ideal for gravity to lower the tool string, it can also be employed for jobs that are typically completed by wireline.

- Snubbing:

  Sometimes referred to as a hydraulic workover, this is a process where necessary duties are carried out by pushing a string of pipe into the well against wellbore pressure. The pipe is stiffer and the rig up is bigger than for coiled tubing.

- Workover:

  It could be necessary to remove an old completion and install a new one in certain older wells due to shifting reservoir circumstances or the completion's declining state.

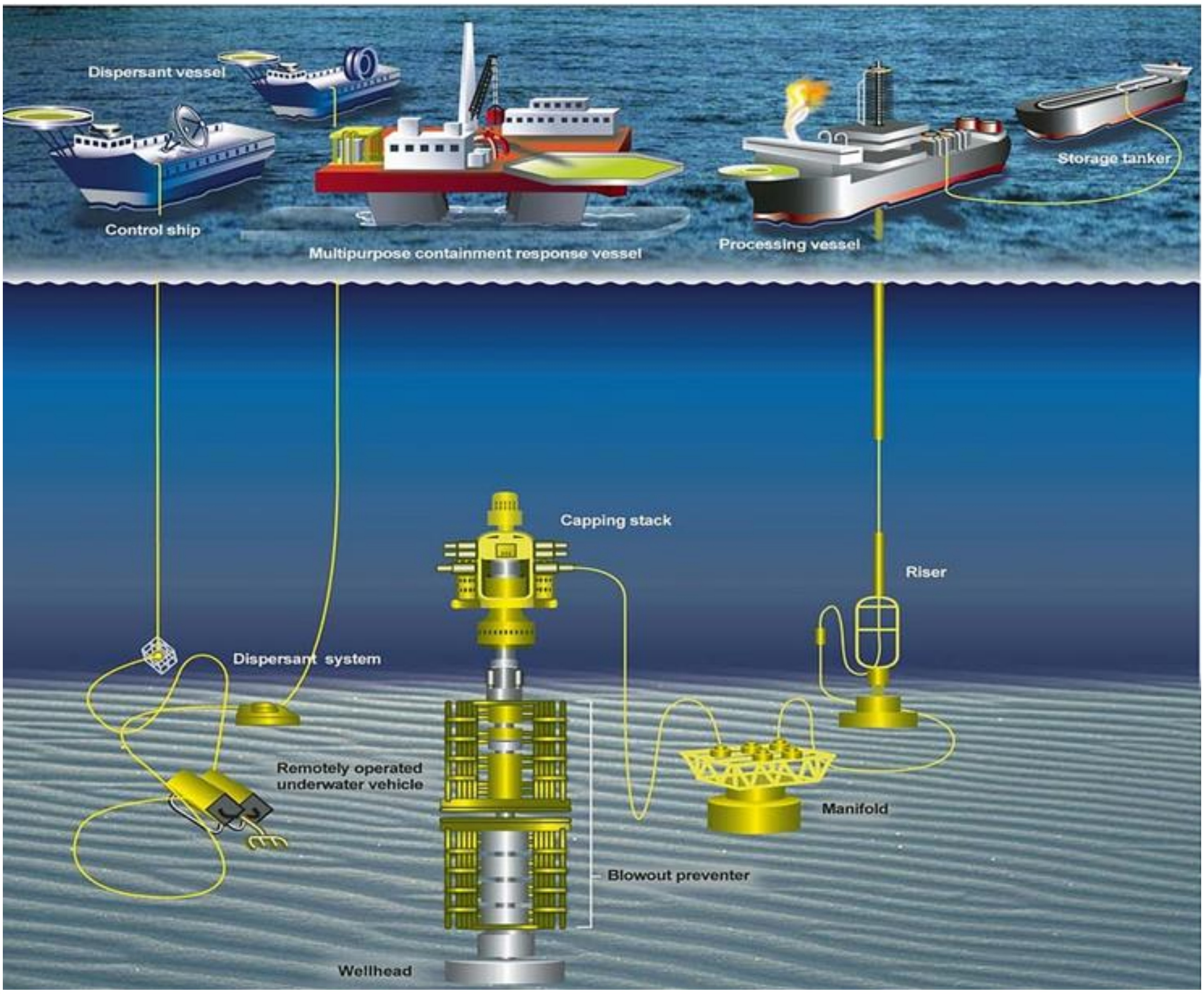
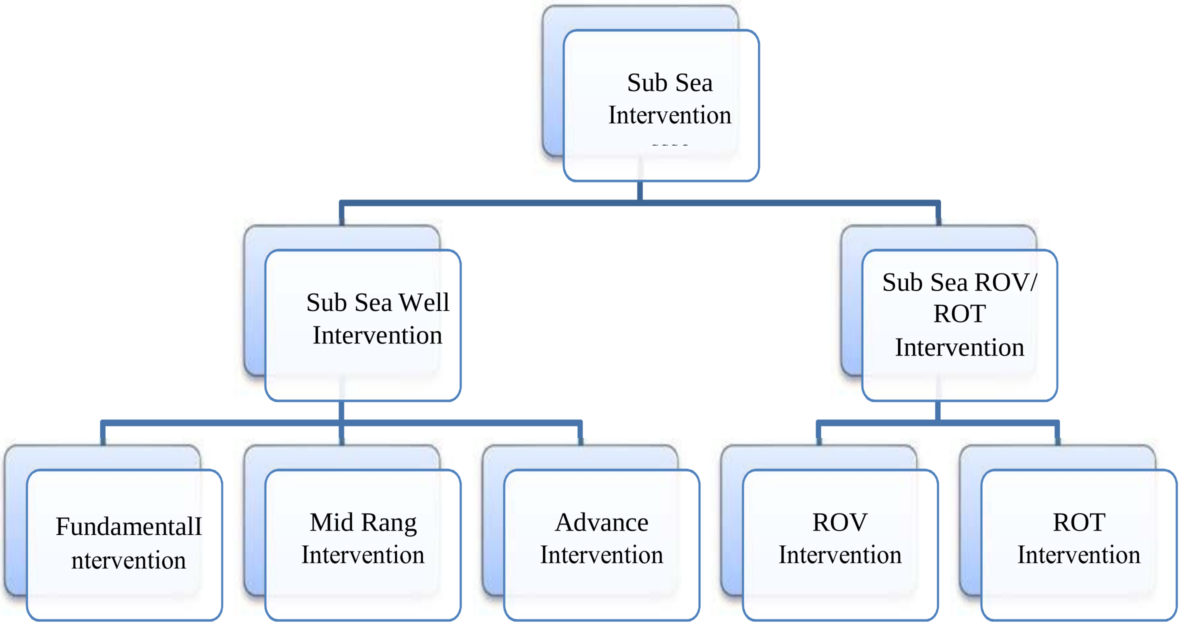


Figure 1: Well intervention equipment’s



CHAPTER 2

EQUIPMENTS INVOLVED

The following are the tools utilized in subsea well intervention.

1. The Vessel

- Fundamental intervention vessel

Helix Well Enhancer is an example of a vessel for fundamental intervention could be the "Well Enhancer" by Helix Energy Solutions. The typical fundamental intervention vessel specification is as follows:

- They can maintain their position during subsea intervention activities with the help of a dynamic positioning system.
- They can also undertake subsea riser less well intervention services with an offshore crane or module handling tower.
- Moon pool, to enable the deployment of intervention tools and ROVs
- Liquid cargo discharge systems refer to the equipment used for unloading liquid cargo from ships or tankers, to the pump mud or transfer from the product to the well - depth of operating of 600 m 100 Te crane - ROV capability, such as ROV control room
- -1,100 m^2 on the main deck - 7 x 7 m moon pool

Figure 2: Fundamental Intervention Vessel (Helix Well Enhancer)

- Mid rang intervention vessel:

Ulstein X-Bow is an illustration of a medium intervention vessel. Amid rang intervention vessel often has a expanded deck space, required crane, and moon pool in addition to the standard features of a intervention vessel, such as a Dynamic Positioning System, Moon Pool, and ROV capability, as listed below:

- The Deck space is area 1380 m^2
- The moon pool measures 8 m by 8 m and is 120 m long by 25 m wide.
- Its deployment depth is 2500 m
- Its Operating crane capacity150 T
- Deck area 1380 m^2

Figure 3: Mid range Intervention Vessel (Ulstein X-Bow)

- Advanced intervention vessel

The Q4000, owned by Well Ops, is an example of a heavy intervention vessel. Its main characteristics set it apart from light and medium intervention vessels:

-Subsea Semisubmersible Deck spaced is 95 m x 64 m

-Well Drilling Operational depth in 3000 m

-Semisubmersible Platform Different kinds Of cranes And They Are 600 T derrick crane, 350 T main crane, 16T secondary crane

- Moon pool is 12 m x 6 m

Figure 4: Advanced Intervention Vessel (Helix Q4000)

- Offshore Support Vessels:

Support vessels sail to far-off deep water fields with people, cargo, gasoline, cement, mud, fresh water, etc. They are capable of firefighting, emergency response/rescue, mooring, towing, and anchor handling. Additionally, they have dynamic placement.

Figure 5:Aker PSV 22 Offshore Support Vessel

- Multipurpose Supply Vessels:

Versatile Equipment Ships transport goods and services to offshore installations, loading and unloading them as needed. They are also capable of dynamic positioning and battling fires. The vessels can also be used for ROV operations, as well as for the storage and transportation of gasoline, methanol, cement, drilling mud, and drinking or industrial water.

Figure 6: HOS Strong line Multipurpose Supply Vessel

Figure 7:HOS Iron horse Multipurpose Support Vessel

1. The Subsea Vehicles operated intervention (Intervention Support)

   The ROV (remote operated vehicle) is the undersea vehicle used to assist interventions.

Figure 8: ROV

The duties of a vehicle during an intervention are:

- Exploration (Visual only)
  - Establishment of Position of well and Depth association
  - Detection of Leak
  - Well Interface state (before to intervention)
  - Wellbore Valve position confirmation Correction
  - Verification of connector placement
  - Etc…..
- Preparation of Wells (Different type its depending on intervention)
  - Eliminating the obstacle (manipulator)

  - Guidewire setup (manipulator) / GuidelineProtective cover removal (manipulator)
  - Establishment of hoist line (manipulator)
  - Well intervention well Swab Cap / Wellhead plunge Connector / etc.
  - Etc ….
- Well Intervention (Varies depending on intervention)

  o TDU/Piston/T-Tool Valve Actuator Override

  o Wellhead all casing Connector Override (HydJack)

  o Temporary/Permanent

  o Sub-assembly retrieval (T-Tool, Piston, and Spec Tooling)

  o MPFM, Cap, Choke, Control Module, etc.

  • Tree cap, wellhead connector, etc.

  o Lift line setup (manipulator).

  o Thrust guiding for heavy lift

  o Hot-stabbing function (Electrical/hydraulic)

  o Measurement o Change-out of the gasket and seal (manipulator)

  o Video support o Surface scrubbing (manipulator, brush, jet) o Etc.

  Further elaboration can be found in Section 3, Subsea Remote Operated Vehicle (ROV) / Remotely Operated Tool (ROT) Intervention

3. The Intervening System (Transient Well Management)

With the use of the intervention system, a Subsea well can be temporarily re-entered using a number of tools:

· To either physically alter the well's status or to gather information about the well's situation

In addition, it installs more well control hardware than what is normally seen in Subsea trees and permits intervention tooling to be inserted and removed from the well while the well is still pressured.

Figure 9: Subsea Intervention Hardware

2. Continuous Production Oversight—The Subsea Tree The submerged tree is situated on the seafloor at the submerged wellhead. The subsea tree regulates the well between the well and the seabed pipeline infrastructure using a control system.

CHAPTER 3

WELL INTERVENTION

'Well work' is another term for a well intervention. It be described as any procedure performed on an oil or gas well for the period of or near the termination of its productive phase life that modifies the well's condition or shape or spatial configuration, offers well diagnostics, or controls production.[1] This well intervention is done to either maintain or increase making levels, fix mechanical problems with the wellbore, or halt production.

Numerous issues are discovered when an oil well is operating. These issues lead to a decline in oil well productivity, which prompts the industry to create new technologies to address the issues. The following are some possible issues that arise when operating an oil well.

- Low Pressure in the reservoir

  In reservoirs that are driven by dissolved gas, the decrease in reservoir pressure and flowrate is quite severe. Pressure maintenance strategies can frequently counteract the drop in pressure brought on by depletion in gas cap and water drive reservoirs. Recompleting the well with slighter tubing or using an artificial lift and injection method can resolve this issue.

- Wellbore Restrictions in production well

  Causes of limits that are common include asphalt, sand, paraffin, and scale. Many of these issues might not be noticeable in the early stages of the field, but as it develops, they might become serious issues. To get rid of the constraint, a variety of mechanical and chemical approaches are used. Though these methods are corrective, prevention of the issues should always be taken into account.

- Primary Cement Failures

  Inadequate primary cement work that creates pathways behind the casing might cause undesirable fluids to enter and, in rare cases, cause casing collapse. This problem needs to be resolved with squeezezee cementing.

- Water and gas production regulation loss

  Losing oversight over water and gas production can lead to decreased productivity. It's essential to have a mechanism in place to regain control over water and gas production.

  Productivity loss may result from losing control over the production of gas and water. Regaining control over the production of gas and water requires a control mechanism.

- Mechanical Failures

Tubing, casing, and underground equipment mechanical failures are commonplace. Fixing the issue calls for a workover. Examples of these common issues are packer failures, downhole safety valve failures, tubing failures, and casing leaks.

The primary goal of well intervention is to raise or enhance oil well productivity. It is expected that intervention in subsea wells might increase oil well production by at least 25%. Naturally, achieving this significant increase in oil well production won't be simple. In order to achieve its goals, well intervention technology must overcome numerous obstacles. The primary obstacle to overcome is the lack of uniformity in the Christmas trees utilized in the subsea operation. Every oil well may have a unique Christmas tree design. Numerous companies encounter challenges as a result, and they must change or adapt their well intervention of all application to suit every type of oil well operation.

Numerous well intervention services, including logging, light re-perforating, Setting/removing plugs, intervening in flow lines, commissioning wells, abandoning wells, down hole pumping replacement, scale cleanout, retrieval of down-hole valves, casing leak repairs, re-drilling, etc., have been completed [lect notes]. We'll go into further detail about fishing and perforating in the section below.

Perforating

The process of perforating allows gas or oil to enter the wellbore by drilling holes through the cement sheath of the production casing and into the reservoir. The most widely used perforator in use today is the bullet perforator. In order to minimize damage to the producing formation, Perforation should establish an unobstructed flow pathway between the producing formation and the wellbore. Options include retrievable unoccupied carrier guns, non- recoverable or disposable guns, and semi-disposable solutions. guns are the three main types of perforating weapons. There are three common ways to employ these kinds of perforating guns:

- Wireline operation is used for casing gun perforating.
- Tubing Perforating (TTP Through): This method operates via wireline.
- Using coiled tubing, through conveyed perforating (TCP) is carried out.

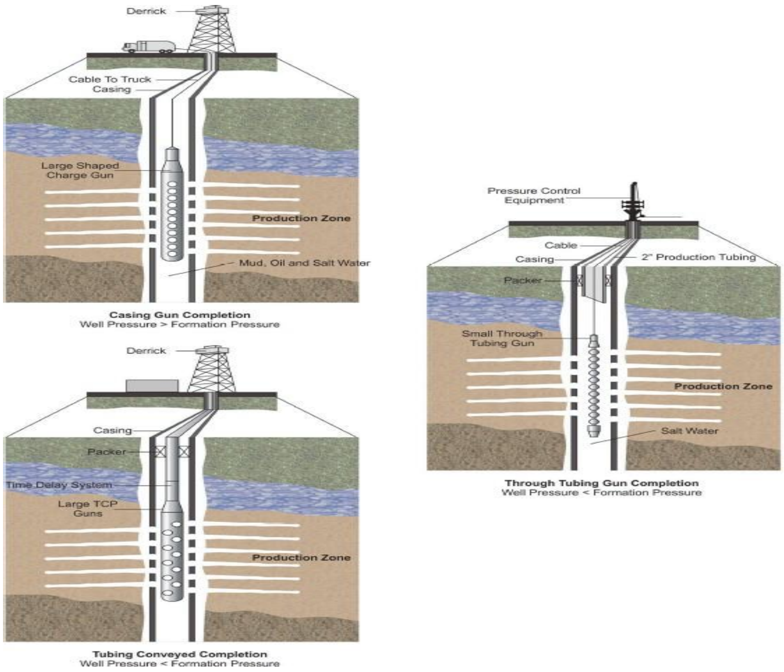


Figure 10: Methods of through tubing gun.perforating system

Because TCP incorporates the best aspects of both casing gun and perforating, it is the most widely utilized perforating technique. TCP method has some of advantages:

- It has the capacity to perforate a wide interval in a single session.
- Deviation from the norm is easily perforated.
- High shot density can be employed with a large gun.
- It can be executed in an unbalanced state.
- till now, it's the safest approach.

TCP has certain drawbacks in spite of its benefits if it is not perforated. To make room for the cannon, the entire system will have to be removed, and a new hole will need to be drilled beneath the reservoir.

The perforating gun is used as a finishing string or as an essential component of the drill system test. Only after installing a surface tree, testing the pressure integrity of the complete completion string, and setting a packer would it be fired. Electrical or mechanical systems can be used to achieve firing. Annulus or tubing

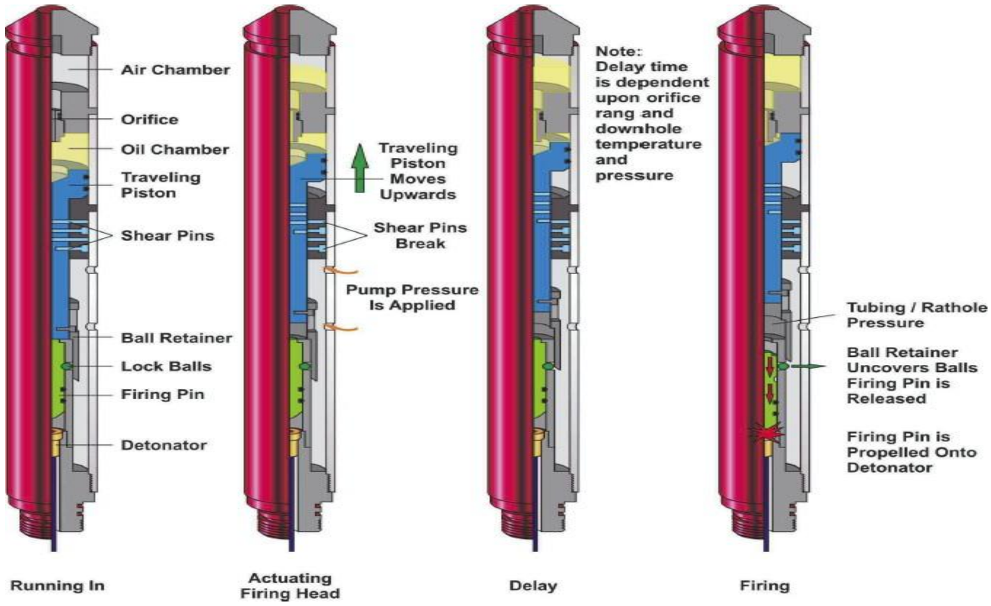


Figure 11: Principle of Hydraulic Time Delay Perforating

For mechanical systems, pressure is used. Hydraulic Time Delay Perforating is one type of mechanical perforating system.

Fishing

When drilling or work over operations leave an object in the wellbore, it's called a fish, and it needs to be recovered before work can resume anything can work, such as a section of the drill stem or a piece of wireline, pipe, or scrap metal. Any activity that aims to extract a fish from a borehole is called fishing. Fishing Tools be engineered to interact with objects not originally intended for engagement. They are tailored to facilitate the specific actions required. For instance, a fishing tool is utilized in wire line operations to retrieve lost equipment from a well. Various types of fishing equipment are presented in the market.

There are twice free mechanisms for fishing: involuntary release systems and hydraulic release systems. While many operators favour hydraulic release systems, the mechanical release system offers advantages, particularly in gas wells lacking a fluid column or when minimizing water introduction to the formation. Examples of fishing gear include:

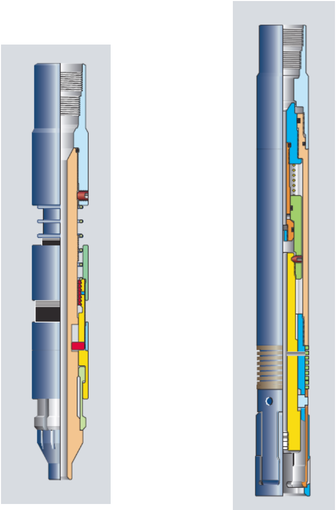


Figure 12: "Mechanical Release Mechanism (left) and Hydraulic Release Mechanism"

The prevalent methods employed for conducting well intervention Provisions include wireline operations, coiled tubing operations, and hydraulic snubbing units.

3.1 WIRELINE AND SLICKLINE OPERATION

Wireline operation

- Multi-filament cable for both Tool transport infrastructure to the Borehole and providing Operator signal pathway.
- Tensile-resistant cable wound on and off a Powered rotating spindle/ drum

Figure 134: Wireline

Slickline

- Monofilament wire utilized for mechanical conveyance of

Machinery into the wellbore.

- Tensile-resistant wire wound on and off a Powered rotating spindle/ drum.

Wireline operation refers to any method employed to operate within a producing or injecting well utilizing a steel cable. This method is utilized to insert, deploy, set, and Retrieve measuring equipment and instruments necessary for production. A wide range of Services can be customized conducted through wireline operations, including logging, Subtle wellbore re-perforation, Section demarcation, and Deployment and retrieval of plugs

Figure 14:Slickline

Slickline, braided line, or electric line are used for wireline operations. A single, solid strand of wire is called slickline. The most widely used size is 0.108 in. Compared to slickline, braided line has a better load capacity since it is made up of stranded wires. Typically, it is utilized for fishing when a slickline is insufficient to support the weight. An electric line is made up of stranded wire and a conductor that may send an electric signal from below to above. Wherever there is an electric line, Electronic applications are increasingly Applied in well integrity restoration services, including Enclosed formation evaluation, production logging, re-perforating, and setting Downhole isolation systems

"Wireline units installed on offshore platforms are typically skid-mounted. The wireline is spooled" could be summarized a

Skid-mounted wireline units with spooled wireline installation on offshore platforms. onto a A reel, usually hydraulically driven refers to a mechanism for spooling or winding wireline, often powered by hydraulic systems. Here's a concise summary.

A hydraulic-driven reel for wireline spooling. For wireline operations, at minimum, the following are required: wireline, wireline winch unit, lubricator, measuring device, hay pulley, wireline clamp, stuffing box, How about this Wireline, winch unit, lubricator, measuring tool, hay pulley, clamp, stuffing box, weight gauge, and Blowout Preventer (BOP) are all integral to wireline operations.

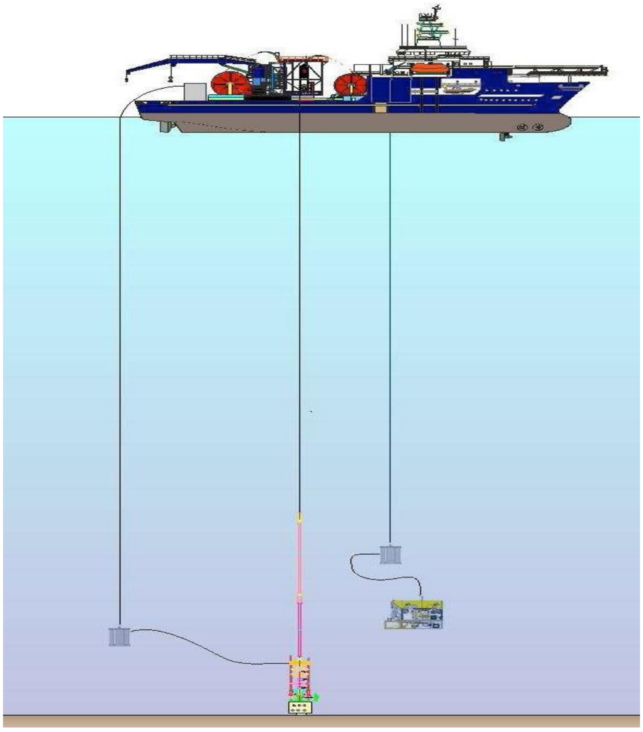


Figure 15: Subsea Open Water Wireline Slickline Operation

Numerous instruments that fall into different categories are used in wireline operations. They're:

- Inspecting and Maintaining Equipment

The instruments are fastened directly onto the wire line's bottom. It is employed to inspect and clean the well's tubing. Swapping tools, sand bailers, scratchers, and gage cutters are a few examples of this type of tool.

- Running and Retrieval

Tools specifically engineered for extracting or retrieving downhole equipment

Fishing Tools:

These tools are employed to remove undesirable items from the borehole.

Despite the many well intervention services that can be performed using wireline operation, it has some limitations:

- It poses risks when operated in highly deviated wells.
- No rotation and circulation are possible during this operation; it can only work under tension and moderate loads.
- Overall, wireline operation offers several advantages:
- Operations can be conducted inside the tubing without killing the well.
- Due to its lightweight and mobility, operations can be performed quickly.
- Minimal risk of damaging the pay zone during operations.

- Relatively easy to handle.
- Cost-effective, with numerous operators available in the market.

3.2 COILED TUBING OPERATION

Coiled tubing operations are suited for larger sizes and loads compared to wireline operations, requiring heavier equipment. Typically, coiled tubing operations precede wireline operations and are often conducted concurrently. This operation is utilized for nitrogen lifting, sand lifting, fluid circulation, fishing, and wellbore cleaning using a downhole motor.

Coiled tubing consists of rolled and welded continuous lengths of steel tubing used to convey tools, provide communication paths, and allow fluid flow.

The coiled tubing is spooled on and off a reel using an "Injector" system.The tube may integrate wireline capabilities.

Figure 16:Coil tubing

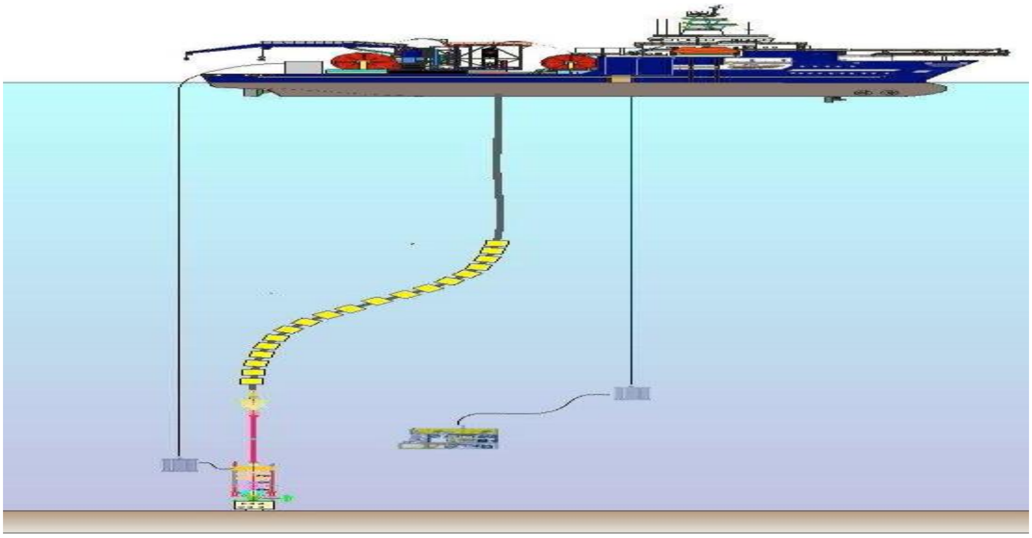


Figure 17: Subsea Coiled tubing technique

3.3 HYDRAULIC SNUBBING UNITS

Another term for snubbing is hydraulic workover. This technique involves pushing or pulling pipe into or out of a well under pressure. It allows for the deployment of small-diameter tubing through the completion without causing damage to the well, using hydraulic snubbing equipment instead of jointed tubing or drill pipe.

Key components of a heavy-duty snubbing unit include the hydraulic jack assembly, guiding tube, window, moving and stationary slips, rotary table, power tongs, work basket for control panel, hydraulic power pack, circulation swivel, Kelly hose, pumps, and Blowout Preventer (BOP) stack.

- Three fundamental tasks should be able to be completed by the sniffing unit:
- Controlled feeding of the pipe into and out of the well against wellhead pressure is required.
- Provide a seal that permits the pipe to be put into or taken out of the well while maintaining integrity.
- Offer a way to block the pipe's inside.

  The following tasks can be completed using a snubbing unit: fishing, casing milling, cement particles removal from tubing, liner, and casing, and pressure control and well cleaning.
- eliminating, removing bridge plugs by drilling, cleaning, pumping out heavy liquids, acidizing, and squeezing cementing.
- There are numerous benefits to hydraulic workover units.
- Compared to coiled tubing, it is more capable of handling relatively large instruments.
- It can be carried out with the well still flowing in some circumstances and under pressure.
- Shorter mobilization and demobilization times mean a shorter total amount of time a well is out of production.
- It is possible to undertake light drilling and milling work since the pipe can be rotated.

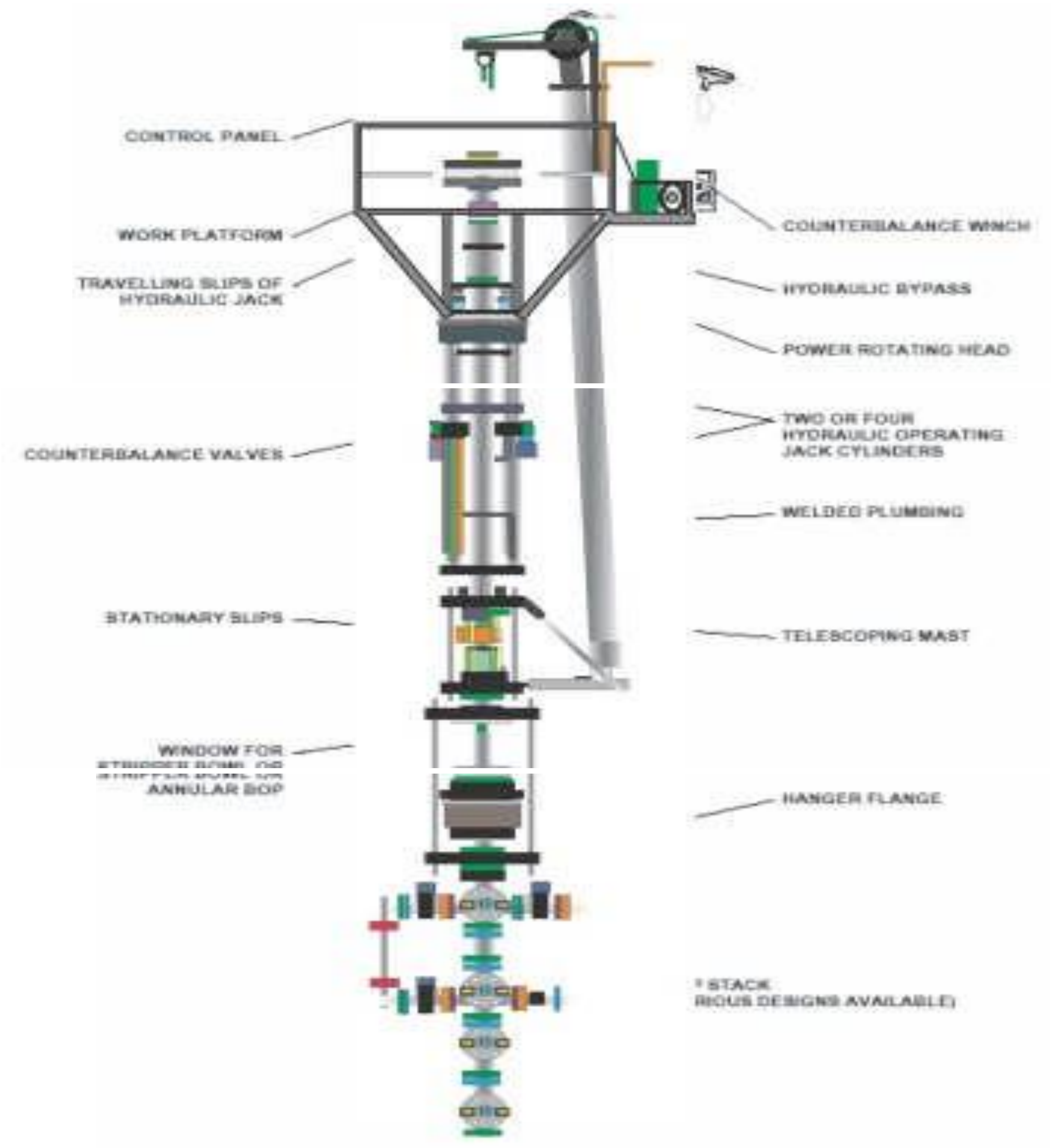


Figure 18: Snubbing Unit

CHAPTER 4

SUBSEA WELL INTERVENTION

Any action performed on a subsea gas or crude well during or near the end of its productive life that modifies the well's state or geometry, offers well diagnostics, controls production, or is necessary for the safe abandonment of subsea wells is referred to as a Deep-sea well servicing.

Innovation in Hydrocarbon industry has been heading toward offshore. The primary force behind this evolution is economic. The graphic below illustrates how subsea technology has grown.

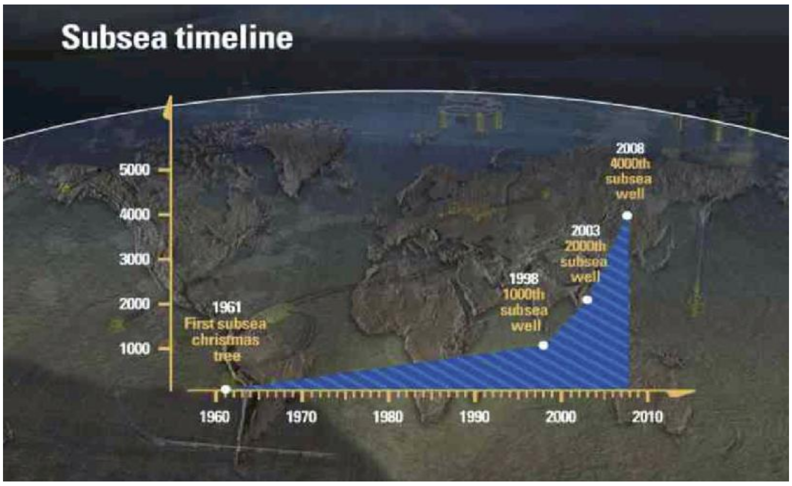
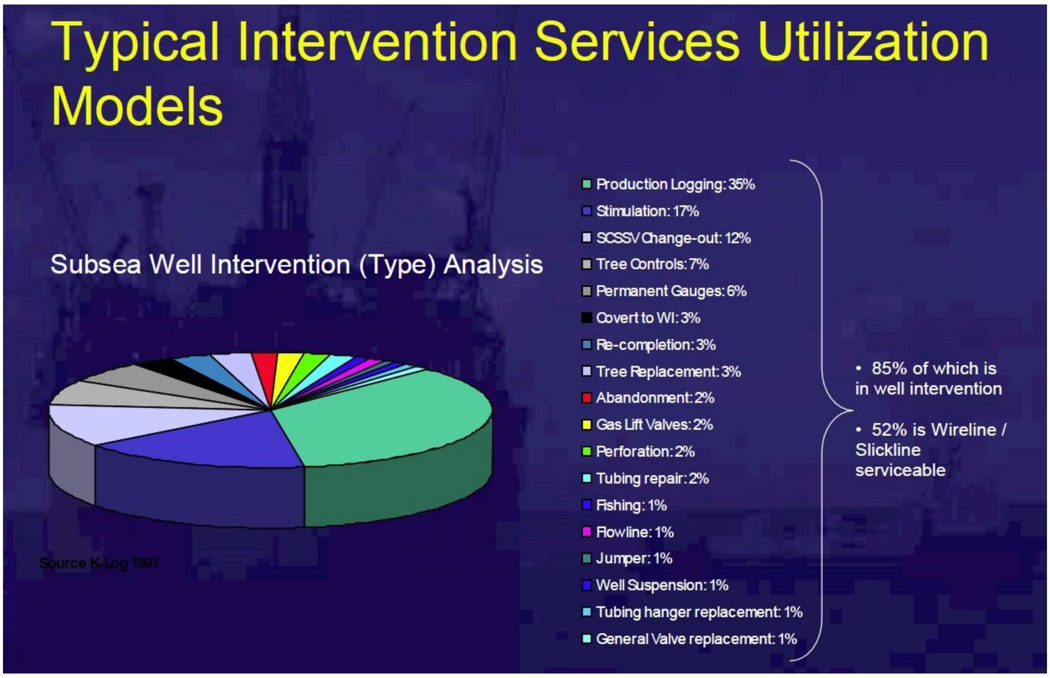


Figure 19: Growth of Subsea Technology

Because of well intervention, subsea operations have performed 25% worse than onshore operations [4]. The $20.7 million productivity gap is equivalent to this. Subsea well intervention is therefore being researched as a solution to this problem. Well intervention techniques used offshore are referred to as subsea well intervention. Although Deep-sea well servicing is a Emerging technology and has a high operating cost, it is expected to have a promising future market. Because of the numerous problems involved, subsea well intervention requires extensive planning in advance.

A vessel is usually used to assist in subsea well intervention, although a ROV (Remote Operation Vehicle) may also be needed to carry out certain tasks like Production well diagnostics, Well productivity enhancement, Surface-controlled subsurface safety valve replacement, Perforation stimulation, leak tubing repairs, fishing, well Wellbore sealing, etc.



Typical Intervention Services Utilization Models

Subsea Well Intervention (Type) Analysis

- 85% of which is in well intervention
- 52% is Wireline / Slickline serviceable

Figure 20: Below are the statistics indicating the number of subsea well interventions conducted up to the year 2006

A lot of sectors have been vying to be the first to use subsea well intervention.

- Shell and Oceaneering Corporation have reportedly set a new industry record in Deep-sea well servicing by replacing a failing subsurface-controlled subsurface safety valve in the involve Gulf of Mexico. This achievement was accomplished using an Deepwater wireline approach Submerged depth of 2,673 feet (815 meters).
- Blue Ocean Technologies and ATP Oil & Gas have also claimed to break numerous industry records for Deep-sea well servicing in 2,950 feet of water without the need for a riser. Utilizing Assortment of intervention machinery such as a wireline tractor, gauges, milling tools, perforating guns, and a logging tool, Blue Ocean Technologies' Interchangeable Riserless Intervention System (IRIS) completed multiple riserless wireline runs successfully. Each run set a new industry record for riserless intervention. This marks the first successful deployment of wireline in open water at a depth of 2,950 feet.

TYPES OF SUBSEA WELL INTERVENTION

Subsea well intervention falls into 3 types

  - Fundamental intervention
  - Mid rang intervention
  - Advanced intervention.

- Light, Medium, and Heavy subsea well intervention are the three main categories based on the kinds of vessels that may support the well intervention operation.

4.1 Fundamental SUBSEA WELL INTERVENTION

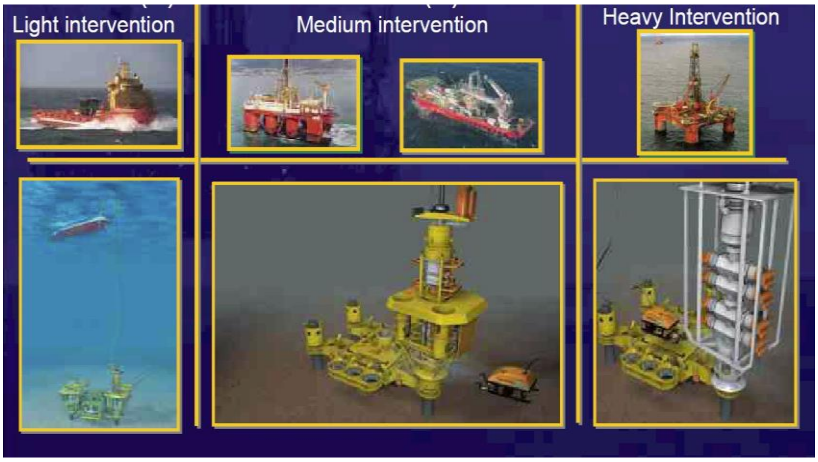


Figure 21: Types of Subsea Well Intervention

The use of wireline and slick line in well intervention involves various activities, including:

Well Logging
Well Light perforating
Production Zone isolation
Well Plug setting/ removal

A light subsea well intervention is one in which the marine support vessel is merely a small vessel. A wire line operation is the one that can be carried out. The services that can be completed by light subsea well intervention include zone isolation plug setting, plug removal, logging, and light perforating.

A light subsea well intervention operation typically takes nine days to complete and costs between $150K and $200K each operating day [4].

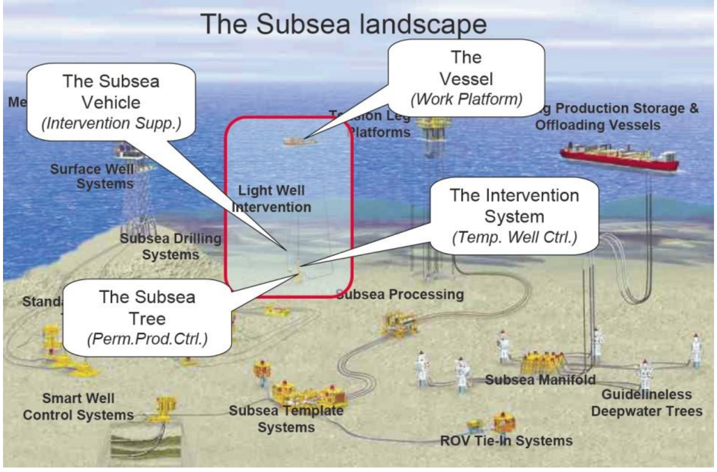


Figure 22:Fundamental subsea well intervention

4.2 MID RANGE SUBSEA WELL INTERVENTION

It uses coiled tubing, wireline and slickline. Activities involved are:

Well Flowline intervention

New Well commissioning

Well abandonment or Killing

Well Downhole pump change out

Well ports Acidizing or frac job

Well Sand or scale cleanout

Well zone Water shut-off

Production zone Scraping

Well Downhole valve retrieval

Zone Replacement

Well communication or Casing leak repairs

Any operation in a subsea wellbore that may be completed without the use of a drilling rig to access the well, transfer the service, or perform the operation is considered a medium subsea well intervention.

In actuality, medium deepwater well intervention and light subsea well intervention are very similar. The distinction is that wireline operation and coiled tubing are used in medium subsea well intervention. Thus, more difficult tasks can be completed. Among the tasks that can be completed by a medium subsea well intervention include scrapping, valve retrieval, casing repair, squeeze, acidizing, water shut-off, well abandonment, well commissioning, perforating, and more. Although medium subsea well intervention offers a broad range of applications, it is limited to those operations that do not require a drilling rig. Significant subsea well intervention will be needed for this kind of activity.

A medium subsea well intervention operation typically takes nine days to complete and costs between $150K and $300K each

Operating day

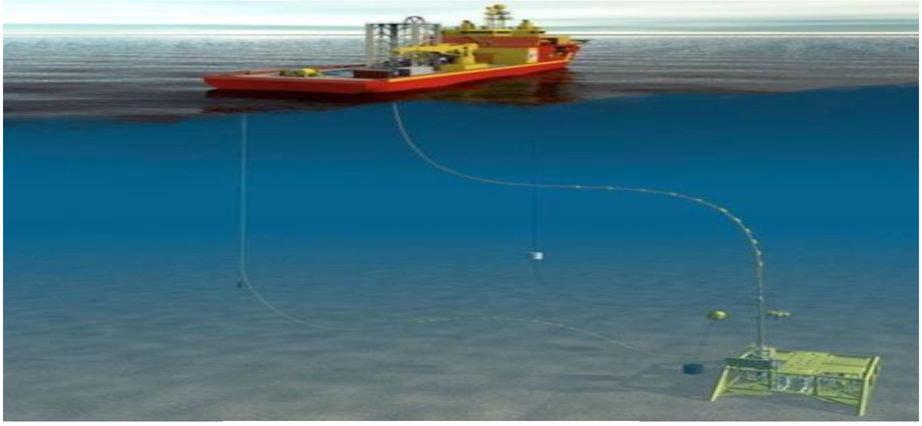


Figure 23:Medium subsea well intervention

4.3 ADVANCE SUBSEA WELL INTERVENTION

Activities involved are:

- Well Production Scale milling
- Well Completion change-out/ repair
- Well Re-drill or sidetrack
- Change-out The Christmas tree

Heavy subsea well intervention, as the name suggests, will require a lot of heavy machinery, such as a drilling rig with all of the heavy machinery on top of it. This reliable platform can be set up and used by several service providers. Heavy subsea well intervention can handle a wide range of heavy services, including sidetrack, re-drilling, scale grinding, Christmas tree change-out, and completion of change out or repair.

The average duration of a heavy subsea well intervention operation is nine days, with a daily operating cost ranging from $360K to $840K [4].

Figure 24: Heavy subsea well intervention

4.4 SUBSEA WELL INTERVENTION SERVICES IN THE MARKET

Indeed, the market offers a wide range of subsea well intervention products. Among the latest developments are Riserless Light Well Intervention (RLWI) and Rigless Well Intervention (RWI). Since RLWI technology can lower maintenance costs and increase recovery rates, it was created in response to the need to maintain subsea wells. In RLWI, dynamically positioned (DP) vessels are utilized to enhance maintenance performance and enable more economical and efficient completion of the task. [8]

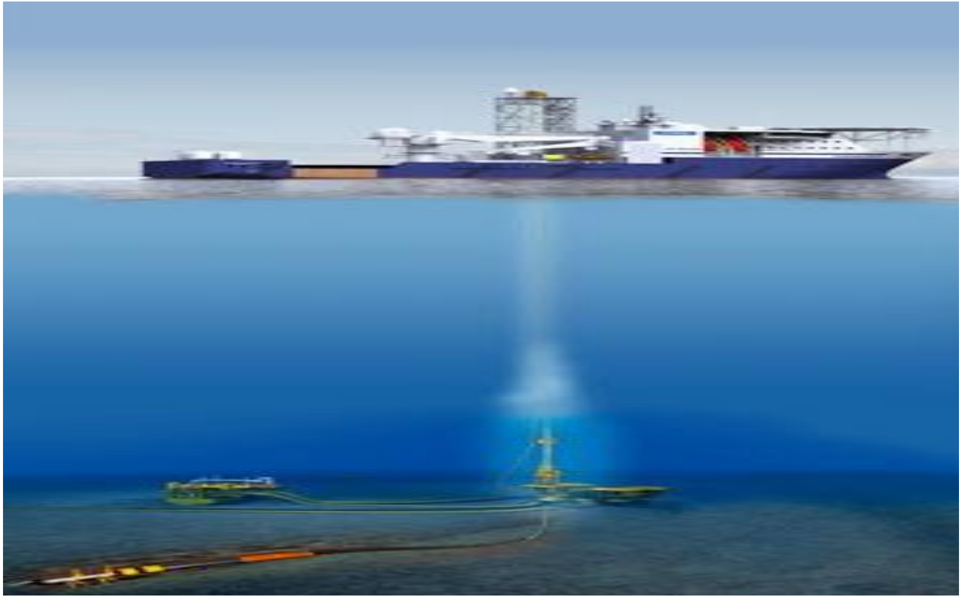


Figure 25:Riserless Light Well Intervention

4.5 SUBSEA RIGLESS WELL INTERVENTION

The Wireline Operation and the Coiled Tubing Operation are two complimentary subsea intervention operations whose capabilities have been optimized by the Rigless Subsea Intervention System [9]. It allows for the use of slickline thru-tuibing, electric line, and rigless coiled tubes in submerged wells up to 3,000 metres below the surface. The system's components include the ROVs, umbilical, vessel, marine support, handling and deployment equipment, underwater Intervention Package (WIP), and Intervention Package Control System (IPCS).

Well Intervention Subsea Package

This Schlumberger device is made to withstand 10,000 psi and has an ID size of 7 3/8 inches, which enables the retrieval of larger horizontal trees. Wireline operation or coiled tubing operation can be used to run the WIP [9]. It is made up of three primary parts:

The Well Lower Intervention Package (LIP)

The Well Intervention Package must be connected to the subsea tree by the LIP, and it must also offer the necessary static, redundant well control barriers.

The Well Lubricator and Package (LUB)

The purpose of the 7 3/8-in ID lubricator is to enable toolstring insertion into the well.

The Well TOP (Upper) Intervention Package (UIP)

The UIP can securely detach in the event of a vessel placement issue or other emergency, in addition to providing the dynamic sealing function needed for in-hole operations under pressure. As long as the support vessel has sufficient handling and lifting capacity, this package can be effectively deployed in deepwater in a single voyage. The differentiation between rigless wireline operation and rigless coiled tubing operation is delineated by this Underwater Intervention Package (UIP). A subsea dynamic barrier is incorporated into the UIP package for coiled tubing operations. Featuring a dual redundant sealing component assembly that eploys and retrieves with a tool string on each run, this seal serves as the well control barrier. .. In contrast, UIP packages used in wireline operations rely on stuffing box technology that is already in place to prevent slickline. For sealing purposes, a polymer embedded cable can be utilized in the same way as a slickline. The UIP coiled tubing operational set is inferior than the UIP wireline operation package. Its cable and seal work together to do away with the need for ubricant infusion during procedure.

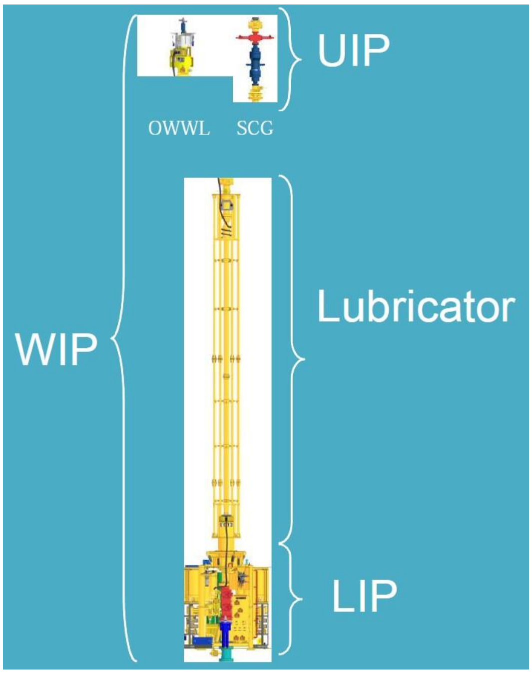


Figure 26: Main component of Well Intervention Package

Intervention Package Control System (IPCS)

The primary controller for the rigless well intervention is IPCS. Its primary control system functions are as follows:

- From the vessel, remotely operate the WIP and a customizable range of subsea Christmas tree functionalities.
- use the ROV to enable a subset of WIP and subsea tree functions.
- Gather a variety of work-in-progress data in real time for surface transmission and display.
- In the event of an emergency, start a series of WIP functions manually or automatically.

IPCS shares a common control system design for both wireline and coiled tubing operations. Independent valve modules are put at different points on the work in progress (WIP) as part of a distributed system design that forms the basis of the control system. Near the valves, which must be managed in the same way as the majority of contemporary work-class ROVs, is an electronic control system. Additionally, a dual redundant subsea WIP Pumping System installed on LIP is powered and controlled by the control system to give the necessary functions for lubricator cleansing, pressure measurement, and hydration prevention/remediation

.

Umbilical

Two separate power and communication bundles—each dedicated to one of the multiplexed telemetry systems (active and backup)—compose the umbilical. The Launch and Recovery System (LARS), positioned on the vessel's side, is actively controlled from the surface to facilitate the management of the down-line, simplifying the deployment of the umbilical.

Well Servicing Equipment

This system can be utilized with standard equipment packages for coiled tubing, electric line, and slickline. Cross-training of employees and the integration of power and control functionalities can result in certain synergies.

Marine Support

A ship that supports the WIP process is known as marine support. We are unable to deploy the WIP package whenever we would want. It will rely on environmental factors like sea current and wave height. Because of this, maritime support is required. The following requirements apply to maritime support vessels based on their equipment size and mode of operation:

- Length: 100–120 m, breadth: 20–25 m
- A minimum deck area of 1,000 m2, excluding ROV specifications. A portion of the apparatus, including pumping machinery and liquid storage containers, will be built into the vessel's hull.
- Level 2 dynamic position
- Accommodations for at least +/- 95 employees
- Two 150 horsepower Work Class ROVs
- A 7 x 7 m moonpool

Manipulating a tower or mast equipped with an AHC deep sea crane or winch It should be mentioned that wireline service requires less deck area, hence the vessel could potentially be smaller.

Handling and Deployment Equipment

The handling system comprises the following primary elements: Structure to uphold the elements of the well intervention package during their transition through the splash zone and into the water column. This structure facilitates the opening and closing of the moonpool and employs a cursor system to guide components through the splash zone.

- The deployment winch is used to lower and recover the intervention well.
- Ship parts to and from the ocean floor.
- Hang-off mechanism to sustain the components of the well intervention package at the moonpool door level
- Sliding system for relocating equipment on the support vessel from parking to operational or deployment positions
- Umbilical handling for launching and retrieving the control system's umbilical
- Tensioner to draw the tubing through the water column in a coil configuration

CHAPTER 5

SUBSEA ROV/ ROT INTERVENTION

Any subaqueous activity using a remotely operated vehicle (ROV) or remotely operated tool (ROT) is referred to as a subsea intervention. Examples of these operations are:

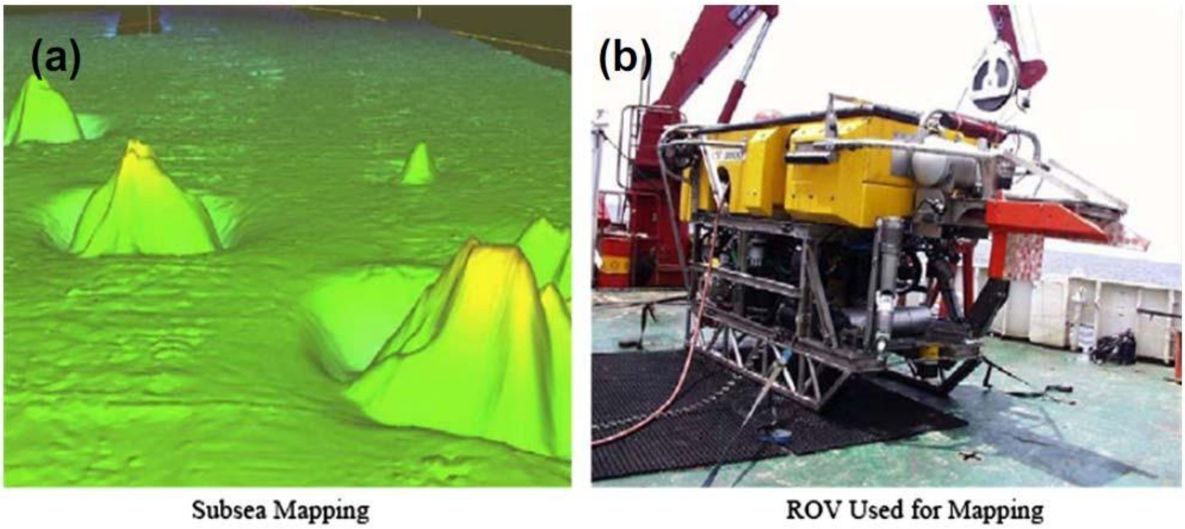
- Site evaluation;
- Helping with drilling;
- Help with installation;
- Support for operations;
- Examination
- Upkeep and restoration.

The actions indicated above will be covered in detail in the following section.

5.1 type of subsea ROV/ ROT intervention activity

Site survey

In order to determine the precise bathymetry and qualities of the seabed, a site survey must be completed prior to any offshore activities, such as drilling and installation.



Subsea Mapping

ROV Used for Mapping

Figure 27:Seabed Mapping with an ROV

A seabed reference system consisting of differential pressure sensors and acoustic data transmission, deployable and recoverable by a ROV, is capable of conducting comprehensive seabed mapping via precision bathymetry.An ROV equipped with a side-scan sonar (SSS) or a multibeam echo sounder (MBE) can also be used for seabed mapping, as depicted in Figure 15. To evaluate seabed parameters for offshore installation foundation quality, a sub-bottom profiler (SBP) can be utilized.

Drilling Assistance

The following are typical drilling operations for production drilling and completion:

- Using a remotely operated vehicle (ROV) to place acoustic devices, like beacons or transponders, for surface or subsea locating

- Visual survey of the bottom using still and video cameras from a remotely operated vehicle;
- Configuring and testing (if necessary) the BOP, Christmas tree, temporary guide base (TGB), and permanent guide base (PGB);
- As-built (bottom) survey using additional equipment and ROV visual observation.

Video cameras, often supplemented by scanning sonar for additional "acoustic observation," play a crucial role in providing assistance during the ROV drilling process primarily through observation tasks.The tasks involve carrying out the bottom survey, observing the structure's descent and landing, verifying the structure's level and orientation using a bull's-eye and gyrocompass, respectively, and carrying out an as-built survey. During the structural setting and testing phase, certain required intervention work may need to be completed using ROVs or ROTs.

- Deployment and recovery of beacons or audio transponders;

- The location and removal of debris, including dropped objects, from the seafloor and trees;
- RoV pull/push aid for structural position;
- Direct wire cutting, recovery, and deployment in emergency situations;
- rigging, which includes shackle connections and disconnections;
- Cleaning cement with a brush or water jet on a guide base
- Operating valves with a hydraulic torque tool or hydraulic stab-in;
- Replacement, pin pull release, and ROV-operable guiding posts;
- If ROV is appropriate, replacing the control pod (otherwise, ROT);
- Anodes are installed using clamps and contact screws.

Installation Assistance

There are two components to installing a subsea production system from the water's surface to the seabed:

- installing submerged equipment (manifold deployment, landing, etc.);
- Installing pipelines and underground utilities (such as initiation, regular lay, and laydown).

There are two main categories of subsea equipment installation techniques. For heavier equipment weighing over 300 metric tons, a heavy lift vessel with a crane capable of reaching the seabed is employed. The crane is utilized to both lift and lower the large subsea gear, and the crane's active heave compensating mechanism may be necessary to ensure a smooth landing on the seafloor. Alternatively, the heavy equipment may be mounted on a drilling rig with a lifting capacity of up to 600 tons.

For smaller subsea hardware weighing around 250 tons or less, a standard vessel equipped with a suitable crane is typically utilized. However, since the crane wire on the ship is often too short to reach the seabed, the equipment is transferred from the crane wire to a powerful winch with a longer wire. The winch then lowers the equipment to the seafloor after passing through the splash zone. In both installation scenarios, ROVs are employed for tasks such as engaging and releasing hooks and guide wires, as well as for observation and verification.

The long baseline (LBL) approach is commonly used to place underwater submerged structures. Packages that will be recovered by a remotely operated vehicle (ROV) can be used to mount transducers for position measurement, a gyrocompass for orientation measurement, and a depth sensor for depth measurement onto the structure. The ROV may help with orientation control, and before the structure is placed down in its final position, it must confirm by video that the structure is level and aligned. Subsea control modules, multiphase meters, and chokes can also be installed using ROVs. Hot stabbing using ROVs is an option for seal pressure tests.

To commence pipeline or umbilical laying operations, ROVs may be employed to install dead anchors. Additionally, they can assist in attaching the pull-in line for the initiation of I- or J-tube procedures. During routine installation and pipeline/umbilical laydown, robotic observation vehicles (ROVs) are commonly utilized to monitor the touchdown point.

The connections between flowlines, subsea equipment, and subsea production apparatus are established through various means. Flying leads extending from the umbilical termination assembly (UTA) to the tree/manifold, well jumpers from the tree to the manifold, and jumpers from the manifold to the PLET are all utilized to finalize umbilicals.

An ROV may directly handle and pull in flying leads. With the aid of a remotely operated vehicle (ROV), jumpers can be launched from a vessel equipped with spreader bar(s), positioned, and connected.

Operation Assistance

Typical primary production activities consist of

- Regulating flow through valves and chokes actuated by hydraulic mechanisms via control pods, umbilicals, or external intervention by ROVs or ROTs;
- Employing suitable measurement devices to monitor flow temperature and pressure;
- Implementing chemical and inhibitor injection to prevent hydrate formation, corrosion, and wax deposition;
- Conducting flow separation (filtration) among liquids, gases, and solids;
- Enhancing flow rates through pumping;
- Adjusting flow temperature through heating or cooling measures.

Except for noncritical valve actuation and sometimes sporadic status checks, sampling, etc., ROVs are typically not needed throughout the operation phase.

Inspection

Structures that are predicted to deteriorate because of flowline vibration, internal erosion, corrosion, etc., might require routine inspection.

Examinees comprise

- Visual examination in general, including measurements of marine growth and cathodic resistance
- Crack identification by nondestructive testing (NDT) and close visual inspection necessitating physical cleaning in addition to CP readings;
- Comprehensive examination that includes measures of wall thickness, visual inspection up close, crack identification, and detection of flooded members.
- Routine pipeline inspection, which also applies to power/control cables and control umbilicals, involves tracking and measuring the level of cover for buried pipes.

Figure 28: Polatrak ROVII Tip-Contact CP Probe

Figure 16 illustrates how a CP probe can be used to complete measurements of cathodic protection (CP) potential. An ROV from the workclass is typically used for this kind of measurement. As seen in Figure 17, cleaning can be done by a remotely operated vehicle (ROV) using brushing tools or high-pressure wet jets and grit entrainment.

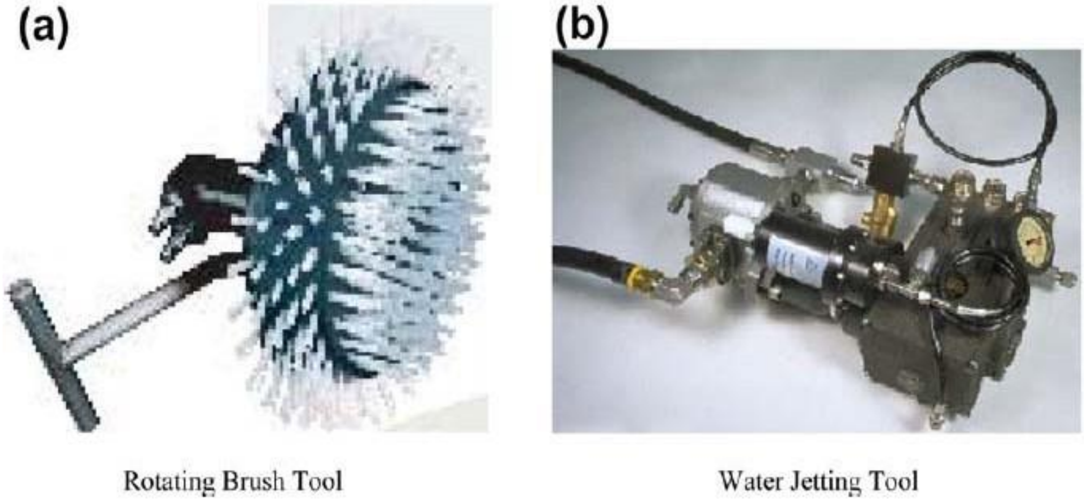


Figure 29:Rotating Brush Tool and Water Jetting Tool

An ROV equipped with magnetic particle inspection (MPI), eddy current testing, alternating current field measurement (ACFM), and various other techniques can be utilized to detect and locate cracks.

Maintenance and Repair

Among the maintenance tasks are the replacement or repair of worn-out modules. The standard procedure for performing maintenance is to retrieve the module to the surface and then replace it with a new or different module.

When designing subsea equipment, retrieval and replacement must be taken into consideration. Certain modules, like control pods, chokes, and multimeters, can be replaced or removed. Because nonretrievable elements of subsea equipment have sustained severe wear or damage, a full replacement may need to be performed.

If replacing the damaged module is not feasible and does not impede output, the procedure can be carried out with routine monitoring due to the high cost and difficulty of maintenance and repair.

perform and operation of subsea ROV/ ROT intervention

Two approaches are employed to finish those duties, and they are as follows:

1. Remotely operated vehicles (ROVs) for cleaning, inspection, and other purposes, and
2. 2. ROTs (Remote Operated Tools) designed for module replacement and subsea tie-in operations.

The ROV and ROT used in the aforementioned procedure are described in the section that follows.

5.2 Equipments involved in subsea ROV/ ROT intervention

ROV Intervention System

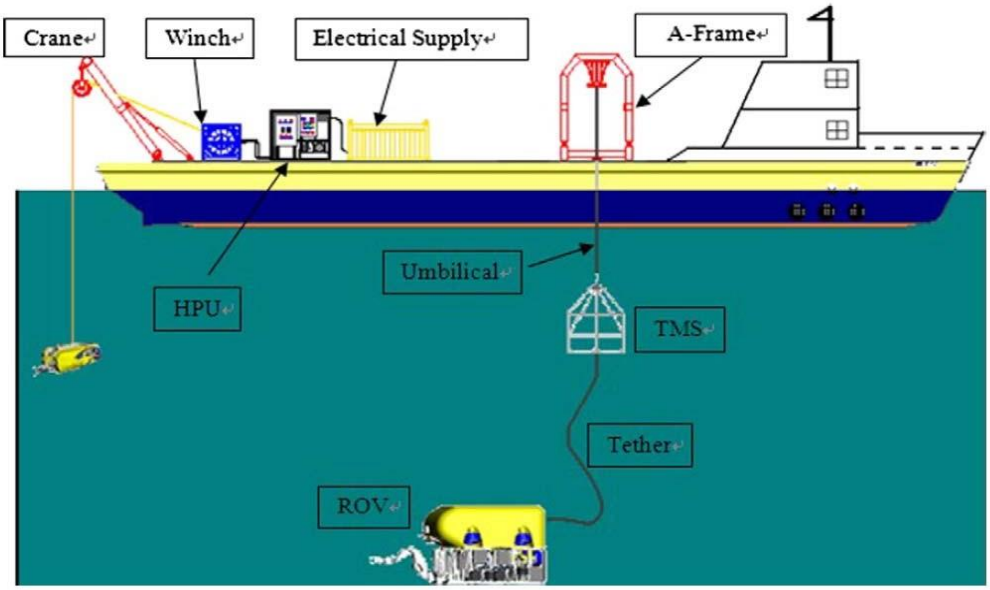


Figure 30:ROV System

The subsystems of a ROV system utilized in subsea engineering, as seen in Figure 18, are as follows:

- The deck-based control room for the ROV subsea;
- A workover room for repairing and maintaining ROVs on deck;
- Equipment for handling and deploying decks, such as A-frames and cranes/winches;
- Umbilical for powering the underwater ROV and launching or recovering it;
- A tether management system to lessen the ROV's impact from umbilical movement;
- Remote underwater video.

5.2.1 ROV Categories

Table 1:summarizes the five classes into which ROV can be classified.

Class	General Definition	Detailed Definition
I just made an observation.Video observation is the only physical use for pure observation vehicles. These are often compact cars with lights, thrusters, and video cameras installed. They need to undergo significant modifications before they can do any additional functions.	I just made an observation.Video observation is the only physical use for pure observation vehicles. These are often compact cars with lights, thrusters, and video cameras installed. They need to undergo significant modifications before they can do any additional functions.	I just made an observation.Video observation is the only physical use for pure observation vehicles. These are often compact cars with lights, thrusters, and video cameras installed. They need to undergo significant modifications before they can do any additional functions.
II Payload-Option Observationvehicles equipped with extra sensors, like sonar systems, extra video cameras, cathodic protection assessment systems, and still color cameras. Class II vehicles are supposed to be able to	Payload-Option Observationvehicles equipped with extra sensors, like sonar systems, extra video cameras, cathodic protection assessment systems, and still color cameras. Class vehicles are supposed to be able to carry at least two extra sensors and still work as intended.	II Payload-Option Observationvehicles equipped with extra sensors, like sonar systems, extra video cameras, cathodic protection assessment systems, and still color cameras. Class II vehicles are supposed to be able to carry at least two extra sensors and still work as intended.

carry at least two extra sensors and still work as intended.		
III	Work-class automobilesvehicles with adequate space to accommodate extra manipulators and/or sensors. A typical feature of Class vehicles is multiplexing, which enables the operation of extra sensors and tools without requiring them to be "hardwired" through the umbilical system. Class I and Class II vehicles are smaller and less powerful than these. Vehicles under 100 horsepower fall under Class III A. Class III B: Workclass cars with 100–150 horsepower Cars over 150 horsepower in Class III C Workclass	Work-class automobilesvehicles with adequate space to accommodate extra manipulators and/or sensors. A typical feature of Class III vehicles is multiplexing, which enables the operation of extra sensors and tools without requiring them to be "hardwired" through the umbilical system. Class I and Class II vehicles are smaller and less powerful than these. Vehicles under 100 horsepower fall under Class III A. Class III B: Workclass cars with 100–150 horsepower Cars over 150 horsepower in Class III C Workclass
IV	Seafloor-operating vehiclesSeabed-working vehicles are propelled on the seabed by a combination of water jet power, thruster propellers, wheel or belt traction systems, or any one of these. Class IV vehicles are designed for specific purposes and are often larger and heavier than Class III work class vehicles. Dredging, excavation, trenching for cables and pipelines, and other remotely managed seabed construction activities are examples of such tasks.	Seafloor-operating vehiclesSeabed-working vehicles are propelled on the seabed by a combination of water jet power, thruster propellers, wheel or belt traction systems, or any one of these. Class IV vehicles are designed for specific purposes and are often larger and heavier than Class III work class vehicles. Dredging, excavation, trenching for cables and pipelines, and other remotely managed seabed construction activities are examples of such tasks.
V	development or prototype automobilesThis kind of vehicle includes both prototype and under development vehicles. Class also includes special-purpose vehicles that don't belong in any of the other classes. As of right now, Class V is home to the AUV.	development or prototype automobilesThis kind of vehicle includes both prototype and under development vehicles. Class V also includes special-purpose vehicles that don't belong in any of the other classes. As of right now, Class V is home to the AUV.

Topside Facilities:

To ensure the safe and efficient operation of ROVs, it's essential to provide adequate deck space and strength, external supplies, and easy launch and recovery capabilities on the deck.

Control Stations:

ROV control stations vary from simple PC game joysticks to complex, room-sized offshore control containers located on platforms or ships. These stations consist of operator/ROV interface control mechanisms and video displays. Components typically found in control containers include the operator console, lighting, electrical outlets, fire alarms, and extinguishers.

ROV Launch and Recovery Systems (LARS):

A LARS comprises a winch, winch power unit, crane/A-frame with a fixed block, and an ROV guiding system. Generally, a basic rope with uplift force suffices for launch and recovery operations, but a reel or drum is often used to facilitate rope deployment and retrieval. A motor, either electromotor or hydraulic, is employed to rotate the reel and provide lifting force. This motor may include a gearbox to enhance torque force and reduce rotational speed. The combination of motor, base frame, reel/drum, and auxiliary components like a clutch and brake constitutes a winch. A fixed block at the end of a crane boom or A-frame beam is used to orient the winch and convert the required upward force into a downward one.

Difference between AUV and ROV:

The distinction between an Autonomous Underwater Vehicle (AUV) and a Remotely Operated Vehicle (ROV) lies in the umbilical that connects the latter to the support vessel, transmitting electrical and hydraulic power, as well as data collected by the ROV to the surface. AUVs, however, are robots capable of underwater travel without being tethered to a surface platform or vehicle. ROVs typically feature external steel coverings for protection and torque balance, while efforts are made to minimize the weight and diameter of the umbilical to reduce drag.

Figure 31: Snubber Rotator Docking Head

Figure 32: Wire-Guided Cursor

Figure 33: Guide Rail System

Umbilical and TMS

An autonomous underwater vehicle (AUV) and a remotely operated vehicle (ROV) vary in that the former has an umbilical running between it and the support vessel that carries hydraulic and electronic power from the latter to the former as well as data collected from the ROV to the surface. In contrast, the AUV is a robot that moves underwater free from a connection to a surface platform or vehicle. An ROV often has torque balancing capability and an exterior steel coating for armor. To lessen drag, the umbilical's weight and diameter should be kept to a minimum.

force from currents and waves in addition to the lifting needed to launch and retrieve the ROV from the water to the surface. In shallow water operations, the umbilical may be attached with buoyancy, for instance, every 100 meters (328.1 meters), to prevent entanglements with subsea equipment or the ROV itself. Normally, the umbilical has negative buoyancy.

For deepwater applications, where an umbilical with negative buoyancy can launch and recover the TMS and ROV, a tether management system (TMS) is utilized to deploy the ROV. An umbilical known as a tether, which has a comparatively modest diameter and neutral buoyancy, can be used as the connection cord between the ROV and TMS. For controlling the soft tether wire, the TMS functions similarly to an underwater winch. A TMS offers two noteworthy benefits.:

1. Because the force indicated by the umbilical is eliminated, ROVs can be moved more readily. In a sea depth of 200 meters (656.2 feet), this force may be the same as the flight resistance of the ROV itself, and it will increase quickly as the water depth increases.
2. The ROV can descend to the operating depth close to the seabed without the necessity of using its own thrusters. A poweredTMS, or adding thrusters to TMS cages, could be used to compensate for the considerable drag force on TMS caused by significant currents (such as current velocities of 1 to 1.5 knots) in specific locations.

Tether control is the TMS's main function. It can be attached to a clump weight, which is mainly for observation ROVs, or to a cage deployment system, as shown in Figures 23–8 and 23–9. The former is mainly for workclass ROVs.

5.2.2 ROV Machine Characteristics

Configuration

The majority of work class ROVs feature an open aluminum frame that shields and supports the thrusters used for propulsion, the underwater cameras used for observation, lights, and other instruments like CCT for heading detection, depth gauges for depth detection, an echo-sounding device for altitude detection, and scanning sonars for environment inspection.

Underwater, most ROVs are near neutral buoyancy. To ensure that the ROVs can float to the water's surface The majority of work class ROVs feature an open aluminum frame that shields and supports the thrusters used for propulsion, the underwater cameras used for observation, lights, and other instruments like CCT for heading detection, depth gauges for depth detection, an echo-sounding device for altitude detection, and scanning sonars for environment inspection.

in an emergency or in the event that they break, they do have some buoyancy. With the use of a vertical thruster, a ROV descends. Above the Al-based ROV structure, synthetic foam material is typically used to give buoyancy. Generally speaking, a ROV weighs between 1000 and 3500 kg. The table in API RP 17H's Annex A provides examples. The ROV has good stability performance because of its reduced weight of gravity and higher buoyancy center.

Operation Depth

In the past, ROVs were largely used to support drilling operations, such as seabed surveys, water jetting, and seal ring installation, as well as light construction support and inspection work. These operations were carried out in water depths of 100 to 1000 meters (328 to 3280 feet). These ROVs can carry up to 250 kg of payload and have 40–75 horsepower.

Deeper and deeper explorations by the oil and gas sector have raised demand for ROVs that offer diverless solutions for activities like remote interventions and pipeline/umbilical tie-ins. The typical ROVs' operating water depths are listed in Table 4.

Payload

The payload capacity of an ROV is limited by

- Power of ROV ;
- ROV Structural integrity;
- torque and load capability of the manipulator
- Current condition.

Payload capacities for typical ROVs are listed in Table 4.

Table 2: Operational Water Depth & Payload Capacity of Typical ROVs

ROV Name	Operational Water Depth (m)	Payload Capacity(kg)
Challenger	**1572**	**113**
H ysub 60	**2000**	**-**
Pioneer HP	**1500**	**100**
Super Scorpio	**914**	**100**
MRV	**1500**	**220**
Diablo	**2000**	**250**
Triton XLS	**3000**	**300**

SCV-3000	**3000**	**100**
Hydra Magnum	**3144**	**227**
Hydra Millennium	**3144**	**318**
INNOVATOR™	**3500**	**-**
Maximum	**-**	**499**

Navigation System

Both precise and generic navigation are part of ROV's navigation system. For general navigation, two methods are used: the hydroacoustic method and the deck reckoning approach. With the LBL system, which consists of a responder array on the seabed, a minimum of one transponder set on the ROV, and a single receiver set on the vessel, the hydroacoustic approach is currently the most extensively used method.

The target object is reached by the ROV through precise navigation. The ROV heading is determined by a gyrocompass, and visual aids such as lights and sonar/low light cameras are employed as part of the viewing system. A subsea light typically has a power output of 250–500W. Additionally, a ROV may contain 100–150 W for tiny lights and 750–1000 W for huge lights. In order to give 3D object configurations—that is, to gather information regarding the target's thickness and the distance between the ROV and the target—there is also a cubic TV.

Propulsion System

A power supply, a controller for an electric motor or a servo-valve pack for a hydraulic motor, and thrusters to modify the vehicle's trim, heel, and direction as well as propel it to navigate from the TMS to the work site and back are the components that make up a ROV's propulsion system.

Underwater thrusters, the primary component of a remotely operated vehicle's propulsion system, are configured in various configurations to enable asymmetrical thrusting and variable thrust levels, hence facilitating optimal vehicle maneuverability and controllability. The thrusters must be of a size sufficient to oppose the forces exerted on the vehicle, including workload and hydrodynamic forces. Thrusters come in a variety of powers, including hydraulic and electrical. Larger and workclass vehicles typically employ hydraulic thrusters, whereas smaller vehicles typically use electrical thrusters. Illustration 22 Typical Electric and Hydraulic Thrusters provides examples of typical electric and hydraulic thrusters. The thruster selection criteria for a remotely operated vehicle (ROV) include power, efficiency, pressure, flow, weight, size, and forward/reverse characteristics should be taken into account.

Figure 36: Typical Electric and Hydraulic Thrusters

Viewing System

ROVs use a variety of underwater video cameras for observation, usually for monitoring, inspection, and navigation.

Charge-coupled devices (CCDs), high-definition image sensors (HADs), and low-light silicon intensified targets (SITs) are examples of camera image sensors. Certain cameras come fitted with LED lights that illuminate the subject for up-close examination and do away with the need for additional lighting. A video capture device on the water's surface receives images taken by a camera as video signals via the tether and umbilical.

Manipulators

Two manipulators are often included with a ROV; one is used for stabilizing the ROV's position and typically has five functions, while the other is used for intervention activities and typically has seven functions. The size, load rating, reach, functionality, and controllability of manipulator devices differ greatly. Simple solenoid-controlled units or servovalve-controlled position feedback units could be used for them. A gripper, often made up of two or three fingers, is attached to the end of the arm to hold handles, objects, and structural components while performing tasks or stabilizing the ROV.

1.1.2 *Remote Operated Tool (ROT)*

An ROT system can be divided into the following subsystems, as shown in Figure 23:

- Equipment for handling and deploying decks, like A-frames and cranes/winch;
- Manages the deck area to oversee the ROT underwater operation
- A workover room for ROT upkeep and repairs on deck;
- Liftwire/umbilical to power the ROT underwater and to deploy or retrieve the ROV
- The ROT.

Module replacement/change-out and flowline tie-in are the two principal uses for an ROT, as they both call for handling forces greater than those of a ROV. Typically, ROTs are installed on liftwires or a hybrid liftwire/umbilical, and an umbilical equipped with specialized thrusters, ROV support, or guidewires powers the lateral steering.

Safe locking of the replacement module during handling, deployment, regular operation, and emergency situations like a power outage should be enabled by the ROT system.

There are three generations of ROT for tie-in tools:

- A first-generation ROT consists of two independent tools that join and pull in separately.
- An integrated tool that connects and pulls in is a second-generation ROT.

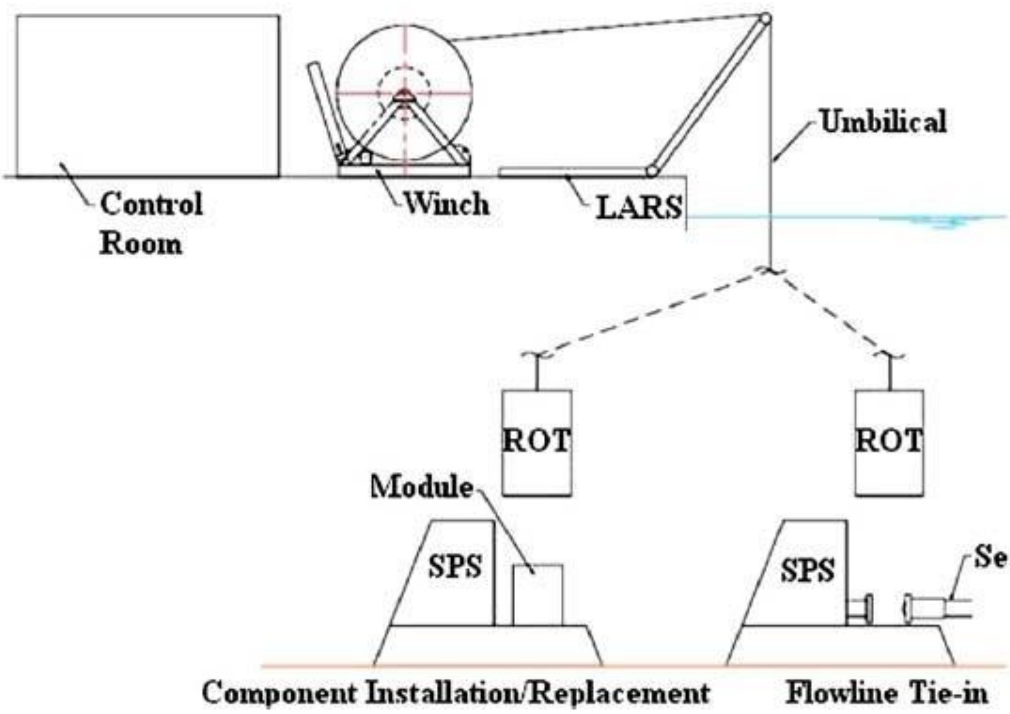


Figure 34: ROT System

CHAPTER 6

CONCLUSSION

In essence, there are not many differences between onshore and subsea well intervention. Thanks to subsea well intervention technology, nearly every well intervention service that was previously only possible onshore may now be performed offshore. The primary force for subsea well intervention is the desire of the oil and gas sector to shift technologies offshore.

There are numerous subsea well intervention options available in terms of vessel support and technique. Wireline operation, coiled tubing operation, and hydraulic snubbing operation for heavy duty are the three basic subsea well intervention procedures. Subterranean well interventions can be further divided into three categories: light, medium, and heavy levels.

The subsea well's productivity has increased by about 25% as a result of the intervention. Although it has done a good job of responding to the challenges for the subsea improvement, many more challenges remain. Although subsea well intervention is a relatively new technology and has a high operating cost, it is expected to have a promising future market. Because of the numerous problems involved, subsea well intervention requires extensive planning in advance. New subsea technologies are expected to be developed. There will be advances in subsea well technology that are more productive and efficient. We now have an obligation to apply all of our might to this underwater technology.

The oil and gas sector regards subsea well intervention technology as novel. It is anticipated that new subsea technology would advance and possibly even lead to new inventions as a result of the push toward offshore technology. To maximize the performance of subsea technology, a few major players in the sector have started to develop innovative and advanced techniques. This advancement is pointing in the direction of a successful and productive subsea well intervention.

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