Well Testing

For you, well testing isn’t just about data. It’s about asset insight, potential and control.
Over 85 years ago, Halliburton introduced drillstem testing (DST) to the industry, establishing the initial standard for well testing. These early well tests provided a basic understanding of a reservoir’s characteristics. Although the discipline of well testing has evolved dramatically since then to provide more extensive and accurate reservoir information, the ultimate goal remains the same: to empower you with the ability to not just optimize a well’s performance, but to also optimize your financial investment. Of course the right data can help determine a reservoir’s size and structure. But it can also discover productivity indicators like permeability, skin, and initial reservoir pressure.

So, not only can the right information aid you in understanding a reservoir’s near-wellbore boundaries, but when you know the existence of heterogeneities, discontinuities, and connectivity, you can better answer your most important questions. When you get exactly what you need, you’ll be equipped to make more efficient and effective decisions about completion design, production facility design, and the establishment of refining procedures. At Halliburton, we understand that well testing isn’t just about data. It’s insight. Potential. Control. Whether it’s making money, saving money, or saving time, well testing is about you achieving your business goals.
Breakthrough developments and continual improvements in Halliburton well testing equipment and techniques have led the industry with effective, accurate testing operations at the greatest depths and temperatures. Due to the value of the results, well testing in both cased and open hole operations has arguably become the most powerful business tool available in oil and gas today.

Of course, a properly conducted well test is a temporary completion of a well to acquire dynamic rate through time, pressure, and fluid property data. The well test often indicates how the well will perform when it is subjected to various flow conditions. An analysis is usually performed on the data to determine reservoir parameters and characteristics including pressure, volume, and temperature (PVT). Production decline may be predicted using these parameters and characteristics. The production decline can be used to predict cash flow.

Once cash flow is known, improved drilling, completion, and production decisions can be made on this well and other wells in the field. Well test objectives can be classified as: short-term or long-term.

### Short-Term Well Test Objectives

- Identify formation fluids
- Identify production rates
- Measure initial reservoir pressures
- Calculate permeability
- Calculate skin

### Long-Term Well Test Objectives

- Existence of heterogeneities
- Discontinuities
- Connectivity

### The Test String

Once a clearly defined test objective is established, the makeup of a test string can be determined. In general, when selecting the components in a test string, it is preferable to keep the string as simple as possible. We focus on avoiding redundancy and only include tools that gain a desired, predefined benefit.

A variety of techniques and arrangements of Halliburton test tools are used to handle diverse types of tests—from openhole to High-Pressure/High Temperature (HP/HT) and underbalanced to name a few. But whatever your well test goal, we only provide you with the tools you need.
Get reliable, efficient reservoir evaluation for virtually any well, in any environment.
Downhole Testing Equipment
Test tools control the flow of hydrocarbons from the reservoir into the work string. By controlling the flow of hydrocarbons, a reservoir is allowed to produce for a period of time, and then be shut in. This process is repeated several times, resulting in measurements that empower operators with an ability to predict the rate of production decline within the reservoir. Proven, reliable test tools are needed for controlling the flow of hydrocarbons and obtaining accurate reservoir performance indicators. And Halliburton offers reliable, efficient, test tools for economic evaluation of virtually any well, in any environment.

Halliburton Test Tools have been designed to enable a temporary completion of a well. The tools are made up of five primary components:

- Packer
- Pressure and Temperature Gauges
- Pressure/Volume/Temperature (PVT) Samplers
- Tester Valve
- Circulating Valve

Packer
The packer creates a barrier between the wellbore fluid and the formation. The packer is typically at or near the bottom of the bottom hole assembly (BHA).

Pressure and Temperature Gauges
Pressure and temperature gauges record the response of the formation when the formation is allowed to flow and when the formation is shut-in. The flow period can be referred to as the drawdown period and the shut-in period can be referred to as the build-up period.

Pressure/Volume/Temperature or PVT Samplers
Pressure-volume-temperature (PVT) samplers answer key questions regarding the types and amounts of fluids the formation will produce. This information is necessary in designing production facilities.

Tester Valve
The tester valve is the central component. It controls the flow from the reservoir by opening and closing for a predetermined number of cycles over a period of time.

Circulator Valve
The last component is the circulating valve. It clears hydrocarbons from the well bore after the test is complete so kill-weight fluids can be pumped back into the workstring. Two circulating valves are used — one as a primary device and the second as a backup.

Cased Hole Test Tools
With more than 80 years of specialized cased hole experience, Halliburton has the resources to help with all your cased hole challenges.

Some of the vital tools used in cased hole testing include circulating valves, tester valves, packers, and a range of accessory tools. They are proven in extreme HP/HT (onshore as well as deepwater environments), are debris tolerant, and can help meet a wide range of your needs.

Halliburton’s full opening, annulus pressure responsive (APR) test valves require no pipe manipulation, making them ideal for testing operations onshore and offshore and in highly deviated wells.

With our Cased Hole DST Tools, safety is greatly improved as the test can be conducted with the blowout preventers (BOPs) in a permanently closed position. Plus, all Halliburton downhole tools are designed in compliance with the NACE MR01-75 standards.
**Open Hole Test Tools**

Halliburton has the tools and experience to help with any open hole testing challenge. Some of the various tools used in open hole testing include packers, valves, safety joints, and testers.

**Tool Sizes**

In order to provide you with test tools that support your specific operations, Halliburton Test Tools come in a variety of sizes. In fact, Halliburton is continually developing and deploying fit-for-purpose sizes of test tools, so be sure to speak with a representative to locate the most current, appropriate test tools for your operation.

**Operating Environments**

From low pressure/low temperature to extreme high pressure/high temperature, Halliburton tools have a proven history of handling extreme testing conditions. In fact, our extreme tools are currently rated to 30,000 psi and 450° F. So, whatever the environment, chances are Halliburton has the test tools you need.

**ENGINEERING TEST FACILITIES**

Through the experience and knowledge of our people and a commitment to innovation, Halliburton continues to deliver technically superior, value-added products and services. A key component of this process is the state-of-the-art testing and design validation facilities at our Carrollton Technology Center in the Dallas Metroplex. The Center has developed a steady stream of innovative industry products with many U.S. Patents issued and numerous engineering innovation awards received.

The Center’s Engineering Test Facilities provide engineering analysis and support, high-pressure/high-temperature testing, and tool pre-qualification to API and ISO requirements.

The Center also includes two working test wells with rig accessories, slickline and E-line operations as well as flow testing capabilities which allow Halliburton to simulate actual well environments before running new tools in customers’ wells.

**“Customers’ Well”**

As the demand for energy increases, the drilling and completing of wells continues to expand industry boundaries. Higher pressures, hotter wells, and tool complexities require a state-of-the-art test facility. The ‘Mike Adams’ Test Well is designed to be safe, operationally efficient, and best in class for testing downhole tools for both vertical and horizontal applications.

The Halliburton Engineering Test Facility also includes:

- High-Temperature Test Facility
- Deep Well Simulator Test Facility
- Subsurface Safety Valve Test Facility
- Test Bunker
- Test Cells

**Comprehensive, Integrated Testing Solutions**

With on-site, rigorous testing facilities and a proven history of providing innovative, results-generating test tools, Halliburton continues to be at the forefront of the oil and gas industry.
Get accurate, reliable well-test data to save rig time.
Data acquisition is one of the most important objectives of well testing. While the equipment used to perform a well test has improved technologically over the years, the need to acquire data remains the same.

In order to consistently acquire well test data, the data acquisition system must be safe, reliable in operation, accurate in measurement, and provide information that is easily accessible. Halliburton has worked continuously to develop its data acquisition portfolio to help ensure reliability, accuracy, and easy access to information as it is being measured.

Halliburton offers memory gauges, surface readout tools, and surface measuring equipment that will not only aid in making sure that the data is secured, but also help make the data available to other locations in real time. Halliburton does not stop at data collection. In data acquisition, focus remains on the reservoir with an emphasis on providing a high level of customer service to meet your data acquisition needs.

**Pre-Job Planning**

In order to achieve success in field operations, pre-job planning must take on a central role in preparing equipment, personnel, and processes for job execution. The Halliburton Management System (HMS) serves as a pre-job planning and execution guide to help ensure that work is conducted professionally, safely, and effectively.

All equipment goes through a calibration process before going to the wellsite to help ensure accuracy of measurement and availability of spare parts that are provided for any contingency. Check sheets are provided to guide personnel through required checks and are verifiable by the customer as required.

Another important aspect of pre-job planning includes use of the myHalliburton.com portal which allows users to set up a collaborative community for sharing documents, posting questions, and managing tasks and calendars with registered team members and key Halliburton personnel worldwide.

Registered users also have access to all the products and service applications that myHalliburton.com provides. The portal provides practical, relevant resources and tools for data gathering, analysis, and real-time decision making for quick, effective service.

**Real-Time Operations**

Today’s competitive environment demands quick decisions. With Real-Time Operations (RTO), Halliburton is optimizing resources, reducing risks, reducing the time required to carry out operations—all to maximize well testing budgets.

Using powerful HalLink® satellite communications technology to bridge the distance between people and data, Real-Time Operations brings well test data directly to the experts, enabling Halliburton and the client to monitor and analyze a well test in real time without traveling to the wellsite. In addition to providing real-time access to data collected at the wellsite, the satellite communications system allows direct access to the Halliburton technical information network, direct voice access, and e-mail access from the wellsite. This means not only faster communication of vital information from the wellsite to support personnel, but also faster solutions for unplanned events.

**DynaLink® Telemetry System**

The DynaLink® system helps reduce the cost of operations and enhances the economical value of the reservoir through flexible access to critical and accurate real time data that’s pertinent to the reservoir evaluation. An electric, wireline-conveyed, bi-directional system, the DynaLink system is capable of transmitting data across Halliburton annulus-operated downhole tester valves in drillstem testing (DST) applications, or can be hung off on wireline in bottomhole pressure survey applications. This allows well-timed decisions to be made in drillstem testing and future sand control or stimulation applications. For pressure and temperature monitoring, a dual memory gauge allows redundancy capability.
DynaMem® HP/HT Electronic Memory Gauges
The Halliburton line of robust electronic gauges have proven track records, and are designed to meet a variety of customer needs. Continued innovation and technological advancement has allowed the development of a new generation of tools that requires less power and has increased stability, resulting in consistent, accurate measurement of reservoir parameters.

The DynaMem® series of gauges is designed for both short-term and long-term monitoring. Gauges come in standard sizes, and a miniature version that maintains the same standard as larger gauges and has been proven reliable in the toughest oil fields — including sour service.

INSITE Anywhere® Service
INSITE Anywhere® service is a next-generation, web-based data delivery system that provides the flexibility of the industry’s most robust database structure without the need to install special software. Using advanced satellite communications technology or any other network, the INSITE Anywhere service moves data from the logging tools onto a secured web site for viewing in real time.

When an unplanned event arises, the INSITE Anywhere web delivery system provides needed facts to help you take command of the situation. Solutions will be based on complete up-to-the-minute information, and operators can participate in multiple wellsite operations from one location. With all the travel time saved, capabilities are stretched further, making the most of company resources.

Multi Phase Flow Meters (MPFM)
Halliburton Multi Phase Flow Meters (MPFM) allow accurate measurement of hydrocarbon flow rates and fractions. They’re available in various sizes and can be deployed as permanently installed, or as a temporary complete skid mounted metering system for exploration, appraisal and production well testing, artificial lift optimization, clean-up trending and reservoir management.
Obtain representative reservoir fluids, collected in any environment, with the highest reliability.
Accurate fluid sampling and analysis are keys to optimizing the profitability of an oil or gas field. Halliburton specializes in reservoir fluids sampling using state-of-the-art tools and techniques to help deliver safe, reliable and accurate results. Halliburton is also working toward providing a complete range of on-site analytical services such as H₂S, mercaptans, radon and mercury analysis to complement our surface well test capabilities. Additionally, in conjunction with alliance partners, Halliburton is also positioned to provide detailed on-site and laboratory-based Pressure, Volume, Temperature (PVT) studies. Collection, analysis and proper interpretation of representative samples is crucial to developing the needed understanding of a hydrocarbon reserve and determining its economical viability.

Physical properties and chemical composition of reservoir fluids play a crucial role in all aspects of petroleum and reservoir engineering. Accurate sampling and analysis techniques often provide critical input to reservoir simulation models and help to optimize processing facility designs while boosting the profitability of an oil or gas field. A physical sample of the reservoir fluid is also crucial to undertaking assay analysis, the results of which provide extensive, detailed hydrocarbon data for refiners, oil traders, and producers. This information is imperative for defining the monetary value of a hydrocarbon reserve.

Our integrated, complete approach to reservoir fluids sampling and analysis will be a valuable tool in helping to increase your knowledge of the reservoir. Moreover, it gives you the insight needed to maximize the net present value of your assets. In short, improved reservoir understanding can not only lead to lower production costs, but it can also maximize recoverable reserves while reducing well intervention expenses.

**Reservoir Fluid Sampling**

Representative reservoir fluid samples are essential prerequisites for providing quality data. Therefore, accurate sampling is of the utmost importance. Special sampling equipment and procedures have been developed to secure the highest quality samples possible.

**Bottomhole Sampling**

Bottomhole sampling represents the simplest and most convenient mechanism for collecting representative reservoir fluid samples. Bottomhole samples collected during a Drill Stem Test (DST) offer the greatest probability of delivering contamination-free samples. This contamination is primarily from the use of oil-based drilling fluids which tend to penetrate the reservoir to be investigated. When subsequently produced, the first fluids recovered tend to have this drilling oil as a contamination. Because a DST allows for large volumes of reservoir fluids to be recovered to the surface, there is a greater probability that contaminant-free fluid will be collected during the sampling step.

Halliburton has designed and deployed state-of-the-art technologies to deliver in situ reservoir samples to the surface at pressures that are usually significantly higher than the reservoir’s pressure. These high recovery pressures help ensure that the sample will stay securely in the single phase region during recovery to the surface. Consequently, the likelihood is greatly reduced that asphaltenes will drop out of solution to create a non-representative sample. When analyzed in the laboratory, these representative samples will deliver an accurate picture of whether the hydrocarbon of interest has asphaltenes present and under what conditions of temperature and pressure they might pose a problem during the life of the reservoir.
The most important success factor for obtaining representative reservoir fluid samples is to ensure the reservoir fluid is single phase prior to sampling. This can be best accomplished by effectively controlling the sample drawdown pressure during the actual sampling phase.

When the reservoir is saturated, or if the pressure is close to the saturation pressure, even minimal drawdown can cause a sample to go two-phase. To better understand the nature of the samples being collected, Halliburton is considering the development to go to a suite of sensors that will deliver a more precise understanding of the fluids adjoining the samplers when the sampling operation is initiated.

Halliburton offers a complete suite of sampling tools that cover all aspects of the sampling operation. For example, the Armada® Fluid Sampling System is our premium, state-of-the-art pipe or tubing conveyed sampler for cased hole sampling. In terms of volume of sample collected, HP/HT operability, and innovative safety and performance features, the Armada system is unmatched in the oil and gas industry. Leveraging the Armada system’s proven technology, a variation of the sampling system called “Agile” is available with carriers holding three to six 400cc samplers and very high recovery pressures.

Halliburton continues to offer its legacy SIMBA® pipe conveyed sample carrier which can accommodate two 600cc SPS-15 samplers. The SIMBA system can be an effective sampling option for situations where more comprehensive sampling operations are not needed.

Both the Armada and the SIMBA systems can be triggered by annulus pressure, while an acoustic trigger is also available for the Armada system. The SPS-15 also serves as the wire/slickline deployed tool to round out the Halliburton bottomhole sampling offerings.

Low levels of H₂S are always an area of concern when sampling. It is imperative for accurate H₂S measurements at these low levels to ensure correct completion equipment. Halliburton has taken the leading role in helping ensure samples are H₂S representative by treating all wetted surfaces with an inert, ceramic coating to help provide the most accurate H₂S measurements possible.

**Surface Sampling**

Samples collected during surface operations are relatively free of the volume restrictions associated with downhole sampling. Multiple samples from multiple zones are also feasible during surface sampling. The very nature of surface operations also allows for a number of parameters to be simultaneously monitored as a measure of stability before sampling. For example, if a steady gas/oil ratio (GOR) value is obtained during a flow period, along with stable wellhead and separator pressures, then an operator has a strong indicator of a stable sampling opportunity. Due to the relatively low cost and simplicity of performing surface sampling, this service will be required on the vast majority of exploration and appraisal test, regardless of the expected fluid type.

These separator samples will require a physical recombination of the oil and gas samples to be undertaken in a laboratory using the GOR measured at the surface test separator. Halliburton has significant experience and the necessary equipment associated with surface sampling operations. With the global introduction of our advanced surface well testing capability, the company is well positioned to provide exceptional and detailed sampling capabilities worldwide.
Reservoir Fluid Analysis

Halliburton, in conjunction with its alliance partners, is well positioned to deliver on-site PVT analytical services through portable laboratories or off-site analysis in permanent laboratories in a number of locations worldwide. Analytical services cover the complete range of information needed to deliver a proper understanding of a hydrocarbon reserve. The complete range of equipment and services includes:

- High pressure/temperature visual cell to 15,000 psia and 600°F
- Compositional analysis up to C70+
- Constant composition expansion with relative volumes (ranges up to 30,000 psia and 500°F)
- Viscosity measurements using capillary viscometers to 20,000 psia and temperature range from 30°F to 600°F (viscosity up to 1 million cP)
- Differential liberation (black oil) or constant volume depletion (condensate or volatile oil)
- Swelling, solubility, and mixing studies
- Compressibility measurements on hydrocarbons and hydraulic fluid systems from 30°F to 600°F and up to 30,000 psia
- Determining the effect of mud additives on fluid behavior for equation-of-state modeling
- Testing additives for viscosity improvement
- Handling heavy oil or sour gas systems
- Performing benchmark compositional analyses
- Performing solid deposition studies
- Drilling mud additives under reservoir conditions
- Slim tube studies to examine fluid behavior for miscible flooding and gas cycling projects

In addition, unconventional studies can also be undertaken to address specific problems that require a unique understanding of the tough challenges facing the modern petroleum industry. If needed, customized tests can be designed to meet specific client needs.

Halliburton has the experience and the capability to deliver reliable, accurate, and complete fluid sampling solutions specific to any anticipated well testing needs.
Optimize surface facilities, with reliable production data, obtained safely and efficiently anywhere in the world.
Halliburton provides surface well testing services and products, including planning, specialized equipment, and monitoring and measurement of all factors relating to the production of oil, gas, and water at a well site.

The end result is complete, accurate and reliable data to make critical decisions regarding additional testing, production methods, secondary recovery programs, and developmental drilling.

From the surface test tree to the separator, from the surge tanks to the burner units, every component of Halliburton’s surface well testing system is engineered to protect personnel, the environment, your well, and the accuracy of your data.

- Packages are tailored to specific test conditions and objectives through use of “Design of Service” process
- Specialized packages meet environmental regulations for highly sensitive areas
- Automated and manual shut-in systems keep control even if unanticipated conditions develop
- Flow measurement devices are precisely calibrated for exceptional accuracy
- Standardized equipment modules fit ISO envelopes, simplifying transport and handling

All system components meet NACE MR-01-75/H₂S service standards as well as all applicable industry API, ASME, ISO/CSC and DNV codes and standards. CE marked packages are available to meet specific area requirements.

**SURFACE WELL TESTING PACKAGE**
The Halliburton standard Surface Well Testing Package components are all designed to allow equipment standardization, ease of maintenance and global uniformity in processes and procedures. Halliburton provides a variety of Surface Well Testing (SWT) equipment options including (but not limited to):

- Surface Test Tree with Swivel and Lower Master Valve (3” or 7 3/8” ID)
- Cofflon® Flow Hose
- Kill Hose
- Surface Safety Valve
- ESD System
- Chemical Injection Pumps
- Data Headers
- 5 and 8 Valve Choke Manifold(s)
- Heat Exchanger
- 3 Phase Horizontal and 4 Phase Vertical Test Separator
- 250 psi Surge Tanks
- 200 bbl Atmospheric Tanks
- Diverter Manifolds
- Pipe Packaging
- Transfer Pumps
- Safe Area and Air-Purged Zone-Specific Lab Containers
- Burner Booms and Burner Head Systems
- A-60 Pressurized Lab Cabins
TRAILER PACKAGE

Dual Trailer Desert Package
Dual Trailer units are designed for desert use. They are comprised of double 40-ton payload, fifty foot step down trailers. Equipped with a fully functional, self sufficient Surface Well Testing package, these SWT trailer packages can be mobilized quickly, rigged up in shorter time than the traditional skid unit packages and are designed specifically for desert/land operations.

Euro Trailer Package
The Dual Package consists of three 40 foot trailers designed to meet European CE and ATEX standards and guidelines. As with the Dual Trailer package, this system will allow a self sufficient Well Testing package to be easily mobilized to and from location, reducing rig-up/rig-down times to improve efficiency.

Express Package System
This mobile single trailer unit consists of a 4 valve choke manifold, a first stage vertical 4 phase and a second stage horizontal 3 phase, and a 2000 psi/14 MPa, 32” x 10’ separator. This trailer unit is designed for fast, efficient mobilization to the wellsite and can be utilized in a variety of well test, clean up and flowback applications.

Frac Flowback Test (FFT) Package
The Surface Well Testing package incorporates a specialized abrasive resistant 7 valve choke manifold and a vertical 4 Phase Separator system. The FFT manifold, with its dual inline positive choke system is designed for enhanced choke manifold durability to handle the flowback of abrasive proppants. The 1440 psi/10 MPa vertical 60” x 11’ 4 Phase Separator provides a means to safely and efficiently separate and measure the flow rates of produced oil, gas and water from the reservoir while also allowing a controlled method of handling solid returns.

Surface Data Acquisition
The Halliburton Well Testing Data Acquisition System combines GeoBalance® Sentry™ Data Acquisition and the Halliburton INSITE Anywhere® service to provide up to date electronic hardware and data gathering software for high performance data gathering during well test operations. Sentry™ software calculates well test parameters such as flow rates and volumes and produces accurate, real-time logs. Well test reports are gathered and information is stored within the INSITE® database. Data is displayed on one of the selectable human machine interface (HMI) screens or customizable display screens and can also be created within Halliburton's INSITE® software. Historical and real-time data can be accessed, displayed and evaluated during the test. Work stations can be placed in various locations during well test operations, such as the company office or service office, enabling the client and Halliburton testing personnel to monitor the test. Gathered data can be accessed without the risk of disturbing overall system performance. Data can be transferred to other locations such as Halliburton Testing Real-Time Operations (RTO) centers or client offices for real-time evaluation and analysis.

Multi-Phase Flow Meters
The MPM* topside meter is intended for production monitoring, well testing and allocation metering purposes. It can be supplied as a Multi-Phase meter, a Wetgas meter, or as a combined Wetgas and Multi-Phase meter. The MPM Meter is an unique measurement methodology that ultimately bridges the gaps between Multiphase and Wet Gas Metering. All meters for well testing services come with full metering technology options and have HP/HT design specifications. All the wetted parts are made of Inconel 625® material and are therefore safe to use on wells with high concentrations of H₂S and CO₂. The design standards for the meters are ISO 13628 – 1,4,6, API 17D, API 6A, ASME B31.3, ASME Sec. VIII Div.2, DNV RP A – 203, ATEX, and NACE MR-0175. The technology is available in various sizes and can be deployed as a permanently installed, or as a temporary complete skid, mounted metering system. Both options provide a compact metering solution for easy deployment and installation no matter what the location. The MPM* measures continuously and in real-time to help ensure the highest meter accuracy. The measurements achieved help to increase the knowledge of the reservoir and how wells behave. A Multi-Phase Flow meter can give significant contributions to optimizing production, recovery and revenue.

Advanced Technology
The meter is technology which was developed by MPM* in partnership with ten major oil and gas operators. It is qualified through an extensive verification program in certified laboratories and field production operations. There have been more than 120 of these systems sold worldwide for topside and subsea applications to date. From the Surface Test Tree to the Separator, from the Surge tanks to the Burner Units, every component of the Halliburton surface well testing system is engineered to protect personnel, the environment, your well, and the accuracy of your data.
In an emergency, have a flexible, efficient system that provides fast disconnect and reliable well isolation.
Subsea Safety Systems for Exploratory Wells and Production Wells

Halliburton offers two innovative, temporary systems in sizes to match your needs:

- Small-Bore systems for exploratory wells
- Large-Bore systems for production wells

Regardless of size, their primary function is to provide well control during certain types of operations run from a mobile offshore drilling unit. Typical mobile offshore drilling units include dynamically positioned drilling vessels and semi-submersible rigs.

The most common type of emergency is when a storm at the surface creates excessive motion in a drilling vessel. Because the vessel is attached to a fixed point on the floor of the sea, that motion could snap the landing string – or riser – if the vessel gets pushed too far off position. A rupture could leak hydrocarbons from both below and above, and gas and oil could be released from the well, or drain down from the riser.

Other conditions creating emergencies that require disconnects include strong currents pushing drill vessels outside of their zone of safe operation and, in the arctic, approaching sea ice or ice bergs that could do the same. In addition to natural causes, a vessel’s dynamic positioning system could fail.

Regardless of the cause, Halliburton Subsea Safety Systems let operators isolate the well within the blowout preventer (BOP) stack and disconnect in a safe and controlled manner. During a disconnect, our systems can even cut coiled tubing that may be running into the well, and still seal off both the riser and the well.

MODULAR DESIGN

A short list of components work together to make up a single Subsea Safety System:

- **Quick Union Joints**
  Quick Union Joints provide safe, simple, fast connections to eliminate difficulties and damage that occasionally occurs with competitive systems.

- **Lubricator Valve**
  The Lubricator Valve controls pressure while running tools into the well and enables testing to proceed without killing the well.

- **Retainer Valve**
  The Retainer Valve seals off the end of the riser in the event of an emergency disconnect so fluids above the blowout preventer will not escape into the sea. A ball valve provides fail-safe operation. When pressure is cut off from below, it seats and seals.

- **Safety Tree**
  The Safety Tree sits inside the blow-out preventer and connects to the preventer’s shearing rams so pipe or tubing can be cut, if necessary, during disconnects. The tree also provides multiple injection ports so that chemicals can be added to the oil and gas flowing out of the well.

- **Emergency Response Module**
  Halliburton Subsea Safety Systems are controlled one of two ways:
  - Direct Hydraulic
  - Electro-Hydraulic

In extremely deep offshore wells, pressure activation of the Emergency Response Module may not be sufficient for all circumstances. So although Halliburton offers direct-hydraulic and electro-hydraulic controls on every tree, to more quickly activate valves below the surface, many operators prefer the electro-hydraulic Emergency Response Module.
Chemical Injection and Control Lines
Halliburton Subsea Safety Trees contain ports for chemical injection and control lines. With these ports, you can work to prevent a riser from icing up in the near-freezing conditions found in deep water. When used for completions, the trees have other ports that allow for running control lines to the pipes and valves that are being installed downhole.

Packaged Services
Our systems also come with:
- Specialized mechanical and hydraulic design work upfront helps ensure our systems will function properly with yours - especially the blowout preventer
- On-shore pressure testing and system deployment includes pre-assembled delivery - minimizing rig time and spaced requirements
- A crew of four to five personnel accompanies each sub sea safety system. This crew remains with the system throughout its deployment and oversees its safe operation
- Project management for multi-well projects
- All equipment maintenance - to help ensure Halliburton Subsea Safety Systems operate properly each and every time we return them to shore for maintenance after each deployment.

Three Different System Designs
Halliburton provides three systems for different applications. The Halliburton Small Bore Subsea Safety System is a 3” system that is used in exploration wells. Of course, because inside casing for production wells is much larger, Halliburton provides a 6 3/8” and 7 3/8” Large Bore Subsea Safety System. Each of the Large Bore Systems has specific pressure and strength ratings. This means that whether your well is in the exploration or production stage, for your Horizontal (or Spool) Production Trees or Wellheads when mud is not present, Halliburton has a reliable, simple, and safe way to disconnect in an emergency while still controlling a well.

Proven Reliable
The fact is, since Halliburton has been offering this service, we have not had a single lost time incident due to this equipment’s failure. Our systems are designed, maintained, and continuously improved for reliability.

For example, redundancies are built in. Every o-ring has a back up. Disconnection methods also have back ups. And, even with the primary disconnection method being a simple, mechanical latch, a secondary, hydraulic system is also available.

Flexible Systems
Of course, reliability is the most important feature of Halliburton Subsea Safety Systems. But, they also provide operators with flexibility:
- Halliburton Safety Tree has the shortest design in the industry. That means it works with the widest variety of blowout preventers.
- Halliburton Subsea Safety Systems can be used in virtually any environment. From High Pressure/High Temperature (HP/HT) to heavy oil, these systems can be leveraged without significant adjustments.
- Halliburton Subsea Safety Systems have tensile ratings that allow them to be used on deeper wells with heavier completions.

Efficient Systems
Halliburton Subsea Safety Systems make drillers more efficient. They include more injection ports for pumping higher volumes of chemicals, faster. The Systems also offer more through-ports to run controls down to chokes and valves in wells that are being completed. The systems feature mechanically locked, high-integrity joints, thus eliminating the need for assembly on the rig floor - they are assembled and pressure tested at Halliburton and arrive ready for deployment, saving all-important rig time and space.

An easy-seating, debris-tolerant, passive latch system also saves rig time. This straight-in bayonet system is designed with a cone on the receiving end that guides the point of a landing string into position until it latches and locks. Other safety systems require rotation to latch, but the Halliburton system does not. By eliminating the need for rotation, potential issues with landing weights and string torsion is eliminated. This also can save a lot of rig time.

Effective Systems
Halliburton Subsea Safety Systems offer dozens of unique features that add up to significant benefits in reliability, flexibility, and efficiency. In short, with Halliburton Subsea Safety Systems, you get peace of mind, knowing that if needed, they are designed to work. And, you will have an effective tool to manage rig costs as well.
Together, we can get to Zero.
Aiming for Zero

The oil and gas service marketplace is facing a critical challenge. The industry itself, and Halliburton as a company, are not satisfied with the rate of improvement in global Health, Safety, and Environment (HSE), Service Quality (SQ), or environmental trends. In fact, operating even more safely and in a more environmentally sound manner is now the new “license to operate” for oil and gas operators and service companies alike.

For any service company, it will take dramatic action to call any meaningful HSE and SQ incident reduction initiative a success. However, Halliburton is taking an industry-leading position by aiming for zero Health, Safety and Environmental incidents, plus zero non-productive time. There can be no higher goal than zero. At Halliburton, we know it is possible and we believe we have a plan to get us there.

The Plan in Action

First, we have appointed a senior-level team to address our company-wide HSE and SQ initiatives. This full time group is focused on processes for personnel safety and process assurance for service quality execution.

We have also reorganized our HSE and SQ strategies to empower us with the ability to greatly improve individual safety, safety in execution of all our processes, and environmental performance in the delivery of all our services.

In addition to reorganizing, strengthening processes, and increasing our focus on HSE and SQ issues, as a company we have developed technologies that decrease our environmental footprint. Our CleanSuite™ offering, which includes CleanStim®, CleanWave™, and CleanStream® products and services, are just a few recent examples.

Service quality issues revolve around competency, maintenance, process, design, operations failures, usage, human error and material/products, and manufacturing. We have initiatives in place to improve in these areas, including:

- Workforce training and competency certification
- Open communication and risk mitigation
- Continual HIMS process improvement
- Pre-testing and re-testing field equipment
- Stop Work authority for all personnel
- Measuring results for verification

Ultimately, Zero is a no-compromise strategy. It is how we work towards a zero recordable incident rate, zero lost time incident rate, zero recordable vehicle incident rate, zero total environmental incident rate, zero poor quality, and zero non productive time. Together, we can get to Zero.
Sales of Halliburton products and services will be in accord solely with the terms and conditions contained in the contract between Halliburton and the customer that is applicable to the sale.