@balance Services
Managed Pressure Drilling and Underbalanced Drilling Services
Schlumberger provides a complete range of pressure control solutions to manage the pressure barrier in the well and drill more efficiently with reduced risk and nonproductive time and greater wellbore stability.

@balance Services
@balance Services managed pressure drilling (MPD) and underbalanced drilling (UBD) includes engineered pressure control solutions.

Safer, efficient, tailored solutions
Unstable boreholes, uncertain pressures, and narrow pressure margins pose heightened safety concerns and add greater levels of complexity for operators seeking ways to increase productivity while reducing cost and nonproductive time.

We take an engineered approach to assess anticipated drilling conditions and align our solutions with the needs of each well and our customers’ performance objectives.

Based on this approach, we tailor our solutions with fit-for-purpose services, which use industry-leading M-I SWACO drilling pressure control equipment and fluid expertise.

MPD / UBD service categories
Engineering services
We take an engineered approach to facilitate MPD and UBD operations and provide fit-for-purpose support in line with our customers’ objectives, beginning with project needs and risk assessment and including model-based analysis, job planning and execution, and pressure performance evaluation.

Rotating control device services
A complete range of high- and low-pressure rotating control device (RCD) services are available for fluid containment, stand-alone pressure management, or full-service MPD and UBD operations, on land and offshore.

Drilling pressure control services
Proactive and reactive pressure control services include a wide selection of chokes, stand-alone manual controls, or automated dynamic controls.

Kick detection services
Detection services for MPD operations use accurate, real-time flow data to identify small amounts of influx and loss early on and issue alarms.

Fluid separation services
Services include a wide range of equipment for the separation, recovery, and management of drilling fluids and solids. These include multiphase separation, gas flow measurements, hazardous gas removal, venting, and flaring.

Nitrogen gas services
Services include N₂ generation and injection, engineering plans for multiphase operations, trailer-mounted or stackable skid units, data acquisition, emergency shutdown and alarms, backpressure control manifolds, and sample catchers.
An engineered approach
We take an engineered approach to facilitate MPD and UBD operations and provide fit-for-purpose support aligned with our customers’ objectives, beginning with project needs and risk assessment and including model-based analysis, job planning and execution, and pressure performance evaluation.

Risk and needs assessment
Assessing the needs and risks of each project begins with understanding customer drilling objectives and the downhole environment in terms of pressure limits, profile uncertainties, and prior experience with losses, gains, instability, and other pressure-related NPT incidents. Qualified by these assessments, we make fit-for-purpose equipment recommendations to minimize the risks.

Job analysis and planning
For an in-depth, engineered solution, we build on our understanding of the needs and risks of the project and analyze various drilling scenarios to determine the optimum pressure limits, fluid hydraulics, and mud weights. This forms an engineered basis for the job plan, including the required degree of control and equipment, drilling and pressure control procedures, contingencies, and training.

In addition, the plan includes
- layout and installation
- surface and downhole pressure and flow rate objectives
- hazard identification
- contingency responses
- rig crew training
- regulatory compliance actions.

The purpose of the plan is to
- maintain the annular pressure within specified wellbore pressure limits
- optimize circulating pressure, hole cleaning, and trip time
- maximize ROP without exceeding mud weight windows.

Job execution
To further facilitate MPD and UBD, we can provide office-based and wellsite engineering support to execute the plan in line with the project’s objectives, ensure on-time delivery and compliance with HSE and regulatory policies, and mobilize and manage additional technical resources as required.

Engineering support can be expanded to include the global network of Schlumberger drilling and petrotechnical experts. Real-time communication links can be established from the rig to leverage this expertise for real-time solutions to unanticipated conditions.

Pressure performance evaluation
We strive for Excellence in Execution on every job. At the end of each job, engineers evaluate service performance relative to the planned objectives, degree of control, and reliability. This allows customers to quantify the value we delivered and drive future pressure control service developments.
Continuous improvement, enhanced performance

The growing use of RCD services in increasingly more demanding drilling conditions has driven continuous improvements in sealing element materials and designs, certification testing per API RP 16 RCD guidelines, operational efficiency and safety, through-bore capacity, and spillage containment.

Low-pressure RCDs are available with compact profiles that are ideally suited for land rigs with limited space. High-pressure RCDs with unique bearing and sealing element features are available for land and offshore rigs that facilitate sealing element replacement and clamping.

High-pressure RCD services

High-pressure RCD services include remotely operated seal clamps, customized low-pressure containment risers, dual sealing element pressure sensors, integrated sealed-bearing assemblies, and in-house sealing element testing with customer drilling fluids. Low-profile designs are available to accommodate rigs with limited space below the drill floor.

Low-pressure RCD services

The low-pressure RCD services include compact, short-profile RCDs for MPD and UBD operations in low-pressure surface holes and large-diameter well sections on rigs with limited space between the wellhead and the rig floor.

The robust design and efficient profiles of the low-pressure RCDs minimize the need for continuous onsite service support, making them ideally suited for onshore drilling rigs in remote areas.

Sealing elements to optimize seal integrity

A choice of sealing elements is available to optimize seal integrity for a range of drilling fluid types and high-temperature conditions, including geothermal.

Sealing element assemblies can be configured with either one or two elements for different drillpipe and casing sizes and Kelly types. Dual sealing element assemblies can be uniquely equipped with an intraseal sensor to monitor pressure and early signs of wear.

Performance-driven acceptance

High-pressure applications for constant bottomhole pressure MPD, single- and multiphase UBD, pressurized mudcap drilling, environmental protection, and exploration drilling have established field-proven acceptance in deepwater, shale gas, HPHT, fractured carbonate, deep tight gas, subsalt, and horizontal development.

Low-pressure RCDs have a long history of robust performance and dependable seal integrity during flow drilling operations, under hazardous conditions, and for influx control. They are widely used in onshore applications in the Bakken, Eagle Ford, Haynesville, Marcellus, and Niobrara shale plays; Permian basin oil and gas fields; and the deep gas fields of South Texas and Louisiana.
Pressure control solutions for trouble-free drilling

MPD and UBD solutions are available for manual, reactive control and fully automated, model-based dynamic control. We tailor the control solution for each application based on the degree of control required in the well.

In applications that call for manual reactive control during unanticipated pressure changes or in wide pressure margins, we provide manually operated and digital control consoles for one or more stand-alone chokes.

Narrow margin applications, where the risk of losses, influx, and instability is high, typically call for proactive, automated, dynamic control. Proactive services include high-speed control integrated with a real-time hydraulics model and remotely actuated chokes and backpressure pump to manage annulus pressure in narrow limits, during every phase of drilling.

We offer a selection of chokes, including automated gear and piston chokes, M-I SWACO eCHOKE† units and high-pressure AUTOCHOKE† units, and small-footprint manifolds rated for high-pressure, high-flow, and severe H2S conditions.

Our pressure control performance has been proven in severely depleted onshore and deepwater reservoirs, high-angle multiphase MPD and UBD wells, horizontal shale gas wells, HPHT and geothermal reservoirs, and drilling with casing, cementing, and closed-loop pressure control with wired drillpipe.

Dynamic Annular Pressure Control

The DAPC system is a benchmark automated MPD system. It is the first to incorporate a real-time hydraulics model capable of simultaneously controlling multiple chokes and a backpressure pump to provide a singular level of field-proven performance, accuracy, and response.

LOW PRESSURE AUTOCHOKE CONSOLE

The M-I SWACO LPAC is a unique, easy-to-use, and simple-to-install digital console with a touchscreen human machine interface that provides precise pressure control in MPD and UBD operations.

Drilling and well-control chokes

Drilling and well-control chokes include industry-leading high-pressure M-I SWACO chokes for well control and managed pressure, underbalanced, and coiled tubing drilling. These include the AUTOCHOKE, 10K SUPER CHOKE†, and eCHOKE units, all known for their robust, fast-acting performance and precise flow control at pressures up to 20,000 psi.
Maximizing safety, minimizing contamination

We offer a wide range of services, equipment, and expertise for the separation, recovery, and management of drilling fluids and solids. These include two-, three-, and four-phase separation; geological sample catching; hazardous gas removal; and gas flow measurement, venting, and flaring.

Our engineered approach to assess anticipated conditions and select fit-for-purpose separation services allows us to provide solutions tailored for maximum safety and minimum risk. Separation services can be configured for conventional, MPD, UBD, and well-control operations on conventional, coiled tubing, and workover rigs, onshore and offshore.

Fluid separation equipment is available for high fluid volumes and hazardous gases including H2S and corrosive oxygen. Compact multiservice units are also available for total gas containment and integrated pressure and fluid management.

We provide equipment planning, installation, operation, maintenance, and hands-on training and skills development for operator and rig personnel.

Multiphase fluid separators

Our fluid separation services include skid-mounted, vertical, and horizontal vessels designed to separate and vent large volumes of free gas from returning fluids and solids, adjustable onshore and compact offshore units, and unique high-capacity units capable of pressurized operation.

CARBONTRACKER gas flowmeter

The M-I SWACO CARBONTRACKER† gas meter is an ultrasonic flowmeter capable of accurately detecting gas at low and high flow rates. It measures gas velocity, pressure, and temperature for determining volumetric and mass flow rates.

Vacuum D-GASSER units

M-I SWACO skid-mounted vertical and horizontal vacuum tanks are designed to remove all entrained gases, including H2S and corrosive oxygen, from returning well fluid. These D-GASSER† units include discharge lines to vent freed gas at safe distances from the rig and return restored mud to the active system.

TOTAL GAS CONTAINMENT SYSTEM

The M-I SWACO TOTAL GAS CONTAINMENT SYSTEM† (TOGA†) is a totally enclosed system designed to safely remove all gases from returning well fluid. It includes a two-phase mud/gas separator and vacuum D-GASSER unit that can be configured to accommodate virtually any drilling operation.

PRESSURE FLUID AND MANAGEMENT SYSTEM

The M-I SWACO PRESSURE AND FLUID MANAGEMENT SYSTEM† (PFMS†) is a skid-mounted, modular system that provides continuous, closed-loop pressure control and gas and waste removal on coiled tubing and workover rigs, performing conventional drilling, cleanup, fracturing flowback, reentry, and recompletion operations.
**Kick Detection Services**

Fluid Influx and Loss Detection to Enhance Drilling Safety and Reduce NPT

**Accurate flow detection, rapid response**

Kick detection services include an accurate Coriolis flowmeter for quick influx detection with delta flow during MPD operations. The kick detection services continuously record flow in and out of the well and calculate delta flow, which is used as an early indicator of influx, kicks, and losses.

In a typical setup, the Coriolis flowmeter is installed downstream of the MPD choke manifold where it monitors the flow rate of the returning fluid. When a backpressure pump is used to augment the annulus pressure during MPD operations, the injected mud will circulate through the choke manifold and Coriolis meter, which enables active kick detection when the rig pump is off.

Used in conjunction with the DAPC system, flow-out data from the Coriolis meter is fed directly to the pressure controller to eliminate delays. The human machine interface in the DAPC system monitors and tracks the delta flow and issues alarms when it exceeds programmed limits.

The early influx and loss detection capability of our kick detection services has been used in real-time flow tests and dynamic leakoff tests to establish critical operating pressure limits.

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**Nitrogen Gas Services**

Flow Drilling Solutions to Optimize Protection and Production of Mature Reservoirs

**Full-service multiphase solutions**

Nitrogen gas services include engineering services for multiphase flow drilling and equipment capable of generating and injecting N₂ at selectable flow rates and purity.

Nitrogen gas equipment is available in two different configurations: integrated trailer-mounted units and stackable skid-mounted units. The trailer-mounted, mobile nitrogen generation unit (MNGU) is easy to transport, has a small footprint, and requires minimal rig-up and rig-down time, making it an ideal solution for onshore underbalanced drilling applications. Built for extreme arctic and desert climates, the skid-mounted nitrogen generation unit (SNGU) can be driven with either diesel or electric motors to provide high-volume nitrogen injection. Trailer- and skid-mounted units can be combined to inject incremental volumes of nitrogen at precise rates.

Our engineering services include injection system planning, multiphase flow modeling and analysis, model calibration while drilling, data acquisition, emergency shutdown and alarm systems, choke manifolds, sample catchers, multiphase fluid separators, gas meters, and flare stacks.

**Record solutions for deep, depleted reservoirs**

In a multiwell onshore project, @balance Services MPD and UBD included a design for a concentric casing N₂ injection system and drilling plans for high-angle wells in deep, highly fractured, and severely depleted carbonate reservoirs. This allowed the operator to protect the reservoir by reducing the hydrostatic pressure to very low levels and controlling it in a narrow margin. It also allowed the operator to drill with MWD and LWD and achieve real-time directional control and reservoir evaluation.
Solutions with fit-for-purpose engineering support and equipment to manage and protect the pressure barrier in the well, ensure wellbore integrity, and improve safety.
@balance Services MPD and UBD offers global experience delivering engineered solutions for better ways to drill. Our experience performing under pressure assures results above expectations in the most challenging drilling areas of the world.

**IMPROVING**
- production
- wellbore stability
- drilling efficiency
- on-bottom drill time
- drilling safety

**REDUCING**
- mud weight and ECD
- formation damage
- NPT
- drilling cost
- lost circulation and stuck pipe

**PERFORMING**
- single- and multiphase gas flow drilling
- pressurized mudcap drilling
- constant bottomhole pressure control
- $N_2$ concentric casing injection
- managed pressure cementing
- dynamic leakoff test control
- static flow check control
- high pressure, high temperature
- geothermal drilling
- kick detection in shale gas wells
Schlumberger provides pressure control solutions to protect the annular pressure barrier in a well, prevent and detect potential well control events, and manage pressure and fluid during over and underbalanced drilling.