@balance Deepwater

MPD services
Achieve drilling objectives with closed-loop systems

MPD provides a closed-loop circulation system in which pore pressure, formation fracture pressure, and bottomhole pressure are balanced and managed at surface. A complete reservoir-to-flare MPD services system delivers a customized combination of hardware, control technologies, and experience-based knowledge that helps operators to achieve their drilling objectives.

Improve drilling efficiency, wellbore stability, and kick management

Traditionally, MPD systems have helped operators “thread the needle” in tight drilling windows, enabling them to complete wells that rank among the world’s most challenging. However, in today’s competitive drilling environment, wells of all types can deploy MPD to improve drilling efficiency, manage wellbore stability, and improve kick detection and management. Downhole pressure plays a critical role in any drilling scenario—and MPD enables operators to manage downhole pressure to improve their drilling performance.

Manage pressure values

MPD provides operators with a “mud-weight-on-demand” circulation system—a system that is faster and more effective compared with conventional mud-weight alteration. The practice of applying and adjusting pressure on the wellbore results in:

- reduced frequency of stuck pipe incidents and the time to resolve them
- decreased mud loss and associated costs
- rapid, controlled response to pressure changes such as kicks and ballooning.

The technology, software, and personnel deployed by M-I SWACO to solve MPD challenges help prevent drilling problems at the field level, not just the well level.

Drill faster and reach farther with @balance Deepwater MPD services
Together, the Schlumberger companies M-I SWACO and Cameron offer the industry’s first top-to-bottom deepwater MPD system. Our technologies and experts provide a seamless and flexible solution to the challenges present in deepwater environments—from planning the well to handling mud and gas as they flow to surface.

Components such as riser gas-handling systems, rotating control devices (RCDs), and control systems are selected to ensure operations achieve MPD objectives. Experienced and dedicated personnel analyze, plan, and execute MPD programs while working with and training operator staff. Depending on customer needs, M-I SWACO can prepare rigs to accept MPD equipment, install equipment to make a rig MPD ready, and even execute MPD operations. An integrated MPD system from M-I SWACO provides customers with the ability to reliably overcome the routine surprises inherent to deepwater fields.
**Deepwater annulus enclosure functionality**

Through @balance Deepwater services, M-I SWACO offers a surface RCD that is positioned above the riser tension ring. The RCD’s 18¾-in pass-through diameter is large enough to accommodate running a plug through for regular BOP pressure testing as well as large-bore drillpipe and tool joints. The RCD improves safety by eliminating the need for personnel below the rig floor.

Operators save rig-related costs with the ability to easily install and remove bearing and sealing elements. Under the most extreme deepwater conditions, the RCD fully encloses the annulus to isolate potentially harmful wellbore fluids, enabling drilling to continue during pressure events. A submersible RCD that sits below the riser tension ring is also available for deepwater applications.

**Fully automated control systems and dynamic chokes**

In deepwater drilling operations, the ability to recognize and control unexpected pressure changes makes the difference between stability and collapse. Fully automated control is achieved with the i-balance® real-time, automated managed pressure drilling control system. The system enables operators to control mud rollover schedules and kick events—as well as to compensate for heave—in even the most difficult wells.

With high-level automation in place, deepwater drilling operations can take advantage of dynamic choke designs for additional performance gains. Introduced in 2014, the VERSA-CHOKE® modular drilling choke technology is well suited for deepwater operations because of its large orifice and HPHT functionality.

**Riser-joint interface integration**

M-I SWACO and Cameron provide MPD technologies that integrate fully and easily with the riser-joint interface through @balance Deepwater services. The ability to directly tap into the drillstring and annulus in this way means operators receive a reliable top-to-bottom MPD solution. Especially in deepwater environments, this integration means greater ease of access when connecting to a riser gas-handling system.
Well engineering and project management

Optimizing drilling performance lowers well construction costs. If pressure-related challenges are expected on a deepwater drilling campaign, M-I SWACO MPD well engineering and project management services can help.

M-I SWACO offers analysis, planning, and execution support for any MPD operation. When customizing a deepwater MPD system and plan, our MPD engineers leverage an unmatched portfolio of technologies, from high- and low-pressure RCDs to industry-leading control systems. M-I SWACO, in conjunction with Cameron, designs, manufactures, and delivers deepwater MPD systems from start to finish.
**Project execution**

Once the components of the MPD system are in place, MPD engineers execute the plan using dedicated resources. Part of the superior functionality of our project management services is the ability of onsite and offsite personnel to respond rapidly and knowledgeably if plans change. At the wellsite or through remote connectivity, M-I SWACO personnel leverage PRESSPRO RT* real-time downhole performance measurement software and PERFORM Toolkit* data optimization and analysis software to carefully manage the pressure window throughout the drilling, tripping, and cementing process. With powerful software and years of experience, M-I SWACO enables operators to turn many MPD decisions from reactive to proactive.

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**Well analysis**

M-I SWACO MPD engineers first seek to understand the needs and risks present in a planned well. It all begins with the customer’s well design. Knowing the desired drilling targets and planned well architecture, our engineers evaluate the pore pressure, fracture pressure, and stability pressure requirements of the well. Understanding the degree of certainty around these boundaries enables the development of a drillable well design.

After analyzing various drilling scenarios, experienced personnel determine the optimal pressure limits, fluid hydraulics, and mud weights for an MPD or underbalanced drilling (UBD) operation. This forms an engineered basis for the well design and drilling plan, including the required degree of control and hardware, drilling and pressure control procedures, contingencies, and training.

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**System engineering**

If the thorough evaluation indicates that an MPD or UBD solution is required, our well engineering services can be used to optimize the equipment best suited to not only execute the job but to integrate economically with the selected rig.

M-I SWACO MPD engineers design these customized systems on a well-by-well basis. Taking into consideration customer requirements, our experienced personnel map out the specific hardware and software components necessary to achieve maximum performance. Our well engineering services enable operators to move from the theoretical to the actual by creating systems geared to achieve specific drilling objectives.
At the center of optimal pressure management in deepwater MPD operations is the i-balance system. This system continuously monitors annular pressure and manages it within specified limits to enable real-time pressure response. The i-balance system was the first automated MPD system approved for use in the deepwater Gulf of Mexico, the first operated remotely from onshore, and the first to control bottomhole pressure while drilling with casing and cementing. The latest version of the system enables even greater precision with heave surge and swab compensation.

Operators achieve accurate and precise MPD control when using the automated, semiautomated, and manual systems offered through @balance Control MPD systems.
Automated control

The advanced i-balance system is ideal for drilling operations that require a high degree of downhole pressure control. This advanced system provides real-time automated MPD control with numerous additional features—including trip pressure management and early kick detection—that add value to drilling operations. By linking choke control to sensor inputs and a real-time hydraulics model, the i-balance system responds quickly and effectively to changing pressures and flow rates to maintain the target bottomhole pressure.

Because the i-balance system traps annular pressure on connections, an auxiliary backpressure pump is no longer necessary, making the system ideal for tight locations and offshore rigs with limited deck space.

Semiautomated control

When fully automated pressure control is not required, the e-balance partially automated MPD control system is available to provide streamlined pressure control. The e-balance system follows a simple, editable ramp schedule to deliver the desired backpressure at any flow rate. The system can also be operated in manual mode, enabling the choke operator to manage the required choke position and pressures via the human machine interface (HMI) on the rig floor. When cost is a priority, the system may be licensed to the operator to reduce crew size, with a customer drilling engineer or wellsite supervisor taking ownership of MPD control.

The e-balance and i-balance systems are delivered on a common equipment platform, enabling a simple transition between automated and semiautomated pressure control as drilling requirements change in different hole sections.

Manual control

The LOW-PRESSURE AUTOCHOKE precision drilling choke console delivers accurate and economical pressure control for low-surface-pressure MPD and UBD operations. This system offers choke control via digital remote or direct mechanical actuation. In either setting, the console enables operators to transition between AUTOCHOKE pressure-balanced drilling chokes, while controlling two units simultaneously.

The console’s sunlight-readable touch screen panels ensure accurate readings in any weather condition and allow for precise pressure inputs to the AUTOCHOKE chokes. Screens display additional operating parameters including casing and drillpipe pressures, pump rates, strokes, and diagnostics.
MPD equipment

To fully enclose deepwater wellbore circulation in an MPD system, M-I SWACO offers an industry-leading array of options across high- and low-pressure RCDs, manifolds and chokes, pumps, sensors and meters, separators, degassers, and mud-containment systems. These hardware components are selected for optimal integration with all levels of control — from automatic to manual.

During the design phase, additional components can be selected for high-specification needs such as kick detection, fluid separation, and nitrogen gas generation and injection. M-I SWACO offers flowmeters, mud-gas separators (MGSs), and other technologies to suit these applications.

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**RCDs**

M-I SWACO supports an extensive fleet of RCDs for a variety of applications, including annular fluid containment and pressure management in onshore and offshore drilling environments. Our diverse product offering comprises low- and high-pressure RCDs with unique features for specific drilling scenarios.

**Control consoles**

Our control consoles are available as single- or dual-choke-control units with standard or digital pressure gauges. The single-choke console provides accurate control, even in the harshest conditions. It operates either hydraulically or manually and is self-contained and skid-mounted for easy installation.

**Drilling chokes**

A wide range of chokes are designed and manufactured for hydrogen sulfide and abrasive fluid applications. These products provide consistent effectiveness in MPD operations, especially where kick control is required. The precision-built chokes deliver accurate control, even in technically complex environments.

**Choke manifolds**

M-I SWACO choke manifolds are engineered to work with multiple choke and gate valve configurations and accommodate pressure ratings from 5,000 to 15,000 psi. With a bore size range from 2½ in to 4½ in, choke manifolds can be adapted to a variety of choke and gate valve configurations.

**Degassers**

Advanced degassers are designed to remove virtually all entrained gases—including hydrogen sulfide and corrosive oxygen—from drilling fluids. These degassers reduce the threat of dangerous and costly blowouts caused by recirculating gas-cut mud.

**Separators**

MGS technologies are ideal for use where drilling is likely to encounter large volumes of gas, such as in deepwater fields. The separators are especially beneficial in sour gas environments or when drilling with an underbalanced mud column.

**Flares**

We offer a range of flare stacks designed to meet the capacity demands and rig-up requirements of deepwater applications.

**Solids control systems**

Our solids control systems optimize drilling efficiencies by maintaining fluid integrity, reducing fluid losses, minimizing HSE impact, and lowering drilling costs through improved NPT management.

**Measurement technologies**

Highly accurate ultrasonic gas-flow measurement technology, combined with a precision pressure and temperature sensing transducer, measure gas-flow velocity, temperature, and pressure to determine actual and standard volumetric flow as well as mass flow rates.

**Additional technologies**

- Mud-containment systems
- Managed pressure cementing units
- Riser gas-handling systems
- Riser interfaces
- Nitrogen generation units