



Rig Integral MPD Equipment and Services

Mi SWACO
A Schlumberger Company



Drill faster and reach farther with MPD equipment integrated into the rig

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 system from M-I SWACO 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 methods of 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.



Rig integral MPD equipment and services

MPD systems are typically offered by service companies on either a callout or contractual basis. This service model can be appropriate for long-term installations but is challenging to execute in high-volume, efficiency-driven operations. The installation of MPD equipment as needed can be time consuming and intrusive to operations, resulting in easily avoidable NPT.

With all the necessary hardware embedded directly into the rig, the M-I SWACO equipment approach enables executing different levels of MPD operations. This integrated pressure control equipment—selected to manage the needs of the specific drilling program—delivers an MPD-ready system for on-demand performance.

Configure tiers for a range of MPD solutions

M-I SWACO recognizes that different MPD applications require different levels of pressure management control. Three tiers of service packages are available, and each is configured for different levels of control depending on the application. With each tier, various combinations of equipment and technical support may be provided as required for the operation.

Tier	Purpose	Description	Included Components	Optional Components
1	Control nuisance gas	Control nuisance gas with a package configured to deliver improved drilling efficiency.	<ul style="list-style-type: none"> ■ Compact rotating control device (RCD) ■ Separator ■ Flare stack 	
2	Manage downhole pressure to continue drilling	<p>Conduct simple MPD and flow drilling operations with a system that enables the rig to continue drilling while flowing gas out of the well. Depending on the application and the degree of control required, the Tier 2 system can be configured with manual, semiautomated, or fully automated choke control. M-I SWACO can further enhance gas management by providing a Coriolis flowmeter or CARBONTRACKER* gas flow measurement system.</p> <p>With Tier 2 services, experienced MPD personnel support the drilling crew throughout the training period to ensure full competency.</p>	<ul style="list-style-type: none"> ■ RCD ■ Separator ■ Flare stack ■ Choke manifold ■ Choke control system 	<ul style="list-style-type: none"> ■ Coriolis flowmeter ■ CARBONTRACKER system ■ Engineering support (as needed)
3	Perform full MPD operations with advanced functionality	<p>Build on the functionality of the Tier 2 system with additional features that deliver advanced MPD functionality. The Tier 3 system features fully automated, accurate control of downhole pressure through @balance Control* MPD systems.</p> <p>The Tier 3 system can be further enhanced by adding an automated pressure-relief choke and an automated backpressure pump for greater control in narrow-window applications.</p> <p>Drilling engineering support is required with the Tier 3 system. The integrated equipment means that callout support mobilizes rapidly for advanced MPD operations.</p>	<ul style="list-style-type: none"> ■ RCD ■ Separator ■ Flare stack ■ Choke manifold ■ Advanced choke control system ■ Full-time engineering support 	<ul style="list-style-type: none"> ■ Coriolis flowmeter ■ CARBONTRACKER system ■ Automated pressure relief choke ■ Automated backpressure pump



Well engineering and project management

Experienced M-I SWACO MPD engineers offer analysis, planning, installation, and job execution services for MPD operations through well engineering and project management services. When customizing an MPD system and plan, we leverage an unmatched portfolio of technologies, from high- and low-pressure RCDs to industry-leading control systems.

With collaboration from the wellsite to the office, M-I SWACO provides top-to-bottom drilling support focused on increasing drilling efficiency and achieving customer objectives.



Well analysis

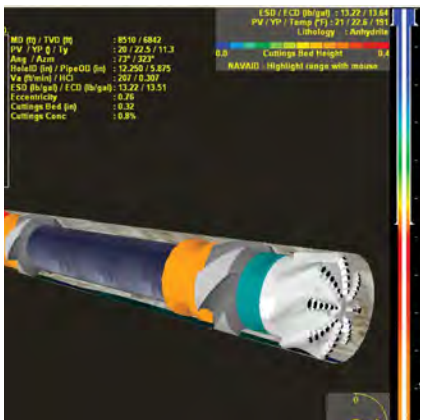
M-I SWACO MPD engineers first seek to understand the needs and risks present in a planned well to deliver a comprehensive drilling solution. Working with customer drilling engineers, we analyze various drilling scenarios to determine the optimal pressure limits, fluid hydraulics, and mud weights for a given well. This analysis forms an engineered MPD basis of design, including drilling and pressure control procedures, contingencies, and required training.

One of the greatest strengths of our well engineering services is the vast, proven suite of M-I SWACO software resources. In prejob planning, MPD engineers use VIRTUAL HYDRAULICS* drilling fluid simulation software to evaluate and design critical drilling hydraulics under simulated conditions.



System engineering

With an in-depth knowledge of operating conditions and drilling parameters, M-I SWACO engineers deploy customized MPD solutions on a well-by-well basis. Our MPD engineers take into consideration customer requirements to map out the specific hardware and software necessary to deliver drilling value to operators. Our well engineering services enable customers to move from the theoretical to the actual by creating systems geared to achieve specific drilling objectives.



Project execution

Once the MPD system components are in place, our MPD engineers execute the plan using dedicated resources. At the wellsite, we leverage PRESSPRO RT* real-time downhole performance measurement software to monitor and optimize downhole pressures. As the job is executed, prejob modeling is compared with encountered conditions to ensure that optimal drilling performance is achieved and that informed decisions are made rapidly if circumstances change.

With powerful software and years of experience, M-I SWACO enables customers to turn many MPD decisions from reactive to proactive.



@balance Control systems

At the center of downhole pressure management is the ability to control applied annular pressure precisely and proactively. M-I SWACO rig equipment packages can be equipped with the right MPD control system to meet the specific requirements of any drilling project. From simple, low-tier pressure control with the LOW-PRESSURE AUTOCHOKE* precision drilling choke console to fully automated, high-tier MPD service with the i-balance* real-time, automated managed pressure drilling control system, our fit-for-purpose systems give customers the desired level of control in any MPD application.

Rig equipment packages can be equipped with the following MPD offerings:

- i-balance system—fully automated pressure control
- e-balance* partially automated MPD control system—semiautomated pressure control
- LOW-PRESSURE AUTOCHOKE console—manual pressure control.



Automated control

For drilling operations that require a high degree of downhole pressure control, M-I SWACO offers the i-balance system. 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 semiautomated e-balance system provides 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 @balance Control systems 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 console delivers accurate and economical pressure control for low-surface-pressure MPD and underbalanced drilling 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.



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.



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.



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.



Additional technologies

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





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