



**@balance Services**  
**Gulf of Mexico MPD Solutions**

# Eliminate up to 53% NPT risks

@balance Services will change the way you look at MPD in GOM. Here's the scenario: In one Gulf of Mexico well, the operator encounters an extremely narrow drilling margin between the pore pressure and fracture gradient that threatens to render the prospect un-drillable. Meanwhile, in a well being drilled from a jackup on another Gulf of Mexico block, the pressure regime is not nearly as troublesome, yet dealing with chronic ballooning has already put the operator more than two days over plan.

If you assume only the first, and by far the most challenging scenario of these hypothetical wells, represents an ideal candidate for Managed Pressure Drilling (MPD), you may want to take another look. The M-I SWACO @balance Services can show you how even conventionally drillable wells can be completed more safely and efficiently.

Whether you are unable to drill your well conventionally or else you find yourself persistently confronting AFE-wrecking non-productive time (NPT), @balance Services can customize an MPD program of unparalleled reliability to help put your prospect safely on track and within budget. @balance Services combines industry leading resources, engineering know-how and support to deliver a fully engineered MPD solution a solution that is proactive, rather than simply reactive.

What separates @balance Services is an engineered design and automated control system that delivers constant bottom hole pressure. Rather than reacting to pressure events once they occur, the wells are designed to eliminate events by controlling bottom hole pressure at all times. In other words, rather than focusing exclusively on controlling abnormal pressure events, the constant BHP methodology of @balance Services helps ensure those events never materialize in the first place. In fact, the more precise and consistent BHP management that @balance Services MPD delivers has been shown to eliminate up to 53% of NPT risks that plague many Gulf of Mexico wells, regardless of the pressure regime. For you, this means reduced NPT, safer and more efficient drilling and considerably lower costs.

@balance Services from M-I SWACO is a Managed Pressure Drilling (MPD) program to assess the well and deliver a tailored MPD solution that meets your needs.



SWACO, a Schlumberger company, looks at every aspect of a well to determine expected conditions and risks, which are then aligned with a solution that meets all your drilling, HSE and economic objectives.



The bottom line: @balance Services delivers MPD solutions that not only make the un-drillable drillable, but bring a new standard of efficiency, safety and value to wells that are drillable conventionally.

#### FEATURES

- Engineered MPD technique
- MPD solution customized for specific wells
- Onsite and offsite engineering support
- MPD permit assistance
- Formation characterization capability
- Highly trained, experienced MPD specialists
- Proprietary VIRTUAL HYDRAULICS<sup>+</sup> software and PRESSPRO RT<sup>+</sup> software
- Constant and accurate BHP management

#### BENEFITS

- Delivers proactive, rather than solely reactive, solution
- Mitigates drilling hazards
- Eliminates up to 53% of NPT risks
- Reduces mud weight to improve ROP, prolong bit life, reduce drilling risks
- Reduces casing strings
- Cuts number of trips
- Improves early kick detection efficiency
- Enhances overall drilling efficiency
- Aids in deepening casing setting depths
- Enables drilling of otherwise un-drillable wells
- Reduces costs
- Minimizes HSE risks
- Enhances asset value
- Identifying upper/lower operating limits

# Maintain a smooth and constant BHP

Why just mitigate when you can eliminate? Certainly, MPD was conceived to address the enormously tight drilling windows, highly depleted zones and similarly challenging environments that require the utmost in annular pressure management.

Here, MPD often is your only option for getting the well down. Our reliable flow measurements that allow precise establishment of formation pore pressure, as well as the capacity to quickly change mud weight and pressures as conditions warrant, make @balance Services MPD the ideal solution for mitigating the full gamut of pressure-related issues, including:

- Loss circulation
- Wellbore instability
- Stuck pipe
- Swab mitigation
- Breakout
- Loss-induced need for cement squeezes

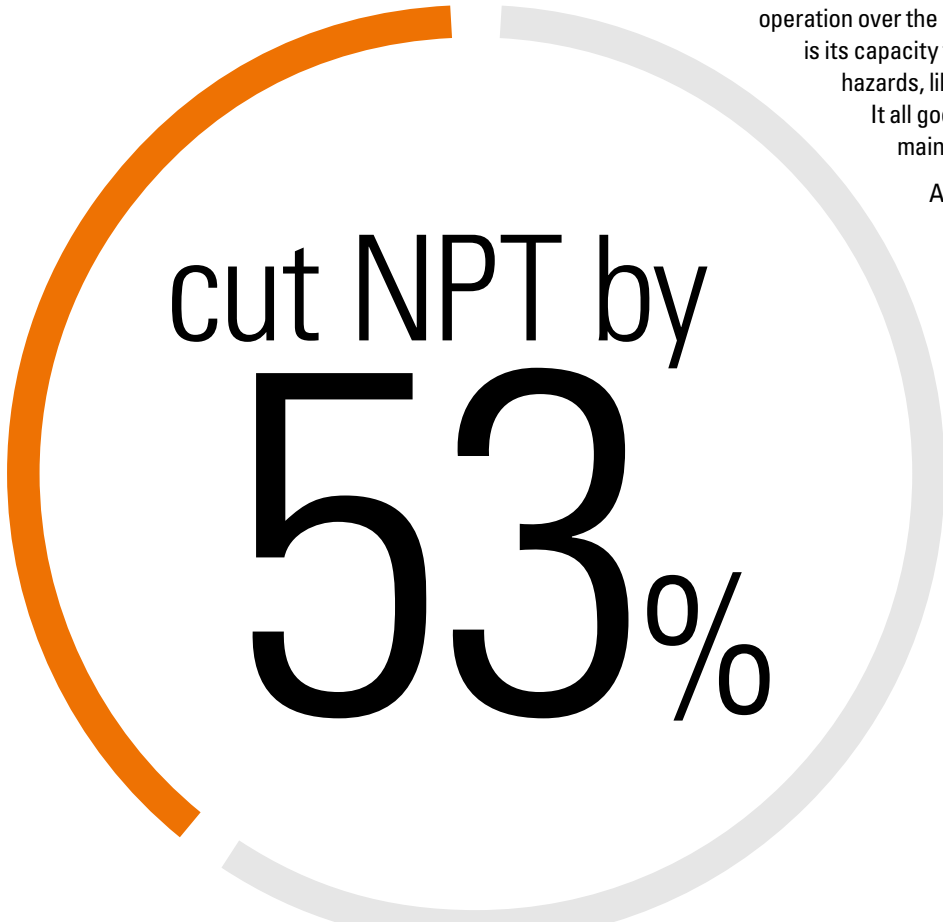
And, more. But, as experience has taught us and @balance Services demonstrates consistently, MPD is much more than a corrective tool.

Compared to a typical conventional drilling operation, an engineered MPD technique from @balance Services can optimize your overall drilling efficiency and reduce your costs. Obviously, the capacity to drill with the lowest mud weight while being statically overbalanced consistently increases your ROP and extends the operational life of the bit and other downhole tools, thereby reducing the number of trips. Likewise, MPD can help you deepen the casing set points and in some cases even eliminate casing strings. By the very nature of closed-loop MPD technology and the delivery of constant BHP, @balance Services also provides you an added safety net by both heading off the issues that can lead to a well control event and enhancing the efficiency of early kick detection.

What's more, the ability to quickly modify the equivalent mud density with applied annular surface pressure, and instantly fine-tune the system in response to well conditions that can change quickly, makes an @balance Services MPD solution an ideal wellbore characterization tool when facing the myriad unknowns that come with drilling on a new block or targeting a new horizon.

The predominant advantage of a finely developed MPD operation over the conventional methodology, however, is its capacity to help eliminate ultra-costly hazards, like ballooning and wellbore fatigue. It all goes back to our unique ability to maintain a smooth and constant BHP.

At the end of the day, throughout the Gulf of Mexico, as in all maturing theaters, all of the more easily accessible reserves have been exploited and put in the production stream. Now, with targets that are harder-to-reach, an MPD solution from @balance Services gives you the best chance of moving those elusive reserves from behind the pipe and into the pipeline.



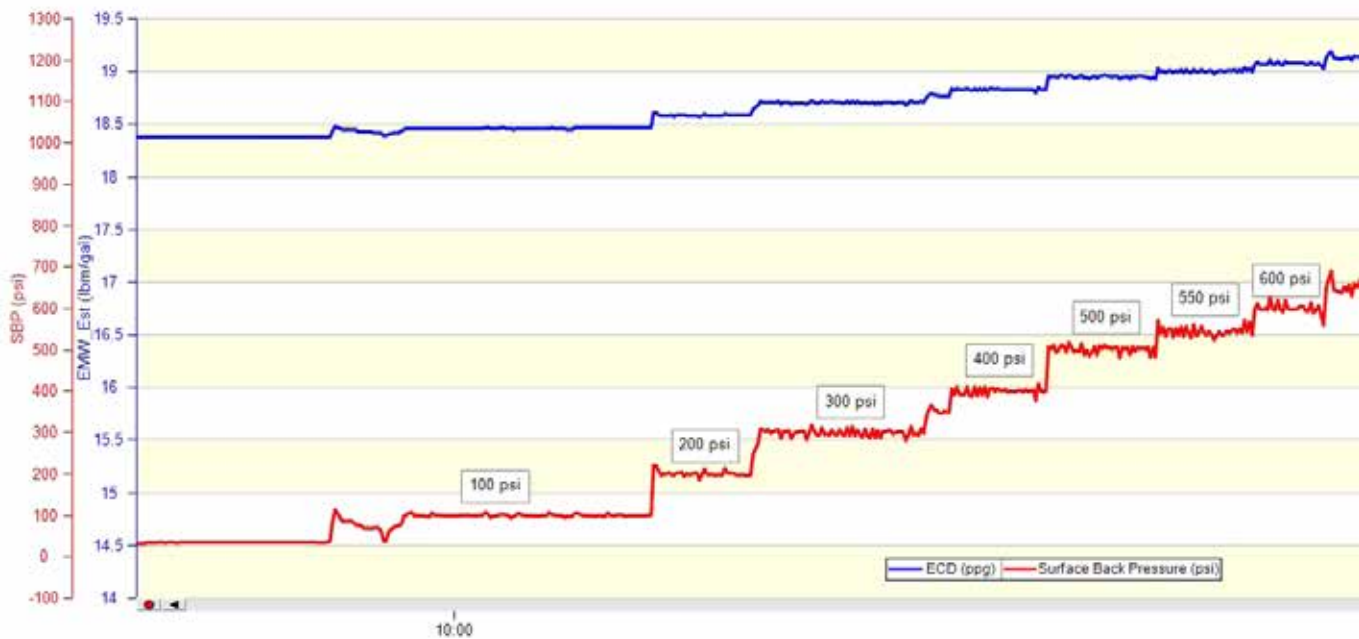
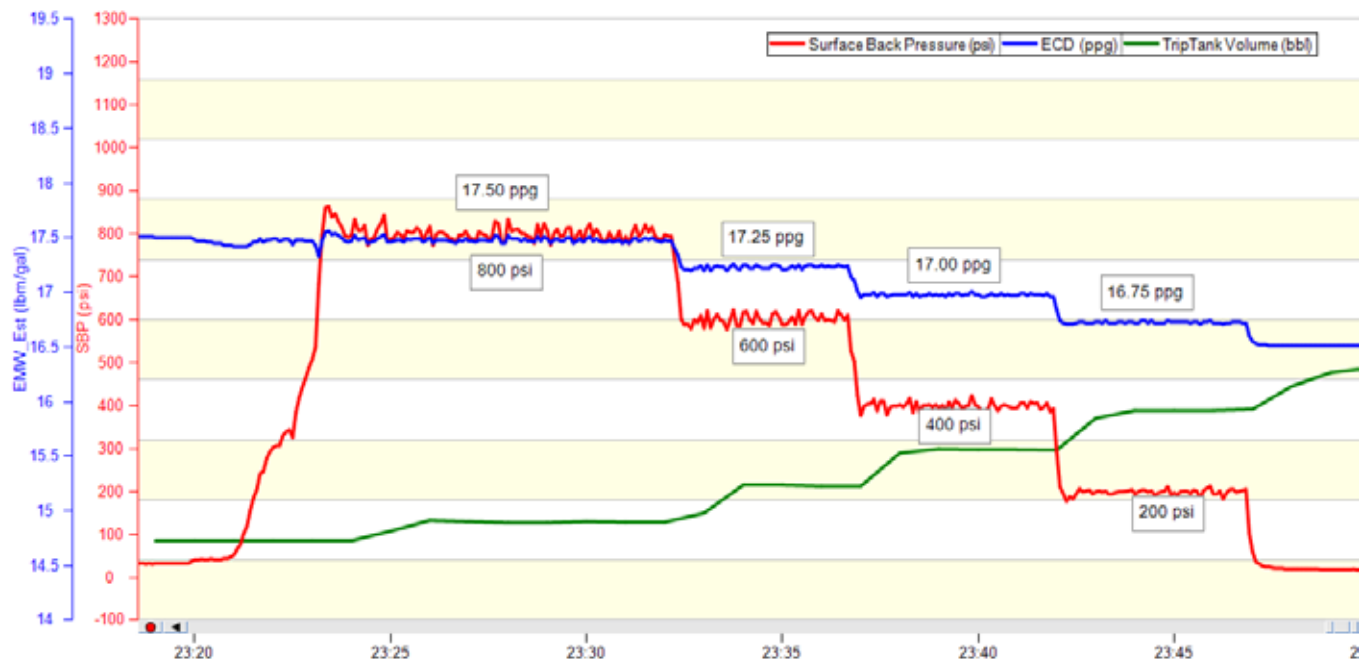
cut NPT by  
**53%**



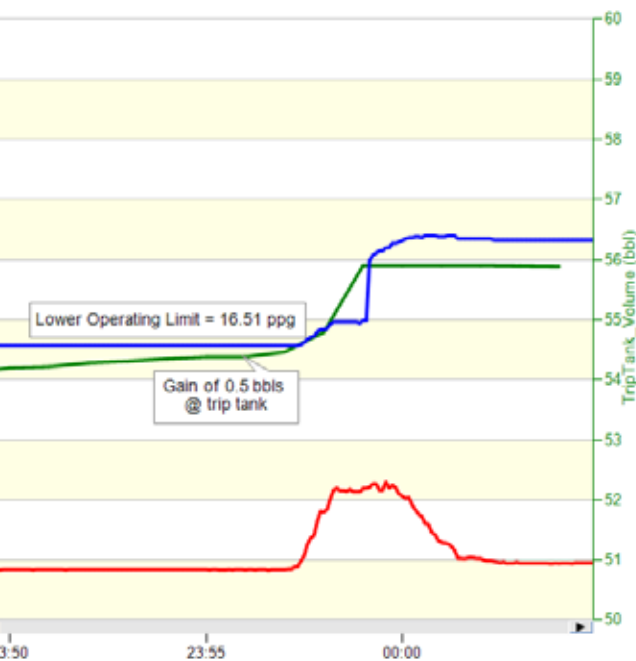
Specialists and crew become an integral part of our clients' operations teams, helping to deliver the well on time and on budget.



# Establishing the drilling pressure boundaries



The ability to quickly and accurately determine formation pressures in real time is a key advantage MPD offers over conventional drilling techniques.



## Dynamic Flow Check procedure

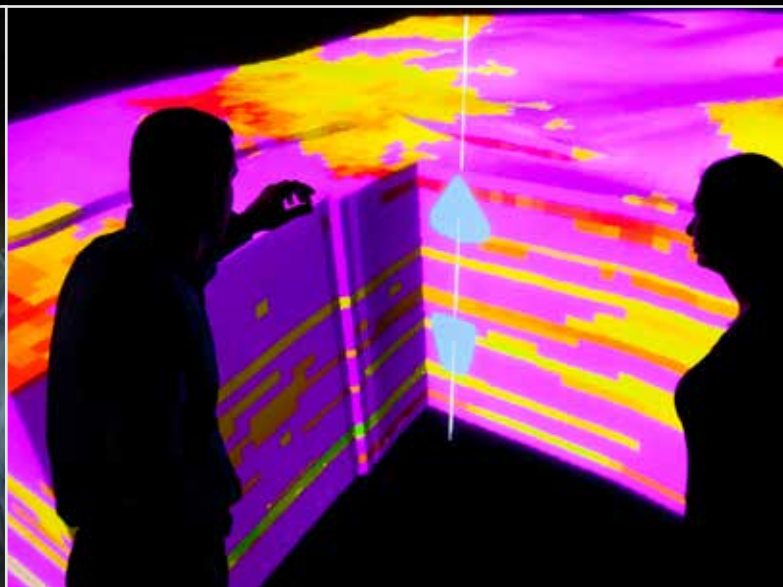
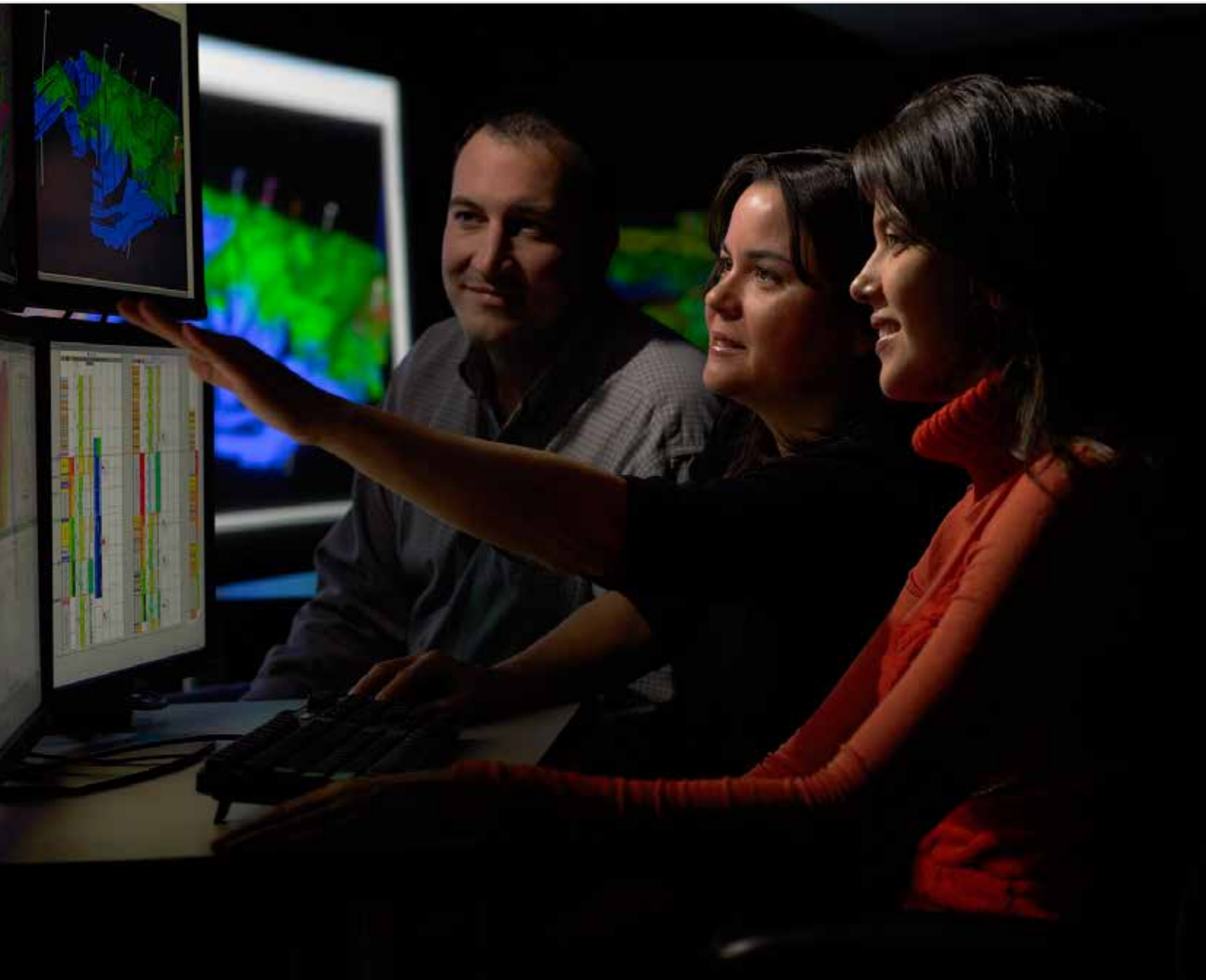
The first step in performing a Dynamic Flow Check (DFC) to identify lower operating pore pressure limit is to immediately increase surface back pressure (SBP) to maintain a safe bottomhole pressure (BHP) as the rig pump flow rate is reduced. The SBP is incrementally stepped down with each step monitored for at least 5 min before continuing. Depending on the total vertical depth (TVD), a typical step-down procedure should be conducted in 50-100 psi increments and monitored for any small increase in flow out. Once the flow out is noted, the well is shut-in, representing the value of the minimum operating pressure. At that point, the SBP can be safely increased and, after completely circulating the influx, operations can continue.

## Dynamic Formation Integrity Test procedure

A reverse procedure is used for conducting a Dynamic Formation Integrity Test (DFIT) to identify the upper operating limit. Here, the SBP is incrementally increased in steps during flow at the normal rate, with each step again monitored for at minimum of 5 min. before continuing. Typically, the step up is performed in 50-100-psi increments, depending on the TVD of the well. Once the designated FIT value has been reached, which in this case the operator set at 19.30 lb/gal (2.3 sg), eliminate the SBP and continue operations. Note: If a Dynamic Leak Off Test (DLOT) is performed, the SBP must be removed before continuing operations if monitoring reveals even minimal losses during the incremental step-up.



# The most proficient and experienced MPD specialists





M-I SWACO is the world leader in MPD technology, providing our clients with the latest techniques and expertise available in the industry.

Engineering that takes the bite out of efficiency-robbing risks. Well before your bit touches the seabed, the industry's most proficient and experienced MPD specialists leave nothing to chance in developing an engineered plan that meets your well-specific requirements and objectives. During project planning, our MPD professionals carry out a methodical risk assessment that includes model-based analysis, job planning and execution, and pressure performance evaluation.

As an added bonus, @balance Services stands apart as the only MPD services provider that gives you constant rig-site as well as office-based engineering support. We even provide comprehensive documentation that addresses all the pertinent regulatory issues to help you facilitate the issuance of the mandated MPD authorization to drill permit. Facilitating permitting is a natural extension of our services, considering @balance Services was instrumental in developing many of the widely used MPD practices commonly used today.

During planning and execution, we have at our disposal the incomparable hydraulic modeling and monitoring capabilities of the pacesetter M-I SWACO VIRTUAL HYDRAULICS software package and the real-time PRESSPRO RT engineering software packages. Joining those innovative and widely accepted software tools are advanced chokes and other M-I SWACO pressure control equipment. A key feature of our Gulf of Mexico-dedicated onsite configurations is the automatic DYNAMIC ANNULAR PRESSURE CONTROL<sup>†</sup> (DAPC<sup>†</sup>) system. The benchmark DAPC is the first to incorporate a real-time hydraulics model capable of simultaneously controlling multiple chokes and the backpressure pump to provide a singular level of field-proven performance, accuracy, and response.

Our while-drilling support also extends to the global network of Schlumberger drilling and petrotechnical experts and, where required, can include the establishment of communication between the rig and these experts for the delivery of real-time solutions to particular drilling challenges.

The job does not end with the completion of the well. In keeping with a commitment to Excellence in Execution, after every job @balance Services engineers routinely conduct a post-well analysis to evaluate the service performance relative to the planned objectives, degree of control, and reliability. This allows customers to quantify the value delivered and supports continuous improvement in pressure control product delivery.

Between our comprehensive and fully engineered planning and execution that is second-to-none with the industry's most proficient MPD specialists and the most sophisticated equipment, little wonder @balance Services can be depended upon to provide a new level of exactness to the wellbore pressure management of your well. An @balance Services fully engineered MPD operation helps ensure you remain within your plan rather than wasting time, and money, fighting downhole issues.

# @balance Services MPD proves itself in the Gulf of Mexico

## MPD eliminates ballooning, saves \$2.8 Million

### **The Situation**

In planning a well in a depleted shelf environment, the operator faced a high potential for NPT associated with ballooning, including wellbore stability and stuck pipe, among other issues. As the prospective pay zone underlay the depleted zone, the resulting narrow drilling margin and low fracture gradient would be difficult to drill conventionally as doing so would require a mud weight with equivalent circulating densities (ECD) that would exceed the fracture gradient. Drilling conventionally with a given ECD would decrease pressure when the pumps were turned off and precipitate the formation returning fluid, or ballooning.

### **The Solution**

The operator requested @balance Services design an MPD operation that would resolve the ballooning risk in the depleted well. With the MPD technique, the well could still be drilled with steady ECD parameters, but when the pumps were turned off surface pressure would replace the surface losses, and thus, downhole pressure would remain constant with no changes in pit volume.

### **The Results**

The MPD solution resulted in the depleted zone being drilled trouble-free and the well successfully reaching TD while maintaining a near-constant overbalance BHP. The MPD technique eliminated ballooning and resulted in zero NPT instances and reduced by nearly 11 days the planned drilling time with an estimated \$2.8 million in cost savings.

### **Put our MPD services to work for you**

To find out more about our @balance Services MPD solutions and how they are performing for our other customers, contact your local M-I SWACO representative.

# DAPC clears the way for trouble-free redevelopment

## The Situation

In the redevelopment of its mature Auger TLP deepwater development, Shell has to contend with a host of drilling issues resulting from reservoir pressure depletion. Owing to the redistribution of stresses in both the sands and shale overburden, the resulting reduction in the fracture gradient emerged as a key component in narrowing the available drilling margin. The predominate concern was maintaining wellbore stability in the shale overburden and virgin pressure sands.

## The Solution

The operator relied on a proactive MPD application to drill the slim-hole redevelopment sidetracks, featuring the @balance Services DAPC system. The automated DAPC system was programmed to maintain constant BHP and designed to manage pressure whether drilling, making a connection, or tripping. Back pressure was not held while drilling ahead as the designed flow rate provided adequate ECD for borehole stability. Complementary equipment included a choke manifold, a back pressure pump, and an Integrated Pressure Manager (IPM).

## The Results

The proactive application of MPD using the DAPC allowed the operator to successfully drill four sidetracks and more than a cumulative 10,000-ft of hole with zero lost circulation or formation influx. The automated MPD approach effectively controlled bottomhole pressure throughout the drilling process to manage the tight drilling margins created from redevelopment drilling. The program entailed more than 140 pump cycles in which 99% of the automated cycles were performed within the set point tolerance.

# MPD and Automated DAPC avoids narrow subsalt drilling hazards

## The Situation

The 12 previous wells the operator drilled on its subsalt shelf discovery all encountered difficult problems while drilling the rubble zone below the salt. The operator planned to re-enter one of the wells through a window milled in the 7¾-in. and 9⅞-in. casing, and drill a 6½-in. hole to access hydrocarbon reserves in a deeper target sand. Drilling the depleted reservoir meant a margin of only 1.2 lb/gal between pore pressure and fracture gradient. Thus, critical issues included avoiding lost circulation, minimizing ballooning, preventing formation breakout due to cyclic pressure changes and minimizing swabbing while tripping out of hole.

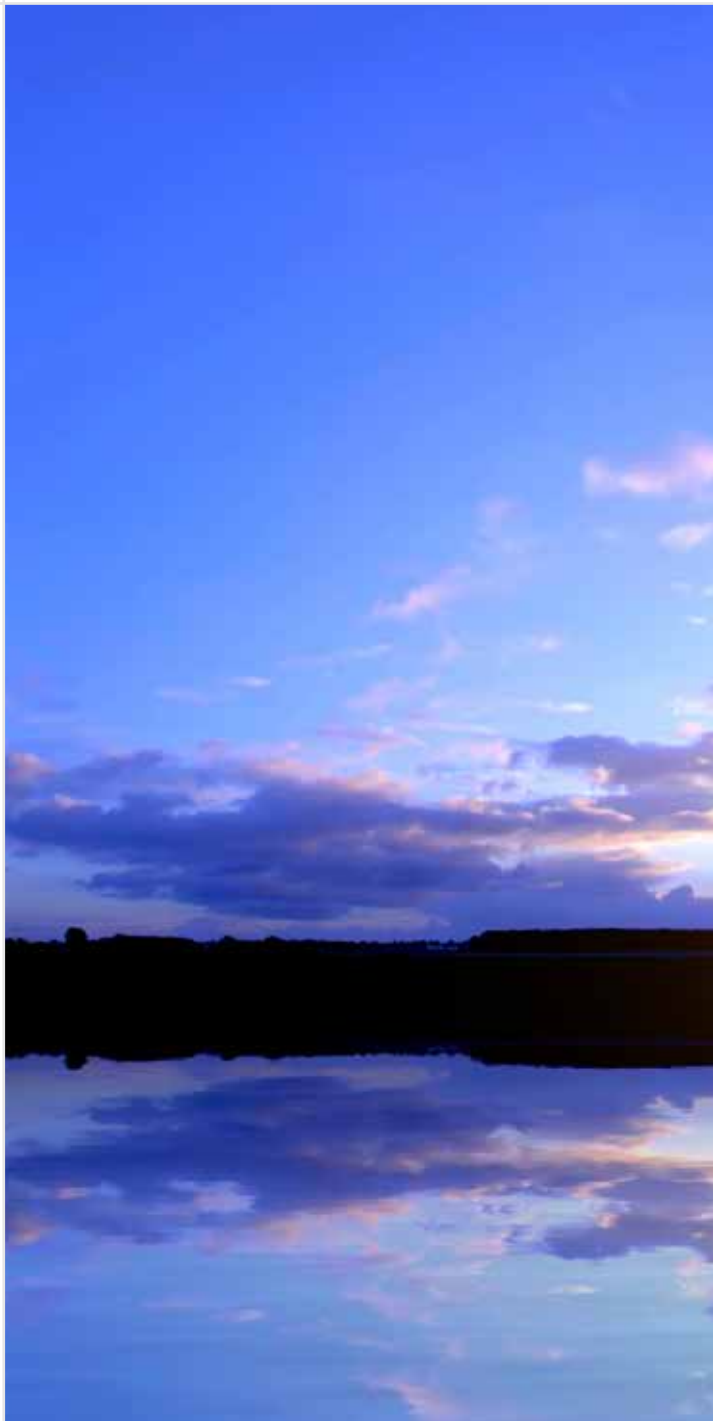
## The Solution

To address those concerns in the re-entry, @balance Services installed its automatic DAPC system, with a Coriolis meter and the HOLD Rotating Control Device. This solution was designed to maintain near constant BHP on connections and provide early kick detection. The DAPC also would be used to hold backpressure and strip out of hole to prevent swabbing.

## The Results

The automated DAPC MPD system successfully drilled the well to TD, maintaining near-constant overbalance BHP within the drilling window while drilling and tripping. The solution effectively avoided losses and swabbing in the depleted reservoir. In addition, the automated MPD technique was rigged up offline prior to the mill out, which minimized rig up time, testing and fine-tuning of the system before beginning the operation. @balance Services was called online early to help control the influx and losses cycle due to the ballooning effect.





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