

Mi SWACO

A Schlumberger Company



PRESSURE AND FLUID MANAGEMENT SYSTEM (PFMS)

An automatic closed-loop system for controlling pressure and removing solids and gas from drilling fluids



A single-package dual-function solution for coiled tubing and any critical-parameter drilling and completion application

Equipment configurations on rigs have often not been optimally designed for safe and efficient execution of coiled tubing (CT) and other drilling and completion applications requiring precise monitoring of pressure and solids-control parameters. M-I SWACO, a Schlumberger company, has engineered its compact PRESSURE AND FLUID MANAGEMENT SYSTEM[†] specifically for the unique demands of CT drilling and other applications requiring precision in pressure and solids control while having a small equipment footprint.

The PFMS[†] unit helps satisfy environmental regulations while effectively addressing narrow pressure-gradient restrictions, meeting solids-removal specifications, and overcoming space, weight, and time limitations.

A seamless solution for pressure and solids control

Features

- Compact skid-mounted modular system
- Continuous closed-loop operation
- Advanced pressure and solids-control technologies
- 154-bbl, three-compartment tank holding pumping, mixing and fluid-moving components
- No welding or bolting required
- Self-contained electrical and plumbing systems
- Capabilities to remove silt and sand particles from 5 to 25 microns
- Meets applicable transportation height and weight regulations
- Sensitive components for controlling wellhead, casing, and drill-pipe pressures
- Chokes rated for severe service conditions
- Advanced gas separation technologies

Benefits

- Small footprint
- Precise pressure monitoring and control
- Generates drier cuttings
- Fast rig-up and rig-down
- Extended screen life
- Reduced requirement for additional hoses, pumps and lines
- Reduced waste disposal and fluid costs
- Optimized environmental compliance
- Reduced logistical challenges
- Hazardous gas removed from drilling and completion fluids
- Reduced formation damage
- Enhanced rig safety
- High durability and reliability

Typical pressure and solids control equipment layouts have frequently been unwieldy, making them ill-suited for space-challenged locations and presenting logistical and economic challenges. In addition, operators and drilling contractors have often found themselves at an operational disadvantage when trying to head-off well control, stuck pipe, reservoir damage and other downhole and environmental issues that can render a project uneconomic.

The modular PFMS unit provides compartmentalized equipment in a single skid-mounted package that incorporates the latest generation of precise field-tested pressure and solids control technologies. The system has been shown to provide continuous closed-loop pressure control and simultaneous drill solids and gas removal in a host of applications, including workovers, cleanup operations, fracing and flow-backs, re-entry, and recompletions. It is also suited for conventional drilling operations when a particularly small equipment footprint is required.

The modular small-footprint design, which includes self-contained plumbing and electrical systems, means that the PFMS requires minimal rig-up and rig-down time. It incorporates advanced technologies such

as the AUTOCHOKE[†] unit and MONGOOSE PT[†] dual-motion shaker to deliver automatic and continuous pressure control while effectively removing drill solids and entrained gas, thus reducing costs and optimizing safety on the rig.

Key features of a typical layout include:

Pressure control

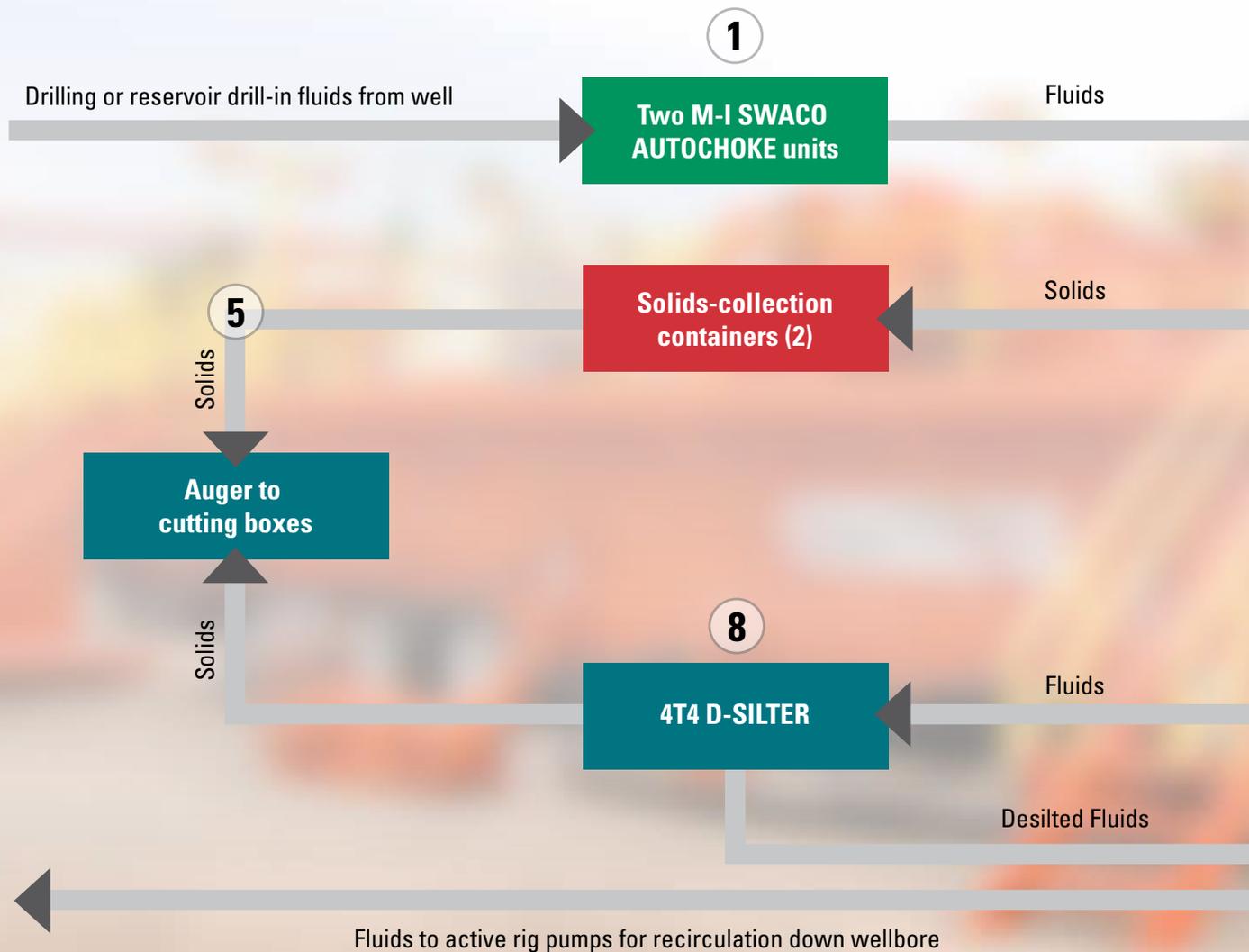
- Specially selected Choke Manifold
- Dual AUTOCHOKE units for precise control of well pressure with improved wear and anti-plugging characteristics for severe service conditions
- Field-proven mud/gas separator for removing high volumes of free gas
- 154-bbl, three-compartment fluid-collection tank equipped with pumps, agitators, gun lines and transfer lines
- Vacuum D-GASSER[†] units for removal of any gas still entrained in the fluid after solids-control processing

Solids control

- Dual-motion MONGOOSE PT Shaker fitted with patented pre-tensioned MAGNUM[†] XR[†] mesh screens
- 600 GPM (2,271 l/min) capacity 4T4 D-SILTER[†] units to efficiently remove silt and sand particles between 5 and 25 microns



How the PFMS unit works



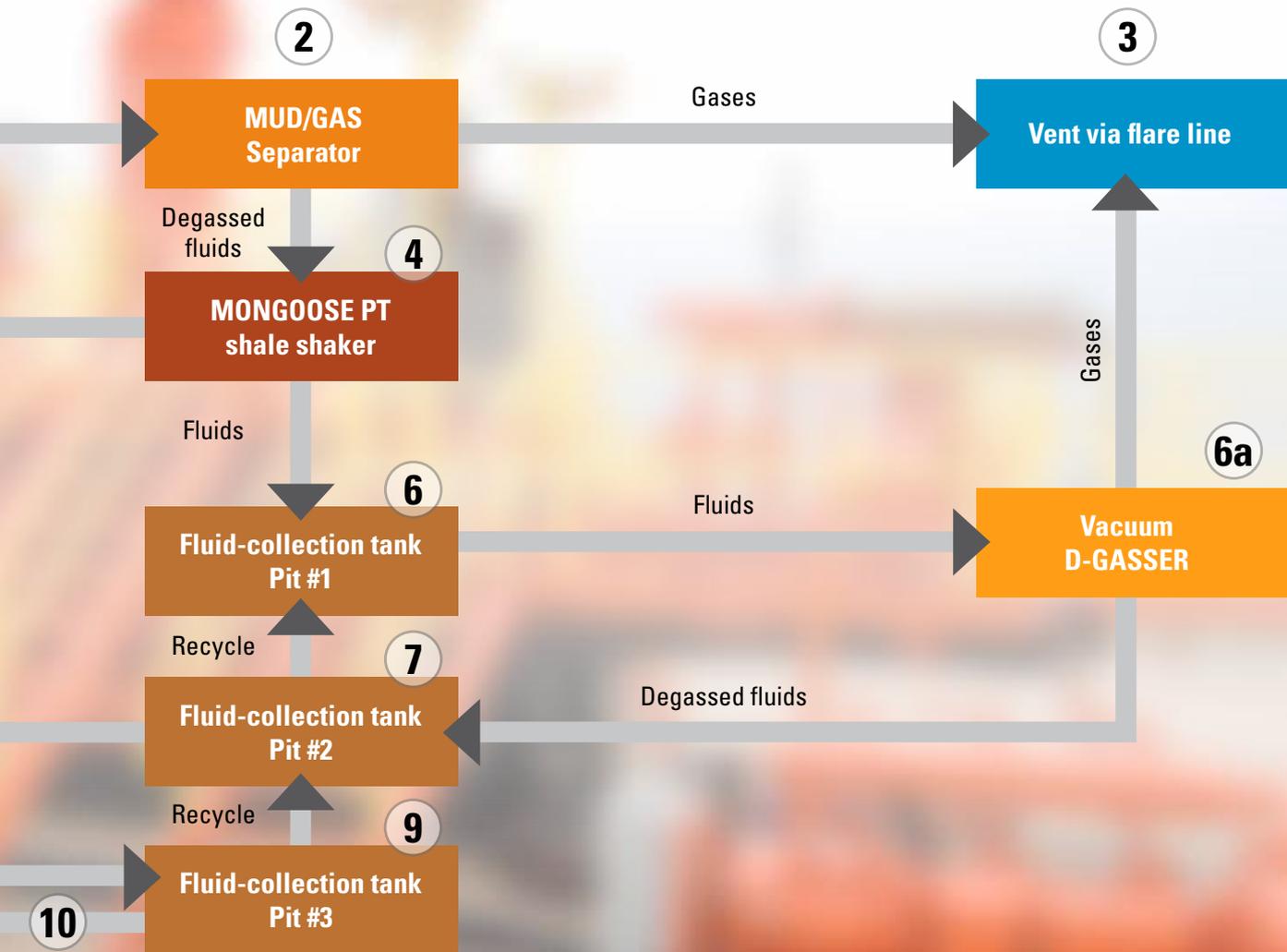
The drilling or drill-in fluid is first routed from the well to a pressure-control-section inlet. The inlet and valves are opened or closed as needed to direct the spent fluid through either the first or second AUTOCHOKE unit. Upon exiting the designated choke, the fluid is directed to a manifold outlet. The pressure-control section uses a dual AUTOCHOKE configuration with the second choke serving as a backup in case the first becomes nonfunctional. If the first choke needs repair, preventive maintenance, or is otherwise offline, the manifold valves can redirect fluid flow to the second choke,

allowing drilling to continue uninterrupted. The manifold also includes a diverter line that acts as a third flow path in the unlikely event the two chokes fail or exceed capacity or pressure limitations.

Fluid from the manifold is next directed to the mud/gas separator, which includes a tank with an internal series of baffles. The fluid is directed through an inlet near the top of the tank. Fluid flow inside the tank is tangential to its wall, effectively creating a vortex effect. The spent fluid splashes over the series of baffles causing entrained gases to break free.

The freed gases are released through a vent in the top of the tank to a flare line that directs the gases to a safe area away from the operations. Meanwhile, the degassed fluid is directed to a separator outlet located on the side of the tank and near the bottom, which is equipped with a float that prevents overloading of the separator and discharge of gas over the drilling-waste-management tank area.

Degassed fluid flows from the gas separator gravity-feeds to the possum belly of the dual-motion MONGOOSE PT shaker outfitted with MAGNUM XR screens that



separate solids of a predetermined size from the fluid. The shaker is mounted on the drilling waste management tank along with two solids-collection containers, the 4T4 D-SILTER, the VACUUM D-GASSER, and a fluid-collection tank divided into three pits.

Drill solids are directed to a solids-collection container. The shaker is mounted above the solids-collection container, allowing gravity to move the separated solids from the shaker to an auger that subsequently moves them to the solids-collection container. The auger's direction of rotation can be changed to allow

cuttings to be collected at both ends if required.

Next, fluid from the shaker moves to pit #1 situated within the fluid-collection tank. From there, it is pumped to the D-GASSER unit, which is situated on a modular skid allowing it to be conveniently located over the fluid-collection tank. The D-GASSER unit removes any entrained gases not extracted initially by the mud/gas separator. These removed gases are immediately vented.

Degassed fluid then moves to pit #2 in the fluid-collection tank. Fluid from the second

pit is designed to back-flow to pit #1 for eventual reprocessing by the D-GASSER unit.

Fluid collected in the second pit is pumped to the D-SILTER apparatus, which removes additional solids up to a 25-micron cut point. Desiltered fluid is then sent to pit #3 in the fluid-collection tank. Fluid from the third pit is designed to back-flow to pit #2 for reprocessing by the D-GASSER unit. Finally, fluid from the third pit is pumped to the active rig pumps for recirculation down the wellbore.

Component specifications

AUTOCHOKE

- 3.06 in. (77.7 mm) x 10,000-psi (689.5-bar) API inlet and outlet flange
- Weight: 580 lb (263.1 kg)
- Stainless steel
- Non-plugging, self-cleaning orifice
- Temperature rating: -20 to 250° F (-29 to 121° C)
- Bore size: 3 in. (76.2 mm)

Choke console

- Stainless steel, 24 x 55 x 26 in. (609.6 x 1,397 x 660.4 mm)
- Air and hydraulic operated, 125 psi (8.6 bar) @ 35 cfm air supply

Manifold

- FMC 1502 2 in. (50.8 mm), 15,000 psi (1,034 bar) tested
- Dimensions: 8 x 6 ft (2.4 x 1.8 m)
- Weight: 4,000 lb (1,814 kg)
- Rated for H₂S service

MUD/GAS SEPARATOR

- Dimensions: 80 x 80 x 220 in. (2,032 x 2,032 x 5,588 mm)
- Weight: 6,450 lb (2,926 kg)
- Liquid capacity: 1,500 GPM (5,678 L/min)
- Gas capacity: 17.5 MMscf/d
- Working pressure: 125 psi (8.6 bar)
- Rated for H₂S service

Three-compartment fluid-collection tank

- Dimensions: 23 x 8 x 7 ft (7 x 2.4 x 2.1 m)
- Weight: 25,000 lb (11,340 kg)
- Capacity: 154 bbl, three compartments
- Pumps: 40-hp motors with 4 x 3-in. (101.6 x 76.2-mm) mission pumps and 11-in. (279.4-mm) impellers
- Power: 460V/60 Hz/300 kw supply

MONGOOSE PT Shale shaker

- Dimensions: 116 x 63 x 47 in. (2,946 x 1,600 x 1,194 mm), mounted on tank
- Weight: 3,450 lb (1,565 kg)
- Gross screen area: 29.4 ft² (2.73 m²)
- Power: 460V/60 Hz/1,800 rpm (supplied by tank distribution)

4T4 D-SILTER

- Dimensions: 52 x 30 x 56.1 in. (1,321 x 762 x 1,425 mm), mounted on tank
- Weight: 680 lb (308.4 kg)
- Capacity: 600 GPM (2,271.2 L/min)

Vacuum D-Gasser

- Dimensions: 157 x 42 x 87 in. (3,988 x 1,067 x 2,210 mm), mounted on tank
- Weight: 3,350 lb (1,520 kg)
- Capacity: 1,000 GPM (3,785 L/min)

Optional equipment

- Cuttings boxes
- 30-hp vacuum system
- Cargo basket
- 185-cfm air compressor
- 200-kw power generator
- Diaphragm pump
- Operating personnel (well-control certified)



Success Story: Cleaning a shut-in well

PFMS removes wellbore scale and saves cost by enabling fluid recirculation

The Situation

A well was shut-in with tubing/casing communication at an undetermined location and milled-out barium scale in the tubing. Shut-in tubing pressure (SITP) was 5,430 psi and the casing gradually built pressure to around 2,000 psi before bleeding it off at the surface. The well was completed with 3 ½-in tubing to 15,185 ft, followed by a 5-in liner to a plug-back total depth (PBSD) of 15,907 ft and perforations from 15,693 to 15,862 ft. The operator sought a solution that would not only remove the scale from the wellbore, but also identify the precise location of the communication between tubing and casing. The operator's strategy was to use 1 ½-in. CT to achieve both of these objectives. A CT unit had earlier milled-out scale to 80 ft (24 m) using a 2 1/8-in. motor and 2.72-in. tapered mill. The maximum outer diameter (OD) drift was accomplished with a 1 ½-in. slickline run.

The Solution

M-I SWACO recommended its solids separation system - an integral component of the PRESSURE AND FLUID MANAGEMENT SYSTEM. The solids separation component would be run in tandem with POWERCLEAN⁺ gel, which is formulated specifically for CT operations.

The Results

The PFMS solids separation system exceeded its objectives, including complete removal of milled-out scale from the wellbore. This enabled the POWERCLEAN fluid to be re-circulated, saving around 1,600 bbl of fluid and an estimated USD 65,000 in mud costs.

Put PFMS to work for you

To find out more about the PRESSURE AND FLUID MANAGEMENT SYSTEM, and how it is performing for operators around the world, contact your local M-I SWACO representative.



ONLINE RESOURCES

PRESSURE AND FLUID MANAGEMENT SYSTEM (PFMS)

www.miswaco.com/pfms

Underbalanced and Managed Pressure drilling (UBD/MPD)

www.slb.com/mpd

Pressure Control Services

www.miswaco.com/pressurecontrol

Solids Control Services

www.miswaco.com/solidscontrol



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