

The Growth of Deepwater Managed Pressure Drilling

From Niche to Norm

Brian Grayson
January 29, 2014



Over a century of growth



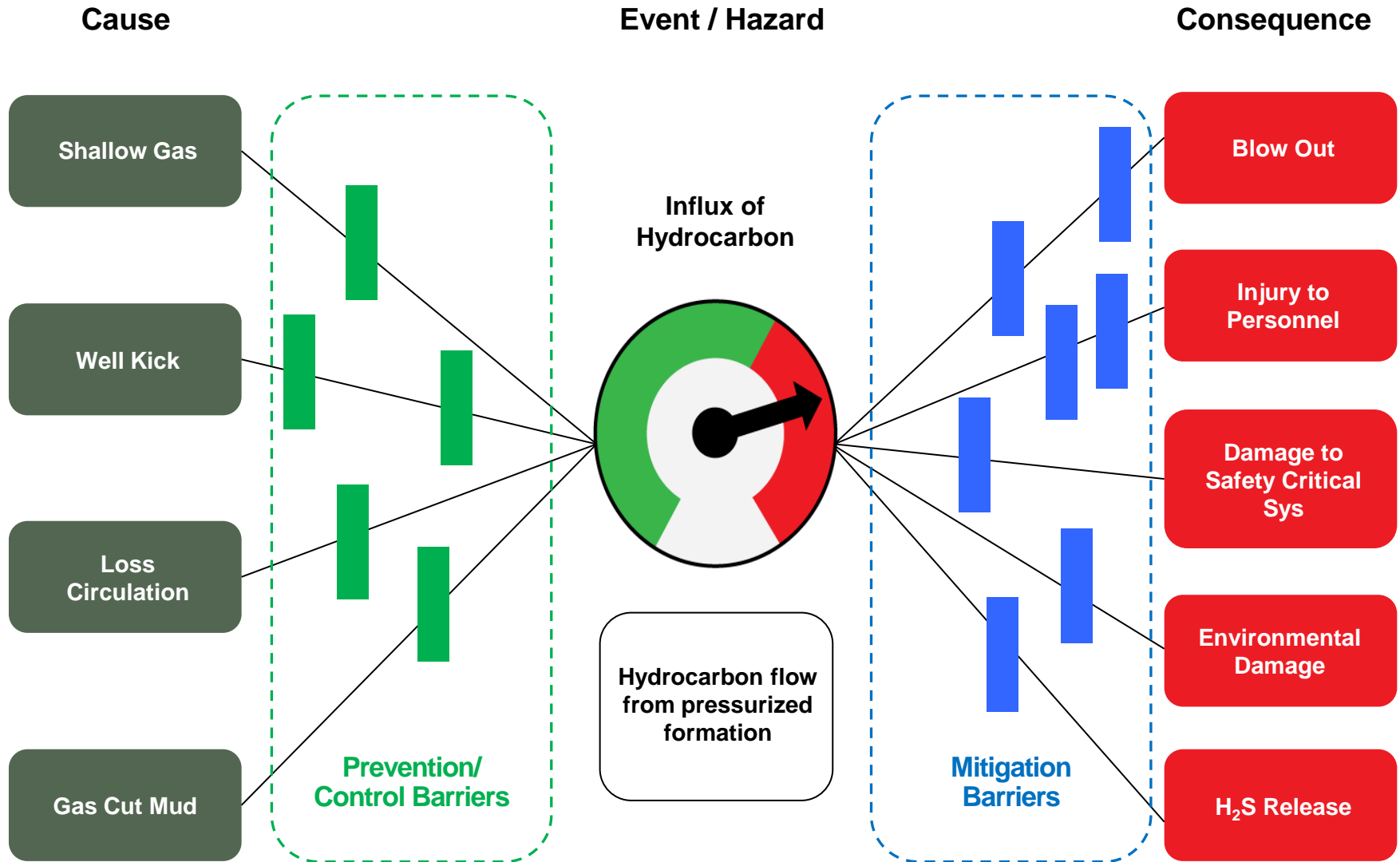
1951



2014

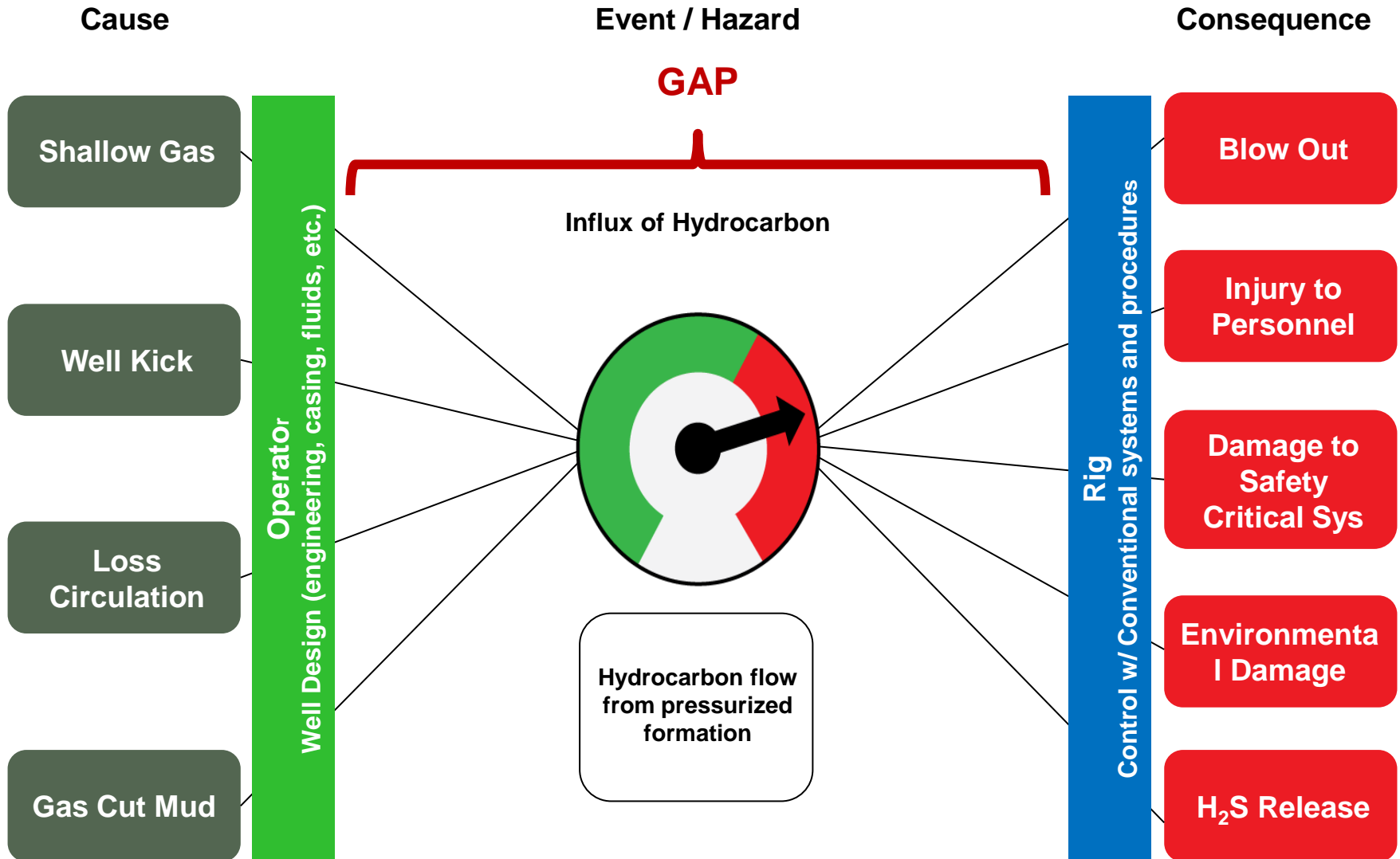


Well Control Philosophy





Conventional Well Control Philosophy

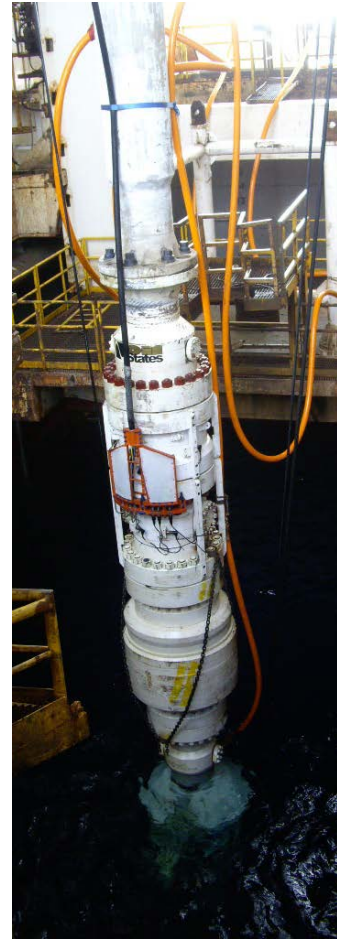




Over a century of growth



1960's



2014

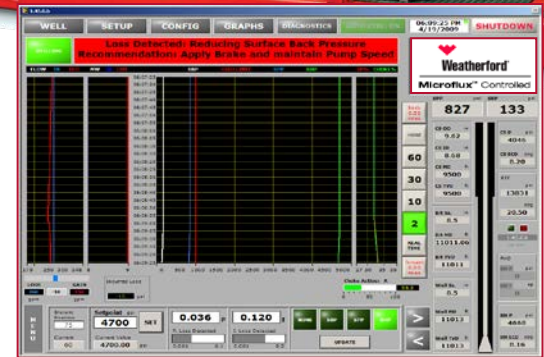
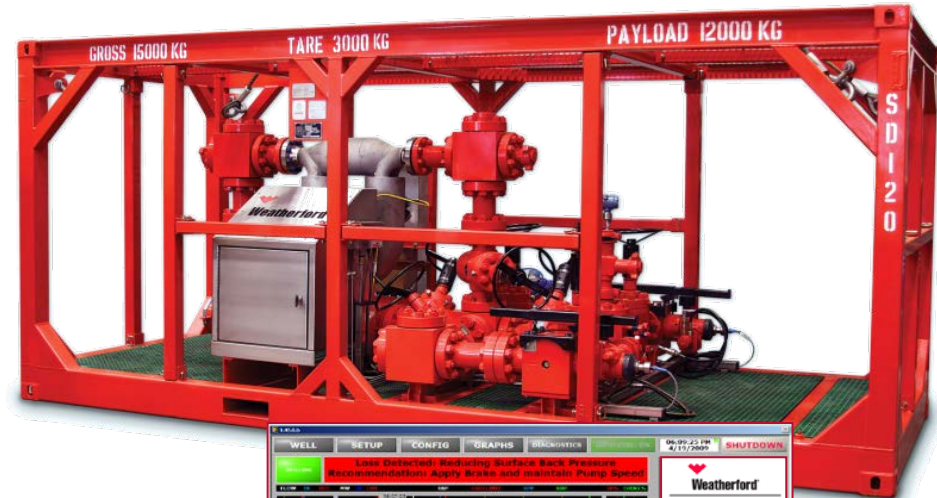




Over a century of growth



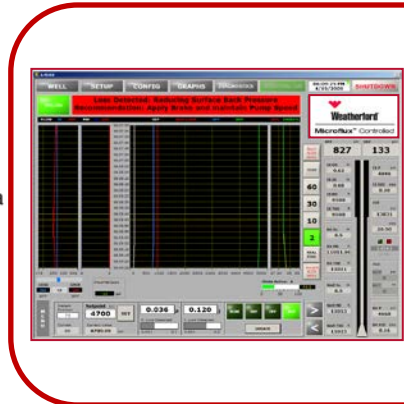
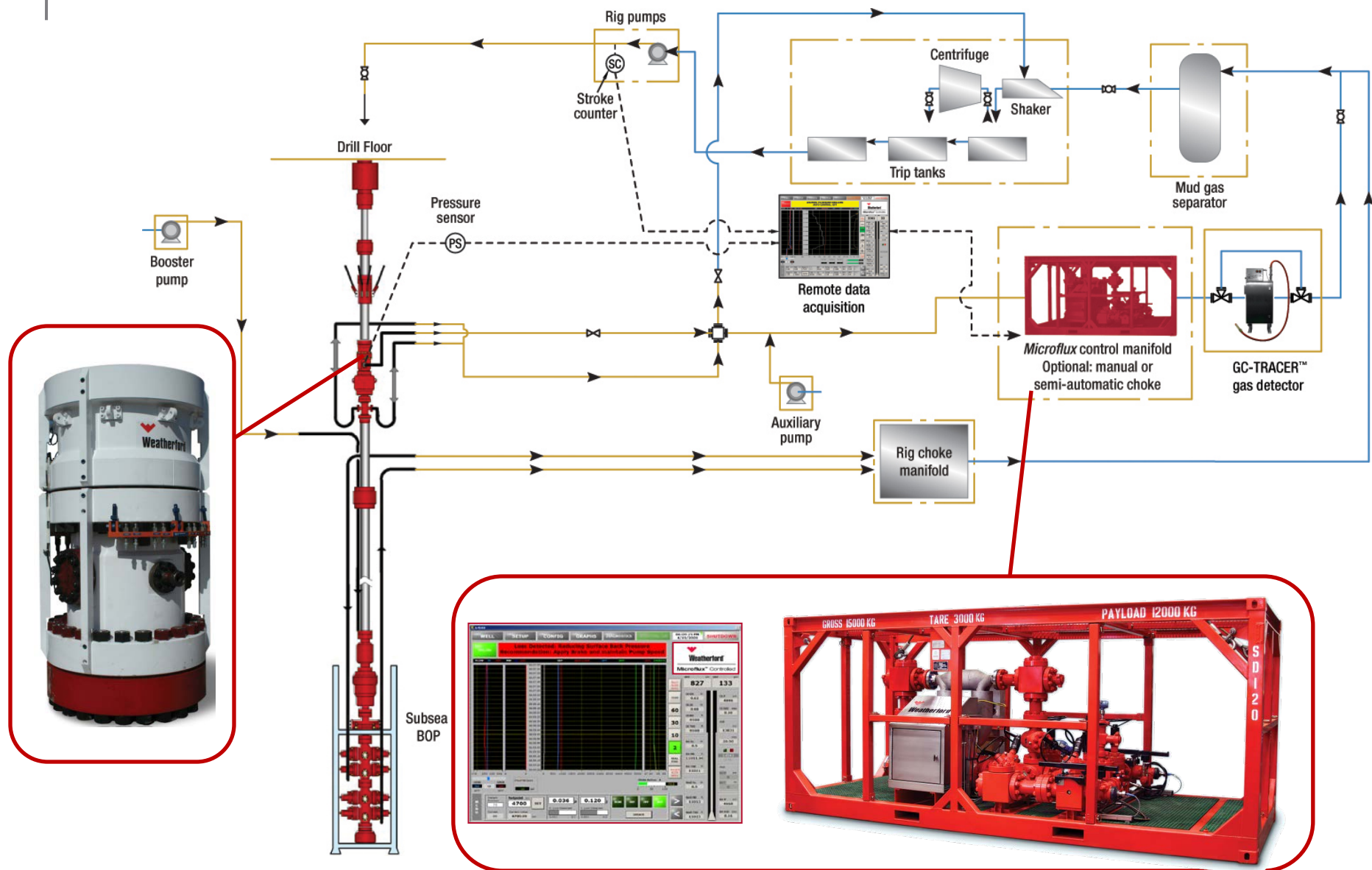
1960's



2014

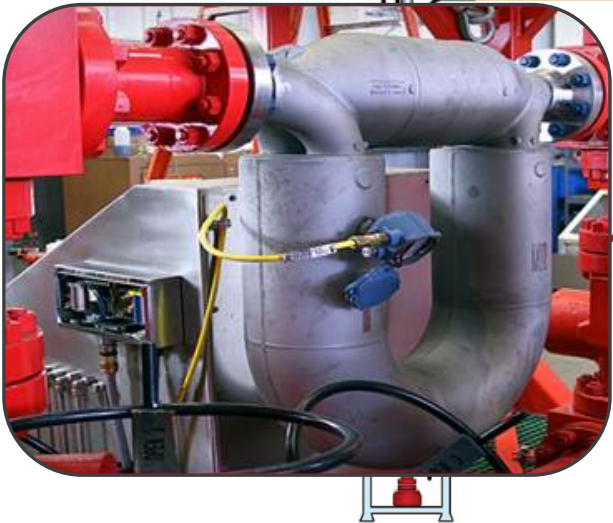
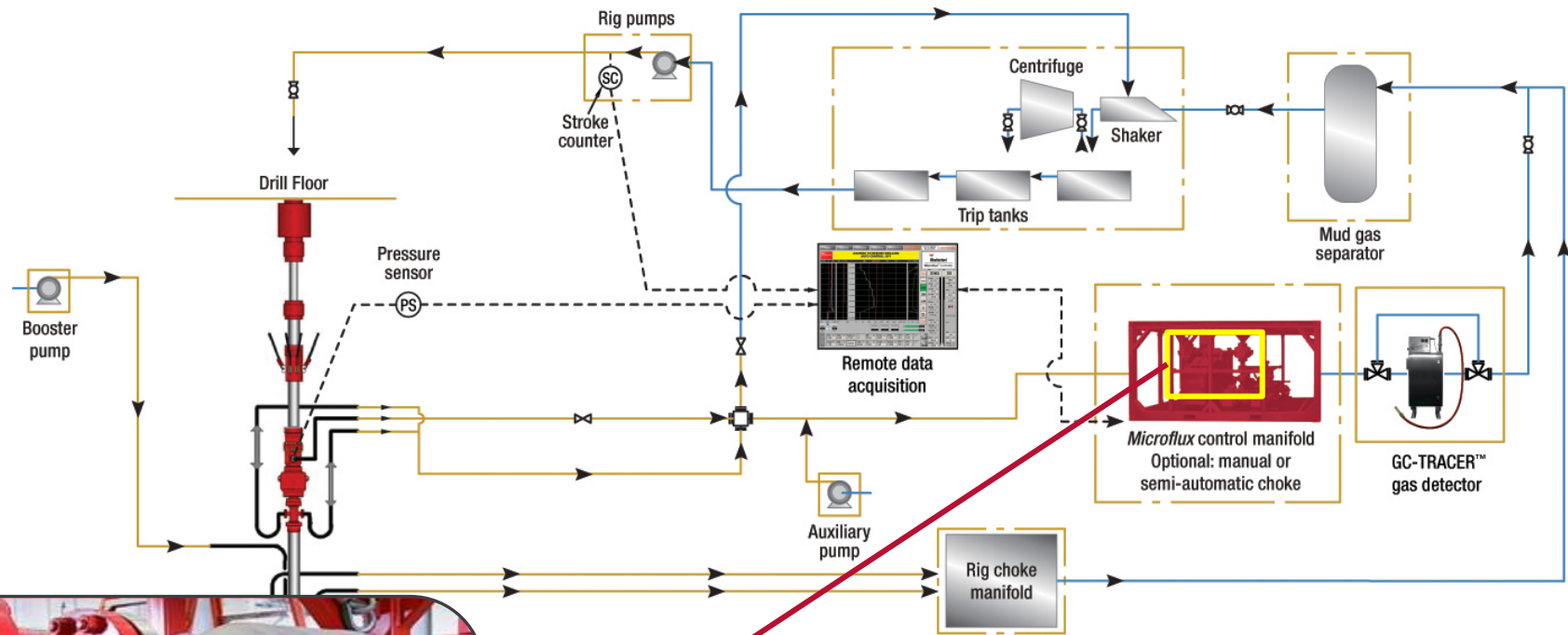


Closing the Loop





Microflux™ Wellbore Monitoring



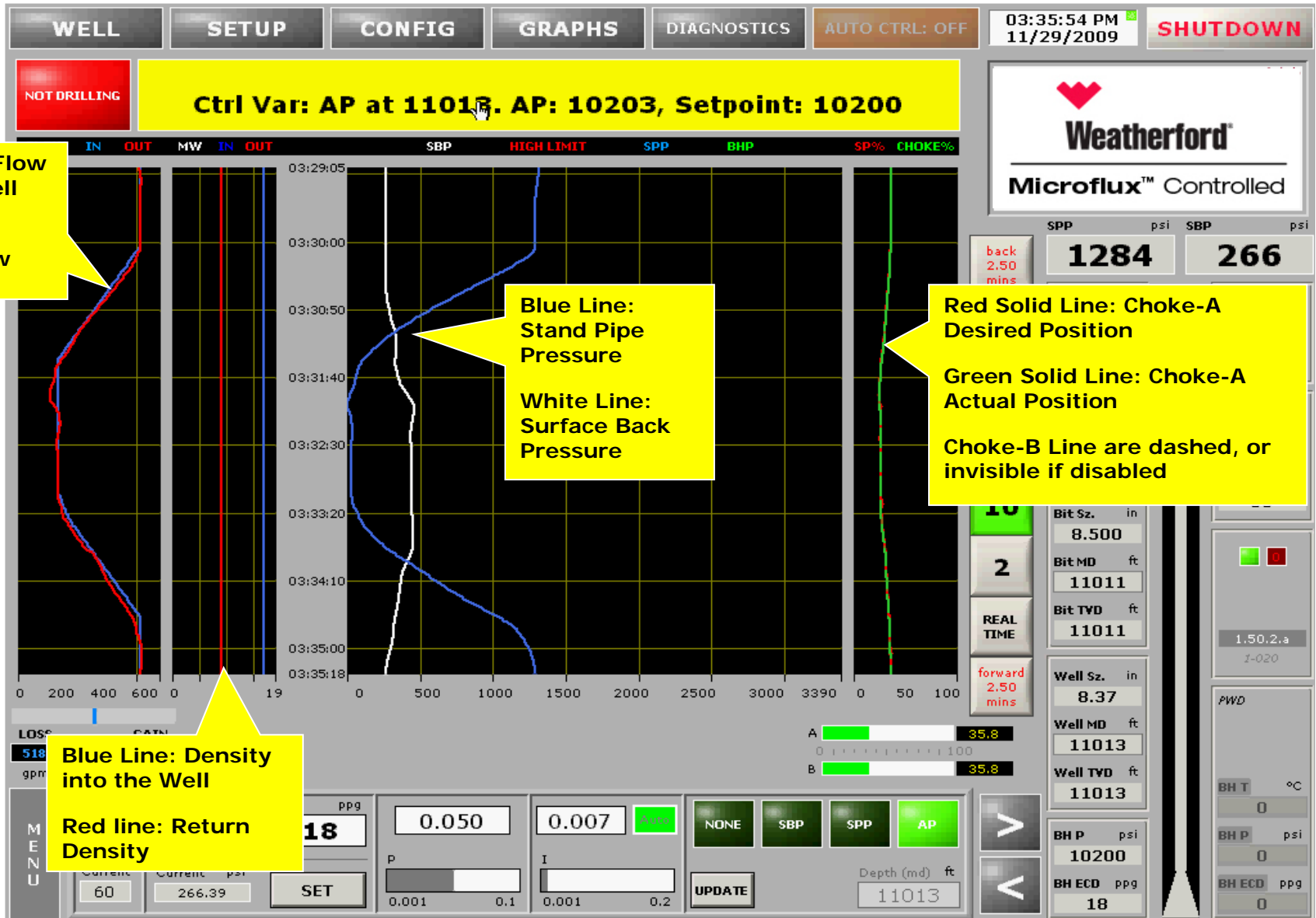
Principle of Mass Balance

Kick : Output > Input

Loss: Output < Input

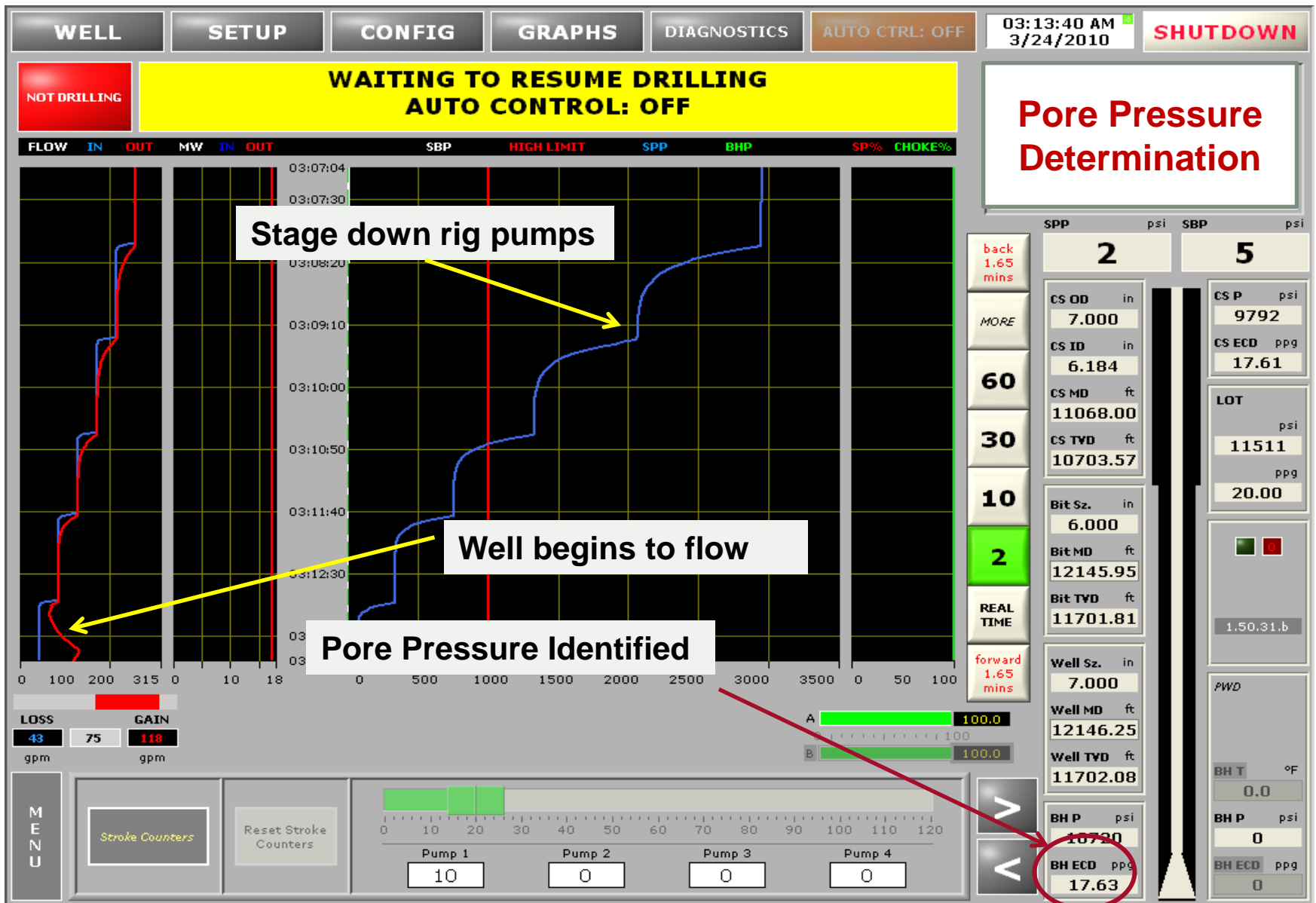


Microflux™ Wellbore Monitoring



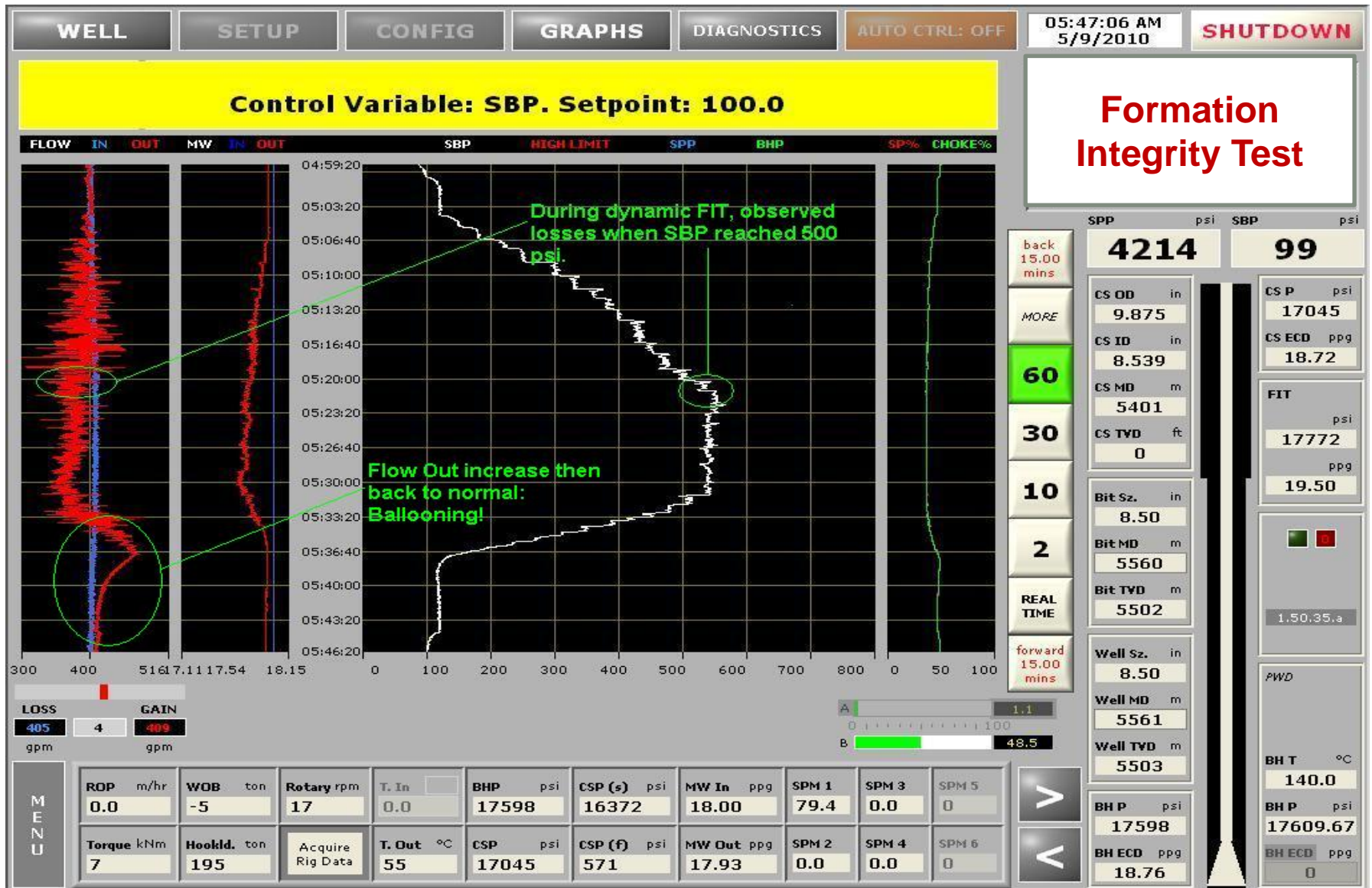


Pore Pressure Identification



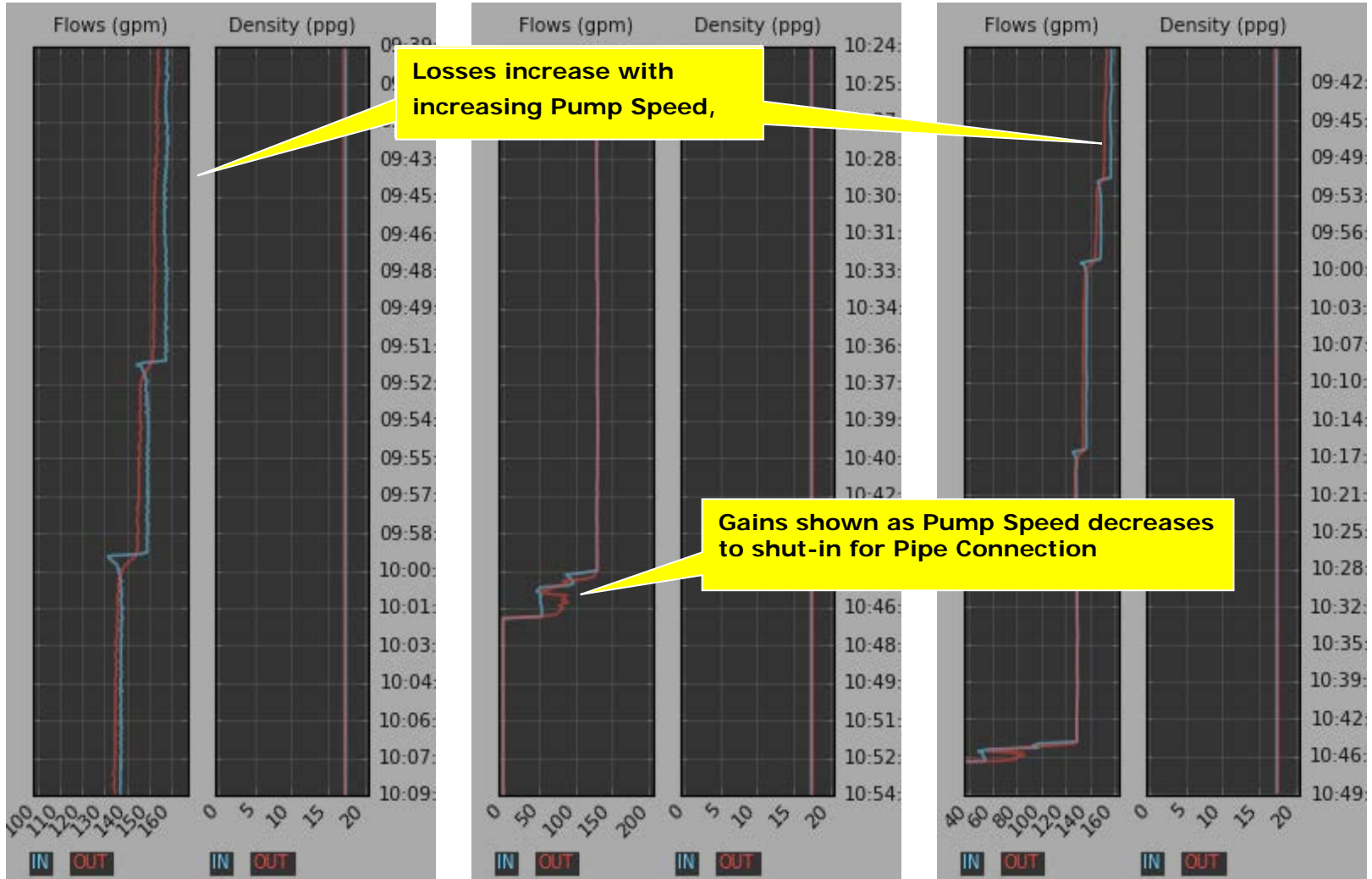


Fracture Gradient Identification via Dynamic LOT



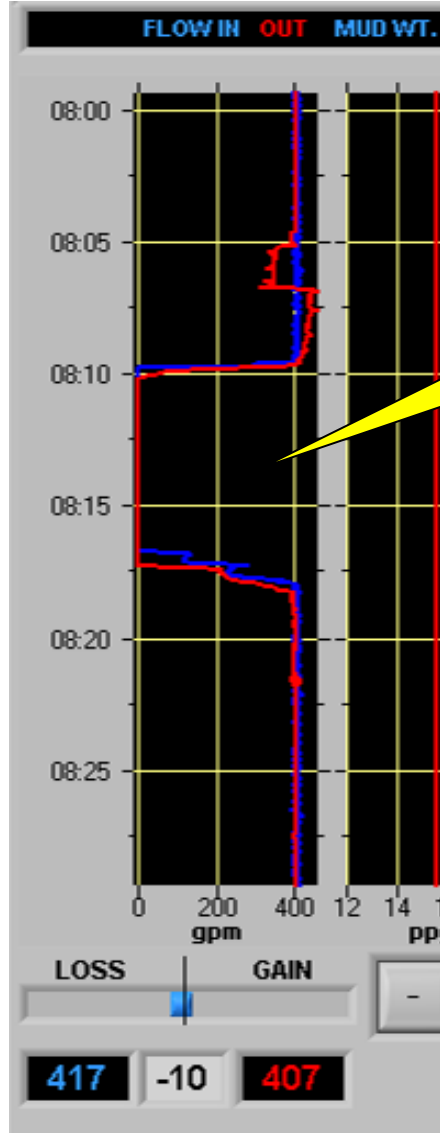


Microflux™ Event Identification - **Ballooning**



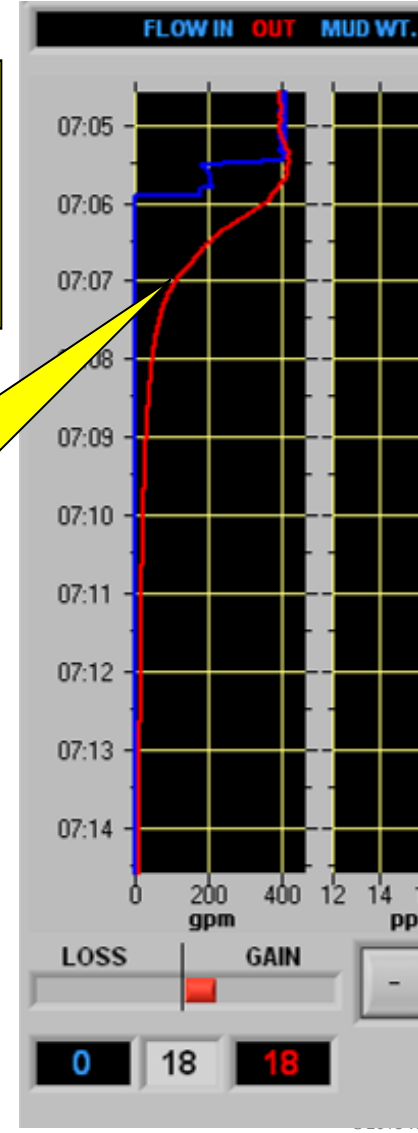


Microflux™ Event Identification - Breathing



During a **Normal Connection**, the flow out of the well (red line) drops to zero quickly, matching the flow-in (blue line) when the pumps are stopped.

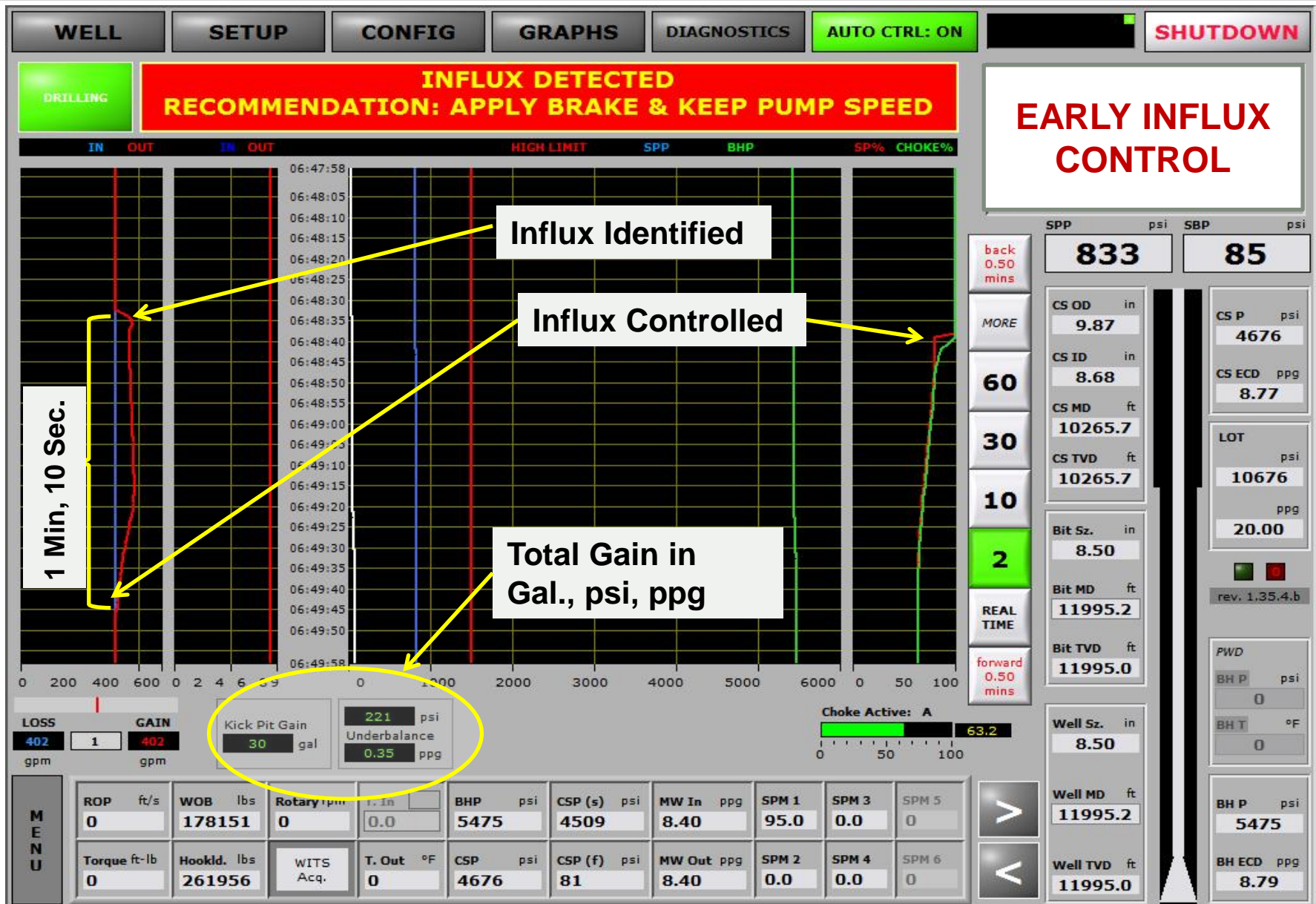
When **breathing occurs**, the flow out of the well (red line) drops gradually to zero when the pumps are stopped. This is clearly distinguished from a kick because the trend line is reducing.



When **breathing occurs**, the flow out of the well (red line) drops gradually to zero when the pumps are stopped. This is clearly distinguished from a kick because the trend line is reducing.

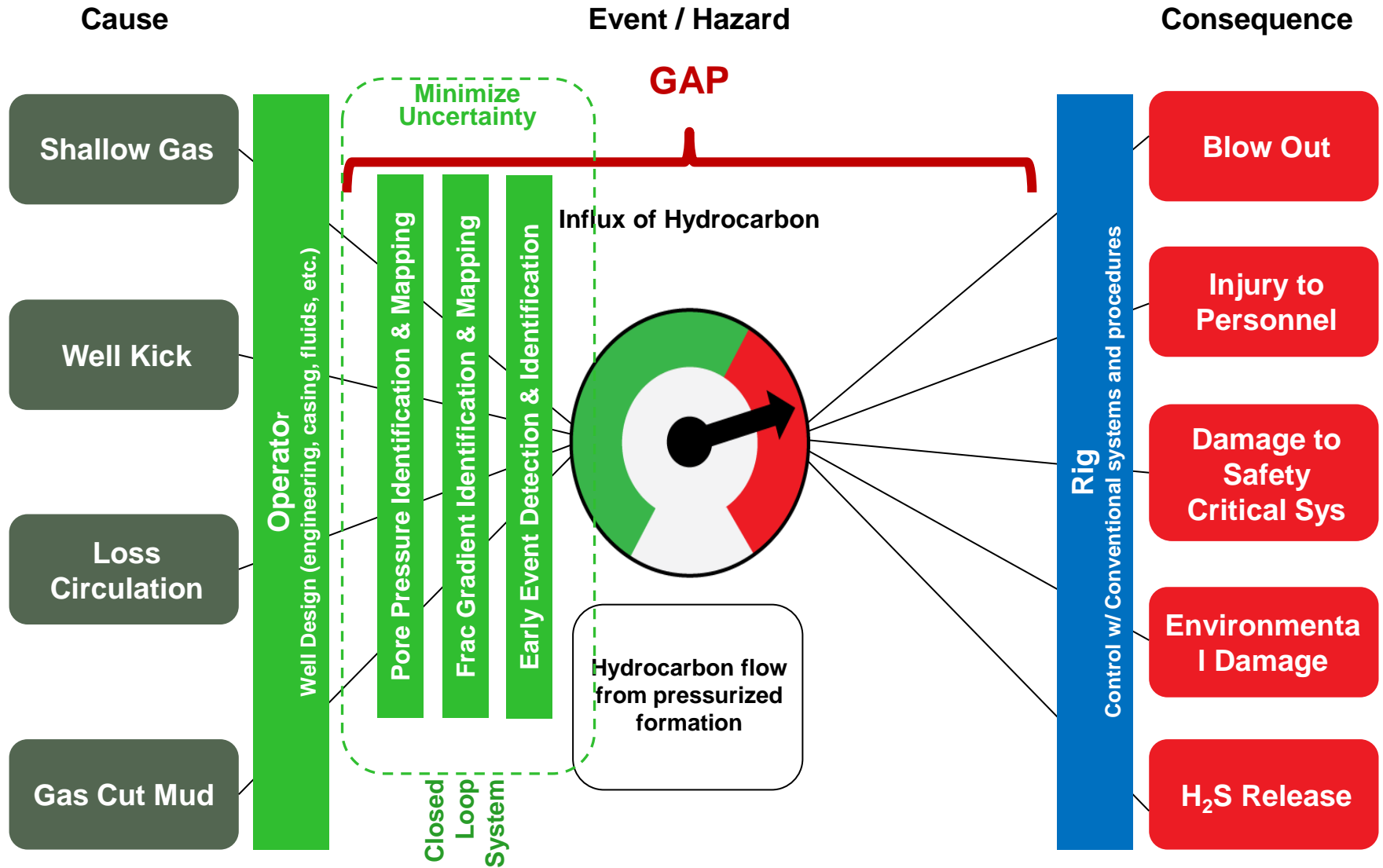


Automated Kick Identification and Control



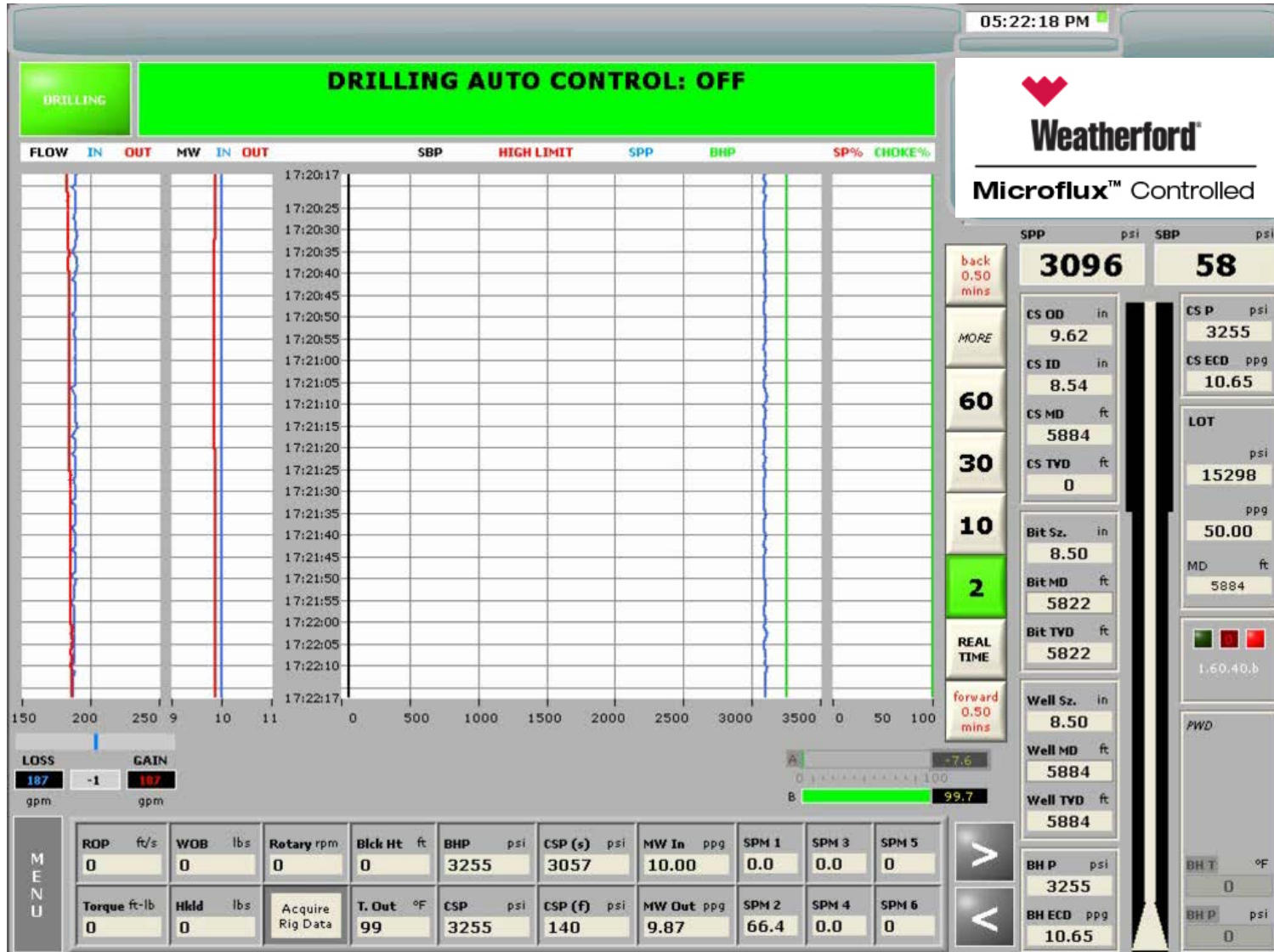


Bridging the Gap



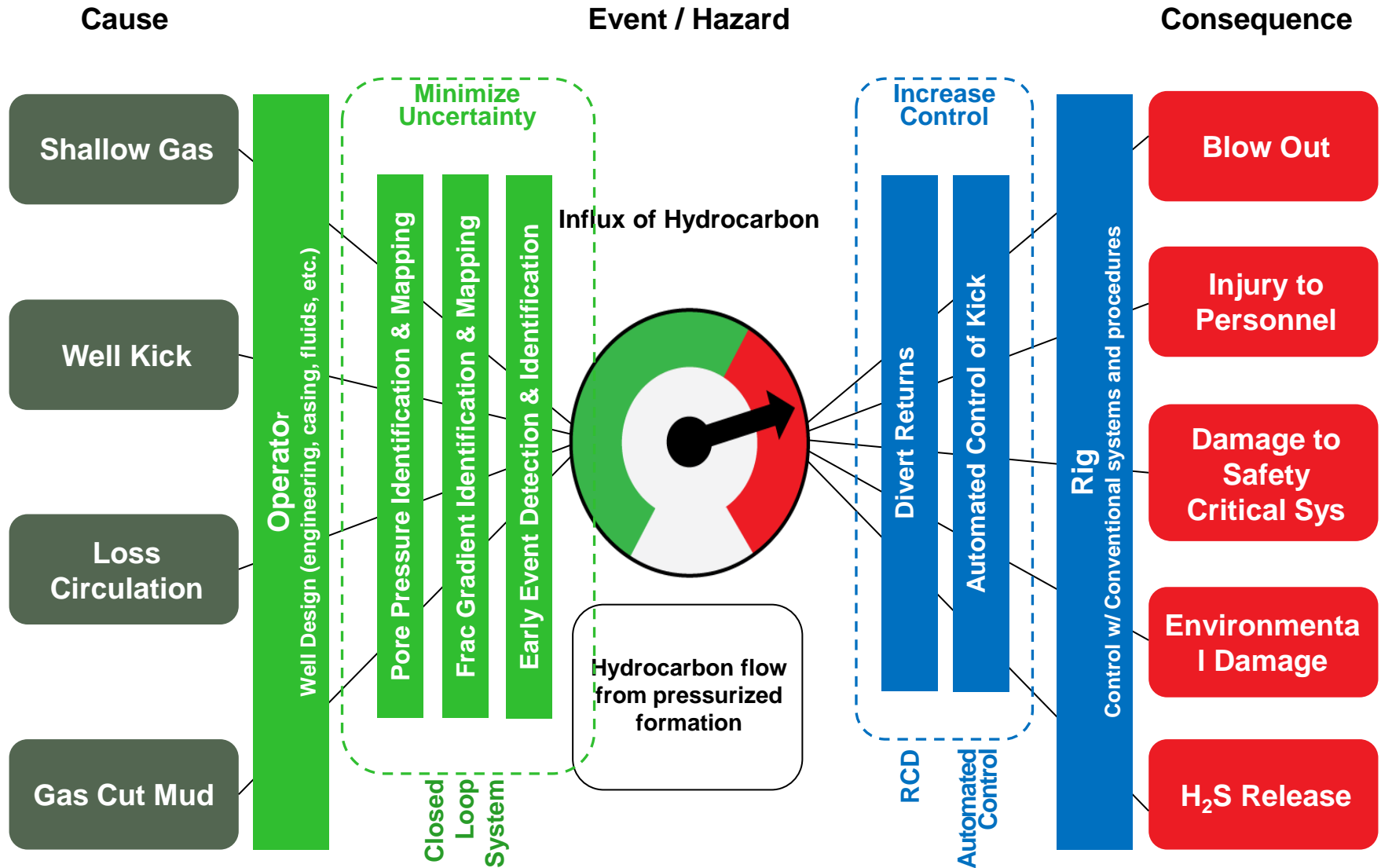


Video of MFC Auto Kick Detection and Control



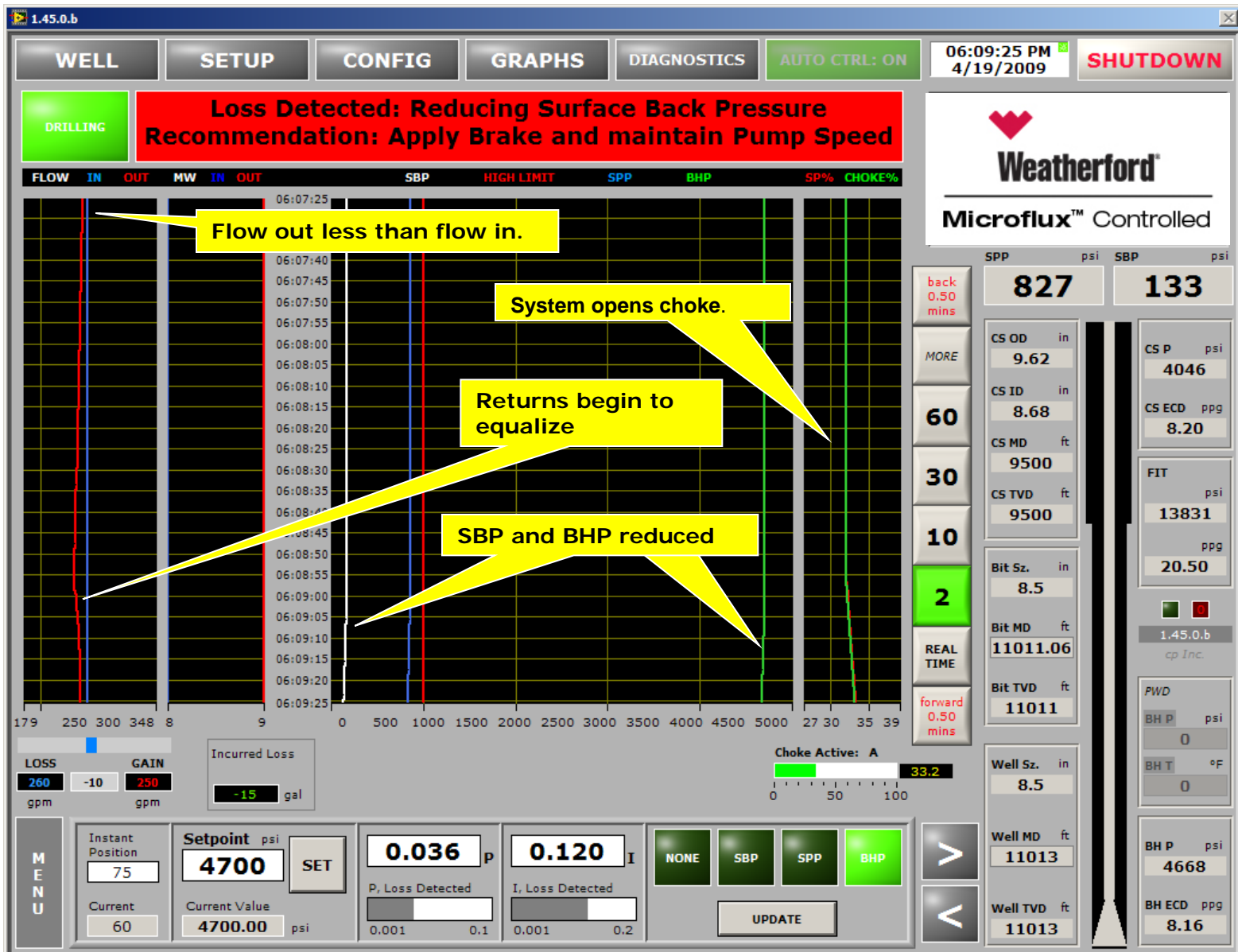


Bridging the Gap





Microflux™ Auto Loss Detection and Control





Conventional Well Control Interface

MPD Drilling Matrix		Surface Pressure Indicator (See Chart 2 Below)			
		At Planned Drilling Back Pressure	At Planned Connection Back Pressure	> Planned Back Pressure & < Back Pressure Limit	≥ Back pressure Limit
Influx Indicator (See Chart 1 Below)	No Influx	Continue Drilling	Continue Drilling	Increase pump rate, mud weight, or both AND reduce surface pressure to planned or contingency levels	Pick up, shut in, evaluate next action
	Operating Limit	Increase back pressure, pump rate, mud weight, or a combination of all	Increase back pressure, pump rate, mud weight, or a combination of all	Increase pump rate, mud weight, or both AND reduce surface pressure to planned or contingency levels	Pick up, shut in, evaluate next action
	< Planned Limit	Cease Drilling. Increase back pressure, pump rate, mud weight or a combination of all	Cease Drilling. Increase back pressure, pump rate, mud weight or a combination of all	Pick up, shut in, evaluate next action	Pick up, shut in, evaluate next action
	≥ Planned Limit	Pick up, shut in, evaluate next action	Pick up, shut in, evaluate next action	Pick up, shut in, evaluate next action	Pick up, shut in, evaluate next action



North Sea HPHT Well ... Real Results

Well challenges

Narrow drilling window

Cap rock close to virgin pressure up to 1000 bar

Severely depleted reservoir

High temperature environment

Nuisance Gas

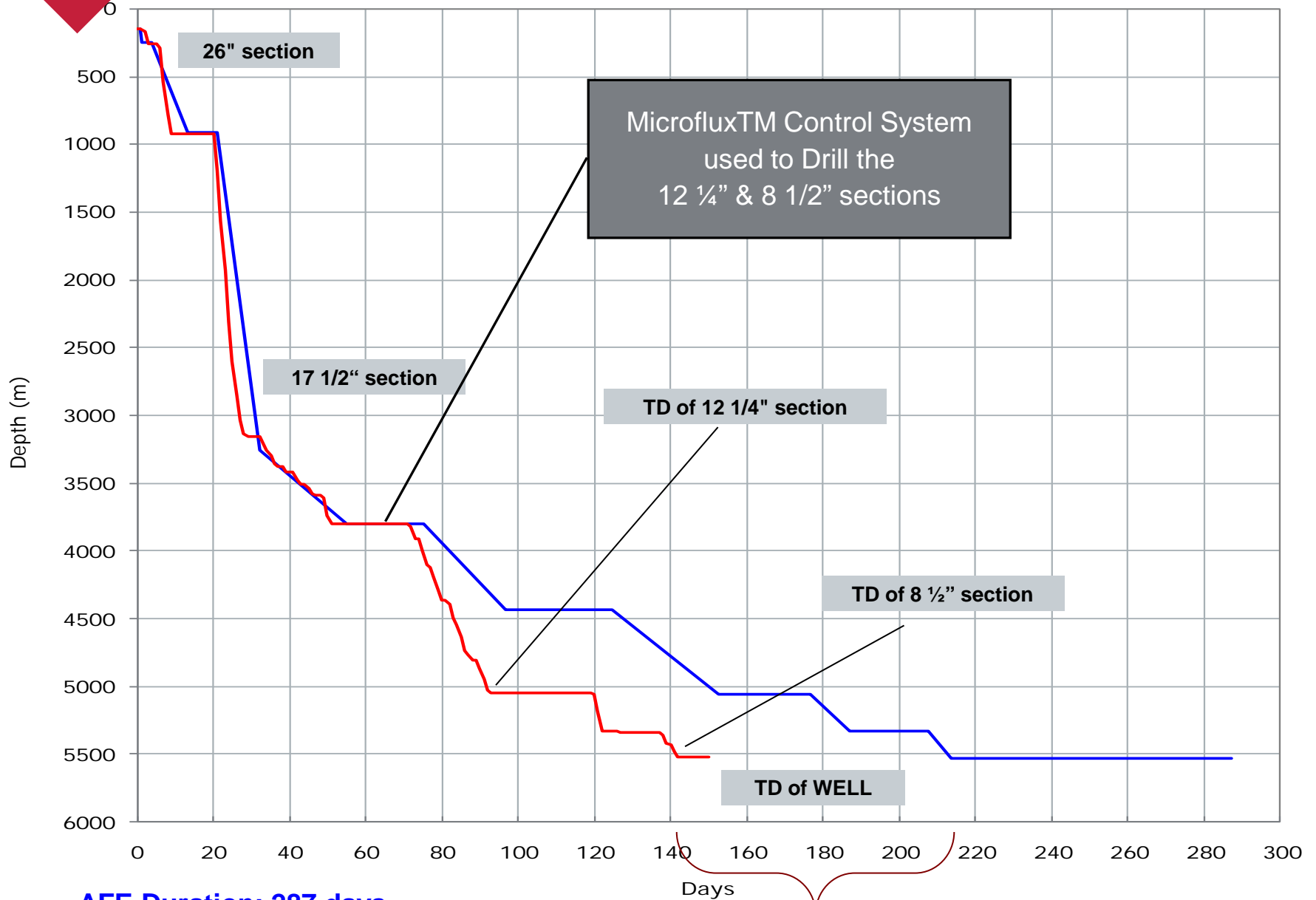
Value from utilizing Weatherford's Microflux™ Control System

Significantly improved drilling performance

Reduced NPT

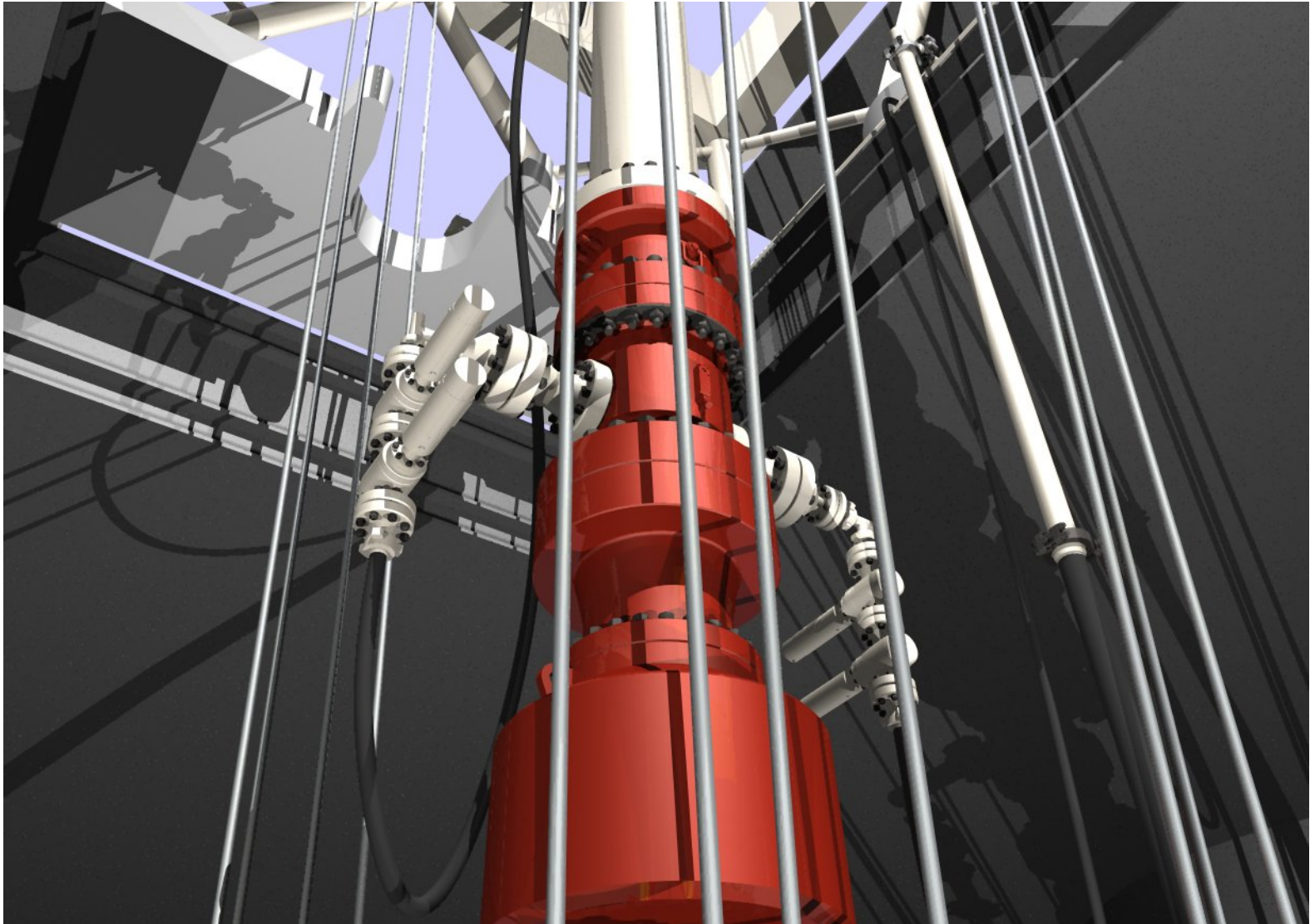
Saved liner section

Significantly reduced mud costs





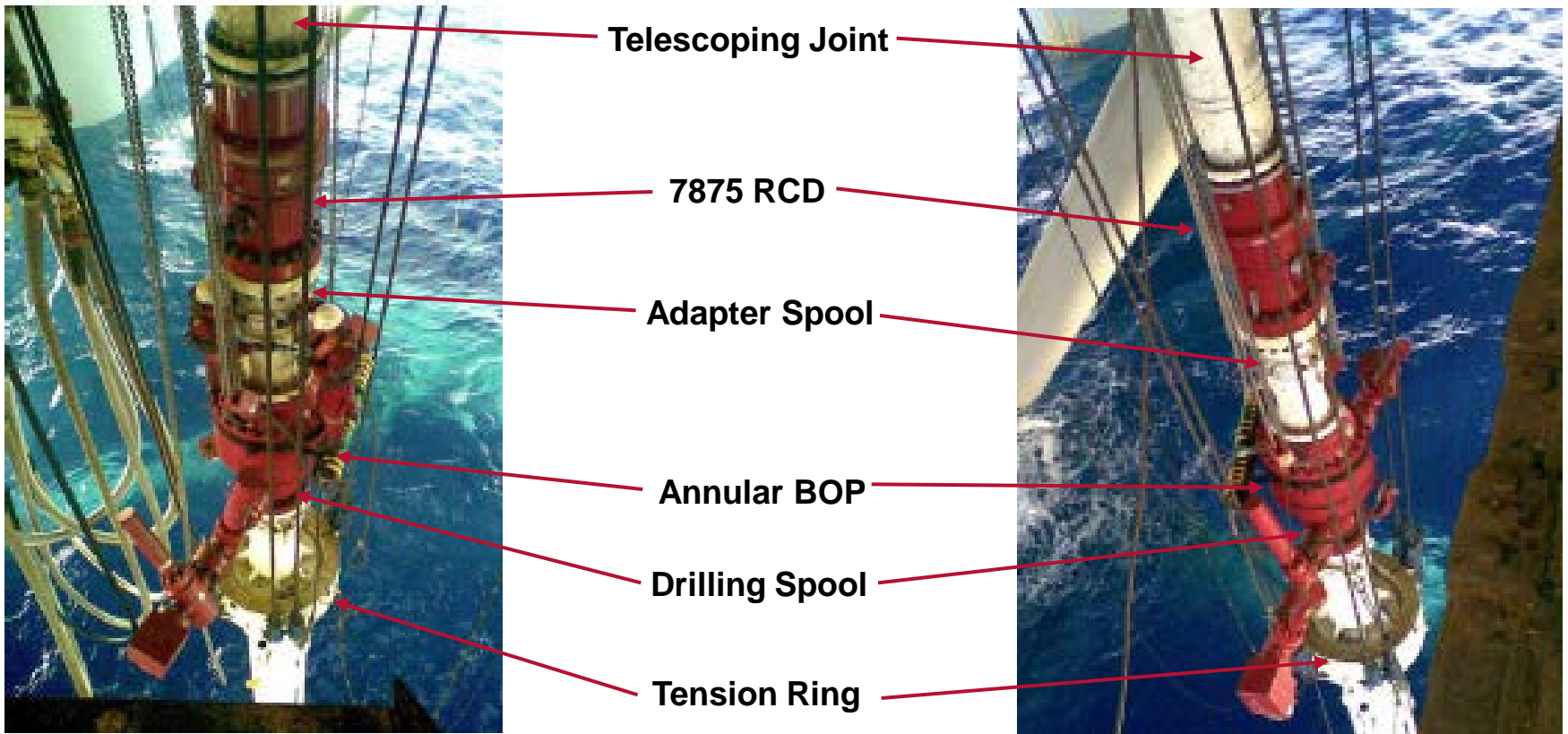
Rotating Control Device



♥ Above Tension Ring Configuration

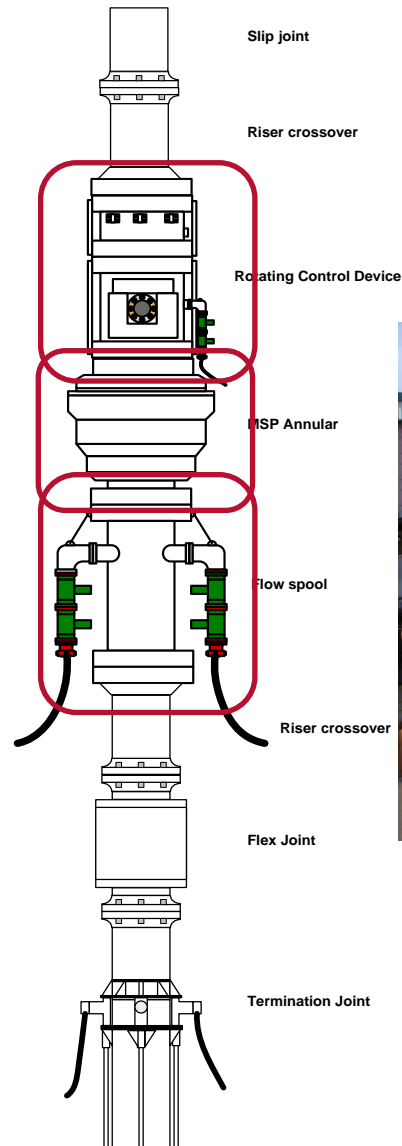
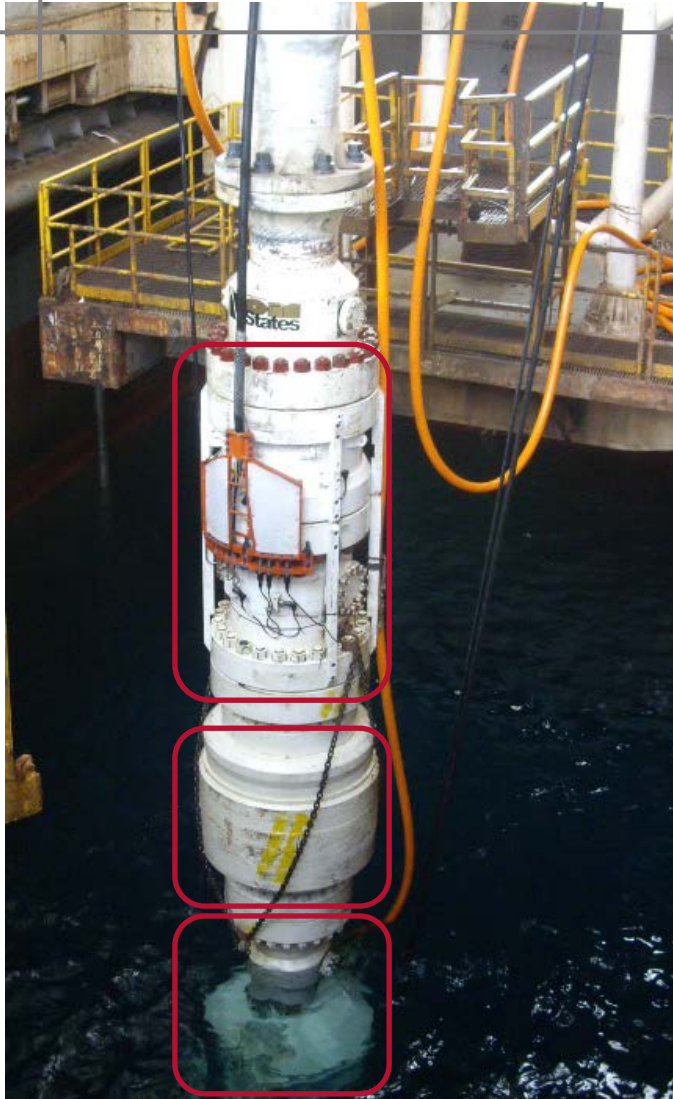
Offshore Rig-up on Semi-Sub ,

- Prior to installation of co-flex hose





Below Tension Ring Configuration





Below Termination Joint Configuration

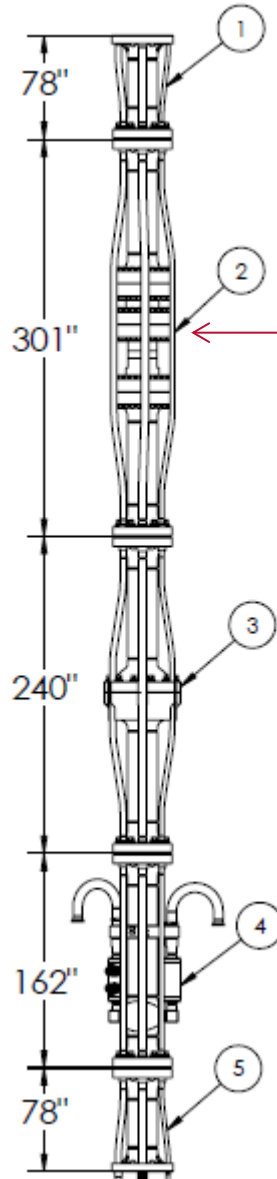
Adapter Spool

Marine series RCD 7875 BTR

DSIT

Flow Spool

Adapter Spool



Cage: Auxiliary Lines (Choke, Kill, Booster & Hydraulic lines will jump around the RCD and terminate at the rigs termination joint)





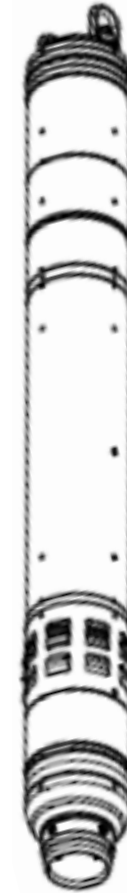
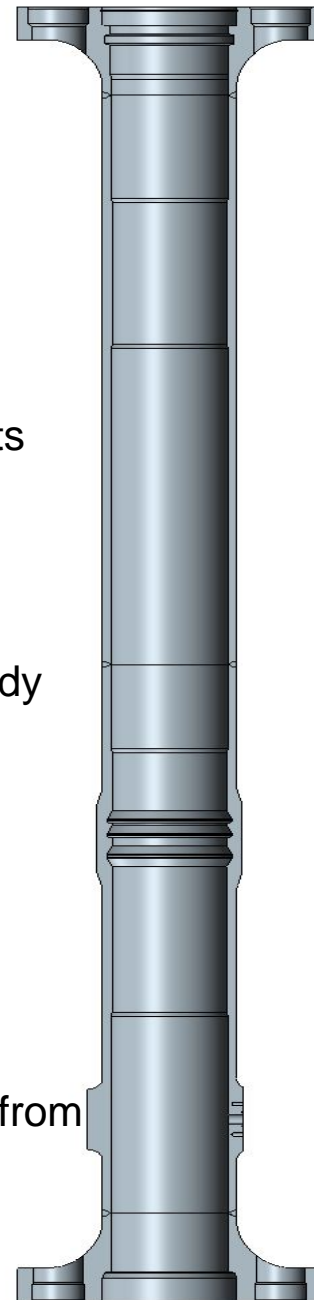
Subsea RCD Systems

Riser Joint Specifications

- 22" OD Riser Body
- 19.25" Nominal ID
- 18.75" Minimum ID in location where RCD seats
- 45" Maximum OD of Joint
- 21 ft. Maximum Length
- 2-1/16" 5K PSI rated studded outlet on riser body
- 3.5 Million Tensile load

RCD Bearing Assembly Specifications

- 18.720" Maximum O.D.
- 9.155" Minimum I.D.
- Static working pressure differential of 2000 psi from below
- Self-Lubricated Bearing Assembly





Constant Wellbore Pressure

Continuous Flow Sub

- Semi Automated Sub based system currently under development
- Allows flow to continue during drill pipe connections while drilling and tripping
- Any hole section length can be drilled with continuous circulation with one sub for each stand

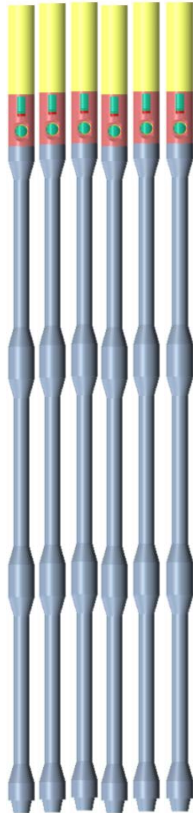




Continuous Flow Systems



CFS sub – One sub per stand is needed. Subs are pre-assembled to stands before putting them in derrick.



Clamp assembly



HPU to operate hydraulic motors



Mud flow control Manifold



Questions?

