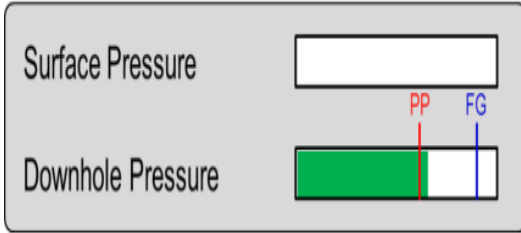


Automated Well Control in MPD

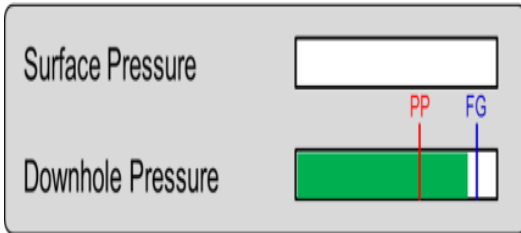
Blaine Dow – Drilling Engineering, Marketing and Technology Manager, DPM

MPD - 101

Conventional – Static Condition (pumps off)

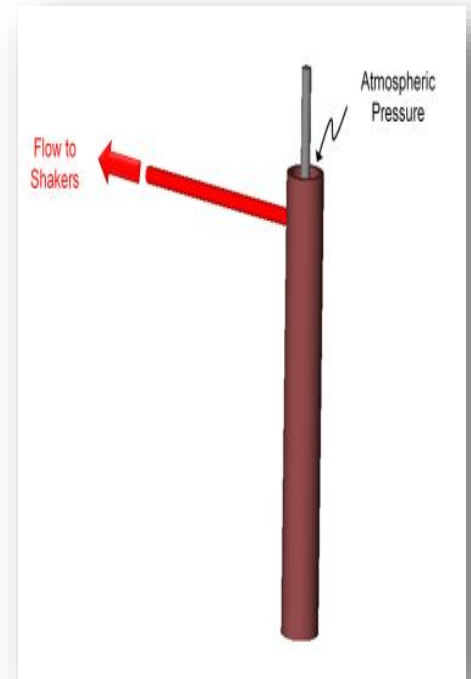
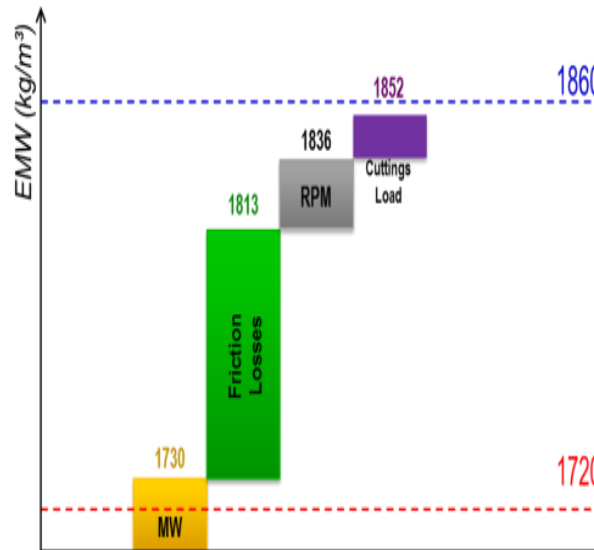


Conventional – Dynamic Condition (pumps on)



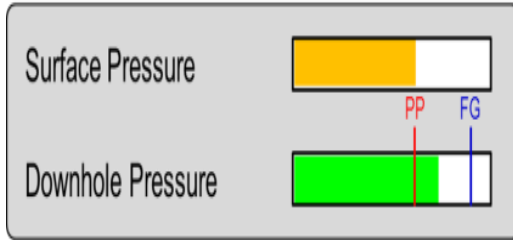
The difference in downhole pressure between dynamic and static conditions and its relevance to operating window defines if the wells can be drilled conventionally

$$1 + 2 = \text{BHP}$$

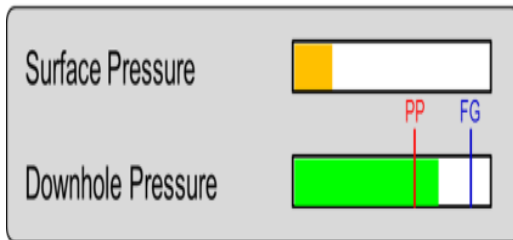


MPD - 101

MPD - Static Condition (pumps off)

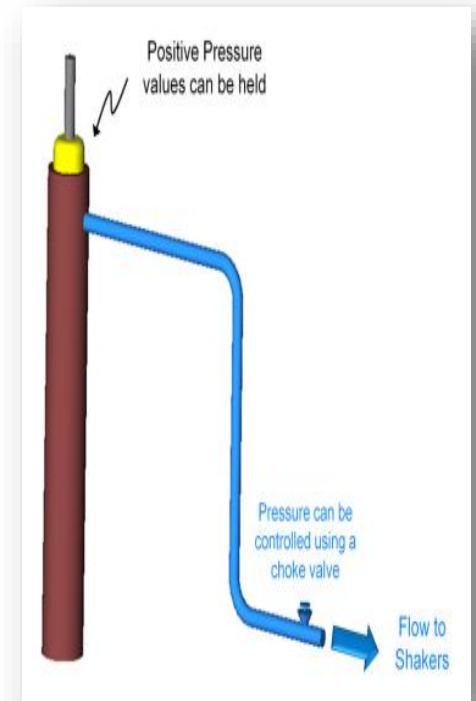
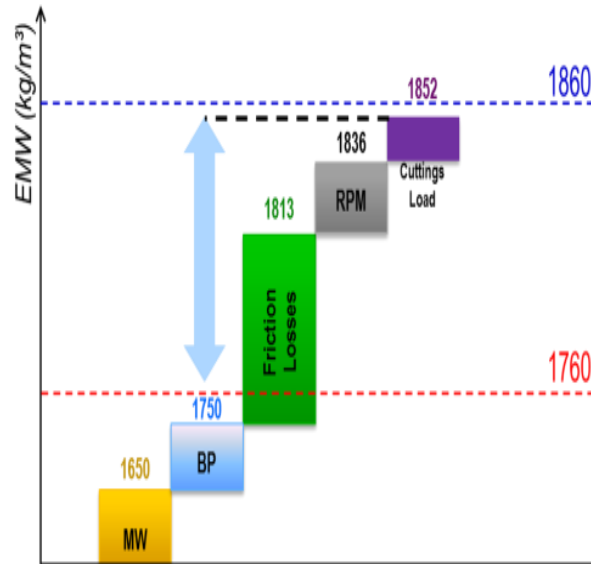


MPD - Dynamic Condition (pumps on)



Using MPD it is possible to use a combination of hydrostatic + surface backpressure to overcome the narrow drilling window limitation – and operate within the available drilling window

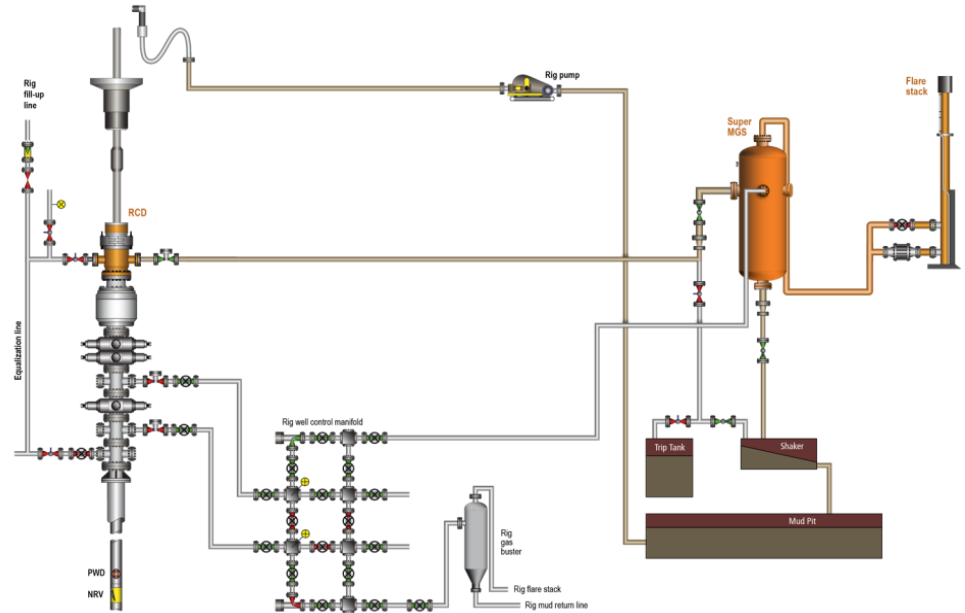
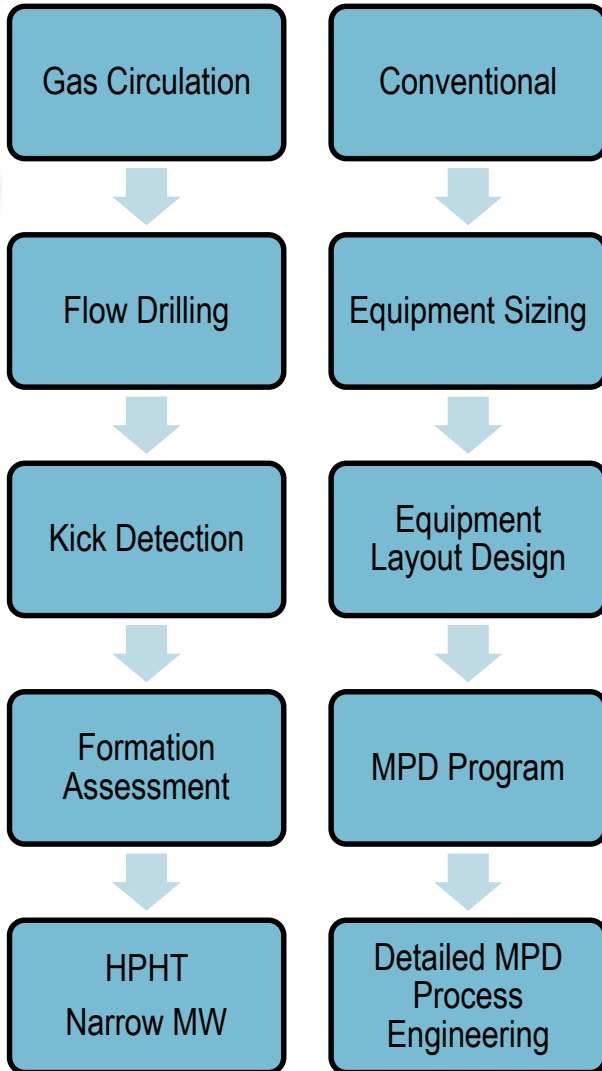
$$1 + 2 + 3 = \text{BHP}$$



Diverting Nuisance Gas

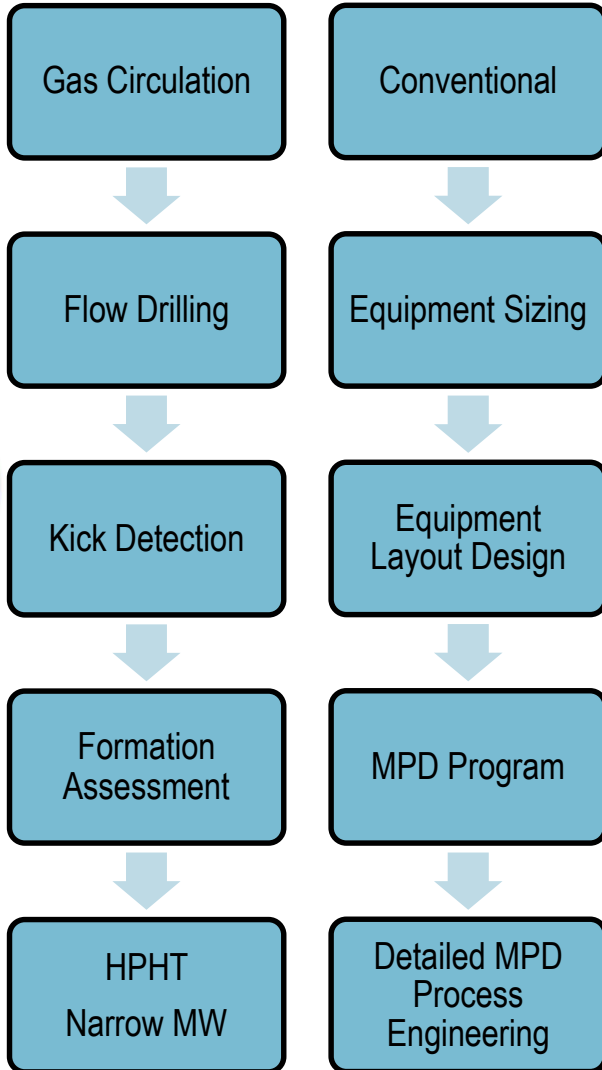
Operational Complexity Engineering Detail

TIER
1

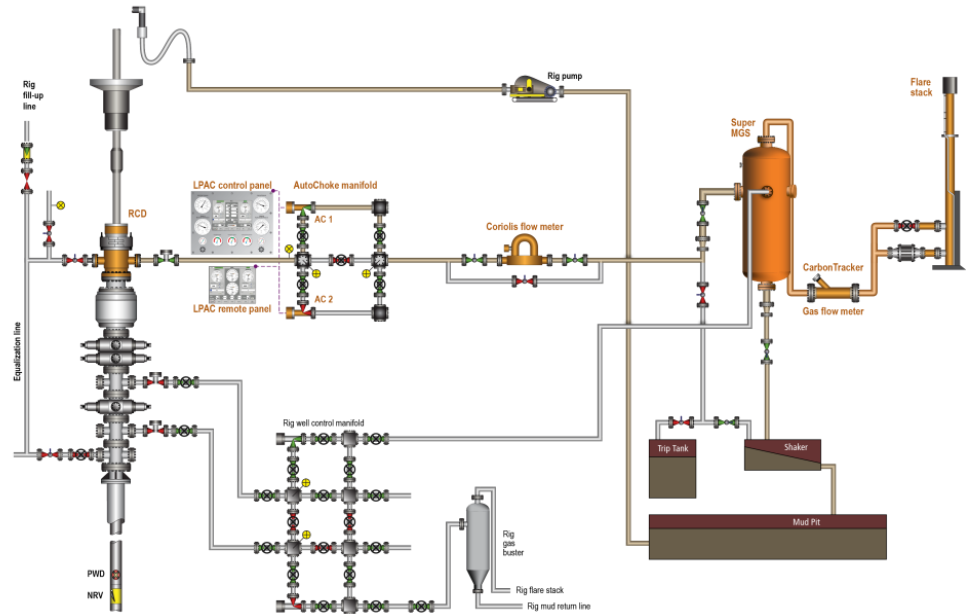


Trapping Pressure On Connections

Operational Complexity Engineering Detail

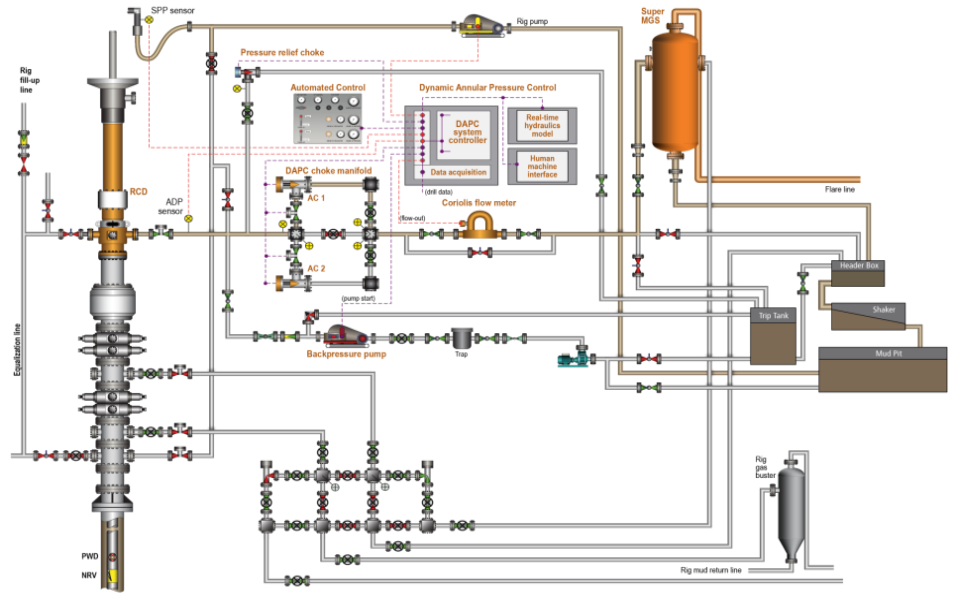
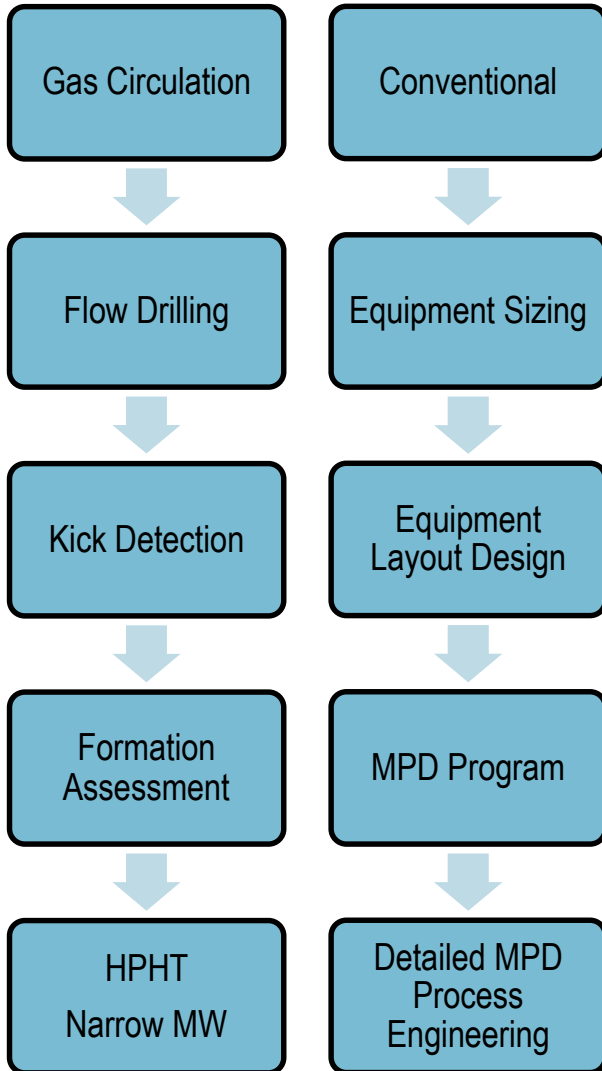


TIER
2



Managing Narrow Window Drilling

Operational Complexity Engineering Detail



TIER 3

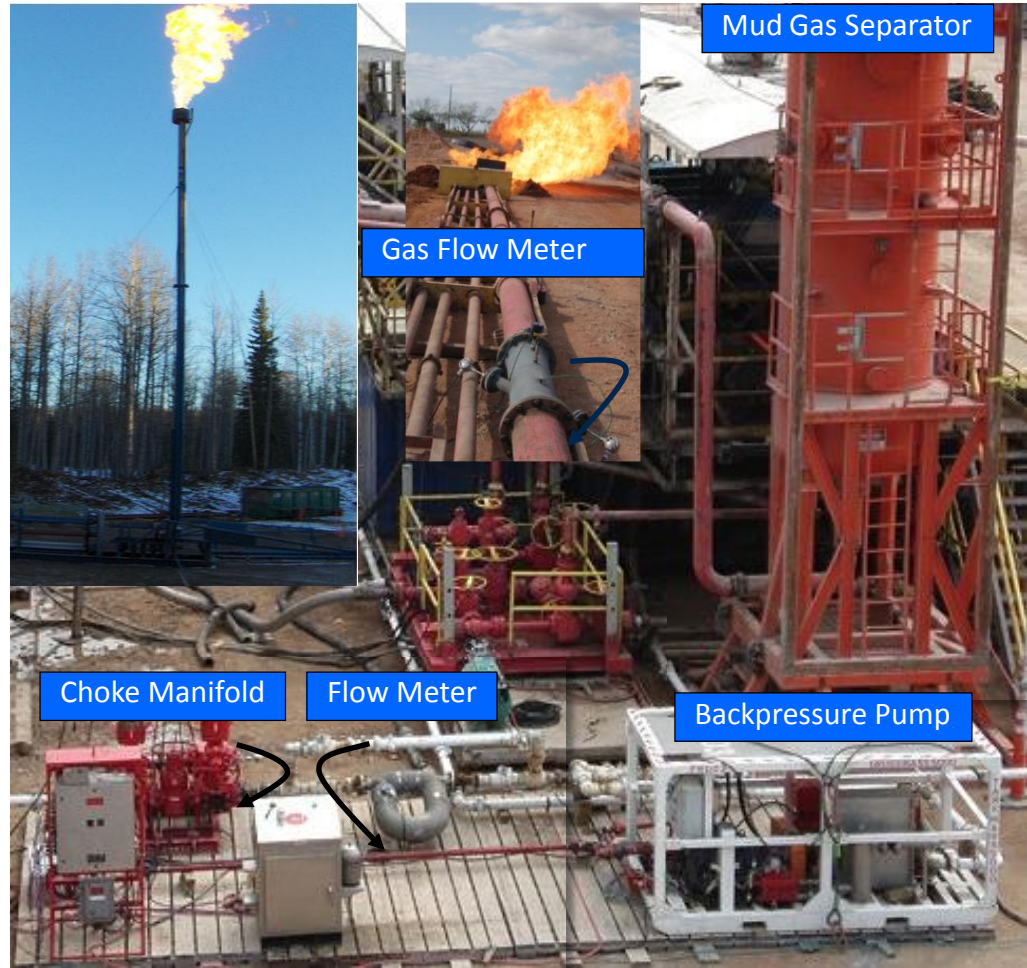
Compelling Questions to address:

Question 1: Can we automate MPD and Well Control?

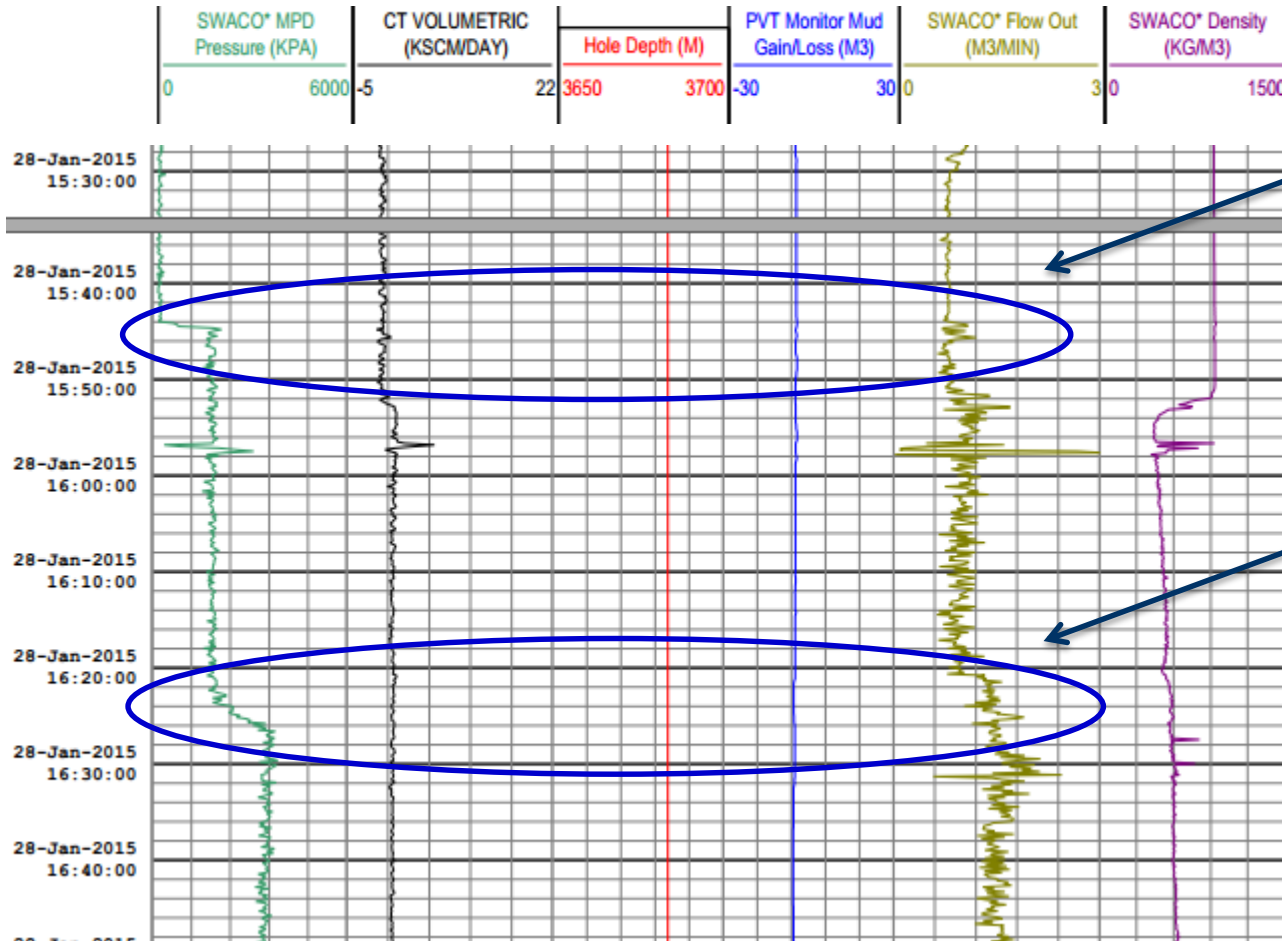
Question 2: What barriers currently exist?

Question 3: How do we remove the barriers?

Field Example: Adaptive Pressure Control – MPD / Flow Drilling



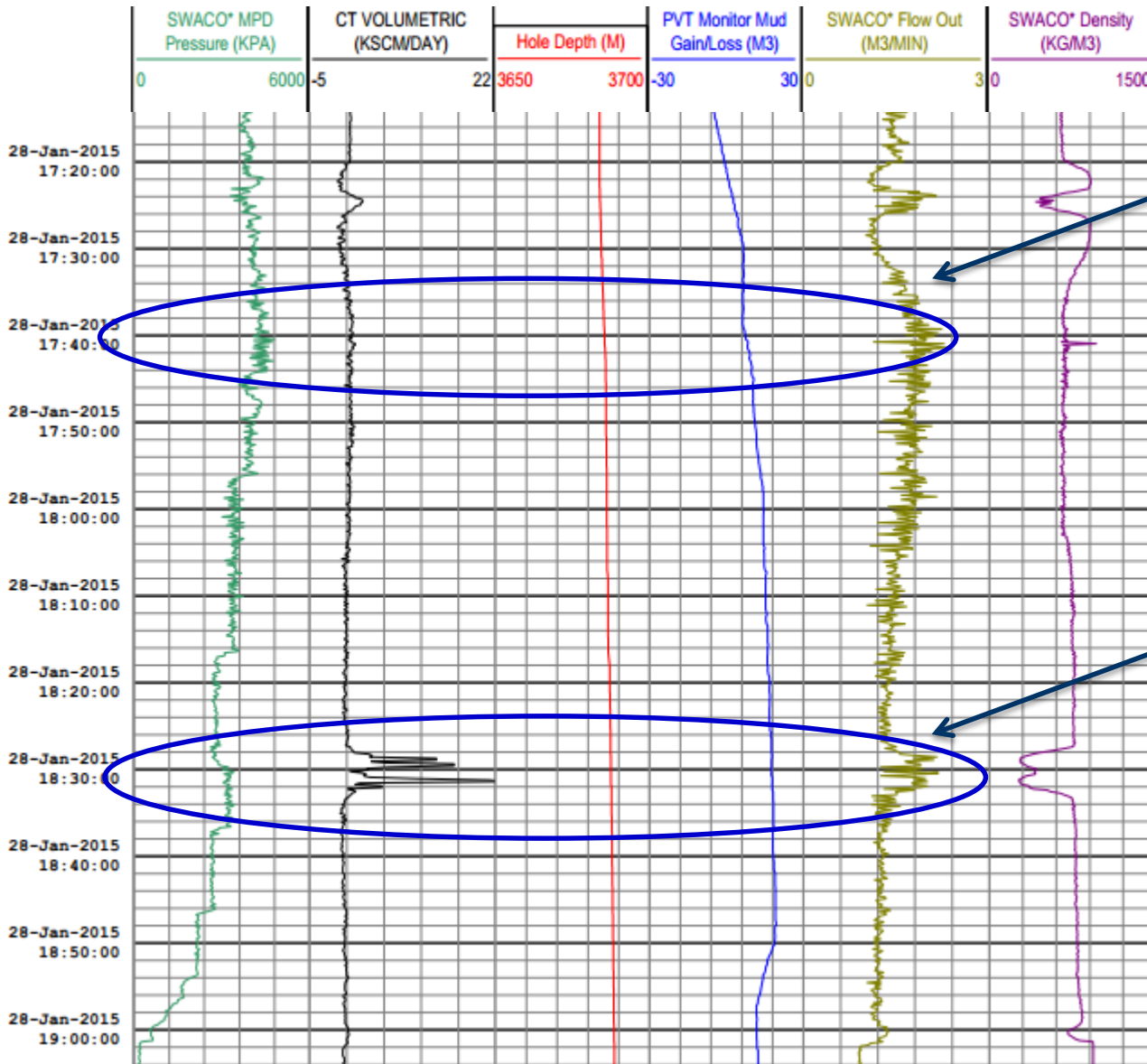
Automated MPD Well Control Event



Influx detected,
backpressure applied

Influx growing, more
backpressure applied

Automated MPD Well Control Event (continued)



Heavy weight rollover initiated while drilling resumes

Last bit of gas passes at surface, Influx managed

Industry Barriers to Automated MPD Well Control

Category	Status
Equipment: pressure and volume	No issues
Technology: detection and control	No issues
Regulations	Outstanding
Liabilities: Drilling contractor and service provider	Outstanding
Legacy: Roles and responsibilities	Outstanding

Well Control in MPD

MPD Operations Matrix Standard

MPD Operations Matrix		Surface Pressure Indicator Defined by MODP			
		At Planned Drilling Back Pressure	At Planned Connection Back Pressure	> Planned Back Pressure & < Back Pressure Limit	≥ Back pressure Limit
Influx Indicator	No Influx	Continue Drilling	Continue Drilling	Continue operation, adjust system to decrease WHP	Secure well, evaluate next planned action
	≤ Operating Limit	Continue drilling, adjust system to increase BHP	Continue drilling, adjust system to increase BHP	Cease drilling, adjust system to decrease WHP and increase BHP	Secure well, evaluate next planned action
	> Operating Limit	Secure well, evaluate next planned action	Secure well, evaluate next planned action	Secure well, evaluate next planned action	Secure well, evaluate next planned action



Optimum parameters for MPD Operations



Continue MPD Operations with caution while the influx is confirmed



Influx confirmed. MPD Operations must be stopped and the well secured to evaluate next action

MPD and Well Control – Real life

- HPHT Exploration well, offshore jackup
- Automated MPD system using flow metering to monitor for influx and loss – navigate PP ramp
- All necessary pre-planning, and Well control matrix in place
- The story.....
- interpretation of roles and responsibilities was left to be discovered during a live event.

- Ref: SPE 143099, SPE 163546

MPD and Well Control – Future State

- Automation of the process Highly likely to improve outcome
 - Desire of several operators
 - Logical
- Dependencies:
 - Integrated control of MPD equipment and Rig equipment
 - Data: quality, frequency, control
 - Liability agreement

Compelling Questions to address:

Question 4: Should we automate MPD and Well Control?

Yes!

Thank you